DOES STUDYING MUSIC AND SOUND DESIGN ENHANCE ACADEMIC ABILITIES IN UNDERGRADUATE NON-MUSIC MAJORS? A PHENOMENOLOGICAL APPROACH

by

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To my children, who have always been my greatest inspiration

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Numerous studies show a correlational relationship between the study of music and academic achievement, but what principles of music study enhance the higher order learning skills required for academic excellence? This research study looked at the experiences of students at UT Dallas taking music and sound design classes who are not music majors, through a Qualtrics survey and follow-up interviews. The data from the survey and interviews was analyzed using phenomenological methods. Additionally, three cohort comparisons were conducted: music and sound design students; STEM (Science, Technology, Engineering and Mathematics) majors and non-STEM majors; and ATEC (Arts, Technology and Emerging Media) majors and other STEM majors. From the analyses, we conclude students who have taken music and sound design courses feel that those experiences enhance their lives in many ways, and the majority of them feel it enhances their academic abilities.

Students benefit by the nature of their experiences in music and sound design, but they benefit the most from the more analytical aspects of music and sound design courses. Those that had taken music theory saw a great benefit from those experiences. They benefit from the experience of listening to aural streams for extended periods of time with attentiveness to detail. Students experience "flow" during music or sound design experiences, which may transfer to other subjects. Students benefit from the two-dimensional nature of both music and sound design by the requirement of analyzing a score or sound design project in both the vertical and horizontal directions.

The results of this work can lead to future research projects, and use the specific skills that were reported by students as a testing ground for evidence-based research. Further, the study has pedagogical implications for curriculum in both music and sound design. Courses should place more emphasis on the analytical skills that transfer to other academic subjects. While study in music and sound design gives students many psychological benefits, the educational benefits should be studied more and in a controlled environment, in order to significantly add to the body of evidence that courses in the arts can lead to higher academic achievement.

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CHAPTER ONE

INTRODUCTION

I teach music to undergraduate students at a university that does not offer a music major. My students come from all across the university, but a great number major in the sciences, technology, engineering and mathematics (the "STEM" subjects). Many of them pursue studies in music very seriously, often taking music courses every semester, and are academically excellent students in both their major course of study and in their music classes. There are numerous studies that show a correlational relationship between the study of music and academic achievement (Kelstrom 2016, Costa-Giomi 2004, Schellenberg 2004), but what principles of music study enhance the higher order learning skills required for academic excellence?

In higher education, the focus should be on individual knowledge, the freedom to explore new subjects and make choices about those subjects, and the value of personal examination and discovery. My experience as both a professional musician and music teacher has led me to examine what processes and experiences are taking place when one participates in music in a deep and meaningful way. Evidence in phenomenological research is derived from first-person accounts. These accounts lead to meaning, to other questions, and then to a new understanding and new meanings through an in-depth examination of the experience. Several principles describe the phenomenological research process. The focus is on the wholeness of the experience. The researcher is searching for meaning rather than measuring. The research is conducted by obtaining descriptions through first-person accounts and these accounts are regarded as a key to understanding human behavior. The researcher formulates questions that

reflect the interest, involvement and personal commitment of the researcher (Moustakas 1994, 11-13). Qualitative research methods are especially efficient where the subject of the study cannot be modeled in terms of independent and dependent variables (Creswell 2007, Phelps 2005). In this study, the subject is the wholeness of the educational experience and our goal is to reveal meanings, rather than metrics about the correlation of quantized variables, such as years of musical study and GPA.

This dissertation describes a research study of music and sound design students currently or previously enrolled in music and sound design courses at The University of Texas at Dallas in order to ascertain what in their musical and sound design study and experiences helps facilitate the higher order learning skills needed for academic success. The study used the empirical phenomenological research method as described in the Duquesne "Studies in Phenomenological Psychology Volume II" (Giorgi, Fischer and Murray 1971) and outlined in "Phenomenological Research Methods" (Moustakas 1994). The empirical approach involves asking subjects to recall an experience in order to obtain descriptions that provide the basis for an analysis of these experiences. There are two descriptive levels in this process: Level I, the original data, comprised of descriptions obtained through questions and dialogue; and Level II, the analysis and interpretation of that data by the researcher. Meanings are derived from the descriptions provided by the subjects. The researcher formulates the question, generates data through surveys and interviews and then analyzes the transcribed data. My data analysis will follow the Van Kaam Method as modified by Moustakis which includes listing and grouping the relevant expressions (horizontalization), reduction and elimination of invariant constituents; clustering

and thematizing the invariant constituents; application validation; and the construction for each interviewed participant of an individual textual and structural description of the experience; and finally, a construct of the meanings and essences of the experience, incorporating the invariant constituents and theme, for each participant (Moustakas 1994, 97-98).

The study commenced in January 2015, with a solicitation of fellow faculty members in music and sound design in order to obtain publicly available email addresses of students who have taken music and sound design courses at the University of Texas at Dallas in the last ten years. Since UT Dallas does not offer a music major, no students in the sample are music majors. Students who pursue sound design may be either ATEC or EMAC majors, or may be taking the courses as an elective. The survey included taking data on their major, their courses of study in music and sound design, gender, ethnicity, and previous musical experiences. It then asked them to reflect on their experiences in studying music as it specifically relates to higher order learning skills and how these experiences have affected their study in other academic fields. The study focused on typical phenomenological concepts such as the structure and immediacy of their experience; their feelings about the capacity to manage time and focus, understand and analyze new forms; and other experiential aspects of musical and sound design study affecting their academic life. Some principles of interest were "stretchiness" or the liberty to bend the rules, as exemplified by the use of rubato in performance; perception of music and sound in space and time and the phenomenon of "flow"; musical form and music theory; the ability to maintain attention to aural information over time; and the ability to segment information. Of some interest was the difference between students currently enrolled in curriculum and describing relatively

recent experiences, and those alumni students who have completed their degrees who are examining their experiences through the lens of memory, rather than current experiences. This study also looked at the differences in response between students who have taken music classes and sound design classes; and those in STEM (Science, Technology, Engineering and Mathematics) majors and those in non-STEM majors. It also looked at whether those majoring in ATEC (Arts, Technology and Emerging Communication) differed substantially from other STEM students.

Given that we have over 500 students taking music courses per term, my own students comprised a relatively small part of the data and hence, this study was not skewed by personal contact. Email invitations to take the survey were sent to 880 students, with three requests at one month intervals. The initial study took place during the Spring 2015 term, with a follow up study in the Fall of 2015 to further refine the study and to focus on essential elements that arose from the pilot study in the Spring. Over 176 students took the on-line survey and 159 students completed the survey to the end. Embedded within the survey was the opportunity to do a one-hour, in-depth interview to elucidate deeper responses to the questions, and 11 personal interviews were conducted.

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This research project used the conceptual framework of transcendental phenomenology, based on the work of Edmund Husserl. The term phenomenology dates back to 1801 in philosophy, first used by Hegel (1801, translated by Miller 1977) to refer to knowledge as it appears in consciousness, and the science of describing what one perceives, senses and knows in one's own

immediate awareness and experience. Husserl defines the process of the co-mingling of the object in nature with the object that appears in consciousness as “ideation”. Hence, meaning is created and there is a relationship between what exists in the world and what exists in conscious awareness (Husserl 1931).

The natural sciences investigate physical phenomena, while the human sciences investigate mental phenomena, such as perception, memory, and judgment. Husserl attempted to develop a rigorous science based on perception, and extended phenomenology to include the intentional nature of consciousness. It emphasized subjectivity and the discovery of the essence of experience. In order for such an investigation to be rigorous, it must be free of presuppositions. Therefore, the meanings and essences of phenomena are derived, not assumed (Husserl 1931). In phenomenological investigation, the researcher constructs a question to guide the study, and derives feelings that will lead to further research. The individual is asked to construct a full description of his/her experience, known as the textual description. Each person experiences phenomena in their own way and perception is individual. Phenomenological research attempts to uncover these individual experiences and then derive greater meanings from them (Moustakas 1994).

I situate this research project in several historical arenas. First, I look at how the current system of higher education became so disciplinary, and how dissatisfaction with the current system may lead to disruption. Second, I look at the history of interdisciplinarity and its values for higher education in the 21st century. While the term “interdisciplinary studies” dates back to the 1920s,

there has been a resurgence of interest in the last twenty-five years (Moran 2002). The diffusion of interdisciplinarity through the academy is "probably the clearest sign of the erosion of disciplines as the predominant mode of academic organization" (Heilbron 2004). According to Julie Thompson Klein, "Interdisciplinarity research and teaching … is a notable feature of academic change, documented by a sharp increase in collaborative research, administrative advocacy, funding and a literature of best practices." (2010, 1). Next, I examine the research finding of evidence-based studies about the arts and skills transfer to other disciplines. Finally, I explore the skill sets required to study music and sound design and question how they may or may not differ.

Music successfully integrates with many other disciplines, including physics, mathematics, psychology, neuroscience, technology, sociology and economics, in addition to more traditional intersections with history, literature, and the other performing arts, and the new disciplines of acoustics, psychoacoustics, and sound design. Many students who pursue music seriously are not music majors, but integrate their musical study into their major field of study (Folkestad 2007, Phelps 1969). The majority of studies in music research generally focus on music majors, since this is the readily available population to most researchers in music education. (Phelps 1969) .Those that looked at non-majors tended to focus on methods of teaching music appreciation and fundamentals rather than the serious study and practice of music (Dobbe 1998, Jumpeter 1985). I was in a unique position to look more deeply into the experiences of non-music majors, and investigate whether or not their experiences in music study transfer to their academic studies in their chosen major.

This history of phenomenology, particularly as it applies to music education research is discussed and the methodology is carefully delineated. The results of the study are included in the Appendices, with observations and conclusions included in the main body of this dissertation. With the information from the research study, I then propose new directions for research in music and sound design, and the arts in general, particularly in the STEM to STEAM (integrating arts into the STEM subjects) discourse. I also propose pedagogical changes in music and sound design curricula that will help students develop the higher order thinking skills necessary for innovation, creativity and academic success in the 21st century, whatever their major field of study. Finally, it is my sincere hope that new and more direct evidence that music and sound design study furthers academic study in other fields will enhance the argument that study in the arts in general, and music and sound design in particular, should be a vital part of any university curriculum.

I hold Master's degrees in mathematics (MA, 1976) and music (MA, 1978), both from the University of California, San Diego. I served the School of Arts and Humanities at UT Dallas for 15 years as the Associate Dean for the Arts, and was involved in creating the current curriculum in the arts; advising on new hires; building, designing and maintaining arts facilities; and creating and overseeing the public arts program currently in place. I am a member of the ArtSci Lab at UT Dallas and a Senior Lecturer in music, teaching three to four courses per term in music performance, theory and history. My master's thesis "An Acoustical Study of a Vocal Performance Technique" involved research with human subjects (Evans 1978).

This study has been approved by the Institutional Review Board in the Office of Research Compliance (MR14-411) at the University of Texas at Dallas. A copy of the approval is in the Appendices.

The History of Disciplinarity in Higher Education

Most four-year universities in the United States have emulated a small number of elite universities that were founded more than 150 years ago, including Harvard, Yale, Johns Hopkins, Cornell and MIT. This common history can be traced to a movement by Charles Eliot at Harvard in the 19th century. In 1858, in an effort to have both depth and breadth, Eliot created the system of general education courses and electives for undergraduates; and set graduate schools at the top of the system, narrowing the curriculum at that level. This also created specialization at the undergraduate level and encouraged universities to pursue both research and teaching. It set the standard of having faculty involved in administrative decisions. In the first three decades of the 20th century, Harvard President Abbot Lawrence Lowell added residential housing, created general education requirements and concentrations. In the 1920s, President James Bryant Conant created the "meritocracy" system, added a generalized title of University Professor, which allowed faculty to work across the traditional departmental boundaries, and added a tenure system that required review by peers, creating competition and a free-agency system for faculty. He also instituted merit-based admissions and the requirement of the Scholastic Aptitude Test for incoming freshmen (Christensen and Eyring 2011).

The post World War II expansion of college enrollments was fueled by the new GI bill, which created a boon of applicants. Harvard alone received over 20,000 applications. This allowed Harvard to create an elite population of students, but it also increased enrollments at colleges and universities everywhere. The launch of Sputnik in 1957 and the ensuing space race led to the creation of the National Science Foundation along with the Atomic Energy Commission. They in turn invited faculty to write grants and comply with required reports. These organizations encouraged the development of the "research university" that would turn out the highly trained scientists and engineers needed for such an effort. At the same time, Harvard redesigned the "Redbook" (formally known as "General Education in a Free Society"), reaffirming the principles of Dewey that the fundamental purpose of education is to promote freedom. The Redbook created required courses for each major. The 1960s saw an expansion of research funding at Harvard (from $58 million in 1960 to over $1 billion in 1965) and a growth to over 50 departments with 2300 subdivisions. In 1970, Derek Bok became President and advocated three main causes: instruction, diversity and engagement. A new core curriculum replaced the old general education requirement and emphasized the capability for acquiring knowledge rather than a common grounding. A broad range of core courses, mostly taught by senior faculty, were created that drew from individual disciplines. At the same time, the emphasis on research and external funding increased the salary differential between the sciences and the humanities, and between faculty and administrators. In the late 1980s and early 1990s, dissatisfaction with higher education began to grow. The combination of a flat economy, political turmoil and rising tuitions led to unrest. President Bok released an annual report in 1988-89, citing a 50% decline in public confidence, accompanied by grade inflation, a culture of tolerance for poor teaching

and a lack of data on instructional quality. He called the emphasis on personal achievement by faculty a sign of "scholarly disengagement". Clark Kerr, the first chancellor of UC Berkeley and the President of the UC system, coined the term "multiversity" in 1963 in his now-famous Godkin Lectures, which he said placed undue burdens on faculty with teaching; publishing original research; writing grant proposals and student recommendations; serving on committees; hiring and tenure; managing programs; hosting visitors; traveling to other campuses and conferences (Brooks 1969). All these policies created an atmosphere where other four-year colleges and universities emulated Harvard in order to be competitive for admission and receipt of grant monies. Many policies were copied by less prestigious and less resource-rich institutions. Some of the traits that were copied were face-to-face instruction; a secular orientation; specialization and faculty self-governance; longer summer recesses; graduate schools at the top of the hierarchy in terms of both prestige and funding; private fund-raising to make up the gap; competitive athletics; academic honors programs; external research funding; the tenure system for faculty retention; and selective admissions. All of these policies fostered a narrowing of the curriculum (Christensen and Eyring 2011).

By 2001, Harvard's endowment had soared to $19 billion. President Larry Summers called for more science, math and international concepts in the curriculum, but attempted to make general education courses more cross-disciplinary by requiring students to take at least one course in each of eight subject areas, two in science and two in globalization. In the first decade of the 21st century, Harvard was facing a financial crisis: donations had dropped off, and most buildings were in need of repair and renovation. The severe competition for spots in the Freshman class

allowed Harvard to raise tuition to the highest rates in their history. The 2008 downturn in the economy put even more pressure on the "envy colleges". These colleges attempted to emulate Harvard, but without the equivalent financial resources or the competition for admission. They continued to rely on lecture-format courses, rather than interactive experiences, and they did not make connections between courses in other disciplines. Teaching was increasing off-loaded to part-time faculty and graduate students. Tuition rates were up (over 400% since the late 1980s), increasing at four times the rate of inflation. Only 35% of students finished in four years, and only 55% in six years. Tuition rates are now public knowledge and easily available on the internet. The for-profit colleges have entered the field, and by 2010, the University of Phoenix, founded in 1978, has created a new learning system using web technology. For-profits operate year round, offer fewer majors and courses, admit all qualified applicants, and encourage them to pursue a strictly disciplinary set of courses (Christensen and Eyring 2011).

Some colleges have attempted to infuse some interest back into general education courses by making them "foundations" courses that encourage inter-departmental collaboration, or making them cross-disciplinary and applicable to real-world problems. These courses emphasize an empathetic perspective rather than expertise. They exist outside the departmental structure, but often are limited to a "freshman" experience that does not translate into inter-disciplinarity at the upper level (Harvard 2016). At the same time, the requirements for majors has grown, now typically 55- 60 units, but some as high as 80 units. This "creeping major" increases the chance that the student will not be able to finish their degree in four years, particularly if they change majors (Powell 2016).

There are signs that disruption is in the wind. In his 2011 book, "Abelard to Apple", Richard DeMillo states the "envy colleges", those in the middle of the university rankings that emulate the top-ranked Universities like Harvard, Yale and Cornell, are "not only unable to articulate their value, but are also unable to reinvent themselves." Michael Crow, the current President of Arizona State University, where state funding accounts for only 20% of the University's total budget, has called for a complete re-conceptualization of how universities are structured and run. His solution at ASU has included collapsing seven colleges into other units, and eliminating more than two dozen departments. DeMillo states that the implicit agreement between universities and students of degrees, diplomas and majors is now irrelevant. New degrees in sustainability focus on several disciplines in a "problem-solving" approach. One of DeMillo's solutions requires the dismantling of disciplines and replacing them with "learning pathways" and "leaning cohorts". Colleges must embrace technology and vary the level of on-line versus face-to-face courses in each semester. Degrees should be created in a more modular fashion that allows students to incorporate other courses outside their discipline (DeMillo 2011).

In "Checklist for Change: Making American Higher Education a Sustainable Enterprise", Robert Zemsky (2013) states that the research orientation of many universities, in fact, drives disciplinarity. In the world of research and research funding, disciplinary conformity is the goal. Peer review makes it almost certain that disciplinary norms will be rewarded. A study in 2014, looking at PhDs from students who graduated in 2010, found that those who wrote interdisciplinary dissertations earned, on average, $1,700 less than those who completed dissertations in a single field. They also found that interdisciplinary research was more likely to

be performed by full professors, who had no concerns about tenure and promotion (Jaschik 2013). Zemsky also advocates that the current assessment practices are woefully inadequate and should be replaced by a series of "examinations that map the broad range of skills, competencies and attitudes whose acquisitions ought to be the central purpose of an undergraduate education" rather than a disciplinary degree (Zemsky 2013).

The creation of the departmental structure has already distanced the academic disciplines from one another. The arts and humanities have taken a back seat, and the salary differential between the disciplines has created stratification and a source of tension between departments (DeMillo 2011). In 2007, in their report *Rising Above the Gathering Storm*, the U.S. National Academy of Sciences, National Academy of Engineering and the Institute of Medicine called for increasing emphasis on science, technology, engineering and math (the "STEM" subjects) in order to "ensure that our nation continues to enjoy the jobs, security, and high standard of living that this and previous generations worked so hard to create" (Committee on Prospering in the Global Economy of the 21st Century 2007, 12). In the 2016 Federal budget, the NSF received $7.7 billion, about 25 times as much direct Federal funding as the NEH and NEA (both at about $148 million) combined (NSF 2016, NEA 2016, NEH 2016). The academic tension and competition created by such disparate funding and emphasis create insularity and isolation among scholars and the students they teach. Recognizing these developments in the U.S, a movement to re-integrate the arts and design into STEM approaches (STEM to STEAM) has emerged; in the U.S congress the "STEAM caucus' has been signed by 50 U.S congressional representatives to encourage and stimulate this development (STEM to STEAM 2013).

According to Christensen and Eyring, Universities have three vital jobs to do, and they have the capacity to do them well: (1) discovering and disseminating new knowledge (2) remembering past achievements and failures and (3) mentoring the next generation. A college education should expose the students to a wide variety of disciplines. Students have a flood of information but not a good way to sort or search it. They lack the ability to critically evaluate the information they receive. As the value of a diploma rises relative to its cost, Universities will need to re-consider the highly disciplinary nature of the current system of general education requirements and majors. Majors need to be trimmed to allow for other coursework including cross-disciplinary courses, and general education should be more cross-disciplinary. Cross-disciplinary courses with practical relevance should be created. Interdepartmental faculty collaboration should be encouraged and innovation should be led by cross-disciplinary teams focused on specific issues and problems (Christensen and Eyring 2011).

My personal experience in teaching music to students at UT Dallas, who are majoring in other disciplines and often those in the STEM areas, is that students are under increasing pressure to drop courses that are not immediately applicable to their major, particularly as they reach their junior and senior years. Advisors, under pressure from their departments to ensure students graduate within four years, tell them to drop any non-major courses and focus only on those courses that are required for their major. Some majors at UT Dallas now only allow for two electives outside the major field of study. Students are discouraged from pursuing minors (in spite of anecdotal evidence that it enhances admission rates to medical and graduate school) or double-majoring. This is all in opposition to the current recommendations from those scholars

who are taking a hard look at the current disciplinary system of higher education. The current disruption in higher education may lead to a less disciplinary structure, but institutions of higher education are like the Titanic – even though they can see the iceberg (and only the tip of it) looming ahead, they are slow to change direction.

The Value of Interdisciplinary Study

Art-making has a serious impact on student creativity and innovation. Students who engage in art-making are more inclined to take risks, create collectively and individually, work in groups, think "outside the box", transfer skills between disciplines, learn to speak persuasively, network, have a willingness to fail and can disregard the dominant point of view to create new perspectives (Reid 2012). The U.S. National Academies have remarked that the need for interdisciplinary education is driven by increasingly complex problems that cut across traditional disciplines and recommended "…students should seek out interdisciplinary experiences, such as courses at the interfaces of traditional disciplines…" (National Academies of Science 2005).

Even though inter-disciplinarity and interdisciplinary studies are terms that are more closely associated with the 20th century, the concept has historical antecedents in Greek philosophy. Aristotle's division of the various disciplines into the area of knowledge (theology, mathematics and physics), the practical subjects (ethics and politics) and the productive subjects (fine arts, poetics and engineering) were then tied together by philosophy as the universal field of inquiry. Up until the end of the nineteenth century, the word "science" was often used interchangeably with "philosophy", to mean all forms of knowledge rather than particular branches of it. From

the 1830s onward, the term "science" began to refer to the natural sciences (Moran 2010). Nietszche attacked the rise of disciplines in his essay *We Scholars* in "Beyond Good and Evil", which he saw as a creation of the research-oriented German universities (Nietszche1888, translated by Zimmern, 2003). The specialized "scholar" replaced the "philosopher" as a way to climb the career ladder within a professionalized society. The university was becoming a closed institution, through the creation of departments, learned societies and journals, and the acquisition of a Ph.D. in a specialized subject. The term "interdisciplinary" emerged within the context of concerns about general education in the mid-1920s and became common usage in the social sciences and humanities after World War II (Moran 2010).

A historical reversal of the trend towards disciplinarity was seen in the 20th century (Gaff 1997) and some scholars felt at that time that the diffusion of interdisciplinary studies through the academy was probably "the clearest sign of the erosion of disciplines as the predominant mode of academic organization" (Heilbron 2004). By the late 20th century, interdisciplinarity was seen as synonymous with creativity, progress, path-breaking ideas, discoveries and paths of investigation. Both interdisciplinary fields and programs grew significantly from 1975-2000. Fields grew by 250%. Interdisciplinarity was considered a notable feature of academic change, with a sharp increase in collaborative research, administrative advocacy, funding and a literature of best practices. Growth was particularly strong in technological innovation (Brint 2009). Indeed, the traditional organizational matrix of disciplines seemed to be dissolving. There is indeed a growing need for students who have had meaningful experiences in more than one discipline during their college years. Colleges and universities, in response to pressure from

more state legislatures and societal factors, emphasize the production of students for job markets and place an emphasis on quick graduation rates and marketability. Students without disciplinary PhDs are at a disadvantage when looking for jobs in disciplinary programs, where hiring committees are generally disciplinary in nature, and they are often paid less (Jaschik 2013). Many foundations, ministries, museums and other cultural institutions have a restricted review process that lies solely within disciplinary frameworks. New forms of funding that acknowledge that the value of interdisciplinary work are needed (Blassnig 2013). And yet, the most fundamental characteristic of science has always been a problem-oriented enterprise. Most socioeconomic problems are interdisciplinary in nature. There have been numerous calls in the last decade for more strategic approached to interdisciplinary approaches as the organizing principle for research collaboration. Todd Presser in his report on the digital humanities calls for "a transformation of scholarly practice from individuals working and writing in isolation to team-based approaches to research problems that cannot be conceptualized, let alone solved, by single scholars" (Pressner 2010).

Some universities are responding to the call. In 2013, Stanford University launched a new interdisciplinary program "Science, Technology and Society", aimed to provide the opportunity to take courses across the sciences and humanities, with guided research opportunities to make connections between disciplines (AAC&U News 2012). They also instituted a new "Honors in the Arts" program in 2013, intended for both arts and non-arts majors, in order to "allow students to integrate arts into their academic careers while opening the door to arts-related career paths" (Stanford Arts Institute 2016). Art majors will have the opportunity to incorporate other arts

activities in an honors project, while non-arts majors will do an honors project involving an arts project and their chosen field of study.

But growth and sustainability are often difficult, with some programs surviving as showpieces or enclaves and others disappearing entirely. Programs that promote collaborations between traditional disciplines often have limited staying power (Feller 2002, 109-115; 2006, 5-15). Few institutions have implemented systemic reforms for lowering institutional barriers (National Academy of Sciences 2004). The NAS report admonished institutions for not examining their structures. A study of ten interdisciplinary programs in the United Kingdom, the United States, Germany and Australia was conducted in 2006 and found that project-based funding was not sufficient for the sustained support of interdisciplinary research in terms of both scale and duration. They concluded the UK model of funding by the Arts Council England and the Wellcome Trust generated a "fragmentary, un-sustained and individualistic" result (Barry 2007). By contrast, the university-based art-science program at the University of California, Irvine, including its ACE (Arts, Computation and Engineering) masters degree and University of Western Australia's SymbioticA programs fared somewhat better, but there was, at the time of the report, concerns that both programs were "fragile". However, both programs have survived and Symbiotica, after some difficult years, launched their first PhD graduate show (SymbioticA 2016). The Arts, Computation and Engineering (ACE) degree is still functioning at UC Irvine and is supported by the Claire Trevor School of the Arts (SOTA), the Donald Bren School of Information and Computer Sciences (ICS), and the Henry Samueli School of Engineering (SOE) (UC Irvine 2016).

There are still many barriers to interdisciplinary work, including different types of training, institutional context, and different pedagogical systems. Study in the humanities tends to be historically organized, while in the sciences knowledge is seen as cumulative, with study focusing on the most up-to-date discoveries and research, characterizing the history of the discipline as a mere stepping-stone to the current work. C. P. Snow delineated this division in his oft-quoted "The Two Cultures and the Scientific Revolution", a lecture delivered at Cambridge in 1959, about the "gulf of mutual incomprehension" that existed between the sciences and the humanities. Those who cite this gulf often forget that Snow suggested that the best way to improve the situation was education and particularly interdisciplinary studies (Snow [1959] 1993).

The current climate of emphasizing assessment in all areas of higher education has been extended to interdisciplinary courses, which have their own unique challenges in defining objectives and setting goals, given that they must often meld these from different areas. Many universities now have suggestions for faculty who engage in interdisciplinary teaching, including defining objectives, specifying outcomes, identifying issues, encouraging critical thinking, and generating evaluative rubrics (San Francisco State University 2013). While they do not directly address the intersection of the arts and sciences, there are long-standing organizations that do. The Association for Interdisciplinary Studies, formed in 1979 to "promote the interchange of ideas among scholars and administrators in all of the arts and sciences" maintains a website that includes a variety of resources, including links to assessment references, a survey of graduate programs, peer-reviewed syllabi, and job listings for interdisciplinary programs and a scholarship

of interdisciplinary teaching page (Association for Integrative Studies 2016). This author still maintains a website CDASH (Curriculum Development in the Arts, Sciences and Humanities) (Evans 2016) contains such courses as the program at Dartmouth, "Mathematics Across the Curriculum" (MATC). This program was created in 1995 and ended in 2000, but the coursework is still in place at Dartmouth and the wide variety of courses connecting mathematics to the arts are offered (Dartmouth 2016). The website is still a good reference for faculty who wish to teach courses of this type. Instructors of art-science-humanities curriculum would be well served by studying the rich tradition of interdisciplinary and integrative studies, in order to ameliorate some of the barriers that still exist in university departments and disciplines.

Evidence-based Research Findings
In Skills Transfer From the Arts to Other Subjects

In 2001, Hetland and Winner of Harvard Project Zero published their results of a review of over 50 years of studies connecting arts to academic improvement, including many unpublished papers. Reviewing 188 studies chosen from over 11,000 articles and books, they identified only three areas where there was a causal link: listening to music and spatial-temporal reasoning (the oft-cited but poorly understood study, termed the "Mozart effect"); learning to play music and spatial reasoning; and classroom drama and verbal skills. Because they found no correlative effect in many of the studies, the article goes on to offer a better justification for the arts in schools: that the arts offer a way of thinking unavailable in other disciplines (Hetland and Winner 2001). In fact, the Mozart effect, which was originally published in Nature in 1993, only demonstrated that students did better on a spatial task when they listened to a sonata by Mozart,

rather than silence or verbal relaxation instructions. It showed only a temporary effect and made no claims as to enhancement of IQ (which was never measured) or other skills, yet the study was misinterpreted to say that listening to Mozart made children smarter (Rauscher 1993). The study was immediately questioned, and a study of 10- and 11-year-olds in the United Kingdom in 1996 involved over 207 schools (thanks in part to the efforts of the BBC) and 8,000 subjects. The results were known as the "Blur Effect", because it demonstrated that positive effects of music listening on cognitive abilities are most likely to be evident when the music is enjoyed by the listener, in this case, the English rock band Blur (Schellenberger 2005).

The question of whether arts skills transfer to other disciplines has long been studied. James Catterall states that "transfer has acquired a tarnished reputation over the years in the realms of learning and developmental psychology" and that current methods do not find the needed evidence. One of the major areas of interest has been cognitive development through music. Catterall has listed a large number of cognitive capacities and motivations, including spatial reasoning, spatial-temporal reasoning, quality of writing, mathematics proficiency, self-efficacy, self-concept, verbal scores on the SAT and English skills for EST learners, that are derived from music study as well as others from dance, drama, visual arts, and multi-arts programs. However, the evidence for this is spotty, and there are few studies that look at the effects of learning in the arts over longer times (Catterall 2002). A 2004 report by the Arts Education Partnership "The Arts and Education: New Opportunities for Research" list the arts and the transfer of learning as one of the major areas for future research. It posits that "future research might thus ask how engagement with the arts affects students' thinking skills, dispositions and inclinations to work

with complex ideas". It further states that studies should pay attention to "specific qualities of arts learning" (Arts Education Partnership 2004).

Finally, a recent meta-analysis by Robert Root-Bernstein, Ania Pathak and Michele Root-Bernstein reviewed studies that demonstrated the effectiveness of integrating arts, music, performing, craft and design (referred to as ACD, arts, crafts and design) into Science, Technology, Engineering, Mathematics and Medical Education (STEMM). This three part study looked at (1) evidence that integration is useful to professional development (2) statistically-validated and controlled pedagogical studies of the Root-Bernsteins' "Tools for Thinking" and (3) statistically-validated and controlled pedagogical studies of eleven ACD-integration strategies utilized by STEMM professionals. This compendium of studies is concerned with the nature of the skills and knowledge that both ACD and STEMM require and how best to integrate them. They looked at the work of Thomas Henry Huxley, who was an early proponent of interdisciplinary education, focusing on the means and the habit of observation. His synthesis of arts, crafts and sciences was, according to the article, "undermined in the UK by disciplinary specialization", although his notion of Colleges of Arts and Sciences has survived to this day in American universities (Huxley, 1898). Studies of mathematicians in the early 20th century yielded findings that they engaged in music at much higher rates than the general population (Claparède and Flournoy 1902; 1904). Nobel prize winners, National Academy of Science members and U.K. Royal Society members report music as an avocation at 23%, 15% and 14% respectively. Bernstein's 2008 study compared all Nobel laureates in the sciences (up to the year 2000) with an average group of scientists and found that the average scientists had the same

interest rate in the arts as the general public, but Nobel laureates proved at least twice as likely to be photographers or musicians as average scientists (Root-Bernstein, et al. 2008). A study of Michigan State University Honors College graduates who went on to careers in the sciences and who had patents or founded scientific companies were more likely to display sustained interest in the arts, particularly drawing, photography, musical composition, dancing and crafts (Lamore, et al. 2013). However, all these studies cite correlational evidence and do not necessarily provide any insight as to what qualities of ACD engagement play a role in the relationship between ACD and STEMM success.

Root- Bernstein, et al. list 12 interdisciplinary "bridges" between ACD and STEMM, some of which are very relevant to this study. In particular, the following bridges were particularly compelling (the numbers are theirs):

Bridge 1. *Mental skills or "tools for thinking", including observing, imaging, abstracting, pattern recognition and pattern forming, analogizing, empathizing and play-acting, body thinking, dimensional thinking, modeling, playing, transforming and synthesizing.* Music and sound design enhance many of these mental skills. Playing an instrument involves observing the score, abstracting from the score to actual music, seeing patterns in musical themes and motifs, forming those patterns in performance, empathizing with the intent of the composer, visual thinking when presented with a two-dimensional score (as is common in choir and conducting), and transforming the abstract notes on a score into music, using body thinking. Sound designers used similar skills, such as dimensional thinking when looking at multiple tracks in a sound

design; abstracting from those tracks and synthesizing a final, combined sound; empathizing a visual element in a film, video or game to an aural one; seeing and using patterns of sound (particularly in film and games) to enhance character or plot points; and modeling a visual impression into an aural one.

Bridge 6. *Experience navigating the creative process more efficiently and cogently*. Georges Urbain said "the musician combines sounds in the same way the chemist combines substances", which is certainly true of any sound designer. The various sounds are the substances from which a soundscape is created. A composer thinks of the various timbres of the orchestra and them combines them in meaningful ways to create an emotional experience (Urbain 1924).

Bridge 9. *Mnemonic and other mental devices that increase acquisition and retention of learned material*. Music requires of its performers a great deal of memorization and the mnemonic devices learned by musicians translate to those in other subjects. In our study, memorization was often mentioned as one of the skills learned through music that enhances other academic studies.

Root-Bernstein goes on to say the integration of ACD into STEMM should be very specific and explicit, but that few studies give us this information. He states that "breaking down the specific types of skills or knowledge developed in any particular art, craft or design project and ascertaining how these may overlap with skills and knowledge requires in a STEMM subject" should be of paramount importance in any study (Root-Bernstein et al, 2016a). This study attempts to discover some of the specific skill sets by asking students about specific experiences

in music and sound design and how (and if) they applied those experiential skills to other academic subjects, including those in STEM (medical education was not a part of this study, as it focused on undergraduates only). This can then be applied to further research studies and the development of a pedagogical strategy that focuses on those specific skills.

In part II of the study, Root-Bernstein et al. describe studies that use their "tools of thinking". A number of these are relevant to music and sound design: aural observation, aural imaging, abstracting, recognizing and inventing new patterns, musical or sound patterns, and mental models. Further, they cite a number of studies that relate these thinking tools to musical concepts. They describe observing as "sustained attention to some phenomenon using any or all of one's senses". Indeed, this is one of the topics of query in this study: the ability to maintain attention to streams of aural information. Musical training has been shown to improve the ability of medical students to distinguish between and correctly identify stethoscope recordings (Mangione and Nieman 1997, 1999). Hence, aural observation skills are trainable (something any music or sound design teacher would verify). Another study showed nursing students with remedial aural observation skills would be helped by music lessons with music specifically composed for the intervention (Pellico 2012). Other studies have shown that musicians have significantly better abilities to distinguish speech in a noisy environment (Parbery-Clark, et al. 2009) and have better working aural memory (Pallesen, et al. 2010). This characteristic of enhanced aural memory was described by some respondents in our study.

Root-Bernstein, et al. cite a number of studies that showed that "visual thinking" is a skill that enhances STEMM outcomes. They state "The salient feature of visual thinking intervention studies is that no matter how visual imaging is taught, it has substantive benefits for STEMM learning outcomes." (Root-Bernstein et al. 2016b). In our study, we will show that reading a musical score has implications for students' abilities to think both horizontally and vertically.

"Abstracting" is the process of eliminating unnecessary information to leave the essential elements of meaning. Root-Bernstein, et al. state that "the purpose of a lesson is to present a principle or process that is to be generalized across a dissimilar set of material" (Root-Bernstein et al. 2016b). Music theory and the study of form is precisely this process: by analyzing the underlying structure and rules that govern a musical piece, students learn to generalize these concepts to other pieces of music, and even to use them to compose music. Our study examined students' responses as to whether that process was then extended to other academic subjects.

"Patterning" involves both recognition of existing patterns and the ability to see organizing principles within a large structure. For many of the concepts we studied, seeing patterns and recognizing larger structures was a salient feature and mentioned often and in several different contexts. Patterning requires the ability to abstract out a set of rules about the objects that form the pattern; music notes are the smallest units in a musical work, which form larger units (melodies, themes, or motifs) that can then be used in other parts of the work, often translated in time or space. Notes can be repeated exactly, or at a different tempo, in a different meter, or

played in a different key, or in the reverse direction. (It should be noted that this is the main basis for the manipulation of themes in the Baroque fugue.)

"Empathizing" refers to placing one's self in another "shoes", so to speak, and music requires the performer to attempt a re-creation of the mood of the composer. "Embodiment" is often spoken of in music, and indeed, some of our respondents talked of "being one with the instrument" or "becoming the instrument". This is also related to "body thinking", another area where musical performance has impact. Voice students (similar to actors and dancers) must learn kinesthetic awareness, that sense of knowing body positions, balance and movement. They must be aware of their breathing and posture. Music students who play instruments learn manual dexterity and hand-eye coordination that can be useful in STEMM settings, particularly for laboratory activities or medical activities like surgery. One study found that medical students with no music training learned surgical techniques slower than their musical counterparts; those that were currently playing an instrument learned the fastest (Boyd et al. 2008). Another study found that musicians and athletes had better knot-tying techniques and learned robotic skills faster (Harper et al. 2007).

All of these studies demonstrate that tools for thinking can be taught, and that at least for those described above, training in music and sound design may enhance those skills. In the conclusion of Part II, Root-Bernstsein, et al. state that "surprisingly little well-controlled pedagogical research has gone into investigating how best to make use of these trans-disciplinary connectors." It should be added that these tools of thinking can be directly connected to skill sets

in the arts. This study helps to define which tools are in play during music and sound design study, with an eye to future studies that would have the necessary controls (Root-Bernstein, et al. 2016b).

In Part III of the study, Root-Bernstein, et al. examine the bridges and their pedagogical utility. One bridge "Experience navigating the creative process more efficiently and cogently" is of interest to our study and has particular relevance to music and surgery (Root-Bernstein, et al. 2016c). Vouhé studied the effects of musicianship on surgery and drew six ways that making music is a metaphor for surgery: concentration, strictness, anticipation, virtuosity, ability to learn, and capacity to create harmony. (Vouhé 2010). Our study looked at a number of these characteristics, not as they apply to surgical technique, but as they apply to academic abilities. In particular, concentration or focus (a question about "flow"), the ability to learn (covered in several questions) and strictness (through a question on rubato) were studied. Another bridge "Mnemonic and mental devices that increase acquisition and retention of learned material" was specifically addressed in our study. Since music contains rhythm, rhyme (in song) and meter, which help organize music, learning these musical devices has been shown to limit error during recall (Bower & Bolton 1969). Many students mentioned enhanced memorization skills in their responses.

Finally, Root-Bernstein mentions the lack of any controlled studies in informal STEMM learning. The differences in music and sound design students were examined in this study, and one salient feature was that the majority of learning prior to college in music was in a formal

setting, whereas the majority of sound design students had learned the techniques in an informal, self-directed setting (Root-Bernstein, et al. 2016c). This study allowed us to look more closely at this one example of formal versus informal learning.

The compendium makes some recommendations for future study in order to rectify the lack of well-controlled studies for arts integration into STEMM subjects. They note that "any use of musical (or any other form of ACD) training must explicitly connect to a particular STEMM education need through one of the twelve bridges described in this tripartite essay" (Root-Bernstein, et al. 2016c). We propose that before that can be done, a study of how music and sound design study is actually benefiting students must be a necessary first step. This study of college undergraduates who study music and sound design, but major in other fields, is a first step in elucidating those benefits.

Music and Sound Design:
Skills Sets and Skill Transfer

Music is an ancient subject, with roots in the prehistoric times. Copland, in "What to Listen for in Music" states that the most primal use of music is movement, a basic human instinct (1957). Every known civilization has created music of some kind. In addition to the human voice, mankind has created instruments since the dawn of time. A recorder-like object made from the thigh bone of a bear may have been carved as long ago as 50,000 years (Bonds 2010, 3). While there is no general agreement about the origins of music, it is clear that music goes beyond a mere arrangement of sounds or tones, and evokes something greater within us. Dowling states

that “every culture studied has some organized behavior that can be labeled music” and that musical performance simultaneously evokes “thinking, listening, remembering, acting and even feeling”. Music shares universal properties across all cultures, including the use of discrete pitch intervals, octave equivalence and the presence of four to seven tones in an organized scale (Dowland 1986). Most agree that music consists of four psychological qualities, defined as pitch, duration, loudness and timbre. In this study, we differentiate between listening to music (a passive experience shared by all but the profoundly deaf, and even they sense rhythm) and actively studying or performing music. The latter requires an intellectual component that Copland calls the “third plane of listening” or “the sheerly musical plane”, going beyond the sensuous and expressive planes, and delving into the notes and their manipulations, the melodies, the rhythms, the harmonies and the tone colors (Copland 1957). It is this intellectual approach to music that is of interest in this study. What skills does it take to study music theory? What skills does it take to perform a piece of music and go beyond merely reproducing the notes and rhythms to make meaning?

Sound design, by contrast, is an academic discipline that came into being only in the 20th century, after the advent of audio technologies. One can simply define sound design as the process of specifying, acquiring, manipulating or generating audio elements. That simple definition, however, belies the complex task at hand that the sound designer must face when they create sound for theatre, film, video and games. Sound design incorporates music, but it also incorporates sounds (“effects”) that would not be defined as music (at least, not by the four required psychological elements above). What skillsets are needed to not only manipulate given

sounds, but create new ones that capture the essence of a visual or theatrical experience? Sound design students are required in "Introduction to Sound Design" at UT Dallas to learn about the aesthetics, technique and theory of sound design; understand the acoustic properties and perception of sound; understand the relationships between sound and visual narrative; and learn the technical skills to edit, process and publish digital sounds for various media. This requires critical listening that is not unlike Copland's third plane. The assumption that musicians and sound designers are utilizing similar skills needs to be studied and will be explored in this study.

In this study, we focus on seven common intellectual experiences students have in making music or practicing sound design. They are:

- the experience of the flow state as defined by Csikszentmihaly in "Beyond Boredom and Anxiety" (Csikszentmihalyi 1990)
- the study of form, the underlying structure of any musical piece or sound design work
- the use of rubato, the creation of expression by subtle changes in tempo
- the connections between music theory, language and mathematics
- the requirement of discipline and time management in order to pursue music or sound design study
- the requirement of maintaining attention to aural information over time
- the requirement that the musician or sound designer deal with small bits of information in a temporal manner, known as "segmenting"

One area of interest of this study is whether music students (defined as students who have taken a music course at UT Dallas) or sound design students (defined as students who have taken a sound design course at UT Dallas) will have different experiences in these seven areas and a different sense of what skills transfer to other courses. It may be that some areas are more reinforced by music study and others by sound design study. Do they feel that their experience in music or sound design in these seven areas extends to their other academic subjects, or will music and sound design subjects respond differently as to the skills that they feel transfer? This will be explored in depth in the "Cohort Comparison: Music Versus Sound Design Students" section that follows. There are also some distinctions between music and sound design that we will be looking for. Music is a canonical subject, with clearly defined "masters" and "great works"; sound design does have well-known designers, but not the 600 years of history that music enjoys, and hence no real "canon" yet. Music (at least western music) has an accepted notational system; sound design does not. Music has a more social aspect, as frequently musicians perform in ensembles or large groups, such as orchestras, bands or choirs. Only soloists who can play their instrument alone (pianists, guitarists, etc.) work alone. Even string players, with the exception of unaccompanied works, need other musicians to perform. Sound designers tend to work alone on their specific part of the project. They may be a part of larger team, creating a film, or video, or game, but the bulk of their work is done in isolation. Sound designers can create new sounds and work at the psychoacoustic level. Some musicians can do this also (one thinks of something like prepared piano or multi-phonic extended vocal techniques), but for the most part, musicians are playing the instrument they have been given (particularly in voice) or chosen, and the main intent is not to create new sounds, but to

understand and interpret others' creations. Finally, musicians often must memorize their pieces, and the performance aspect can help with other skills such as public speaking. Sound designers rarely need memorization techniques and do not appear publicly. One personal anecdote shines a light on the difference between sound designers and musicians: in 2010, I worked with a large team of animators, computer programmer and sound designers to help create a digitally controlled character for a Broadway-style musical. The character was manipulated live during the show and at the end, we asked all the team members, along with the cast, to take a bow. The team members had never experienced getting applause for their work – and many remarked how wonderful it felt. Most came every night to see the audience reactions to their work and get that applause, a unique experience for them (Evans and Evans 2013).

It should be noted that we specifically avoided certain experiences that take place during music making or the creation of a sound design: the psychological aspects of the experience (joy, emotion, tension, etc.); the affect of parental influence (given that these are college students); and the social implications of working in a group such as an orchestra, choir, or other musical ensembles, or working as the sound designer as a part of a team in the creation of a film, game or video. While these are areas of interest, they are outside the scope of this study. Respondents did mention experiences of this nature in the open-ended questions at the beginning and end of the survey, and sometimes within the seven areas listed above. These are noted in the "Observations" area of this dissertation.

It should also be noted that definitions of “music” and “sound design” are intensely personal. There are many who consider “rap” a form of music, and others who feel it lacks melody, and hence is not music. Others would argue that it contains the four psychological states of pitch, duration, loudness and timbre, and therefore qualifies as music. Clearly music is a part of sound design, but not a necessary one. The game “Ico” contains mainly ambient sounds throughout most of the game play and very little music (Ueda 2001). Natural sounds are not generally classified as music by most, but some include birdsong or whale song as “music” made by animals. There is more to sound design than just the simple definition given above, if the syllabus of “Introduction to Sound Design” is any indication of the substantial skill sets required of a sound designer. In any case, both require similar skills that may or may not transfer to other academic subjects. The experiences of students in both music and sound design will hopefully given some direction as to what skills are of greatest interest and if, in fact, there are significant differences in these two samples.

CHAPTER TWO

METHODOLOGY

This research project will use the conceptual framework of transcendental phenomenology, based on the work of Edmund Husserl. The term phenomenology dates back to the 1800s in philosophy, first used by Hegel to refer to knowledge as it appears in consciousness, and the science of describing what one perceives, senses and knows in one's own immediate awareness and experience (Hegel 1801, translated by Miller 1977). Husserl defines the process of the co-mingling of the object in nature with the object that appears in consciousness as "ideation". Hence, meaning is created and there is a relationship between what exists in the world and what exists in conscious awareness (Husserl and Gibson 1931).

A Brief History of Phenomenology

Phenomenology is broadly defined as the philosophical study of the structures of experience and consciousness. The term was first used by G. W. F. Hegel (1770-1831) in his text "Phänomenologie des Geistes" (1801) which can be translated as either "The Phenomenology of the Mind" or "The Phenomenology of the Spirit" since "Geist" means both. It is an approach to philosophy that begins with an exploration of phenomena (what presents itself to us in conscious experience) as a means to finally grasp the absolute, logical, and metaphysical Spirit that is behind phenomena. Phenomenology refers to knowledge as it appears in consciousness, the science of describing what one perceives, senses and knows in one's own immediate awareness and experience (Hegel 1801, translated by Miller 1977).

Hegel's work was extended in 1913 by Edmund Husserl (1859-1938). His book "Ideas: General Introduction to a Pure Phenomenology" was described by Husserl as "an essentially new science". He felt that it was "not a science of facts, but a science of essential Being … a science which aims exclusively at establishing the 'knowledge of essences'." The basis of his thought is that people can be certain about how things appear in their consciousness and their descriptions are reliable. This new realm of philosophy and science was initially not well received. Husserl's transcendental phenomenology is bound up with the concept of intentionality, that is, the orientation of the mind to its object. Intentionality is the internal experience of being conscious of something. It is objective whereas feeling is non-objective. Every intentionality is comprised of a noema (the phenomenon) and noesis (cognition). The essential function of intentionality is the working out of the relationship between noema and noesis (Husserl and Gibson 1931, Moustakas 1994).

Husserl believed that information about objects in the real world is unreliable. He argued that people can only be certain about things as they appear to them in their consciousness (Fouche 1993). To be certain, anything outside immediate experience must be ignored and in this way only the contests of personal consciousness are relevant. Phenomenology attempts to return to the concrete experience of the subject (Groenewald 2004).

Husserl's work was carried forward by Maurice Merleau-Ponty (1908-1961). In his text, "Phenomenology of Perception", he defines phenomenology as "the study of essences" and posits that "all problems amount to finding definitions of essences: the essence of perception, or

the essence of consciousness". It tries to give a direct description of an experience without "taking account of its psychological origin" (Merleau-Ponty, translated Smith 1967).

As a research method, phenomenology was not fully developed until the 1970s, when psychologists established a praxis, a methodological realization of the philosophical attitude of phenomenology (Kruger and Stones 1981). In phenomenological investigation, the researcher constructs a question to guide the study, and derives feelings that will lead to further research. The individual is asked to construct a full description of his/her experience, known as the textual description. Every perception is a primary source of knowledge, based on the acts of memory that are relevant to the phenomena and the current awareness. Husserl asserts that each person experiences phenomena in their own way and that perception is individual. Even though we may wish to have our experiences validated by others, we must rely on our own perceptions as our only source of knowledge (Husserl and Gibson 1931). The researcher has a personal interest in the investigation and is intimately connected with the phenomena, but must construct a research question where every word is deliberately chosen. In education, the focus should be on individual acquisition of knowledge, freedom to explore and make choices, and the validity of personal vision, discovery and self-assessment. The researcher's journey will lead to other questions, new understanding and new meanings.

The Phenomenological Research Method

Evidence in phenomenological research is derived from first-person accounts. We must identify then set aside prejudgments, biases and preconceived notions. No position is taken; every quality has equal value. Phenomenological reduction is the task of describing in textual language what one perceives and also the internal act of consciousness, the experience as such. We must look and describe and then look and describe again. The process of horizontalization takes place, where every statement is treated as having equal value. We can never exhaust our experience of things no matter how many times we reflect on them. We seek a complete textual description of the experience in order to derive the meaning of the experience.

The empirical phenomenological research method as outlined in the "Duquesne Studies in Phenomenological Psychology" involves asking subjects to return to an experience in order to obtain descriptions that provide the basis for an analysis that portrays the essences of these experiences (Georgi et al.,1975). There are two descriptive levels in this process: Level I, the original data comprised of descriptions obtained through questions and dialogue; and Level II, the analysis and interpretation of that data by the researcher. In this sense the phenomena speaks for itself. Meanings are derived from the descriptions provided by the subjects. There are many principles that govern phenomenological research. The most basic is that qualitative research methods have value, especially in situations where quantitative methods do not apply and when the primary research orientation is the understanding of how phenomena are manifested to consciousness and how in this process they form meanings and values. The focus of phenomenology is the wholeness of the experience and using methods that will bring out that

experience among chosen participants. The phenomenologist searches for meanings, rather than measuring data. The researcher views the personal experience as an integrated and inseparable relationship of subject and object, of parts and whole. The most reliable method of data-gathering is first person accounts, either through extended surveys or personal interviews. The gathered data is considered as the key to understanding human behavior. The intention of the analyses of the data is not to deconstruct the problem, but rather to posit that integrated whole. The researcher then uses the data to answer questions that reflect the interest, involvement and personal commitment of the researcher. The researcher begins with the formation of the problem and the question to be studied; then chooses methods to generate relevant data, including surveys and interviews; and then analyzes the data using a chosen procedure (Moustakas 1994).

The phenomenological research project begins with bracketing of the researchers personal views and preconceptions. The researcher should listen repeatedly to the interview recordings to become familiar with the words of the interviewee and develop a holistic sense, a gestalt of the experience. Then, statements that seem to illuminate the research phenomenon are extracted or isolated. Units of relevant meaning that have been extracted are carefully scrutinized and clearly redundant units are eliminated. One useful technique is to look at the number of times a meaning was mentioned and how it was stated. The next step is the clustering of units of meaning to form themes. Each interview is then summarized and all relevant themes are elicited from the data for each interview. Finally, general and unique themes for all the interviews are created and a composite summary of all the interviews is written. This must reflect the context or “horizon”

from which the themes emerge. Everyday expressions are translated into appropriate scientific discourse (Groenewald 2004).

Phenomenological research methods use the following terminology for each of these steps:

- Bracketing: a focus on the research topic and question
- Horizontalizing: every statement is treated as having equal value
- Delineating: establishing units of meaning
- Clustering: grouping the units of meaning into themes
- Summarizing: putting the horizons and clusters into a coherent textural description
- Extracting: obtaining general themes from all the interviews and making a composite summary

The final step is the integration of the fundamental textural and structural descriptions into a unified statement of the essences of the experience of the phenomenon. This methodology is useful to thoroughly investigate human experience and derive knowledge and meaning from these experiences (Moustakas 1994).

Phenomenology and Music Education

Phenomenology is grounded in 20th-century philosophy. The discussion focuses on the "lived experience" and is a "human science which studies persons" (Bresler, 1995). This experience happens in time and can only be reflected upon as past experience. There are countless studies of music as a perceptual activity, that focus primarily on listening, rather than active music-making. As early as 1944, Alfred Shutz explored the connection in his work "Fragments on the Phenomenology of Music, written at Lake Placid in English after his immigration to the United States in 1939. He discusses music and language, painting, and dance, and then explores music

from a phenomenological perspective, with emphases on ideal objects and time, defines three basic categories of musical perception, and the general experience of music from the listener's point of view. It does not, however, address the experience of the person making music as an activity (Schutz and Kersten, 1976).

Many studies focus on using phenomenology to study music education within the realm of the education of music majors. In their study "A Phenomenological Study of Music Education Majors' Identity Development in Methods Course Outside Their Areas of Focus" the concept of "outside" was restricted to studying vocal majors who enrolled in instrumental music courses and vice versa (Parker and Powell 2015). In a study of 148 music education dissertations using qualitative methods between 1998 and 2002, the first five topics, comprising more than 40% of the dissertations, were focused on multicultural implications, music programs, teacher education, curriculum integration and instructional strategies. Most were in the realm of case studies; only nine studies were identified as phenomenological in basis (Kantorksi and Stegman 2006). Other studies focus on using phenomenology to study music and health (McLennan et al. 2013), interpretive phenomenological analysis (IPA) for music therapy (Pothoulaki et al. 2012) and using a phenomenological approach to music notation, which presents a rather novel approach, challenging current accepted music notation as too semiotic and fixed (Casey 2015).

Studies of music education from a phenomenological viewpoint should attempt to deepen the understanding of the experience of this kind of education. Subjects are often referred to as "co-researchers", acknowledging their crucial role in the study. One such study by Collier-Stone

examined the “lived experience” while students studied violin with the Suzuki method. The study involved 26 “co-researchers” over a long period of time, from pre-school or early elementary years through high school graduation. Her report, as do many of this nature, includes her own background as a Suzuki teacher and her personal experiences. Her study focused more on the relationships between parents, students and teachers, as do many of these studies, and the values the Suzuki method purports, such as self-esteem, spirituality and an understanding of the existential nature of music. Indeed, co-researchers reported experiencing more self-esteem in other areas of their lives due to their music study. The ability to be “in the moment” was mentioned as a positive force in their lives. Some spoke of the discipline and ritual imposed by the Suzuki method. They emphasized the idea of step-by-step learning as useful in other tasks (Collier-Slone 1991). According to Bresler, “Collier’s findings were all new to the scholarly literature” (Bresler, 1995). Other studies have noted the pedagogic importance of phenomenological study in education. The sensitivity required in such an investigation can enhance the ability of the educator. As van Menen remarks, “Its method requires an ability to be reflective, insightful, sensitive to language and constantly open to experience” (Manen 1990). This researcher could not find any studies that addressed the experience of college music students who were not majoring in music. The “Oxford Handbook of Qualitative Research in Music Education” lists studies in early childhood development, instrumental music, choral music, teaching music at the elementary level, community engagement and cultural diversity (Conway et al. 2014). It encourages the use of phenomenology as a research method in studying music education and describes how phenomenology can be used as a lens for the experience of the participant and the researcher (Hourigan and Edgar 2014). The use of phenomenological

study in the process of musical education has a positive impact upon the participants of the study as it encourages participants to reflect on their experience. It also often has a positive impact on the researcher, as changes in pedagogy may be a result of the study.

A phenomenological approach was selected for this study, as the main concern was to capture the experiences students, who are not majors in music, are having while they are actively pursuing music or sound design in coursework at the University of Texas at Dallas. It is an attempt to capture a meaningful experience that has a direct relationship with their other academic studies, and implications for teaching and curriculum within this particular setting.

Using Phenomenological Methods for Research in Music Education

The practice of music, whether in performance study, music theory or sound design, is a perceptual activity. Research in music education falls into several broad categories: aesthetic-philosophical, descriptive, historical, experimental and behavioral. The goal of such research is often to propose a new pedagogical method or a change in current methodology. Prediction and control are often abandoned in favor of understanding a phenomenon. While some quantitative methods may be used to analyze the survey population, such as demographics and other pertinent data, the main goal of the research is a qualitative understanding of the participants' perceptions. The focus of that desired understanding is to reveal participants' perceptions and views. In order to study the perception of musical activity, researchers must draw on multiple methods and be methodologically flexible. In this study, we used both an on-line survey and in-depth interviews.

The goal is not prediction, but rather the understanding of the participants' perceptions and views of the effect of music and sound design study on their other academic skills. This research used "the structured interview process", using the answers to the Qualtrics survey to elicit deeper responses. In this process, the same questions are posed to all participants (Phelps 1969).

The qualitative nature of phenomenological research necessarily draws on participant observation or interview and open-ended questions. This research study used open-ended questions through both a Qualtrics survey and follow-up interviews. There is an underlying relationship between the researcher and the researched. The researcher comes to the study with a set of biases and expectations. The goal, then, is to be conscious of their biases and prejudices and to monitor them throughout the process.

The steps for analyzing a survey are organizing, reducing, describing, prioritizing and interpreting. The results of the Qualtrics survey text responses was obtained as follows: (1) the creation of key words in responses (2) categorization of keywords (3) qualitative methods to determine the most common categories including word counts for each question with a text response and (4) use of coding families (Phelps 1969).

Context codes: very general data on topic
Situation codes: the way subjects define an issue
Process codes: words or phrases commonly used
Activity codes: regularly occurring types of activities
Strategy codes: the means by which subjects accomplish objectives

The results for each text response were tabled, which allowed for analysis of the most commonplace categories or responses and also a comparison of cohorts. This was coupled with

the narrative reports of the interviews, which used a phenomenological process of analysis. From these two methods, observations about the responses of the participant were noted, including pertinent textual responses. Additionally, a comparison of cohorts of students was performed as follows:

1. A comparison of music students and sound design students. For the sake of this analysis, five cohorts were created, as the lack of a music major or a sound design major makes it impossible to designate students as "music students" or "sound design students" by their majors alone. These five cohorts were: students who had taken music courses who may or may not have taken sound design courses also; students who had taken sound design courses who may or may not have taken music courses also; students who had taken only music courses; students who had taken only sound design courses; and students who had taken both music and sound design courses. These cohorts were also compared to the full sample.
2. STEM (Science, Technology, Engineering and Mathematics) majors and non-STEM majors.
3. ATEC (Arts and Technology) majors and other STEM majors

My own experience as a music teacher and educator for over 40 years has strengthened my belief that music is a positive force in people's lives, not only for their well-being but from an educational standpoint as well. For the last 20 years of my teaching career, I have been teaching at a university with no music major. Therefore, the students enrolled in my classes and engaged in music-making and music study are not studying music as their primary educational interest;

rather, they come to my classes and those of my colleagues with other intents. Most have considerable background in music; most have enjoyed their experiences in the past; and most want music to be a part of their college life. Students in sound design, on the other hand, are a different type of student. Most are majoring in Arts and Technology (ATEC) or Emerging Media and Communication (EMAC), both within the School of Arts, Technology, and Emerging Communication (ATEC). Some actually list themselves as "sound design majors", even though no such major exists. They clearly identify themselves as students focusing their time and study in that field.

I have come to believe, after many conversations, and letters of recommendation to medical and graduate schools, along with a study of the accompanying transcripts of the interviews, that music has benefits beyond the psychological or emotional. My belief that music benefits the academic abilities of those students is the bias that I chose to explore in this research project (and, hopefully, in a future study, fully test). In recognition of my bias, I changed the language of the study from "enhances" to "affects", allowing for negative responses in the survey. Questions were couched in the most neutral fashion possible. In the follow-up interviews, my responses were limited to "tell me more about that" or "describe that experience". However, the inclusion of my own personal experience in examining the results of the study was invaluable, in that this researcher, with advanced degrees in both music and mathematics, could understand deeply the descriptive responses of the students, particularly when it entered the realm of mathematics and the sciences.

Qualtrics Survey Design

Qualtrics, Inc. offers software that allows for on-line data collection and analysis through surveys. It allows for quantitative statistical analysis and is cited in a number of professional and academic journals and books. The University of Texas at Dallas has a subscription to Qualtrics and it is freely available to currently enrolled students and faculty through their UTD login and the eLearning system. It includes tutorials and assistance with survey design, including checking for bias and best practices. It allows for "skip logic", where the respondent will skip various question depending on their responses. The survey was designed in January of 2015. The complete survey is contained in the Appendices.

Consent Form

The UT Dallas Institutional Review Board requires the first page of any survey list the consent form and the respondent must agree. Respondents were asked to check "I have read the consent form, understand it and I agree to participate". If they did not agree, they were skipped to the end of the survey. The following consent text was used:

> I agree to participate in a research study of "Does studying music enhance higher order learning skills in undergraduate non-music majors?" I understand the purpose and nature of this study is to explore the nature of music study and its effects on academic achievement. I have been solicited because I have taken at least one music or sound design course at the University of Texas at Dallas and I am participating voluntarily. I grant permission for the data to be used in the process of completing a Ph.D. degree, including a dissertation and any other future publication. I understand that a brief synopsis of each participant, including myself, may be used and will include the following information: the fact that I am or was a UT Dallas student enrolled in one or more music or sound design courses; which courses I was enrolled in; and my major

> course of study. I further understand that at no time will my identity be used or revealed in any way and that participation in this study has no bearing on my coursework at any time during my enrollment at UT Dallas. Your responses will be anonymous. Please do not answer the survey more than once.

Identification Number Generation and Anonymous Responses

Participants were asked to answer three questions in order to generate a unique identification number: the day of their birth date, the month of their mother's birth, and the last two digits of the year of their father's birth. If they did not know, they were instructed to pick random numbers. In addition, Qualtrics assigns a random number to each participant. No data on the names of participants was retained.

Background Information: Ethnicity, Gender and Enrollment History, Majors and Minors

In order to establish background information on each participant, they were asked their gender, ethnicity (according to the same categories as the UT Dallas Office for Strategic Planning) and their enrollment history in music and/or sound design courses for the last ten years. They were then asked about their major and minor at UT Dallas, and their background in music and sound design prior to entrance to UT Dallas.

Questions About Music and Sound Design Study and Academic Abilities

In order to remove any possible bias, all questions were asked in a neutral position, using the word "affect' rather than "enhance", when referring to other academic skills. The first question asked whether students felt that their participation in music or sound design courses had affected their academic abilities in other courses. The question was intentionally neutral and non-specific,

intended to get participants thinking about the possible connections between their music or sound design study and their other academic pursuits.

Participants were asked to strongly disagree/disagree/agree or strongly agree with this statement: "Participating in music or sound design courses has affected my academic abilities in other courses." Those that responded "agree" or "strongly agree" were asked to describe one experience in another course in an open-ended text box.

Music and Sound Design Concept Questions: Flow

The term "flow" was first coined by Mihaly Csikszentmihalyi in his book "Beyond Boredom and Anxiety: Experiencing Flow in Work and Play. He described it as a state of complete absorption and related it to intrinsic motivation, where the person is completely absorbed in what they are doing. Csikszentmihalyi's concept of "flow", the optimal state of enjoyment with high skill and high challenge supports the relevance of musical education. These aspects must be included:

(1) clear goals (2) immediate feedback (3) emergence of action and awareness (4) deep concentration (5) possible control and (5) disappearance of self-consciousness (Csikzentmihalyi 2000). Csikszentmihalyi himself felt entering into the flow state was a critical factor in academic achievement (Shernoff 2003).

Music has an innate ability to initiate the flow state. Music making challenges us and invites our best efforts. The multi-sensory nature of music demands our full involvement, demonstrated by

fMRI data that shows activation of multiple brain regions. Music can express that which cannot be expressed through language. What makes music and sound design intelligence "special" may be its function as a primary organizer of cognition, particularly to organize sound in time. A longitudinal study by Custodero noted that helping children get into the flow state during music education was beneficial and had long term effects (Custodero 1998).

Flow is a common experience among musicians and sound designers. It has been studied in sports settings and those standards have sometimes been applied to music research. In their study in 2012, Sinnamon, Moran and O'Connell found that flow states are quite commonly experienced by musicians and that existing scales can be used to measure the state (Sinnamon et al. 2012). High achievers in music schools reported more flow experience than moderate achievers (O'Neill 1999). In fact, flow is considered such an important part of musical performance that programs that encourage flow are now marketed for musicians and their teachers.

Participants were asked if they had experienced flow doing music or sound design, and then asked to describe that experience in an open-ended text box. Flow was described in the question as a sense that one has "lost track of time" during the experience. They were also asked if they had experienced flow in a non-musical activity and if so, to describe that experience and in what context.

Music and Sound Design Concept Questions: Form

Form in music describes the overall structure of a work, as well as the layout of a composition in sections. In its most basic iteration, form designates each musical section by a capital letter, such as ABA. More complicated analyses included interior sections, repeated sections and functional harmonic analysis. Form is not always taught in performance courses, but most students are taught about basic sections, particularly as a device to facilitate learning and memorization. Form was chosen as one of the intellectual processes that are common in music and sound design education. Form has been a part of music since its earliest written works: the first musical work that has come down to us in written form is the medieval 13th century rota (a type of round that becomes a part song) "Sumer is Icumin In". The work has three distinct sections that repeat, and form polyphony between the voices. Various forms have been predominant through the centuries of music composition, up to and including present day. Forms are so critical to musical composition that many forms have names that define the period from which they come. In contrast, some forms have different meanings during different periods: a "cantata" prior to J.S. Bach was any composition for voice and continuo (typically viola da gamba and keyboard). In Bach's day it took on the specific form of a church piece, with varying sections for soloists and choir, accompanied by organ and instruments. While some composers in every century have written without form as a major component (generally know as "through composition"), the majority of music, in any style, has sectional form (Bonds 2006).

Susanne Langer (1895-1985) was an American philosopher that described form in her book "Feeling and Form: A Theory of Art". She said "music is time made audible" (Langer 1953). Form allows us to make sense of a work of music or sound design, in that it allows us to

associate what has happened in the past and present, and to expect what will happen in the future. The fulfillment or disappointment of such expectation and the resulting tension and release is basic to most works of music. Form in music allows students to study not only smaller sections of the work and their details, but also look at the over-arching structure of the work. Hence, it encourages critical analysis at two levels: the lower level of the establishment of a section through harmony and melody; and the higher level of the work as a whole. Such techniques may be valuable in the study of the structure of other academic subjects.

The survey asked if participants had studied form ("such as ABA, rondo form, sonata form, etc.") and given three choices: not at all, occasionally and frequently. Those that responded occasionally and frequently where then asked to strongly disagree/disagree/agree/strongly agree with this statement: "Learning to analyze musical structure affects my academic skills in other classes." Those that marked agree/strongly agree asked to describe the experience in an open-ended text box.

Music and Sound Design Concept Questions: Rubato

Rubato is described in the "Harvard Dictionary of Music" as "an elastic, flexible tempo involving slight *accelerandos* and *ritardandos* that alternate according to the requirements of musical expression" (Apel 1969). In fact, it is one of the most difficult terms to define in performance, and consequently, also one of the most difficult features of musical expression to teach. Rubato represents both a "bending of the rules" in music (the steady tempo) and a means of personal interpretation. It is difficult to teach as it must come from the aesthetic feeling of the

performer. Many music students learn rubato by imitating recordings, but that is just the beginning of understanding the concept. It is more typical of soloists (pianist, violinist, singers, etc.) than in orchestral or choral works, but can be led by a conductor in those instances. It is present in all forms of music that are not dependent on a metronomic, unvarying tempo, and in sound design it can be used to heighten emotion in a particular section or passage.

Rubato is one way for performers to inject their own personality and expression into the music. It is a part of performance practice that varies in different musical historical periods, and became increasingly in use in the Romantic period. Even in the beat-driven era of pop music, vocal students tend to vary the tempo depending on the emotional content of a song. It is so important a part of performance that current studies are looking at ways to "program in" rubato in order to make computer-generated music more appealing and humanistic (Todd 1989 a-b). A study compared the ability of musicians and non-musicians to perceive rubato in a solo performance. It found that only the "most proficient" musicians could clearly perceive subtle changes in tempo and that the use of rubato might be one element that separates the very finest performances from those perceived as ordinary (Johnson 1996).

The survey defined rubato as "the concept of changing slightly the tempo of a piece, a slight speeding up and then slowing down of the tempo". Participants were asked if they had ever used rubato in a piece and then asked to describe the experience.

Music and Sound Design Concept Questions: Music Theory, Mathematics and Language

Music theory has its origins in prehistory, with the study of ancient Paleolithic instruments and their construction to create pre-ordained pitches. Most commonly, the term describes the academic study and analysis of fundamental elements of music such as pitch, rhythm, harmony, and form. Earliest written treatises of music theory date from the Greeks, notably Pythagoras (c. 530 BCE), Aristotle (c. 350 BCE), Aristoxenus (c. 335 BCE), and later Ptolemy (c. 120 CE), who speculated and experimented with ideas that became the basis of music theory in Middle Eastern and Western cultures during the Middle Ages. This can be seen, for example, in the writing of Boethius in 5th century Rome (James 1993). Music and mathematics have been intertwined through history, with the separation of music into the field of the arts and mathematics into the field of the sciences occurring in the 16th and 17th centuries. In the 19th and 20th centuries, music and mathematics were reconnected through compositional means. The fundamental properties of music – pitch, rhythm and organizational structure – have lent themselves to a systematic approach to music that reflects mathematical planning (Fauvel 2003).

Music has also been referred to as a language. Henry Wadsworth Longfellow referred to music as "the universal language of mankind". Heinrich Heine remarked "Where words leave off, music begins." Indeed, all cultures have music and use it as a form of communication. Studies have shown that music and language are processed in the same structures in the brain (Limb 2008). In his famous talks at Harvard "The Unanswered Question", Leonard Bernstein devoted an entire talk to "Musical Syntax", a discussion of music as a language. Rather than using the traditional western music theory, he starts with the universal syntax and phonology of Noam

Chomsky. Given that there must exist the innate ability in all humans to understand and create language, Chomsky looked for "formal universals", genetically inherited rules that form language at the most basic level. Relating Chomsky's terms phoneme, morpheme, word, clause, sentence and piece to similar musical terms such as note, motive, phrase, section and movement, Bernstein draws a parallel between the two systems and then derives a musico-language analysis of Mozart's "G Minor Symphony" using what he calls "that special musical wonder, contrapuntal syntax." He finally states, in his answer to "The Unanswered Question" (drawn from the composition by Charles Ives), which he re-states as "Whither music?", that there is a universal musical syntax, understood by all humans in all cultures, that can be codified and structured in terms of symmetry and repetition (Bernstein 1976).

Participants were asked if they had studied music theory. They were not specifically asked about having taken a separate course in music theory, since the study of music, either in a performance course, in an ensemble, or in private study, often involves some music theory. Those that responded "yes" were asked if they agreed with the statement "Studying music theory affected my academic skills in other courses" and then asked to describe the experience in an open-ended text box.

Music and Sound Design Concept Questions: Discipline and Time Management Skills

Discipline and time management are the hallmark of both music study and sound design. Parts and songs must be learned, and technique must be practiced over and over again until muscle memory takes over. Techniques of sound design must be learned and then applied to projects

and creative designs. Memorization takes rote drill until a piece is committed to memory. When students are young, the discipline is often imposed by a parent or teacher. At the college level, it may be possible that the imposition of discipline from without falls away, and an internal motivation takes over. Many students who have practiced music in high school have also managed many high-level academic courses, and time management is necessary to achieve both musical and academic success. Indeed, there are some that feel that this is the major benefit from musical study; but it is not unique to music or any of the arts or in fact, to life in general. This affect is sometimes attributed to parental involvement in providing the students with lessons, and dictating their practice schedule. This effect may fall away at the college level, as many students no longer live with their parents, or if they do, spend much less time at home or under their control. Fred Hargadon, former Dean of Admissions at Princeton University, in a 1983 interview said, "We look for students who have taken part in orchestra, symphonic band, chorus and drama. It shows a level of energy and an ability to organize time that we are after here. It shows that they [the students] can carry a full academic load and learn something else." (Campbell 2011). Nobel prize winner Thomas Südhof (in Psychology or Medicine, 2013) thanked his bassoon teacher for instilling in him the "value of disciplined study, or repetitive learning" as a means of enhancing creativity. He went on to say "You cannot be creative on a bassoon if you don't know it inside out, and you cannot be creative in science if you don't have a deep knowledge of the details." (Romine 2013).

Participants were asked to strongly disagree/disagree/agree/strongly agree with the statement "Studying music or sound design has affected my discipline and time management skills in other subjects." Those that agreed were asked to describe an experience in an open-ended text box.

Music and Sound Design Concept Questions: Maintaining Attention

Music and sound design are aural and temporal by nature. Studying a work of music or working on a sound design project requires the student to maintain their attention to aural information over a fixed span of time, often longer than the usual attention span for students of this generation. Listening to an aural stream of information in our visually-laden society takes a particular kind of skill that is not often cultivated in other forms of study. Yet our educational system, despite many innovations in technology, still retains a fair number of academic courses that feature the "sage on the stage" – one professor, standing at the front of the room, lecturing for one to three hours about a topic, with little or no engagement by the students.

Recent research in neuroscience has shown that music training leads to changes throughout the auditory system that prime musicians for listening challenges beyond music processing. A survey of recent neuroscience literature stated that while transfer effects have not been well-documented, the fine-grained auditory skills of musicians lead to enhanced results in other domains, such as speech, language and auditory processing. They went so far as to say "... music training improves auditory skills that are not exclusively related to music." Music training gives students enhanced cognitive and sensory abilities that give them a distinct advantage for

processing speech in challenging listening environments – such as long lectures in a college classroom (Kraus 2010).

Participants were asked to strongly disagree/disagree/agree/strongly agree with the statement "Studying music or sound design requires one to maintain attention while listening to a stream of aural information." Those that agreed were asked "Has the need to maintain attention through listening to a stream of aural information affected your academic skills". Those that answered "yes" were asked to describe the experience in an open-ended text box.

Music and Sound Design Concept Questions: Segmenting

Music and sound design, as aural streams of information, require that the performer or designer deal with small bits of information in a temporal manner. This phenomena is called "segmenting" or "chunking". The "chunking" theory was first set forth by Chase and Simon in 1972, and modified by the work of Gobet in the late 1990s. Studies show that most people can only hold so much information in their consciousness at once, and hence, a larger work requires breaking the work into smaller, more manageable segments or chunks. The implications for education are multi-varied: teach from the simple to the complex; teach from the known to the unknown; use easily identified elements; use necessary repetition; and other concepts. Some elements of chunking that may be transferable may include strategies about how to learn and how to direct one's attention. In particular, the segmenting of material is of primary importance (Chase and Simon 1973, Gobet 2001).

This technique is useful for dealing with all kinds of information, not just music or sound. Neurological studies have looked at the interaction of attention and time-keeping mechanisms in perceiving complex patterns of information that are distributed in time, such as those that occur in music. Music passages consist of hundreds or thousands of elements that must be memorized and then recalled. The musician must group or "chunk" elements into larger combinations. Indeed, music practice offers neurological scientists the opportunity to study learning in abstract experimental tasks that relate to real-world behavior (Janata 2003).

Participants were asked if they had experienced this notion of segmenting while studying music. Those that answered "yes" were asked to describe the experience. Participants were then asked to describe that experience in an open-ended text box.

Questions for Alumni

Students who have graduated from UT Dallas with a bachelor's degree and who studied music or sound design during their college years have a longer view on their education. No longer involved in the daily life of an undergraduate student, they can reflect back on their time at college with a new perspective. We asked what degree they had earned, and what they were doing now (graduate school, medical or dental school, working, seeking work, etc.). They were then asked to strongly disagree/disagree/agree/strongly agree with this statement: "Study in music or sound design helped me with my post-graduation activities (school, work, etc.)". Those that agreed where asked to describe how it helped them in an open-ended text box.

General Question and Opportunity for Interview

Finally, participants were asked to describe any other music or sound design experience that they felt had affected their ability in other coursework. They were then given the opportunity to participate in a one-on-one interview with the researcher, for no longer than one hour, with a compensation of $10. Compensation level was set at this level to avoid the incidence of overly encouraging participants to volunteer based solely for monetary reasons. Participants were told the interview would be scheduled at a mutually agreeable time and place. They were given a text box where they could enter an email address for contact. The final question thanked participants for taking the survey.

Survey Sample

The University of Texas at Dallas is a public, four-year institution of higher education located in Richardson, Texas with over 133 academic programs across its eight schools and hosts more than 50 research centers and institutes. It offers majors in most fields but does not offer distinct majors in the arts, including music. Founded as a graduate school of engineering, it is listed as a Tier One research institution, and over 37% of its students are majoring in STEM (Science, Technology, Engineering and Mathematics). The campus currently has an enrollment of over 27,000 students with approximately 15,000 undergraduate students. The most popular majors are business, biological sciences and engineering. (Office of Strategic Planning and Analysis 2016) Its engineering program is ranked 71st in the nation by the U. S. News and World Report in 2015 and its computer science program is 70th in the nation. (US News and World Report 2015)

Music Courses at UT Dallas

Students of any major may take music courses offered by the School of Arts and Humanities. The School offers an interdisciplinary degree in Arts and Performance, which requires students to take courses in history and literature, as well as the arts. Thus, students enrolled in music courses are not music majors, as at most universities. This presented an opportunity to study students from other majors, particularly those in STEM fields, who elect to take courses in music, some every semester, as electives or as a part of a music minor, which requires six courses in music, including history and theory. UT Dallas offers music courses in music history, theory, performances in ensembles and courses in individual instruction in voice, piano, guitar and the traditional orchestral instruments. Ensembles include string ensemble, wind ensemble, guitar ensemble, choral groups and a pep band. A small chamber music program is in the early stages, and offerings in piano, voice and guitar include three levels of instruction. UT Dallas has nine full-time faculty members and a number of part-time instructors, varying as needed each term. For this study, instructors in music courses (labeled MUSI) were asked to provide email addresses of student who enrolled for the Fall 2014 and Spring 2015 term. History courses (both the freshman level MUSI1306 Understanding Music and upper level MUSI3322 Music in Historical Context) were excluded form the study, in order to target students who were actively involved in performance or theory, rather than historical study which primarily involved listening skills but not performance skills. Email addresses where obtained from the entire music faculty. Enrollments for Fall 2014 and Spring 2015 (excluding music history courses) were 361 and 298, respectively. Because students take multiple classes and often take classes in both Fall and Spring semesters, emails were collated an duplications removed. This result in 501

distinct email addresses for students enrolled in music courses for Fall 2014 and Spring 2015.

Sound Design Courses at UT Dallas

Sound design courses were formerly offered through the Arts and Technology program, in the School of Arts and Humanities, and now through the new School of Arts, Technology and Emerging Communication (ATEC), officially formed in the Fall of 2015. Unlike music, which has been offered at UT Dallas since the 1970s, sound design is a relatively new program, with the first courses offered in 2006. With only three full time faculty members, offerings are still somewhat limited. The popularity of the Art and Technology major, coupled by the fact that all Emerging Media and Communications (EMAC) majors were required to take ATEC2385, the basic sound design course, led to healthy enrollments in 2015-16. Those introductory classes often close at the maximum 30 seats. Upper level courses are offered in Sound for Animation, Sound of Games, Audio Technologies and other topics courses. Students who wish to study sound design are usually ATEC or EMAC majors. Enrollment figures for Fall 2014 and Spring 2015 were 186 and 132, respectively. Sound design students at the lower level do not repeat the course, but upper level students take multiple courses and in multiple terms. Eliminating duplications, 245 distinct email addresses were obtained for students who had taken sound design courses.

Music alumni at UT Dallas

In addition, students who had taken music courses during their undergraduate years, and have since graduated, were contacted through Facebook and asked to provide current emails for the

study. Through this method, 73 emails addresses were obtained.

The Interview Process

The interview is the cornerstone of the phenomenological research process. The aim of the researcher is to describe as accurately as possible the phenomenon, based on first-person accounts. The researcher first selects a topic to be explored, and then locates research subjects. Using data gathering methods, the data is then explicated in several steps.

Unlike other research, the researcher in phenomenological research is not required to hold a non-biased view. Rather, the interest and experience of the researcher is an important part of the process and leads the data gathering process. Phenomenologists believe that the researcher cannot detach themselves from previously held beliefs and should acknowledge that. In fact, the goal is to gather data about a phenomenon they are passionate about (Hammersley 2000).

In order to mitigate this bias, the researcher should endeavor, in the interview process, to let the participants speak for themselves. Five major principles lead the interview process: (1) The researcher gives only a brief introduction to the research project. (2) All participants are given the same introduction and sequence of questions. (3) No suggestions of alternate answers are given, and the researcher does not debate the answers provided. Therefore, the researcher does not introduce their own point of view. (4) No interpretations of the responses are given during the interview. The researcher should clarify if the participant does not understand the question.

(5) No new categories or questions should be introduced during the interview process, but participants are allowed to discourse about their own personal experiences.

The interview is a reciprocal process. Both researcher and participant are engaged in a dialogue, conversing about a theme of mutual interest. The goal is to create an atmosphere where honesty, coupled with confidentiality, will lead the participant to give sincere responses, hence reducing the possibility of deception inherent in sociological research.

In phenomenological research, ten interviews is generally considered sufficient in studying a phenomenon (Cresswell 1998). This is based on the principle of "saturation", where additional interviews yield no new information or themes. Saturation usually occurs at around ten to twelve interviews, but basic elements of meta-themes can be present as early as six interviews (Guest 2006).

In this study, the topic selected was "Does studying music enhance higher order learning skills in undergraduate non-music majors?" During the aforementioned Qualtrics study, participants were given the option to meet with the researcher for an interview, to last no more than one hour. Participants were promised compensation at the rate of $10 for a completed interview. Over 30 participants responded in the survey, and eleven were scheduled for interviews in March and April of 2015. The first step of the interview was to have the participant read, understand and sign the following consent form, similar to the survey consent form, but with the additional information about recording and transcribing the interview.

I agree to participate in a research study of "Does studying music enhance higher order learning skills in undergraduate non-music majors I understand the purpose and nature of this study is to explore the nature of music study and its effects on academic achievement. I have been solicited because I have taken at least one music or sound design course at the University of Texas at Dallas and I am participating voluntarily. I grant permission for the data to be used in the process of completing a Ph.D. degree, including a dissertation and any other future publication. I understand that a brief synopsis of each participant, including myself, may be used and will include the following information: the fact that I am or was a UT Dallas students enrolled in music course; which courses I was enrolled in; and my major course of study. I further understand that at no time will my identity be used or revealed in any way and that participation in this study has no bearing on my coursework at any time during my enrollment at UT Dallas. Interviews will be conducted by the primary researcher at a mutually agreed upon time and I will be compensated for my time at the rate of $10. Interviews will not exceed one hour. I also grant permission for the primary researcher to audio record and transcribe the interview.

Both the participant and the researcher signed and dated the form. Participants also signed a receipt for the $10 compensation. Recording commenced after the form was signed.

The researcher then used a printed copy of the survey from the participant as a guideline for the interview. Participants were first asked to speak their six-digit identifier number, generated from questions 2-4 in the survey and also the date of the interview. During the interview, the research

also took field notes, to validate and re-iterate the responses. The following procedure was followed for all participants:

1. Have participant read the consent form, and then sign the form for consent and payment
2. Ask the participant to speak their six-digit number and date for the record
3. Confirm their major and ask which courses have been taken at UT Dallas (questions 9 - 19)
4. Then ask them to talk more about answers to the following questions:
    - General academic abilities (question 22)
    - Flow (question 24)
    - From (question 28)
    - Rubato (question 31)
    - Theory (question 34)
    - Practice and discipline (question 36)
    - Maintaining attention (question 40)
    - Segmenting (question 43)
    - Practice habits (daily or weekly? Where? Do you turn off your cell phone? Other devices?)
    - Any other experiences? (question 48)

The questions about major and courses verified that the researcher was using the correct survey form to conduct the interview. Since the survey questions were standardized, all participants received the same questions and in the same order. Questions were skipped if the participant had marked “no” or “disagree/strongly disagree” and had not completed the corresponding text boxes. Participants were asked to elaborate on their text essay answers, and the researcher used clarification if the participant did not understand the question. No additional questions were asked, but participants were allowed to expand their discourse to include other topics, if they wished to do so. The last question was open-ended in order to allow participants to add anything they felt was relevant. Recordings with then coded with the six digit number and date, and then re-recorded by the researcher to add punctuation and enhance the transcription ability of available software. No essential phrasing or words were changed. Dragon speech-to-text

software was used to transcribe the recording (Dragon Naturally Speaking, version 12, 2012). Transcriptions were then edited to remove errors of transcription and introduce commas, periods, question marks and other punctuation. Transcriptions were then compared to the original recording again to check them for accuracy. Every interview has the following items in a file, marked by the six digit number and date, stored on a computer within a specific file folder:

- Interview Consent Form
  Forms were signed, scanned and kept in a separate file, with a password since they contain the names of the participants
- Qualtrics survey for each participant
- Field notes made during the interview
- Mp3 of the recorded interview
- Transcription of the re-recorded interview

Analyzing the Interviews from a Phenomenological Viewpoint

Phenomenological research methods use the following terminology for each of these independent steps:

- Bracketing: a focus on the research topic and question
- Horizontalizing: every statement is treated as having equal value
- Delineating: establishing units of meaning
- Clustering: grouping the units of meaning into themes
- Summarizing: putting the horizons and clusters into a coherent textural description
- Extracting general themes from all the interviews and making a composite summary

This study used the following steps.

Bracketing

The focus of this research is to understand how study in music and sound design affects the academic abilities of undergraduate students at a four-year public university.

Horizontalizing

Statements were drawn first from the Qualtrics survey and used to assist in conducting the interviews. All statements by participants were treated as of value, even if they did not conform to the predetermined topics of the survey. Major themes from the survey were explored.

Delineating

A key phrase process was use to delineate units of meaning. First, keywords for the text responses in the Qualtrics study were obtained for questions in these major themes: general effect of studying music or sound design on academic abilities; flow in musical and other activities; studying musical form; using rubato; studying music theory; discipline and time management; maintaining attention to aural information; segmenting of information; and other comments. Alumni were asked about the affect of studying music at the undergraduate level on their present activities. Responses were coded for themes and relevant passages were highlighted in bold. Interviews were then parsed for keywords and phrases already obtained in the survey and a second pass was made to see if any words not on the keyword list were of importance.

Clustering

The analysis of the Qualtrics survey test responses including a categorization process that was extended to the interview analysis. In addition, a coding process to separate categories was conducted. Additional analysis was performed to see if any major themes in the interviews were not covered in the survey.

Summarizing

The categories of keywords in the Qualtrics survey was compared to the categories in the interviews to see if any additional information was gleaned and to look for major differences in responses. An analysis of the categories and codes was then summarized for each major theme. A summary was written for each interview and an analysis of the keywords and themes was applied.

Extracting

The interviews were examined to extract conclusions about student attitudes and expressions.

Cohort Comparison: Music versus Sound Design Students

Initially, we decided to look at the sample responses from the survey in two related areas:

"Music students", defined as those who have taken one or more music classes.

"Sound design students", defined as those who have taken one or more sound design classes.

Question 1. Consent form number of respondents

Full: 159
Music: 127
Sound Design: 83

Therefore, there appearrf to be 51 students in the survey who have taken both music and sound design classes. It was suspected that in fact, this was not the case (as many who did the consent form did not finish the survey). However, there was potentially a significant number of students who had taken courses in both areas that would influence the results. Therefore, we needed a finer distinction between students and some idea of how to "label" them. With no major in either

music or sound design, students can take courses in one area or both. Therefore, labeling a student a “music” student or a “sound design” student was not possible without looking at the actual courses they had taken.

By looking at Questions 15 (Have you taken a music course?) and 16 (Have you taken a sound design course?), we determined the number of participants who answered these questions in either the positive or negative sense and divided them into the five cohorts. This encouraged a finer selection of cohorts, in order to study these different populations, as follows with the determining response to Questions 15 and 16. Note these numbers are lower than the consent form numbers as some students did not complete the survey through these questions. The five groups are:

Cohort I. Music students who may have also taken sound design courses (“Music”)
Yes to Question 15, any response to Question 16
Cohort II. Sound design students who may have also taken music courses (“Sound Design”)
Yes to Question 15, any response to Question 15
Cohort III. Music student who have not taken sound design courses (“Music only”)
Yes to Question 15, “none” for Question 16
Cohort IV. Sound design students who have not taken any music courses (“Sound Design only”)
Yes to Question 16, “none for Question 15
Cohort V. Students who have taken both music and sound design courses (“Both”)
Yes to both Questions 15 and 16

Not all students answered all questions. The number of students in these cohorts varied from question to question.

What is STEM?

The term “STEM” (Science, Technology, Engineering and Mathematics) is often also referred to as STEM fields or STEM education. At its simplest, STEM refers to those just those subjects.

However, the use of the word STEM has now been broadened to include the social sciences in some contexts.

From a Report for Congress Prepared in 2012

The term "STEM education" refers to teaching and learning in the fields of science, technology, engineering, and mathematics. It typically includes educational activities across all grade levels—from pre-school to post-doctorate—in both formal (e.g., classrooms) and informal (e.g., after school programs) settings (Gonzalez 2013). The same document goes to great lengths to define STEM thus, noting the various definitions used by federal agencies. Gonzalez states "Whether it is visas for foreign workers, scholarships for STEM majors, or funding for scientific research, the question of what we mean by the term 'STEM' is central to the federal policy conversation." Some federal agencies, such as the NSF, use a broader definition of STEM that includes psychology and the social sciences (e.g., political science, economics) as well as the so-called core sciences and engineering (e.g., physics, chemistry, mathematics). Others, including the Department of Homeland Security (DHS), and the U.S. Immigration and Customs Enforcement (ICE), use a narrower definition that generally excludes social sciences and focuses on mathematics, chemistry, physics, computer and information sciences, and engineering. Some analysts argue that field-specific definitions such as these are too static and that definitions of STEM should focus on "an assemblage of practices and processes that transcend disciplinary lines and from which knowledge and learning of a particular kind emerges." (Gonzalez 2013, Monn and Singer 2012)

Broader Definitions Than Just Those Four Words

The National Career Clusters defines STEM as "Planning, managing, and providing scientific research and professional and technical services (e.g., physical science, social science, engineering) including laboratory and testing services, and research and development services." (Education Policy Center at the American Institutes for Research 2016). The four STEM subjects as defined by the National Research Council are:

> Science is the study of the natural world, including the laws of nature associated with physics, chemistry, and biology and the treatment or application of facts, principles, concepts, or conventions associated with these disciplines.
>
> Technology comprises the entire system of people and organizations, knowledge, processes, and devices that go into creating and operating technological artifacts, as well as the artifacts themselves.
>
> Engineering is a body of knowledge about the design and creation of products and a process for solving problems. Engineering utilizes concepts in science and mathematics and technological tools.
>
> Mathematics is the study of patterns and relationships among quantities, numbers, and shapes. Mathematics includes theoretical mathematics and applied mathematics.
>
> (Robinson, et al. 2012)

The National Science Foundation definition of STEM fields includes mathematics, natural sciences, engineering, computer and information sciences, and the social and behavioral sciences – psychology, economics, sociology, and political science (National Science Foundation 2013).

The National Governor's Association, in its report, "Innovation America: Building a Science, Technology, Engineering, and Math Agenda," notes a main goal of STEM education is "STEM literacy", or the ability to apply understanding of how the world works within and across the

areas of science, technology, engineering, and math. In this sense, STEM is an interdisciplinary area of study that bridges the four areas; it does not simply mean achieving literacy in each of these strands or silos. A STEM-literate student is experienced in problem-solving, analytical, communication, and technology skills (Thomasian 2016).

The broadest of all comes from the California Department of Education in a report that compares STEM in all 50 states. STEM education is a sequence of courses or program of study that prepares students "for successful employment, post-secondary education, or both that require different and more technically sophisticated skills including the application of mathematics and science skills and concepts, and to be competent, capable citizens in our technology-dependent, democratic society." Further, the California Department of Education states "STEM education can be an interdisciplinary or trans-disciplinary approach to learning where rigorous academic concepts are coupled with real-world problem-based and performance-based lessons" (California Department of Education 2016).

Controversy About the Definitions of STEM

The issue of a good definition in STEM has been problematic and addressed in several papers for state and federal agencies. In "A Conceptual and Operational Definition for Stem for Iowa Community Colleges", the author takes the stricter definition: "Our research into the technical definitions of state, federal, and national not-for-profit agencies reveal that an objective definition of STEM is largely illusive. The Iowa Department of Education proposes an integrative STEM model which emphasizes the interplay between math, science, engineering,

engineering technology, and technology (Schenk and Lund 2010). It goes on to give a history of the use of the word (which was SMET originally):

> The origin of the STEM acronym was explained to us in an electronic communication by Neeraj P. Gorkhaly, Research Associate at the Committee for Science, Engineering and Public Policy; he stated that when Rita Colwell became the Director of the National Science Foundation in 2003, she re-arranged SMET into STEM, a more attractive acronym. This change was symbolically reflected when the former Journal of SMET Education changed their title to Journal of STEM Education in their volume 4, issue 3 publication. The journal stated "Please note that we have renamed the journal (from the Journal of SMET Education) to reflect a change in usage by the National Science Foundation, which has adopted the term ―STEM to emphasize that the focus needs to be on science, technology, engineering and math." (Lund and Shenk, 2010)

Official Definitions

And probably where it counts the most, here are the definitions from the Office for the President of the United States, National Science and Technology Council from May 2013:

> "The reorganization of STEM programs will consolidate or restructure 114 STEM education programs across 11 agencies, improving the delivery, impact, and visibility of STEM efforts. Nearly $180 million will be redirected from consolidated programs to the Department of Education, the National Science Foundation, and the Smithsonian Institution to implement initiatives in the four core reform areas. The administration will coordinate and streamline federal efforts to improve STEM education."

This document also lays out how the programs will be divided up: the Department of Education will oversee K-12, the National Science Foundation will oversee graduate and undergraduate education, including fellowships; and the Smithsonian Museum will oversee informal education (The U.S. Department of Education 2016).

Informal Education

STEM education can also be informal education that is primarily focused on physical and natural sciences, technology, engineering, and mathematics disciplines, topics, or issues, including

environmental science education or environmental stewardship. Per the document from the President's Office, STEM education has one of the following as the primary objectives:

"Learning: Develop STEM skills, practices, or knowledge of students or the public;

Engagement: Increase learners' engagement, interest in STEM and their perception of its value to their lives, or their ability or participate in STEM.

Pre and In Service Educator/Education Leader Performance: Train or retrain STEM educators (K-12 pre-service or in-service, post-secondary, and informal) and education leaders to improve their content knowledge and pedagogical skills.

Post-Secondary STEM Degrees: Increase the number of students who enroll in STEM majors, complete STEM credentials or degree programs, or are prepared to enter STEM careers or advanced education.

STEM Careers: Prepare people to enter the STEM workforce with training or certification (where STEM discipline specific knowledge and skill are the primary focus of the education investment).

STEM System Reform: Improve STEM education through a focus on education system reform.

Institutional Capacity: Support advancement and development of STEM personnel, programs, and infrastructure in educational institutions such as universities, informal education institutions, state education agencies, and local education agencies.

Education Research and Development: Develop evidence-based STEM education models and practices."
(Executive Office of the President: National Science and Technology Council 2013).

And Now We Add Architecture…

Again at the federal level, a report from the 2010 Standard Occupational Classification (SOC) system to the Office of Management and Budget (OMB) also includes architecture as a STEM subject. It divides the STEM subjects into domains as follows:

"Science, Engineering, Mathematics, and Information Technology Domain

1. Life and Physical Science, Engineering, Mathematics, and Information Technology

Occupations

2. Social Science Occupations
Science and Engineering-Related Domain

3. Architecture Occupations

4. Health Occupations"

(SOC Policy Committee 2012)

Even the Department of Education has an ongoing discussion on their website.

> "Since 'STEM' is used in a variety of ways, it is useful to consider what it means in this particular report. There, the authors note that while the acronym STEM is reasonably precise—referring to science, technology, engineering, and mathematics—there is no standard definition of a STEM job. This Department of Commerce report defines STEM jobs as those including professional and technical support occupations in computer science and mathematics, engineering, and life and physical sciences. The definition also includes three management occupations closely tied to STEM—computer and information systems, engineering, and natural science managers. (Education jobs and social science jobs allied with STEM fields are not included. Future discussions in OVAE Connection will look at STEM aspects of education."

They seem to just say "Science, Technology, Engineering and Mathematics" and leave it at that on official documents. In fact, several of the granted proposals included sections where they defined STEM. One interesting note: when a project involves the arts, they use STEM/Arts, not STEAM (Office of Vocational and Adult Education 2011).

Outside the United States

STEM is primarily a US acronym. There is a National STEM Centre in the UK, which uses STEM as an adjective (STEM education, STEM workforce, etc.) and the strict four areas, but does also mention design and computer science (National STEM Centre 2016).

And Finally a Summary Paper from Ohio University

This conference paper at the American Association for Electrical Engineers sums it up quite nicely:

> "In this paper, definitions for STEM fall into one of two domains: education or occupation. The specific discipline categories used in the education domain are derived from the National Center for Education Statistics Classification of Instructional Programs 20008 and the Classification of Instructional Programs 19909. The Standard Occupational Classification (SOC) system is used in the occupational domain."

They then did an analysis and came up with "high frequency" terms as noted.

> "High-frequency STEM fields derived from educational organization definitions are mathematics, chemistry, computer science, biological sciences, physics, geometric analysis, and engineering disciplines related to computer science, electrical, chemical and mechanical engineering. These fields are more heavily focused on the mathematics and science fields.
>
> Occupational definitions showed that high-frequency STEM occupations include sophisticated technology or science related engineers, biological scientists, physicists, mathematicians, chemists, astronomy related scientists, food related technicians. It focuses more on the practical and applicable job titles, such as chemical engineer, civil engineer, materials engineers, and electrical engineers. The natural sciences related disciplines also have a high frequency of being defined as STEM fields."
> (Koonce, et al. 2011)

So apparently the greatest usage in the educational arena is the traditional four STEM subjects.

ATEC and EMAC at UT Dallas: STEM Fields?

Defining STEM fields for any discussion for STEM to STEAM will necessitate some clarity as to what you mean by STEM (and in fact STEAM). At UT Dallas, the three schools of Behavioral and Brain Sciences, Natural Sciences and Mathematics and the School of Engineering and Computer Science are clearly awarding STEM degrees. But the Arts and Technology program was originated in the School of Arts and Humanities, whose other three areas, Art and Performance, History and Literature are clearly not STEM areas. So does it fall

into STEM or non-STEM? We would argue that given its technological nature in all its areas (the "T" of STEM), plus the requirement that all ATEC majors take two semesters of computer programming, would place it firmly in STEM. Further, the EMAC program requires students to take sound design, computer imaging and design, and courses in psychology, so it is also a STEM area due to its technological emphasis and required courses.

As the world becomes more technological and digital, the definition of STEM and STEAM will have to evolve along with the changing nature of the disciplines in all areas of education. For the present, the new School of Arts, Technology and Emerging Communications, by its emphasis on technology, its focus on animation and game design, and its additional focus on emerging media, is firmly in the new technological, STEM-focused area of education. In our analysis of the survey data, we will compare STEM to non-STEM majors; and also look at how the inclusion of ATEC/EMAC majors influences the results with the other three traditional STEM schools.

In fact, the ATEC program and the new School of Arts, Technology and Emerging Communication may be the exemplar of STEAM, the addition of the arts to STEM. With its strong grounding in art and design, the addition of music and sound-based subjects, and topics like 3D fabrication, it is uniquely positioned to take its place as an exemplary program in STEAM. Students enrolled in its courses find nothing unusual about the use of technology and associated engineering and computer science applications to create art. It well may be that the increasingly artificial divisions between the "arts" and the "sciences" (and engineering and technology) will fall away as we become more technologically verbose in the 21st century. The

mission statement of the School of Arts, Technology and Emerging Communication, states "The Arts and Technology (ATEC) program at the University of Texas at Dallas merges the innovation processes of artists, scientists and engineers. ATEC explores their experimental models through new technologies. It augments the study of the arts and humanities by engagement with the research tools, measures and practices of the sciences and technology." Should ATEC fulfill this mission, the terms STEM and STEAM will take on a whole new meaning – or may be unnecessary as the barriers continue to fall.

Cohort Comparison: STEM versus Non-STEM Majors

The University of Texas at Dallas consists of eight Schools, four of which have STEM-related majors, and four which do not:

STEM Major Schools:	Arts, Technology and Emerging Communications (ATEC) Behavioral and Brain Science (BBS) Natural Science and Mathematics (NS&M) Electrical Engineering and Computer Science (EECS)
Non-STEM Major Schools:	Arts and Humanities (A&H) Management (SOM) Economics, Political and Policy Science (EPPS_ Interdisciplinary Studies (IS)

By using Qualtrics filters and the "contain" feature, it was possible to create reports that identified all those students within a certain major, and to aggregate them into STEM and non-STEM fields. The resulting reports allowed a comparison of answers to the survey questions. There were four students who listed "undeclared" as a major; they are not included in these samples. There was also one double major in both STEM (speech pathology) and non-STEM

(Art and Performance). There were initially 114 STEM students and 33 non-STEM students but not all students answered all questions. Therefore, responses varied from question to question.

ATEC/EMAC Majors versus Other STEM Majors

Since we used ATEC/EMAC students in the STEM versus non-STEM analysis, we were also interested as to whether the inclusion of the ATEC/EMAC students had perturbed the STEM data in any significant way. By using Qualtrics filters to aggregate majors, we could create two distinct groups: ATEC/EMAC majors and STEM majors who were not ATEC/EMAC. This allowed a comparison between the two groups. There were 45 students who identified themselves as ATEC/EMAC majors and 68 STEM students who were not ATEC/EMAC. Not all students answered all questions.

CHAPTER THREE

OBSERVATIONS

Qualtrics Survey and Interviews

The most compelling observation of this study is how invested the students were and how articulate their responses were, both in the survey and in the interviews. The participants in the survey answered many of the open-ended text responses in great detail about their experiences. The interviewees spoke at length, without prompting, about the impact studying music and sound design had made in their academic studies and in their lives in general. In general, it seemed that students were eager to speak of their experiences, but had never been asked about this topic. The University of Texas at Dallas has a most superior student population, with an acceptance rate of about 50% and average grade point averages in the 3.5 range (UT Dallas website, Office of Strategic Planning and Analysis 2016). Test scores are equally high. Therefore, it is expected that students would have good writing and speaking skills. However, the level of passion and dedication these students demonstrated was extraordinary.

The response rate to the survey was much higher than anticipated. The survey was sent, via email, to nearly all students taking music and sound design classes in the 2014-2015 academic year. More responses were received during the summer of 2015. Additional sound design students were solicited in the Fall of 2015 to increase the representation in the population. There were (taking out duplications) over 500 students taking music classes and over 250 students taking sound design classes. An additional 73 alumni were also contacted. In all, 880 email

addresses were obtained and 2016 emails were sent to solicit students to take the survey during the study. By January of 2016, 159 full responses were recorded. Over 27% of respondents opened the email, and over half of the respondents took the survey to the end. The general response rate, taking out duplicate solicitations, was 18%.

Demographics: Gender

As of Fall of 2015, The University of Texas at Dallas has a higher male undergraduate population than female, with 57% male and 43% female. Our survey had a slightly higher female population, with 48% male and 52% female. The interview population, however, was much more heavily male, as only three of the 11 interviewees were female at 27%.

Demographics: Ethnicity

UT Dallas has a primarily white, Asian or Hispanic demographic, with 37% self-identifying as white/Caucasian, 29% as Asian American and 18% as Hispanic. The survey had a much higher proportion of whites (43%) and Asians (30%) but a lower proportion of Hispanics (11%). The eleven interviewees were all either white (six interviews or 55%) or Asian (five interviews or 45%).

Demographics: Majors and Minors of Participants and Interviewees

Table 3.1 shows the comparison of the majors of students in the survey by School, along with the representation of those majors at UT Dallas in general.

Table 3.1. Comparison of majors of students in the survey vs. UT Dallas

MAJORS BY SCHOOL		SURVEY	UT DALLAS
		%	%
Arts and Humanities (AH)		11.04	3
Arts, Technology & Emerging Communications (ATEC)		29.22	8
Behavioral and Brain Sciences (BBS)		15.58	13
Electrical Engineering & Computer Science (EECS)		7.79	22
Economic, Political and Policy Science (EPPS)		2.6	6
Interdisciplinary Studies (IS)		0.65	5
School of Management (SOM)		8.44	24
Natural Science & Mathematics (NSM)		22.08	18

The two highest majors in the survey were Arts, Technology and Emerging Media (ATEC, 29%) and Natural Science and Mathematics (NSM, 22%). Students in sound design were solicited for the survey and are typically ATEC majors, leading to a higher percentage in that area. Students who are pursuing a degree in EMAC (a major within the ATEC School) must take an introductory sound design class. The much higher rate of science majors in music courses has frequently been observed by the faculty, particularly in orchestra classes. This contrasts to the concentrations of majors at UT Dallas. The ATEC School was officially formed in September of 2015 and the number of majors is rising rapidly. ATEC majors were previously counted in the School of Arts and Humanities.

A slightly higher percentage of BBS students took the survey (16% vs. 13%), but a much lower proportion of EECS majors (8%) was surveyed as they represent 22% of majors on campus. The

degrees in EECS allow few electives outside their major field of study, and this may explain the lower participation in music and sound design by those students. Again, many of our faculty have observed a higher percentage of neuroscience and psychology majors in their classes (who are in BBS), and there were 14 students from those two areas in the survey. Since students who study Art and Performance are AH majors, that percentage, which is much higher than the 3% who major in Arts and Humanities (which also includes history and literature majors), is expected.

The interviewees were heavily weighted towards the sciences, with six of them either biology or biochemistry majors. It should be noted that many pre-medicine students elect to continue music during their college years, as there is anecdotal evidence that it helps with admission to medical school. Two of the interviewees were neuroscience majors, two were computer science majors and one student was an EMAC major.

If you consider STEM (Science, Technology, Engineering and Mathematics) students, then our survey showed a much higher percentage of majors in those areas: combining the students in EECS, ATEC, BBS and NSM yields 74.67% of survey respondents in those areas, as compared to 61% for UT Dallas in the Spring of 2015. Our survey and interviews would therefore indicate that a higher proportion of students in STEM fields are taking music and sound design courses at UT Dallas. Further results will show that they feel they are deriving skills from that study that enhance their abilities in their other academic courses.

The number of undeclared majors at UT Dallas for Spring of 2015 was less than 1%, but our survey included almost 3% of students in that category.

The music minor requires six courses (two at the lower level and four at the upper level) and 25% of the survey recipients were pursuing a music minor. Only one of the interviewees indicated they were pursuing a music minor, as one who responded "yes" on the survey had since dropped it. One interviewee had elected to pursue an art and performance minor, which has less stringent course requirements than the music minor, as it does not require music theory. The University of Texas at Dallas does not publish statistics on minors, and many students elect to have it placed on their transcript shortly before graduation. Therefore, a comparison to the University as a whole could not be made.

Experience in Music and Sound Design

Eighty-two percent of the respondents had considerable experience in music, many from their childhood years. The average number of years in choir was greater than six years and the average number of years for vocal students was also six years. Instrumental studies showed similar figures: slightly more than five years in band, almost seven years in piano and slightly less than six years in orchestra. Since the public K-12 schools in Texas start band and orchestra practice in sixth grade, it is not surprising that students had pursued those areas for most of middle and high school. The same can be said of choir and vocal studies. Piano studies are mostly private and taken in a home environment.

What was more striking was the range of years of study for the music students: some indicated they had studied a musical instrument (including voice) for over 15 years. In choir, band and orchestra the numbers were even more striking: some respondents indicated they had pursued this interest for 20 years. Since most of the respondents are college age students in their 20s, that means many of them began to pursue musical students at a very early age. Many had played or sung for fifteen to twenty years. Additionally, while 57% listed only one instrument, 29% said they had studied two instruments (often voice and something else), and six students had pursued three instruments. One student had played four!

Sound design, however, is not taught at the middle or high school level, and therefore we asked participants if they had participated in an informal activity instead, in either music or sound design. Forty-nine percent of respondents had not engaged in any activity prior to college. For those that had, activities listed included composition (17%), sound/audio engineering (16%), recording (12%), playing in a band (`7%), and arranging (9%). The remaining positive answers included digital music (5%), singing in a cappella group (6%), private study (6%), musical theatre (less than 1%) and Indian classical music (less than 1%). This was expected, as sound design activities are generally adopted in the teenage years and are not curricular. The average number of years was slightly less than four, with many students having only one or two years of experience. One individual had pursued sound design study for 14 years, but this was exceptional. It should also be noted that of the 81 respondents who said they had studied sound design in an informal capacity, only 39 indicated the number of years of engagement. It would seem that informal study is less easily measured in terms of the length of study.

The interviewees all had considerable experience, mostly in music. One had been in choir since first grade. Those playing instruments (tuba, violin, piano, clarinet and guitar were listed) had studied for many years, often from the age of five. One student, who was taking a digital music course, had been composing from a young age but had no formal music education until high school. Only one had started music studies in voice when he entered college and not before. This international student pursued music as a part of his first studies in the United States. The one student in sound design was an EMAC major who had played the drums for about five years and worked a sound board in high school.

Courses Taken at UT Dallas in Music and Sound Design

The music program is well established at UT Dallas, in spite of having no major. Students can pursue an interdisciplinary Art and Performance major and the program has existed since the 1980s. The area had, in Fall of 2015, nine full time faculty members, a number of adjuncts teaching part-time as needed and offers courses in vocal and instrumental performance, including ensembles in choir, orchestra, guitar and jazz, plus the traditional courses in music history, theory and composition. Many students take multiple courses, often taking them for multiple semesters, as most performance courses can be repeated three times for credit. The Understanding Music (MUSI1306) course satisfies the state core curriculum requirement in the arts and five to six sections are offered every term. That course, plus music theory and history courses, are required for the minor. All courses were offered for three credits in 2014-2015 with two exceptions. Students could participate in chamber music ensembles for one to three credits. Pep Band, a spirit organization, is offered for one credit and plays for athletic events. The

majority of faculty members teach at the undergraduate level, with only two faculty members teaching graduate courses as a regular part of their teaching load. Those graduate level courses are not performance based, but rather focus on critical analysis. The School now offers a “music concentration”, which is new as of Fall, 2015.

Students who responded in the survey had taken 320 courses at UT Dallas in Music, with a large proportion (47%) in a vocal or choral class, followed by an instrumental ensemble (15%) and music history and appreciation (12%). Eleven percent had participated in guitar. The remainder had taken courses in piano, music theory and composition. The researcher teaches both choral and vocal music at UT Dallas, which accounts for the higher participation in those areas. Both orchestra and guitar have multiple faculty members (at the adjunct level) and this is currently a growth area in the program. The numbers in music history are easily explained by the 8% that took the required core course Understanding Music.

Sound design, however is a relatively new area, added with the hire of Dr. Frank Dufour in 2004. Dr. Dufour also oversaw the graduate program at UTD in the School of Arts and Technology and taught one undergraduate course per term at the time of this survey. The remainder of his teaching load is in graduate courses. The addition of a second faculty member in 2103 added a few more courses to the curriculum, and a third was hired in 2014 to primarily teach the lower level sound design course, ATEC2385, Introduction to Sound Design. However, these courses are currently required of all EMAC majors and the majority of students do not elect to go on to upper level sound design classes.

It was therefore no surprise that only 68 courses in sound design had been taken by survey respondents, and of those, 37 were at the introductory level. The solicitation of upper level sound design students in the Fall of 2015 added significant numbers of those students, and 31 students were identified as upper level sound design students. Only 18% had pursued any sound design activities prior to college, as opposed to 80% in music. The great variation of these two samples yields an opportunity to see if prior formal experience or informal experience is of greater importance in their other academic abilities, as the sound design sample has little or no prior formal experience in comparison to the music sample, and less informal experience as well. Soliciting more sound design students at the upper level was successful thanks to the efforts of the sound design faculty. The increase in the number of sound design students allowed for a cohort comparison of these two populations.

Ten of the eleven interviewees were students who had taken music classes. The remaining student was enrolled in beginning sound design. Those in music had mostly taken multiple classes for multiple terms. The one student in sound design expressed that he was an EMAC major (rather than a music major) because he wanted to learn marketing to help his career goals of becoming a professional drummer. There were no interviewees who were pursuing sound design as a part of an ATEC major.

Music and Sound Design and General Academic Skills

The first questions about music or sound design and academic skills were intentionally open-ended in order to give participants an entry point into both the survey and the interviews. While

some of the answers fell into the categories explored in the survey (flow, form, rubato, music theory, practice and discipline, maintaining attention and segmenting), many other responses were received. The most common answer was stress relief (16%) and enhanced skills in concentration and focus (15%). Over 13% mentioned that it had given them greater actual knowledge, mostly in historical or cultural studies, or literary studies. This researcher specifically chose not to study the psychological benefits of music and sound design study, such as stress relief and relationships with others. Many other areas such as memorization (3%), time management (4%), communication (5%), mathematical skills (10%), critical thinking skills (9%) and expressivity (3%) were inter-related to the topics we chose to study.

It is significant that 15% spoke of concentration and focus, which is required of music and sound design activities to a high degree. One respondent noted that their major, communication disorders, was related: "I think about the vocal system in communication disorders classes all of the time since speech is made with the same mechanism." Another related it to design: "It has helped me understand the theory of production, which was helpful for other design courses." Some related it to acoustics and physics: "The audio technology class combined with other music classes has given me a visual to the sine waves produced by instruments and what makes the tone. I would say that brought programming to a new light for me on the ability to program sound and incorporating digitally produced sound patterns to create a sequence or even to be produced by actions in a game." "Whenever we studied the ear, and how sound travels through it and is processed in the brain, because of my musical training, I was always able to grasp it more definitely than most of my non-singing counterparts. I was lucky in my musical training that my

teachers found it important to teach the actual mechanics of sound to help us better understand how to control it." An animator said "Learning to express emotions through playing music and singing has helped me express emotion in drawing and animation."

Learning to wait for a result was often mentioned: "Music has helped me to realize that long hard work pays off. Studying for hours and hours a week will improve my grade just as practicing my instrument improves my sound. Music has given me a sense of delayed gratification." One mentioned enhanced problem solving: "Music is very mathematical and meticulous in one sense but it is also very fluid and free. I'd say music helps me to relax while still involving the left side of my brain while problem solving in organic chemistry or physics or calculus." Stress relief was a common element: "…helps relieve the stress of being a … physics major at this ridiculous & challenging university. It allows me to participate in something I love to do and increases my focus when studying physics." Studying habits were enhanced: "Music helped me develop my studying technique by learning compositions in pieces and repetition that build upon the previous measures and bars. This carried over into my science studies like in biochemistry when I would learn the first few parts of a pathway through recitation and repetition until I would move on to the next few steps of a pathway."

Creativity was enhanced: "Music is an escape from rigorous academic studies or work. Music gives you a moment to express yourself and the creativity that can't be expressed in other academic courses." "The creative thinking process required for audio work has complemented other courses that have required a creative approach, such as my Computer Imaging course."

Some felt music induced a “zen” state: “I specifically remember putting the Bjork album Biophilia on loop for a few weeks after it had released while I was doing my math homework, and the music created a sort of hyper-focused zen state where I had almost no distractions and completed my homework quickly and easily.” Finally, one student talked about a difficult period where music classes had helped him remain motivated: “My music studies have taught and reinforced in me the drive to focus and work to achieve my goals. Additionally, music has provided the release and rejuvenation to get through some very difficult periods in my life, including when my mother passed away suddenly at the start of my junior year of college. In fact, the only reason I could make myself get out of bed was to attend my music classes and practice, which in turn helped me get back into my non-music classes. That isn't an easily quantifiable experience, but it was quite profound for me. I credit my music studies for my graduation and subsequent graduate studies because I am fairly certain I would have been unable to return to school after her passing without my music classes and music in my life.”

The interviews yielded more in-depth responses to this initial question. Some focused mainly on the discipline required to pursue music and the time management skills required of doing music and many other academic subjects. One repeatedly referred to delayed gratification, saying “long hard work pays off”. Several made the connection between studying music at an early age and understanding mathematical concepts. Many mentioned the increase in their ability to focus on a topic, and how music had taught them to concentrate. One had developed a method of “practicing smart” and applied that to his other studies. Another mentioned that music had given him a different perspective and allowed him to “take different routes … as opposed to being very

linear." Only one felt he was so involved in music that it had negatively impacted his other studies (the same student who chose to do EMAC as a major, rather than music). Two students mentioned that they had autism (or had in the past) and that musical studies had helped with that. The two alumni emphasized the analytical skills that music had given them, mentioning patterns and the need to organize information.

Music and Sound Design and Flow

Most participants understood the concept of flow, as defined in the question as "losing track of time". In fact, 85% of respondents in the survey said they had experienced flow and went on to describe it. While most used some reference to time ("time flies"), they described the experience in positive terms, using words like soothing, uplifting, serene, joyous, euphoric, etc. Many used words of embodiment such as "I became the music" or "you become the instrument". Several felt it helped them to focus on their studies. When asked about flow in other activities, 81% responded that they had that experience in other areas. The most common was sports (21%), follow by artistic endeavors (21%), entertainment (11%) and reading (12%). Other activities were writing (10%), studying (8%), programming (4%) and doing science or mathematics (6%). Their descriptions of time included both slowing down and speeding up. Some felt flow was an essential part of creativity and there was an effortless nature to the experience. Many described the experience in length: "I lose myself, like I don't really have an identity, I just become the music, and I'm not really aware of being the person making the music, it is just happening. There may be other somewhat delusional experiences, like the air is made of colors, or I can't feel my body, or I can't even remember what I'm playing/singing (I couldn't tell you the name of the

piece if I had to). It's like, time out of mind." "In this respect I would describe flow as 'losing myself' and just immersing myself into music. I have played flute long enough to have technical aspects and now I am capable of focusing on the musicality of a piece easily, so I feel that I am capable of expressing my feelings of the song through performance. Instead of just listening to a song, I can live through it." It was an almost unconscious experience: "Hard to describe, but it feels as though time is moving by more quickly, yet your actions themselves are slowed down and you're able to focus on them more precisely. For example, in drum line with the marching component, I always felt like I was in a state of 'conscious autopilot' during performances where muscle memory took over for the most part, but I retained ultimate control." "When deep enough into character, it can feel like time exists in a separate dimension from what I am saying/doing, and so I simultaneously am hyperaware of my words/notes/movements and everything blurs together into a stream of unconscious instinct. A lot of times, afterwards, I will remember a very few specific events but the experience as a whole will be very blurry and impressionistic." "It feels like a journey of pure thought and emotion. I feel like I can come completely out of myself and experience what the musician and composer are trying together to express. I often find myself breathing along with the music without meaning to. It feels a lot like a daydream, but there aren't usually specific images involved--like drama or joy or sadness are unfolding in me without a need for any particular cause or storyline to give them a reason."

They could look at both the pieces and the whole: "My focus was split, and yet not; I was working on minute details and yet it felt like I was focused on the piece as a whole, but at the same time." It inspired confidence and creativity: "I've found this kind of 'flow' to encompass a

natural confidence and a sense that the creative ideas forming in your thoughts are being directly and easily translated into experience, with very little resistance from things like mechanical inability, feelings of fear or hesitation, and similar roadblocks." One can seek perfection but not achieve it in a flow state: "I have spent countless hours editing and lost track of time. It's like art, the artist never feels like his or her work is perfect, so he keeps trying until there is a point where you have to stop yourself and ask opinions of others and realize your work is done." One related music, math and flow: "It often felt like I'd lose track of time when I combined music and math. Maybe that's because I was doubling up on that portion of the brain, I don't know, but often I'm acutely aware of time when I'm listening to music since it's often so time- and math-based." Flow is not forced: "The 'flow', in my experience, is more of a focus. It becomes a 'flow' when it **i**sn't a forced focus. I'm into what I'm doing and I want to continue to do it. That's where the 'flow' kicks in."

In the interviews, the participants also gave in-depth responses, but along the same lines. One spoke of "practicing for hours and hours" in both music and in academic tasks. One described it as "indescribable" saying it was just the experience that "everything clicks and then you can focus". Several emphasized that they must be working on a task that was enjoyable to them, rather than a chore and that it depended on how "deeply I connected with it". Some related that they experienced flow more in singing than in playing an instrument. A few mentioned the immersion they felt in doing research or a programming assignment was similar in that they lost track of time doing the activity. All the responses were positive, one saying "it's the coolest feeling ever". One had experienced it both in performing (improvising on the piano) and in

doing an audio project. Only one subject had not experienced flow in music, but did when he was doing a visual arts creative activity. His personal response was that music was more difficult for him and he could not get into the flow state. Several who did composition felt that the flow state felt like "the universe was playing my body" and mentioned that the notes just came from somewhere else.

It was clear from the responses that the flow state was a desirable one for most respondents and that having that experience in music was special to them and had enabled them to experience it in other areas also. If, as Mihaly Csikszentmihalyi feels, that entering the flow state is essential to academic achievement, then music has done a great deal for these students by allowing them to experience it in their musical studies.

Form, Structure and Academic Abilities

Form is not always taught in music performance or music historical studies and is described differently in sound design. Usually, music theory classes cover the various forms in music and students are taught to analyze form in a variety of viewpoints in those courses. Students who participate in ensembles or private study are not always exposed to the concept of form in music, but it is an essential part of music study. Over 29% of the respondents in the survey had never studied form. Of those that had, only 28% answered "frequently", with the rest (43%) responding "occasionally". Those that responded positively felt that studying form had affected their other academic studies at a rate of 68%. The two most common related subjects were identifying patterns (26%) and learning to analyze or use critical thinking (25%), closely followed by those

that mentioned seeing an overall structure (19%). There were three subjects that they applied these skills to the most: mathematics (36%), the natural sciences (29%) and literature (25%) but there were many other answers. Several mentioned attention to details as an important skill they had acquired. One student compared form to his science studies: "I guess I use ideas of structure as metaphors for understanding different types of neurotransmitter receptors, or how different elements in the periodic table can have similar properties within columns." Repetition and variation are important: "It helps relate to the structure of essay writing, and how repetition and variation can get your point across persuasively." Many students mentioned patterns: "Music is much more mathematical than I expected. I like finding the patterns and reasons why certain chords seem more pleasing to the ear, dramatically affecting us more than others." "Recognizing musical structures is similar to recognizing other patterns. This has helped especially with mathematics, but has also helped with more creative tasks, like graphic art." You pay attention to details: "It makes you pay attention to detail and see how these things correlate to one another to come together and show you the entire concept of something." Form relates to both writing and science: "Studying the form of music is an extension of critical thinking that is used when reading or writing an argument. When studying the form of a composition, the different textures of a composition can represent the different characters of a story or sides of an argument. Learning to break down music into its more basic components helped me critically read through passages and understand what purpose each paragraph was serving to help the thesis. In my science courses, breaking down physiology or a pathway into its basic components helped to visualize and memorize the purpose of each substrate and enzyme." "Well, this is my research definitely. It's like a flowchart, To see an affect, that's like section A and when you get

to the end of that you go on to section B which is follow-up and then you look at that incident in a different way. If that ends this way, then you go back to A; if it ends poorly, where the effect disappeared or sometimes you go back to A. You look for something else and maybe that will be a slightly different version of A, A prime where it ends a little differently because it's an unrelated affect or maybe you will see something. Then you get to go on to B, which is the complete statistical analysis and C, where you write the paper and maybe in a very basic rudimentary way. I guess mostly where structure is helpful is in chemistry, where it's tables and you can match up the rows and the columns of the table with the idea of different types of pieces of things that you would use in music. But I guess most academic subjects are rote learning rather than a system like that."

It is clear that in spite of many years of study, both privately and in formal courses, most participants in both the survey and interviews had little knowledge of the inner workings of form and how music is constructed. This highlights a crisis in music education. Too much time and attention are paid to technical aspects of performance or ensemble playing, and not enough to the actual music being played. Since the majority of students taking music classes in high school or college are not heading into careers in music, the lack of education in an area like form, which is most applicable to other academic subjects, is distressing. Given that the students who had even a rudimentary knowledge of form could see how it applied to other subjects, it is necessary to take a hard look at how we are educating students in music. An emphasis on form would enhance their other skills in a way that mere technical prowess does not. Understanding form is

essential to good sound design, as that subject involves the creation of an aural work of art. An emphasis on design (the equivalent of form) in audio technologies could address this lack.

Rubato and Academic Skills

Of all the questions on the survey, the ones about rubato were the least edifying. Rubato is an advanced performance technique used by soloists to enhance their performance and add an individual, emotional interpretation of their own. As such, it is not experienced by students whose musical study was in choirs or orchestra ensembles. It was surprising, however, given the large number of years of study in piano and violin by participants, that more students had not had this experience or did not understand the concept. Surprisingly, 75% responded "yes" as to whether or not they had experienced rubato, yet their descriptions did not always match the concept. The great majority said that changing the tempo was something they did to express emotion and that it had to be a natural state. Those that did describe the experience correctly almost always connected it to emotion and individual creativity. It was not easy to do: "It took a lot more skill and concentration to do this than I expected, but when done well it really conveys the emotions in a piece." It compares to speech: "I have used this technique frequently. It allows one to be less strict or 'robotic' with the rhythm of a piece, when appropriate. It also can make the rhythm of melodic lines (sung or otherwise) better resemble the rhythm of speech, which opens up a wide range of expressive possibilities." One understood the concept and that it was more commonly used in the Romantic period: "Rubato is incredibly important for conveying emotion in music. Holding a note or a pause just a little bit longer allows one to stress a chosen

note or idea, and often music (particularly from the romantic period) doesn't sound right unless rubato is used to phrase everything correctly."

It was possible to delve more deeply into this subject in the interviews, and elucidate better responses. Those that had used rubato spoke quite correctly about the "stretching" that is required in terms of time and one very experienced violinist mentioned "giving complete freedom in how one would play something". This subject had listened to and studied great master performances, which no doubt enhanced his understanding of the concept. The singers in the survey were more likely to have had the experience of adding rubato to a piece, particularly in the jazz idiom. One even made a comparison to teaching organic chemistry, where he said he would "…selectively shorten some topics and speed things up depending on what was needed." A clarinetist described using rubato as "more calm and more emotional" but also said it was "nerve-wracking", because of the responsibility it imposed. Those that used improvisation in their music-making found the concept quite common, as they often varied the tempo according to their mood. One alumna related it to driving a car, and the speeding up and slowing down needed to negotiate a road and then parking at the end of the musical piece.

Rubato is a way for musicians to add their own creativity to a piece, but is also at the most fundamental level a kind of "bending the rules". Only one student saw that analogy and he felt that "rules were meant to be broken" in any case. He went on to relate an incident in another course where he encouraged the professor to take a different approach. The remainder did not really see the analogy between rubato and musical rules.

Music Theory, Mathematics and Language

There is a long standing relationship between music and mathematics, and music as a meta-language. Respondents here quickly made the connections, and their responses indicated that if they had studied music theory, either in lessons or in a formal class, they understood the mathematical underpinnings of that theory. Sixty-two percent felt that studying music theory had helped them in their other academic courses. They mentioned that it helped them think in a more critical way (19%), in seeing patterns (21%) and in general learning (29%). The most common subject mentioned was mathematics (22%), followed by language, writing and physics (all 4%). One mentioned that he had learned that anything can have "emergent properties": "Having to learn huge patterns and all the various pieces that make up those patterns helped me learn about the different levels that anything can have, and emergent properties. Because I was so young when I first started learning about chords and harmonic progressions and transposing, I think about almost everything I've ever learned in terms of patterns of pieces made up of smaller pieces."

The connection to language and writing skills was also often mentioned, with one student mentioned using theory devices to help write essays: "Music theory, through studying harmonization and progression patterns, has actually really helped my writing skills. I have legitimately used theory devices (in full knowledge at the time because I was just stuck with nowhere to go) to help me write and develop essays." Many mentioned enhanced mathematical skills and one said it helped him get over his phobia: "I have a flat out math phobia and have since long before anyone knew to look for that in children. Music theory gave me a safe way to

learn and explore the mathematical concepts I need in my life and my studies. The only time I had trouble with music theory is when people started insisting to me that it was just mathematics in a different format. I had to disassociate that idea in order to continue my music theory studies."

While several of the interviewees had not studied theory, those that had likened it to a mindset, where understanding and applying rules could be extended to other subjects. Another related it to the way you can analysis a literary work from many perspectives, just as you can in music theory. A computer science major remarked that it had "increased my ability to do analytical thinking" because coding was, like music, more of an art. One subject felt music was not like a language, in that language was too arbitrary, but music was non-arbitrary in that it has a "pattern that rules the sound."

For those respondents in the survey who they had studied music theory, it was clear from the responses that they easily made the connection to analytical thinking in other subjects, and felt their music theory study had enhanced that. It is therefore unfortunate that not more music and sound design students take music theory. It is not required for the Art and Performance major, but is required for the music minor and the new music concentration. The sound design area, which does not have a concentration or degree, does not require students to take any music classes. Music theory is, however, one of the most valuable courses for students to take and this researcher includes it in her coursework wherever she can. The two music theory courses that

are offered usually see good enrollments and students often remarked after taking the course how useful a subject it is.

Discipline, Time Management and Academic Skills

The discipline and practice required of music study is often quoted as one area that an impact on student's academic skills. The belief is that discipline in any area transfers easily to another. The answers on the survey to this question varied widely, as 78% of students saw benefits beyond the simple task of managing their time. While 44% responded that it helped their planning skills, some mentioned focus (8%) and motivation (11%). Other responses included awareness of their surroundings (4%), dedication (4%), balance (4%), patience (4%) and prioritizing (4%). One mentioned that there is no "perfect" in music and that encouraged a discipline that was more "significant and impactful than … non-musical activities." Many mentioned passion and dedication, saying "all passion requires discipline." Finally, several mentioned that music study had taught them delayed gratification and the notion that there is "a payoff at the end of the road". One took it ever further, saying "past successes make current studying…seem worth it because I know I am capable of future successes."

Music took time because it was not black and white: "Also music is more difficult because it's much complex because there is no 'right or wrong' answer in several cases, and if you really want to immerse yourself in study you would need to record yourself, and then listen to the recording to get an accurate feel of how you're really performing, doubling the amount of time needed already." You learn to avoid procrastination: "Studying music helped greatly to increase

my discipline and help me in regard to procrastination. It's next to impossible to pull off procrastinating learning a solo the way you would procrastinate writing an essay by leaving it to the very last minute." Sound design taught independent thinking: "Sound design was no easy task at hand. There were no problems for you to solve, there were no stories or passages for you to read to understand and interpret. In most cases, you had to make something you or someone had in mind for a scene from scratch. So it had a really 'Do-It-yourself' vibe and gave you so much independence, as well as responsibilities." It required perseverance: "Studying music is often an exercise in pushing through frustration in order to achieve success. It requires setting high but reasonable goals, setting aside time to practice every day, and having the discipline to do things that are boring or banal in order to achieve good results. These are all skills I use a lot in school, as past successes make current studying and work seem worth it because I know I am capable of future success."

Music transfers to other subjects: "I've noticed that I lose myself when studying music because I enjoy it so much. My focus is completely on the task at hand and I'm not distracted by technology or other thoughts. I've learned to apply that same discipline for short periods of time to other tasks and it makes me more productive, rather than sitting and studying half-heartedly for hours at a time." You must set a schedule: "I have an obsession with producing digital music and studying music. So, in order to control this, I've learned to reserve certain hours within the day just for composing and producing. This has aided my ability to create a solid work schedule." And it can help overcome learning disabilities:" My music studies taught me discipline and determination. I didn't have it early on in my schooling because I have two

learning disabilities, but I'm also very intelligent and started learning skills like reading and writing far earlier than my schools believed possible, especially in a student with learning disabilities. Consequently, I did not develop academic discipline or the drive to learn and succeed until I started studying music."

The interviews tended to echo these sentiments. A new feature was the idea that intense music study required one to be proactive about other academic skills: "Being proactive … is probably the biggest thing that I learned. It's so much easier to try and catch up before rather than after." One student, realizing that his music pursuits took a lot of his time, also talked about working ahead: "I don't have the luxury of putting the essay off to the last minute" and felt he got a better product that way. One very organized pre-medical student was very clear about what music had taught him about discipline: "It betters me." One said he had applied his practice regimen on his violin to his other studies, mimicking the way he would be "putting in a good hour and then doing something else, and then coming back and doing that same thing." Another subject gave a similar account in how practicing music and doing his programming projects required the same discipline and approach. One student, who had struggled to keep up in his musical studies, felt even that experience had taught him to "build a passion for trying to achieve and succeed at something." One alumna felt that pushing through difficult passages in music and taught her to push through the difficult parts of the Master's degree. She had learned to be "motivated through the challenge."

The discipline and time management skills required to pursue either music or sound design in a serious way are clearly beneficial to high-achieving students, who can often come to college with a sense that they can accomplish anything, and easily. Learning to overcome hurdles is a valuable lesson taught by both music and sound design. Additionally, the time it takes to master an instrument or learn how to use a sound design program has an impact on the time available for other studies, particularly for students who are pursuing other majors that are intensely time-consuming, such as in those in the sciences. These students seem to be able to balance their pursuits because they have learned how to budget their time.

Maintaining Attention to Aural Information

So much of the information we receive in the 21st century is visual. We are bombarded by visual information constantly, on computer screens and billboards. But in studying music or sound design, the skills required to maintain attention to auditory, rather than visual, information are paramount. Therefore, it was not surprising that 94% of respondents felt studying music or sound design required an enhanced ability to maintain attention to aural information. We asked if acquiring those skills through music or sound design study helped with other academic subjects and 73% felt it had and responded with a variety of activities. While many mentioned "listening skills" (35%), a significant number also talked about the ability to multitask (19%) and focus (30%). Additional topics included paying attention to details (7%) and enhanced memorization skills (9%). One mentioned they had gone from being a visual learner to being an auditory learner. Many respondents mentioned that it had enhanced their ability to listen to lectures in other classes, which still seems to be the primary format of instruction in most majors. In fact,

two students mentioned this fact in their responses and many students mentioned listening to "long boring lectures" and learning to keep their attention on them from music and sound design studies. One stated that it helped develop an "auditory playback mechanism" so she could replay what she had just heard (an analogy highly dependent on modern technology). If she had missed an important detail or concept, she could simply "replay those last few seconds."

In the interviews, subjects went a little more in depth, but relayed essentially the same concepts. One subject said that studying music had helped her pick out the important details and then identify the "over-arching concept that is being taught." One student was working on a twenty-one minute composition that contained "very complicated things" and that, in spite of the fact he had attention deficit disorder, he could maintain his focus on that. He then extended that to maintaining attention in class, saying he could tell himself "next five minutes, let's go". The student who mentioned the auditory playback mechanism also did the interview and felt it compensated for her short attention span. She credited music with giving her a high auditory working memory, and in fact had tested it in her own laboratory. Music and sound design trains aural abilities: "I'm not a very good listener. I learn by seeing, not by listening. But aural information helped to train my ears and to force me to pay attention to what I was hearing". "I went from having a majority of my learning come from visualizing to being an auditory learner. I have more of a working memory when I take notes in class, so I can focus and memorize longer phrases of words." Students learn to differentiate between signal and noise: "By learning to listen and pick up on subtle nuances of music and sound design aural information, I have learned to discern minor bits of information that can be crucial later on. It has also assisted me in 'tuning

out' unneeded information." Several mentioned listening to lectures in other classes: "To rephrase it, the process of maintaining attention in order to listen to and analyze a piece of music is generally no different than maintaining attention in a lecture hall, listening to and analyzing the information a professor might convey. It seems to me that we tend to think about them differently because we associate music as being more pleasurable, but the basic mental processes involved in each seem to be essentially the same." "Most traditionally taught classes are taught in lecture style which requires students to acquire information aurally. I am not by nature an aural learner, so I've had to consciously strengthen those skills. The critical listening skills required to perform music have been key."

It was distressing to learn that, in this age of multiple modes of teaching and learning, many students still experience their college education in a passive-style classroom, listening to a lecture, with no interaction with the professor. Certainly music and sound design courses do not function this way, and the active learning that goes on in these pursuits had many added benefits, including teaching students to maintain auditory attention. This seems to have enhanced their ability to listen to lectures in their other academic subjects, where that is still the primary mode of delivery.

Segmenting and Academic Skills

This section was intended to elicit responses about a well-know style of practicing music, that is, breaking the work into horizontal, temporal sections and practicing those sections intensely before playing the entire piece. Indeed, 87% of respondents answered they had experienced

segmenting in studying music or sound design. Of those, 59% of respondents did answer the question with the horizontal, temporal segments the researcher had in mind. However, 41% saw the concept as a vertical one, i.e. looking at a stacked set of music instruments, or voices, or a set of tracks. Those that answered in the expected horizontal direction mention that it enhanced their learning abilities, and their analytical skills. Horizontal responses tended to look at a particular smaller segment and discussed how they used this concept in studying in other courses. One responded as expected "you have to understand one measure before moving to the next" but then compared it to academic learning: "The same principle applies to my academic studies and keeps me from trying to learn the broad picture before the individual moving pieces that make it up." "When I get to a difficult section in any piece, but especially when playing the violin, I take that section out of context, break it up into the smallest meaningful parts and practice each separately until I can fuse sections together again." "When learning music, you have to understand one measure before moving to the next. The same principle applies to my academic studies and keeps me from trying to learn the broad picture before the individual moving pieces that make it up."

Those that answered the question in a vertical fashion tended to be students who had sung in a choir or sound design students who worked with multiple tracks: "I usually mix drums, voices, strings, etc. in stems, or essentially (sub-mixing). I like to be a control freak with the drums, miking each individual drum to a separate track. Then I will mix the output of all the tracks together. I usually do this with each similar instrument. It makes the final mix a lot easier, especially if you have a lot of tracks. I have a similar process for audio for video." But the concept was used in music also: "Listening to classical or symphonic music allows me to

separate the music into individual instruments." Or in a choir: "I can choose to follow one melody within an orchestral piece, or one synth track in a pop song, while still hearing/singing the song. As an alto, I have always sung harmonies, and I am particularly trained to do only one thing while hearing at least three others without getting them confused." Several students analyzed both: one said "Music has bars, sound design has tracks". A sound design student analyzed the situation quite clearly, and then mentioned that in addition to the traditional horizontal, temporal analysis or the vertical analysis of tracks you also had to "treat different regions of the sound spectrum as separate segments", a quite sophisticated approach. This ability to analyze a situation from a two-dimensional perspective is of great value. The majority of activities listed were learning (41%), analyzing (33%) and listening (16%), with others referring to memorization (3%).

The same concepts tended to be repeated in the interviews, with a higher proportion treating segments in a horizontal fashion. One mentioned the well-known psychological principle of "you remember the first thing, you remember the last thing" and that the middle would require more attention. A chemistry major compared learning sections of music to studying polyatomic ions, which requires one to "isolate one and figure out a system to remember that one and then to remember each one in a main category". Two pre-medical majors mentioned treating biology and anatomy as a set of systems that have to be studied first and then integrated into the whole so that you can understand "how the systems work together and how they come together to help each other out." A composer and computer science major compared composition to

programming and how you separate the source code from the interface. Another compared breaking music into progression, harmony and melody with the different types of programming.

Most students related that segmenting is typical of academic subjects and often how textbooks are written. One student acknowledged that it took "critical thinking skills to realize it's presented that way" and that learning music enhanced that. One student felt segmenting helped to overcome frustration and that when she got to a difficult section in a piece of music she would make herself "fall in love with this little measure" and then master it. She then related that she had practiced the same technique to get through the more difficult and less-appealing part of her master's thesis.

Alumni Responses

Alumni were solicited to respond to the survey in order to get a "longer view" on students' perception of music and how it benefited their other academic subjects. Twenty-one alumni took the survey and they had earned baccalaureate degrees in all areas of the University, with a fairly even distribution (all at about 3%), with a slightly higher number in the natural sciences (4%) and Behavioral and Brain Science (4%). Of the twenty-one students, twelve had received degrees in the STEM fields, slightly more than half. Most were either in graduate or medical school, or applying for acceptance. A few were working, one as a full time writer and one as a research assistant. Sixty-eight percent felt music had helped them with their post-graduate activities, citing stress relief (17%), time management skills (15%) and critical thinking skills (11%). A

few mentioned that their listening skills were better, even in medical work, stating “My hearing is more sensitive to auscultatory nuance, especially cardiac rhythms.”

Several felt it had enhanced their resume to have a music minor on their transcript. There were general benefits: “It reminded me each and every day that it's important to do what you love and what you enjoy, but it's equally important to give it your best 110% of the time. You must live your passion, study it, and know all aspects of it. Respect it. And it will be worth it.” It helped get a job: “Well, for one, it has helped me with my scientific research (I study emotional speech/sound, and almost everyone in my lab has been a performer or artist). It has helped me understand acoustics in general. It has helped my resume be not so boring. It has helped my networking by being a sort of global community that I belong to -- when you walk into a room and hear someone say that they're a musician, you have an excuse to connect with them, like membership in a fraternity or something. And we all know that getting jobs is 30% qualification, 30% luck, and 40% networking.”

A business student valued his music study: “Music has been such an important part of my life, that I think it overall just helps me understand things quicker and has trained my brain to invoke logical reasoning. I don't know why exactly, but I think that somehow the different aspects in music have helped me in my learning skills and time management skills to make me a smarter individual. I graduated Summa Cum Laude and was part of the Management Honors Program.” Stress relief was mentioned often, particularly among those in medical school: “Music has become a source of peace for me when I am stressed or anxious. It has helped me cope with

periods of my life when I was unsure what was going to happen or how I would get through a situation."

Two alumni participated in the interview process. One is applying to graduate school in medical science and listens to music daily. While he doesn't think about it as critically as he did during his undergraduate education, he feels it raises his mental health and relieves stress. The second interviewee was finishing a Master's Degree in Psychology and is now pursuing her doctorate in psychology. Her undergraduate degree was in neuroscience and her research focuses on that area. She chose her PhD program because the director encouraged his students to do artistic activities and felt that science did not teach researchers to be creative and innovative, but that the arts did indeed teach that kind of thinking.

Music and Sound Design and General Benefits

In the survey, participants were given the opportunity to respond with any other way they thought studying music and sound design had affected their abilities in their other coursework. Over 34% felt that the survey had sufficiently covered the topic. The remainder of answers mentioned relieving stress, sharpened senses, creativity, networking, persistence, and patience, cooperating with others, stage presence, self-esteem and confidence. It helped them be more critical: "Observing audio in movies, plays, and radio has helped me to sharpen my senses and discern quality work." Music and sound design affect some students differently: "Sound design is a very tedious task, so the main lesson it teaches is persistence and patience. Stress relief and mindfulness is a byproduct of the end product that is music." You learn cooperation: "Music

requires cooperation. Working, especially in a small ensemble, is very similar to coursework done in a group project setting. It is important to coordinate closely with other musicians/team members and fine tune each section before the project is complete." And simply, "The people in music change who you are."

The interviews were far more revealing in this area. The first interview involved a student who had been diagnosed as autistic and had no language at the age of three. She strongly felt music had helped her overcome her autism and also given her a chance to travel, to perform and to do beautiful music. She felt it was one of her greatest accomplishments. One felt that the arts and the sciences were intimately connected and that he knew his performing had an effect on other people that was borne out by studies in brain science but admitted that "I can't completely understand it yet." He felt music had given him "a world view". Another subject felt there was clearly something higher at work in music. It had taught him "a lot about my life experiences." One subject spoke passionately about what music had done for him in his life: "I'm a sensitive person so one of the ways to express (my) emotion is through music." Another expressed that she judged other people and her relationships to them by what music they listened to and liked. Another student who felt he was on the autism spectrum spoke about how studying music and its details helped him to understand small facial expressions. Two alumni mentioned both music and social relationships as a significant factor in their lives after graduation. All of the interviewees clearly felt doing music or sound design as an undergraduate had benefited their lives, both during their education and after. Most expressed that music had opened up their world to new

experiences, helped them relieve stress and many had continued their music pursuits or wished that they had more time to do so.

Response to Requests for Interviews

Of the 159 respondents, 113 indicated that they were open to doing an interview. Scheduling the interviews proved to be far more challenging, with many not responding to email requests to set up times. Eleven interviews were conducted during the spring semester of 2105.

The last question thanked respondents for their participation and the survey concluded.

Cohort Comparison: Music versus Sound Design Students

Initially, we decided to analyze the results of the population in the survey in two related areas: "Music students", defined as those who have taken one or more music classes; and "Sound design students", defined as those who have taken one or more sound design classes.

Question 1. Consent form number of respondents

Full: 159
Music: 127
Sound Design: 83

Therefore, there appear to be 51 students in the survey who have taken both music and sound design classes. It was suspected that in fact, this was not the case (as many who did the consent form did not finish the survey). However, there was potentially a significant number of students who had taken courses in both areas that would influence the results. Therefore, we needed a

finer distinction between students and some idea of how to "label" them. With no major in either music or sound design, students can take courses in one area or both. Therefore, labeling a student a "music" student or a "sound design" student was not possible without looking at the actual courses they had taken.

By looking at Questions 15 (Have you taken a music course?) and 16 (Have you taken a sound design course?), we determined the number of participants who answered these questions in either the positive or negative sense and divided them into the five cohorts. This encouraged a finer selection of cohorts, in order to study these different populations, as follows with the determining response to Questions 15 and 16. Note these numbers are lower than the consent form numbers as some students did not complete the survey through these questions. The four groups are:

Cohort I. Music students who <u>may</u> have also taken sound design courses ("Music"), identified as MUSIC (music)

Yes to Question 15, any response to Question 16

Cohort II. Sound design students who <u>may</u> have also taken music courses ("Sound Design"), identified as SD

Yes to Question 16, any response to Question 15

Cohort III. Music students who have not taken sound design courses ("Music only"), identified as MO (Music Only)

Yes to Question 15, "none" for Question 16

Cohort IV. Sound design students who have not taken any music courses ("Sound Design only"), identified as SDO (Sound Design Only)

Yes to Question 16, "none" for Question 15

Cohort V. Students who have taken both music and sound design courses ("Both"), identified as BOTH

Yes to both Questions 15 and 16

The number of students in these cohorts varied from question to question. The number of responses for text entry questions is listed with the results (See Appendices).

Demographics: Gender

A comparison of gender among the cohorts is listed in Table 3.2.

Table 3.2. Gender of respondents, cohort analysis

	FULL	MUSIC	SD	MO	SDO	BOTH
Male	0.49	0.49	0.55	0.42	0.50	0.57
Female	0.51	0.51	0.45	0.58	0.50	0.45

The general breakdown for the full samples was nearly even (51% male, 49% female) and remained the same for those taking music courses (Cohort I) but an analysis of the subgroups revealed a higher percentage of males taking sound design classes (Cohort II, 55%) and a higher percentage of females taking music classes only (Cohort III, 58%). The distribution for students who had taken sound design only was even (50/50) but that sample was quite small (20 responses) while students who had taken both types of classes was heavily male (57%).

Demographics: Ethnicity

The ethnicity of the students in the cohorts is listed in Table 3.3. The greatest percentage of ethnicity in all samples was white/Caucasian (a feature of the University as a whole), with 45% in the full sample. This percentage was nearly matched by music students (43%), rose with sound design students (51%) but fell considerably with students who had taken music only (38%) due to the number of Asian students in that sample (36%).

Table 3.3. Ethnicity by cohort

	FULL	MUSIC	SD	MO	SDO	BOTH
White/Caucasian	0.45	0.43	0.51	0.38	0.55	0.50
Asian	0.31	0.31	0.26	0.36	0.25	0.26
Hispanic	0.10	0.12	0.09	0.12	0.00	0.12
African/American	0.03	0.02	0.03	0.04	0.10	0.00
Native American	0.01	0.01	0.01	0.00	0.00	0.02
Native Hawaiian	0.00	0.00	0.00	0.00	0.00	0.00
Two or more races	0.09	0.09	0.09	0.09	0.10	0.09
Don't Know/Prefer Not to Answer	0.01	0.01	0.01	0.01	0.00	0.02

is the highest of all the cohorts at 55%, and falls slightly for students who had taken both subjects (50%). It should be mentioned that the combination of white/Caucasian and Asian represented nearly 75% of the samples in all cohorts (ranging from 74% to 80%). Other ethnicities are under-represented in the sample, with the next largest (Hispanic) ranging from 0% (sound design only) to 12 % (several samples). There are a significant number of students reporting two or more races (9-10%) in the sample. The University does not collect data on the nature of those races.

Question 8 asked if students had taken a music or sound design course in the last 10 years. Those who answered No were directed to the end of the questionnaire.

Demographics: Majors and Minors of Participants and Interviewees

Question 9 asked respondents for their major. It should be noted that some students double major and those degrees were reported separately. A school-by-school comparison is listed in Table 3.4. An analysis of STEM majors (Science, Technology, Engineering and Mathematics)

was performed by looking at the four schools that contain those majors: ATEC, BBS, EECS and NSM.

Table 3.4. Majors of Respondents by School and Cohort

	FULL	MUS	SD	MO	SDO	BOTH
Arts and Humanities (A&H)	0.11	0.12	0.09	0.13	0.00	0.09
Arts, Technology & Emerging Communication (ATEC)	0.29	0.20	0.55	0.05	0.95	0.43
Behavioral and Brain Science (BBS)	0.16	0.17	0.09	0.18	0.05	0.09
Electrical Engineering & Computer Science (EECS)	0.08	0.09	0.04	0.12	0.00	0.06
Economic, Political and Policy Science (EPPS)	0.03	0.03	0.00	0.05	0.00	0.04
Interdisciplinary Studies (IS)	0.01	0.01	0.00	0.01	0.00	0.00
School of Management (SOM)	0.08	0.10	0.04	0.12	0.00	0.06
Natural Science & Mathematics (NS&M)	0.22	0.26	0.16	0.29	0.00	0.22
Undeclared	0.03	0.03	0.01	0.04	0.00	0.02
TOTAL (including double majors)	1.00	1.00	1.00	1.00	1.00	1.00

Students who wish to pursue the music concentration within the Art and Performance degree are majors in the School of Arts and Humanities, hence the higher numbers for Music and Music Only in the sample. Conversely, students who decide to focus on Sound Design major in ATEC within the School of Arts, Technology and Emerging Communications, hence the higher numbers in Sound Design (SD) and Sound Design Only (SDO). It is also significant that those students who have taken both types of classes have chosen to major in ATEC (43%) and not in A&H (9%). Students in Natural Science and Mathematics choose to take music classes in a much higher percentage than sound design classes (which runs counter to expectations that physics and mathematics students might gravitate to sound design, give the crossover with acoustics). The lowest sample for that School was those taking sound design only.

Looking at STEM (Science, Technology, Engineering and Mathematics) majors was accomplished by listing just the STEM schools, i.e. the Schools of ATEC, EECS, BBS and NS&M. This is displayed in Table 3.5.

Table 3.5. Students with STEM majors by cohort

STEM ONLY	FULL	MUS	SD	MO	SDO	BOTH
Arts, Technology & Emerging Communication (ATEC)	0.29	0.20	0.55	0.05	0.95	0.43
Behavioral and Brain Science (BBS)	0.16	0.17	0.09	0.18	0.05	0.09
Electrical Engineering & Computer Science (EECS)	0.08	0.09	0.04	0.12	0.00	0.06
Natural Science & Mathematics (NS&M)	0.22	0.26	0.16	0.29	0.00	0.22
Undeclared	0.03	0.03	0.01	0.04	0.00	0.02
TOTAL (including double majors)	0.77	0.74	0.86	0.68	1.00	0.81

There is an over-representation of STEM students in the sample, 77%. The differences between STEM and non-STEM respondents will be explored in another chapter. A surprising 100% of students in the sound design only area major in ATEC or BBS, quite contrary to the full sample, which has a fairly diverse distribution, as do all the other cohorts. This also influences the high percentage that who have taken both sound design and music (81%). Those students who have taken music only tend to come from the School of Natural Science and Mathematics, which confirms anecdotal evidence from fellow music faculty that a high percentage of their students are from that school.

The music minor is only pursued by students who are not majoring in Arts and Humanities with a music concentration (students are not allowed to “double dip”, i.e. pursue the music concentration and the music minor). The response to Question 10 is listed in Table 3.6.

Table 3.6. Music minors by cohort

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.25	0.28	0.22	0.29	0.05	0.28
No	0.75	0.72	0.48	0.71	0.95	0.72

In the full sample, 28% were pursuing the music minor (it should be noted there is no minor in sound design at present), similar to those who reported taking music classes only (29%) and those who had taken both (28%). It falls sharply for Sound Design students (22%) and even further for those taking Sound Design Only (5%), indicating those students intend to pursue the minor but have not yet taken any music courses! It is unfortunate that students focusing on sound design do not find it necessary to take music courses. It is not required by ATEC for students to take any music courses and the sound design concentration (essentially a set of required courses for a specific area within a school that does not have a specific major in that area) has not yet been implemented. Therefore, a student can identify themselves as a "sound design" student in ATEC and never take a single music course. In this author's opinion, that is a serious detriment of the area that needs to be rectified when the sound design concentration is created. The concentration should include courses in music, particularly in music history, theory and composition, which should be integral to any program that trains students to create sound and music for games, films, etc.

Experience in Music and Sound Design, Formal and Informal Learning

Since music is a formal activity in high school and, in general, sound design is not, this area gives an interesting look at formal versus informal experience. Question 11 asked if respondents had done music or sound design in a formal setting and the results are listed in Table 3.7.

Table 3.7. Previous experience in music, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.82	0.87	0.78	0.88	0.60	0.85
No	0.18	0.13	0.22	0.12	0.40	0.15

For the full sample, 82% had studied music, which rose to 87% for those than had taken music courses, but fell to 78% for those who had taken sound design courses. For those that had taken Music Only, 88% reported prior experience. Therefore, some of the students in the sample were taking music for the first time. For those who had taken Sound Design Only, only 60% reported prior experience. This is an important statistic for those teaching in the sound design area in particular, since this means that a significant portion of those students have no formal musical experience.

Question 12 asked what the activity was and for how long, with answers tallied by choir, voice, band, piano or orchestra. The number of instruments played (counting voice as an instrument) was also tallied. A table comparing the average number of years (in all instruments) and the range of answers in each category is displayed in Table 3.8. The average of the five areas was used and the average of the top range was used.

Table 3.8. Average number of years of formal experience, cohort comparison

	FULL	MUS	SD	MO	SDO	BOTH
average	6.054	6.018	5.368	6.454	4.528	5.046
range in years	1 to 18.4	1 to 18.4	1 to 12	1 to 17.2	1 to 8.2	1 to 12

Surprisingly, the sound design students and the music students seem to have similar experiences in formal activities. So, while sound design students are not taking music courses in great numbers, they do enter their sound design courses with approximately the same level of music experiences as all students in the survey (around 5-6 years). Music students have a large range of years of experience, with some students as high as 22 years, but sound design students have a much smaller range, only up to 12 years for those who had also taken music, and only 8.2 years for those who had taken Sound Design Only.

Question 13 asked if students had participated in music or sound design in an informal capacity. The results for all but one cohort were close to the same as the full sample: about one half of the respondents said Yes. For students who had studied both subjects, those with informal experience rose slightly to 56%. It seems students in the sample had roughly the same informal experiences. Question 14 asked for more detail about the experiences. There was a wide variety of answers. The results for those answers for all cohorts is shown in Table 3.9.

A salient feature is the much reduced number of years of informal experience for all cohorts, in comparison with the years of formal experience. Many students who pursue music do so at a very early age, and the inclinations to compose or arrange comes later. While a few had reported music or sound design activity early in life (hence the top range of 14 years for music study), most come to this activity later in life. It is also significant that composition and arranging, which are musical activities but not necessarily identified as such by sound design students, had the highest reported percentages unless you look at the sound design cohorts. Then the highest

Table 3.9. Years and areas of informal experience for cohorts

	FULL	MUSIC	SD	MO	SDO	BOTH
	%	%	%	%	%	%
composition	0.17	0.18	0.13	0.29	0.30	0.06
arranging	0.09	0.08	0.03	0.16	0.20	0.00
digital music	0.05	0.05	0.09	0.03	0.00	0.00
recording	0.12	0.15	0.13	0.11	0.10	0.29
sound/audio engineer	0.16	0.17	0.28	0.16	0.30	0.10
band	0.17	0.14	0.19	0.13	0.10	0.10
a cappella group	0.07	0.05	0.03	0.05	0.00	0.13
private study	0.07	0.08	0.06	0.08	0.00	0.06
podcasting	0.02	0.03	0.06	0.00	0.00	0.26
no response	0.06	0.08	0.00	0.00	0.00	0.00
	1.00	1.00	1.00	1.00	1.00	1.00
Average years	3.69	3.78	3.65	4.04	3.92	2.38

reported activity is audio engineering (which includes recording and editing). For those who had studied sound design only, however, composition and audio engineering were equal, possibly because those who pursue sound design may feel that what they do falls into the realm of composition, even it not in the classical music sense. Soundscapes, sound for games and film can all be considered “composition” type activities. Many also reported playing in a band or singing in an a cappella group as informal activity at fairly equal numbers across the cohorts.

Probably the most interesting comparison is those who have taken sound design only and those who have taken music only, with no overlap between the two groups. Sound design is simply not a private study activity (reported as zero) whereas music heavily is (reported as 8%). It is possible that some of our respondents considered private lessons to be a formal activity, given that those lessons can be offered through a school program. In any case, the lack of one-on-one instruction is a salient feature of sound design, and perhaps should be more closely examined.

Certainly sound design students would benefit from this kind of activity, the same way music students do. It does not seem to be a part of the sound design culture, but perhaps it should be. Private instruction in music is a common part of a music teacher's activities and often produces considerable income for them, and indeed, some music teachers exclusively offer private lessons as their professional career. As the sound design culture develops, it is quite possible that able sound designers may see this as a viable career move; but sound designers often enjoy well-paying positions and may not feel the need to augment their salaries with private instruction.

Courses Taken at UT Dallas in Music and Sound Design

Question 15 asked students about the music courses they had taken at UT Dallas. Table 3.10 lists the percentages of the types of courses taken by the full sample and the cohorts by type of course. Because the music program offers a wide variety of courses, analysis was grouped by the type of course. Courses in music history and appreciation, vocal and choral, piano, guitar and music theory are offered at both the lower and upper level. UT Dallas offers one course in creating music and one in digital music. More advanced study and chamber music are frequently offered as Independent Study.

Since music history as a lower level course is required for the music minor and also satisfies a state core curriculum requirement, it was expected for a high percentage of students, and that percentage was expected to remain constant across the cohorts. It rises slightly in those students who had taken sound design and music classes. Similarly, upper level music

Table 3.10. Music courses taken by category, cohort comparison

	FULL	MUSIC*	SD	MO	SDO**	BOTH
Music History and Appreciation	0.12	0.12	0.17	0.11	0.00	0.16
Instrumental Ensemble	0.15	0.15	0.14	0.15	0.00	0.15
Vocal and choral	0.47	0.47	0.34	0.53	0.00	0.36
Piano	0.03	0.03	0.01	0.05	0.00	0.01
Guitar	0.03	0.03	0.08	0.01	0.00	0.09
Music Theory	0.11	0.11	0.14	0.09	0.00	0.14
Independent Study in Music	0.04	0.04	0.02	0.04	0.00	0.03
Creating Music	0.00	0.00	0.01	0.00	0.00	0.00
Digital Music	0.04	0.04	0.08	0.04	0.00	0.06
	1.00	1.00	1.00	1.00	0.00	1.00

*The responses will be identical to the full sample above, as “music students” were defined as those that had taken music classes.
**The SDO cohort is defined as students who have not taken music courses.

history is required for the minor and contributes to the high percentages there. Likewise, the number of students taking instrumental ensembles, piano and guitar is fairly consistent across the cohorts. The high level of vocal and choral classes has already been observed as an artifact of the area of specialization of the researcher, but the high percentage in the sound design students was surprising. This also contributed to the high percentage for students who had taken both. Digital music is a course that is quite attractive to sound design students, so it was no surprise to see higher numbers there. Finally, music theory is a part of the music minor, which is generally not pursued by sound design students, so it was interesting to observe a higher percentage there than expected. Music theory is one of the most helpful courses for both music and sound design, and it is gratifying to see that result. Finally, Creating Music is a course in digital composition, but it does not seem to be well represented among sound design students. This is probably because there are ATEC courses in sound design that essentially offer the same experience (or at least, that is the perception of students).

Question 16 asked about the sound design courses that students had taken at UT Dallas. The sound design area at UT Dallas has a limited number of offerings, so analysis was done by the actual course. The results are listed in Table 3.11.

Table 3.11. Courses taken in sound design, cohort comparison

	FULL	MUSIC	SD*	MO	SDO	BOTH
INTRO TO SOUND DESIGN	0.54	0.58	0.54	0.00	0.67	0.60
AUDIO TECHNOLOGIES	0.13	0.15	0.13	0.00	0.11	0.17
AUDIO PRODUCTION LAB	0.01	0.00	0.01	0.00	0.00	0.00
SOUND DESIGN FOR GAMES	0.07	0.06	0.07	0.00	0.04	0.07
SPECIAL TOPICS IN SOUND DESIGN	0.24	0.21	0.24	0.00	0.19	0.17
	1.00	1.00	1.00	0.00	1.00	1.00

*The responses will be identical to the full sample above, as "sound design students" were defined as those that had taken sound design classes.
**The MO cohort is defined as students who have not taken sound design courses.

Only one student had taken the course "Audio Production Lab" and that student was a Sound Design Only student. As mentioned before, since Introduction to Sound Design is required of EMAC majors, the largest percentage fall in that area and is relatively consistent throughout, except for a small increase in students who take music only or sound design only. Of the other courses (which are all upper level), music students are taking audio technologies at a slightly higher rate; the rest of the percentages vary by only three percentage points. It seems that it does not matter what cohort the student is in; they have taken sound design courses at about the same rate.

Previous Experience in Music and Sound Design

The next two questions asked students about their experience prior to attending UT Dallas.

Music has been a part of high school curriculum for many years, is a long-term curricular subject, and given in a formal capacity. Sound design, however, is not a high school subject and is seldom taught at that level. A comparison of these two questions in the various populations yields some results about formal versus informal education in music-related topics at the high school level.

Question 17 asked students if they had studied music prior to attending UT Dallas. The results of the cohorts are shown in Table 3.12.

Table 3.12. Was music taken prior to UT Dallas, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.80	0.86	0.86	0.84	0.55	0.91
No	0.20	0.14	0.14	0.16	0.45	0.09

It was somewhat surprising that the number of music students and sound design students reported taking music classes prior to enrollment at UT Dallas at the same rate. However, when you look at those students who had elected to take sound design classes only, the percentage drops by 31 percentage points. Such a large gap leads us to conclude that students with no prior experience in music often do not elect to take music courses in college, even when they are enrolled a “music-related” area like sound design. This lack of music background would seem to be a hindrance to attempting music courses in college, even for those engaged in sound design, where one would assume some musical background would be helpful. Indeed, the highest percentage of students who had taken music prior to college is those who are enrolling in both music and sound design courses.

Question 18 examined the type of musical experience students had, both how long and in what capacity. Answers were given in years and then averaged, and the type of experience was grouped into choir, voice, band, piano and orchestra. Table 3.13 lists the average number of years of experience in the various cohorts in each type of experience. The number of responses is also listed as the low number of responses in one cohort (sound design only) affects the average.

Table 3.13. Average years of prior musical experience, cohort comparison

Type	FULL	MUSIC	SD	MO	SDO	BOTH
Choir	5.95	5.00	6.00	6.31	11.00	3.17
Voice	4.00	4.00	3.50	2.73	0.00	3.67
Band	5.69	5.60	6.17	6.27	7.00	6.60
Piano	7.48	7.33	7.11	7.40	6.33	7.20
Orchestra	7.00	7.00	7.60	7.20	6.00	6.00
Responses	101	91	39	62	10	29

The percentages for the full sample, students who have taken music (and maybe some sound design) and those who have taken sound design (and maybe some music) are fairly similar across all types of experience. In choir they range from 5 to 6 years; in voice from 3.5 to 4 years, in band from 5.6 to 6.17 years, in piano from 7.11 to 7.48 years and in orchestra from 7 to 7.6 years. It is in the music only or sound design only cohorts that we see some variation. The music only sample is more reliable, with 62 responses spread across the five subject areas fairly evenly, except in voice, where there was a steep drop off.

The Sound Design Only cohort, with only 10 responses, meant that each area had only 0-3 responses, leaving this sample open to interpretation. No Sound Design Only students had taken

choir; only one had taken band or orchestra; two had taken choir and three had taken piano lessons (perhaps more useful for sound design students, since some software requires piano proficiency). The response numbers in each category are too small to be extrapolated into any conclusion about this sample. The sample of students who had taken Both was large enough for analysis, and in that cohort, the number taking choir and voice was again significantly less but percentages for band, orchestra and piano were in the same range as the Full, Music, and Sound Design cohorts.

Question 19 asked students if they had studied sound design before attending UT Dallas. It was expected that these numbers would be considerably lower than Question 17 about music, since sound design is not offered in high school as a distinct subject. The responses for Question 19 are listed in Table 3.14.

Table 3.14. Was sound design studied prior to UT Dallas, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.14	0.11	0.24	0.05	0.25	0.24
No	0.86	0.89	0.76	0.95	0.75	0.76

In comparison to Table 3.12, where students were asked if they had studied music, the full sample drops from 80% to only 14%. For those who had taken music courses at UTD, it drops even further to just 11%. Not surprisingly, for those who had studied sound design at UTD, a much higher percentage, 24%, had some prior experience. The percentage for those who had not taken sound design, but only music courses, was quite low at 5%. Those who had taken sound design only, or sound design and music, in their college courses, had similar percentages at 24

and 25%. This is not unexpected, since students often gravitate to classes where they have some experience.

Question 20 asked how long they had studied sound design prior to attending UT Dallas, and in what capacity. There was a relatively low response rate to this question, given that a great percentage of students in all samples had answered “No” to the previous question and were not directed to answer here. Since sound design is not a formal high school course, the answers were quite brief. The cohort analysis yielded little information, other than the range of the years of experience listed in Table 3.15, as well as the number of responses. Since one respondent had 20 years of experience in a professional arena (and has returned to school to formally study sound design), the range number were skewed by his response. Two students actually had a formal sound design class in high school. It is possible that sound design may be included in high school curriculum as the area grows. The types of experience included recording, composing music using software (clearly a crossover area with traditional music), and editing and mixing music samples. It should be noted that given the informal nature of the activity, many respondents were unclear as to the number of years they had engaged in the activity. Many responses were vague, mentioning “very little” or “on my own time” or “many years”. Because they had not had a formal course-based experience, it was harder for respondents to judge how long they had engaged in that activity and in what area. This is one feature of studying formal versus informal activity in general: it is easy to judge what the experience was and for how long in a formal experience, since the experience is clearly delineated for the student. However, when studying

informally on one's own time, it can be unclear as the nature and the length of the experience, which can vary widely over time.

Table 3.15. Years of sound design experience prior to UT Dallas, cohort comparison

Range	FULL	MUSIC	SD	MO	SDO	BOTH
in years	1-20	1-20	1-8	1-4	1-4	1-20
Responses	14	12	29	4	5	7

Music and Sound Design and General Academic Skills

Question 21 simply asked students if they agreed that studying music or sound design had enhanced their academic abilities in other courses. The results for the cohorts are shown in Table 3.16.

Table 3.16. Responses to "Does music/sound design enhance academic skills?", cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Strongly disagree	0.06	0.05	0.08	0.05	0.15	0.03
Disagree	0.14	0.17	0.19	0.15	0.15	0.21
Agree	0.46	0.44	0.45	0.46	0.55	0.39
Strongly Agree	0.34	0.37	0.28	0.38	0.15	0.36

For students in the full sample, or those who had some music experience, the response for "strongly disagree" was generally quite low, and less than 10%. However, students who had studied sound design only questioned the validity of the statement, with 15% feeling it had not enhanced their skills. Conversely, those in the full sample or those who had studied music (either with or without sound design) either agreed or strongly agreed at about the same percentages (80% for the full sample, 81% for music students, and 73% for sound design

students, and 75% for those who had studied both). The lowest positive response was again in those students who had only taken sound design courses, but 70% of that population still felt that studying sound design had enhanced their academic skills.

Question 22 asked respondents to describe those skills, which were then coded and identified in the following categories; concentration (or focus), memorization, stress relief, time management, public speaking (communication), gaining new perspectives, knowledge, mathematics skills, interrelationship of parts (connections), discipline, critical thinking skills, expressivity or others. Table 3.17 compares the responses for these categories for each cohort, with coding as follows: SC are strategy codes, AC are activity codes, STC are situation codes and PC are process codes. (Please see the observations of the full survey for a description of these terms).

Of the categories, the one that is the most consistent across the cohorts is concentration/focus, with responses of 14-15% of respondents. This was also generally (but not always) the highest area of response. Except for the Sound Design Only cohort, memorization fell in the 2-4% range. Since music (and performance in general) requires memorization skills, but sound design does not, that result was expected. No Sound Design Only students reported stress relief. One can infer that taking sound design, with its high degree of detail work, is a stressful activity rather than a stress relieving activity. Conversely, those students reported the highest level of time management skills (8%), as opposed to those in the other cohorts (3-5%). It was not unexpected that Sound Design Only students reported no benefit to public speaking skills (since

Table 3.17. Keyword responses for “Does music/sound design enhance skills?”, cohort comparison

Categories	FULL	MUSIC	SD	MO	SDO	BOTH	CODES
Concentration, focus	0.15	0.14	0.14	0.14	0.15	0.14	STC
Memorization	0.03	0.04	0.02	0.04	0.00	0.03	AC
Relieve stress	0.16	0.17	0.07	0.20	0.00	0.10	STC
Time management	0.04	0.03	0.05	0.03	0.08	0.03	STC
Public speaking, communication	0.05	0.07	0.02	0.08	0.00	0.17	AC
New perspectives	0.08	0.08	0.14	0.04	0.08	0.14	SC
Knowledge	0.13	0.08	0.19	0.10	0.38	0.10	SC
Mathematics skills	0.10	0.10	0.07	0.08	0.00	0.07	AC
Interrelationship of parts, connections	0.04	0.06	0.05	0.06	0.00	0.00	SC
Discipline	0.07	0.05	0.05	0.06	0.15	0.03	STC
Critical thinking skills	0.09	0.08	0.05	0.11	0.08	0.03	AC
Expressivity	0.03	0.03	0.02	0.03	0.00	0.14	PC
Other	0.05	0.07	0.12	0.03	0.08	0.00	*

it is not a part of that activity) but the other cohorts did, and those who had taken both types of classes reported this activity at 17%. However, sound design students reported gaining new perspectives more often than music students, with sound design students at the highest reporting percentage, 14%, along with those taking both sound design and music. Again, sound design students also reported the highest percentage of gaining new knowledge at a surprising 36% for students who had taken sound design but not music. This is probably a feature of the lack of prior experience in sound design, hence students perceive it as a “new” knowledge subject. Enhancement of mathematical skills was only reported by those who had taken music at 10%. Sound Design Only students did not report this benefit, nor did they feel sound design had helped them see the interrelationship of parts; only music students reported this benefit at 6%. Students in all cohorts felt they had learned discipline and the highest reporting cohort was the Sound Design Only students at 15%. As sound design requires a great deal of detail work, that

was not surprising. Critical thinking skills were most reported by students who had taken music only, as sound design students did not report this benefit. Finally, expressivity was reported most by students who taken both sound design and music courses, and not reported at all by those who had taken sound design only. It should also be noted that sound design students reported many other activities not reported by other cohorts.

Music and Sound Design and Flow

With Question 23, we began to explore specific tasks that might be enhanced by music or sound design study. Questions 23 asked students if they had experience the concept of "flow", both during music or sound design activities and in other contexts. Table 3.18 shows the responses to flow in musical or sound design activity. Question 24 asked them to describe that activity. Responses were coded and grouped and are displayed in Table 3.19.

Again, the responses from sound design students, particularly those who had taken no music, were markedly different from the other cohorts. While all the other cohorts reported feeling serenity, Sound Design Only students did not. However, they were more likely (8%) to report that the feeling was natural, but not free and easy (0%). Music students reported that the flow experience was free and easy and also fun, but Sound Design Only students did not report those feelings. All cohorts reported that flow affect their perception of time, but sound design students at a much higher rate (77%) than the other cohorts. They tended, however, to be more immersed in the experience (8%) than the other cohorts. It was not surprising that sound design students did not report feeling joy, confidence, focus or emotion. Music students reported these

Table 3.18. Flow in music or sound design activities, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Never	0.05	0.03	0.04	0.04	0.11	0.00
Rarely	0.06	0.06	0.08	0.04	0.05	0.09
Sometimes	0.34	0.35	0.23	0.44	0.32	0.18
Most of the time	0.37	0.38	0.45	0.32	0.37	0.50
Always	0.18	0.18	0.21	0.15	0.16	0.24

Table 3.19. Description of the flow experience in music or sound design, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH	CODES
Serenity	0.04	0.05	0.03	0.05	0.00	0.04	SC
Natural	0.04	0.04	0.08	0.01	0.08	0.07	SC
Free and easy	0.05	0.06	0.03	0.05	0.00	0.04	SC
Fun	0.03	0.04	0.03	0.04	0.00	0.04	SC
Perception of time	0.48	0.44	0.65	0.41	0.77	0.57	SC
Immersion	0.03	0.02	0.03	0.01	0.08	0.04	SC
Embodiment	0.03	0.04	0.03	0.03	0.00	0.04	AC
Joy	0.06	0.07	0.03	0.07	0.00	0.04	SC
Confidence	0.02	0.02	0.03	0.03	0.00	0.04	SC
Focus	0.06	0.07	0.00	0.10	0.00	0.00	STC
Feeling the emotion	0.07	0.08	0.05	0.08	0.00	0.07	SC

experiences at significant percentages. Apparently sound design students feel their tasks cause an altered perception of time, that the experience is natural and immersive, but do not report the positive feelings of joy or confidence that is common to music students. The sound design students reported only strategy codes.

Questions 24 and 25 asked about flow in non-musical or sound design activities. The results are displayed in Tables 3.20 and 3.21. While many reported experiencing flow in sports activities in all the cohorts, there were some marked differences in other activities. Sound Design Only students reported a much higher level of artistic activities, but did not engage in reading

Table 3.20. Responses to “Did you experience flow in other activities?”, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.81	0.83	0.87	0.80	0.79	0.91
No	0.19	0.17	0.13	0.20	0.21	0.09

Table 3.21. Flow activities in other areas, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Sports/exercise	0.21	0.21	0.18	0.24	0.18	0.19
Artistic/creative	0.21	0.20	0.28	0.18	0.36	0.26
Entertainment	0.11	0.12	0.15	0.09	0.09	0.15
Reading for pleasure	0.12	0.14	0.13	0.15	0.00	0.15
Studying/learning	0.08	0.07	0.10	0.07	0.18	0.07
Writing	0.10	0.08	0.05	0.07	0.09	0.04
Programming	0.04	0.05	0.03	0.07	0.00	0.04
Science/math	0.06	0.05	0.03	0.07	0.00	0.00
Presentation	0.02	0.02	0.00	0.04	0.00	0.00

for pleasure, programming, science and math, or presentations. Since we expect a higher percentage of music students to be in science and math fields, it was no surprise that the highest percentage reporting flow in that area, and in programming, were the music only students. All reported entertainment (video games, films), but the sound design students reported at the highest percentage. All reported that they experienced flow in studying, but again the sound design only students had the highest percentage there also. Finally, presentation activities were reported only by music students.

Form, Structure and Academic Abilities

Students were asked if they had studied “form” and given examples (ABA, rondo form, sonata form, etc.) in Question 27. The results are listed in Table 3.22.

Table 3.22. Response to “Have you studied from?”, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Not at all	0.31	0.06	0.42	0.24	0.63	0.30
Occasionally	0.42	0.48	0.37	0.49	0.21	0.45
Frequently	0.24	0.26	0.21	0.27	0.16	0.24

Since form is a musical concept, one might assume that music students would respond more favorably to this question, and the response rates for “frequently” were quite similar (24-26%) for those who had taken music classes. It falls for those who had take sound design (26%) and falls further for those who had taken only sound design classes (16%). The same drop-offs are seen in the “occasionally” categories, with Sound Design Only with the lowest percentage. This is borne our by the number of respondents who answered they have never studied form. Those who had take only sound design courses said “not at all” with a high percentage of 64%. Again, this is an area where sound design curriculum could be enhanced by an awareness of the areas of music that can help instruction. Form is so integral to composition and design in music, that it would be unfortunate if a sound design student never covered those concepts. The deficit in their previous knowledge base indicates the need for inclusion of form in sound design curriculum.

Those that had studied form were asked if they felt that study had enhanced their academic skills in Question 28. The responses are tabulated in Table 3.23. It should be noted that the number of sound design students responding to this question was 29, still a reasonable size sample. However, there were only eight respondents in the sound design only cohort.

No respondents marked “strongly disagree”, but 27% of the full sample marked “disagree”, with the majority of those students in the Both category (43%), stemming primarily from those

Table 3.23. Responses to “Does studying form enhance academic skills?”, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Strongly disagree	0.00	0.00	0.00	0.00	0.00	0.00
Disagree	0.27	0.28	0.36	0.23	0.13	0.43
Agree	0.57	0.57	0.43	0.64	0.50	0.38
Strongly agree	0.19	0.16	0.25	0.15	0.37	0.19

students who had studied sound design (36%). Over half the sample agreed, with the exception of the sound design students. The strongest indication that students felt studying form had enhanced their academic skills was easier to see when we combine the “agree” and “strongly agree” categories: the percentages range from 57% to 79%. Over three quarters of students in music who had studied form felt it had helped them. Even in sound design, over half the students felt it had helped them.

Students who answered “agree” or “strongly agree” were asked to describe an experience where they felt studying form had affected their other academic skills. The results are listed by keywords in Table 3.24. Note that all responses were coded as “strategy” codes, since these are skills that aid in studying. Respondents also often listed the subjects they had studied and that is tabulated in Table 3.25.

It should be noted that the large percentage of “other” responses was partly those who did not answer the question within the parameters. The top three categories, patterns, critical thinking and structure, were predominant in all cohorts, but less so in the sound design cohorts. They mentioned “learning” more often, with 11% and 14%. It would seem that music and sound

Table 3.24. Experiences where form affected academic skill, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
patterns	0.26	0.25	0.32	0.23	0.29	0.33
analysis/critical thinking	0.25	0.25	0.21	0.26	0.14	0.25
structure	0.19	0.19	0.21	0.21	0.29	0.17
details	0.09	0.10	0.05	0.10	0.00	0.08
learning	0.05	0.04	0.11	0.03	0.14	0.08
other	0.16	0.17	0.11	0.18	0.14	0.08

Table 3.25. Subjects listed where form affects skills, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Mathematics	0.36	0.31	0.83	0.23	1.00	0.75
Literature	0.25	0.27	0.17	0.27	0.00	0.25
Natural sciences	0.28	0.31	0.00	0.36	0.00	0.00
Writing	0.11	0.12	0.00	0.14	0.00	0.00

design students who value form, value it in different ways. This is a subject for further research, as it indicates that these cohorts are thinking about the structure of music and sound in very different ways.

Because many of the students in the sample major in STEM fields, it was expected that the areas mentioned would fall into that category. However, many mentioned writing and literature in their responses also. The Full, Music and Music Only cohorts listed the most diverse areas, with mathematics the clear favorite and getting 83% and 100% of the sound and Sound Design Only cohorts. However, the low number of responses there (19 and 6, but only 6 and 2 mentioned areas) makes it difficult to draw any conclusions there. Of those that had taken both types of classes, only four mentioned areas, so again that data is not significant. What is significant is

that the music cohorts, because of the prevalence of STEM majors, clearly see the connection between form in music and structure in other subjects.

Rubato and Academic Skills

Rubato is the concept of slightly changing the tempo of a piece in order to add personal expressivity. Students were asked in Question 30 if they had ever used rubato in a musical piece and their responses are recorded in Table 3.26.

Table 3.26. Response to "Have you ever used rubato in a musical piece?", cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.75	0.83	0.63	0.86	0.39	0.77
No	0.25	0.17	0.37	0.14	0.61	0.23

Given the highly musical nature of the question, it was not surprising that the highest percentage was in the Music Only cohort, and the lowest in the Sound Design Only cohort. However, given that some of the sound design students also had musical backgrounds, it was expected that there would still be at least 1/3 of respondents that had experienced using rubato. Whether or not they use it in their current sound design work would be answered by Question 31, which asked them to describe that experience. Answers were coded according to keywords and the results are listed in Table 3.27.

It should be noted that only five Sound Design Only students responded to this question, and that many of the responses from all cohorts did not describe an experience that was within the correct concept of rubato. Many did respond that changing the tempo (not of a passage, but of a section)

Table 3.27. Experience of using rubato, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH	CODES
natural	0.08	0.09	0.12	0.07	0.00	0.17	SC
expression	0.20	0.22	0.18	0.23	0.20	0.17	STC
emotion	0.37	0.38	0.35	0.37	0.20	0.42	AC
technique	0.15	0.16	0.12	0.16	0.00	0.17	AC
individual creativity	0.14	0.13	0.12	0.14	0.20	0.08	AC
add or hold interest	0.05	0.02	0.12	0.02	0.40	0.00	STC

was an expressive technique in music. The music students rated emotion as the highest type of experience, whereas the sound design students used it to add or hold interest in a work. All felt it added emotion to a piece, but again the sound design only students less so. Music students considered it a technical skill, whereas sound design students did not see that as a part of rubato. Finally, music students and sound design students who had both courses felt rubato was a natural part of music, but those students who were Sound Design Only did not. However, given the small number of respondents, this is not a significant finding. Activity codes were most prevalent in all cohorts, ranging from 40% (sound design only) to a high of 67% for Music and Both cohorts.

Music Theory, Mathematics and Language

It was assumed that one strong area of influence on skills would be music theory, with its natural relationships to mathematics and languages. Students were asked if they had student music theory in Question 32. Since most music courses cover some theory (even performance courses) a high rate of response was expected. It was, therefore, disappointing to see rates of only about 2/3 of the respondents, as shown in Table 3.28.

Table 3.28. Responses to “Have you ever studied music theory?”, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.67	0.70	0.68	0.67	0.56	0.75
No	0.33	0.30	0.32	0.33	0.44	0.25

The rate did rise to 75% in students who had taken both sound design and music courses. This concept was more common in the Sound Design Only cohort, where there were 18 responses.

In Question 33, those who responded yes to the previous question were asked if they agreed with the statement “Studying music theory enhance my academic skills in other course”. The results are shown in Table 3.29.

Table 3.29. Do you agree with “Studying music theory enhanced my academic skills in other courses?, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Strongly Disagree	0.00	0.00	0.00	0.00	0.00	0.00
Disagree	0.38	0.41	0.32	0.42	0.20	0.38
Agree	0.35	0.35	0.32	0.38	0.40	0.29
Strongly Agree	0.27	0.25	0.35	0.20	0.40	0.33

The responses by cohort to this question were fairly similar. No one strongly disagreed with the statement and responses for “disagree” ranged from 20% (surprisingly, in the Sound Design Only students) to a high of 41% for music students. Given that music theory is an integral part of music study, one can only surmise that music students find it less helpful than sound design students. This may reflect the nature of the activities: you can play an instrument or sing without any background in theory (although most music teachers would argue that it enhances your performance) but sound design students find it more helpful. In any case, in all cohorts, the

majority of students agree that music theory had helped them in their other classes, ranging from 58% (in the Music Only cohort) to 80% (in the Sound Design Only cohort). This certainly makes the case for including music theory not only in all music curricula, but also in sound design curricula. In Question 34, students were asked to describe the experience and often also mentioned the subject were they felt music theory had helped them. These results are listed in Tables 3.30 and 3.31.

Table 3.30. Describe how studying music theory has affected academic skills, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH	CODES
critical analysis	0.19	0.21	0.11	0.25	0.00	0.15	STC
patterns	0.21	0.21	0.32	0.13	0.17	0.38	STC
form	0.05	0.05	0.05	0.04	0.00	0.08	STC
learning	0.29	0.26	0.32	0.21	0.50	0.23	SC
writing skills	0.07	0.08	0.00	0.08	0.00	0.00	STC
other	0.19	0.21	0.21	0.29	0.33	0.15	n/a

Again, those students who only took sound design responded differently to this question, limiting their responses to detecting patterns and general learning. They did not see any enhancement in writing skills, detecting form or critical analysis. Music students, on the other hand in both the Music cohort and the Music Only cohorts saw pattern recognition and critical analysis as two of the skills they felt had been enhanced. This was also true of students who had studied both music and sound design. Because of the diversity of answers, a fair number did not fall into categories, and were single responses.

Given the natural connection between mathematics and music, plus the fact that all UT Dallas students must take six units of mathematics during their undergraduate education, it was no

Table 3.31. Subject affected by music theory study, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
mathematics	0.46	0.43	0.54	0.47	0.60	0.58
language	0.15	0.19	0.15	0.13	0.00	0.14
writing	0.15	0.19	0.08	0.20	0.00	0.14
physics	0.15	0.14	0.15	0.13	0.20	0.14
history	0.08	0.05	0.08	0.07	0.20	0.00

surprise that mathematics was by far the most common answer, ranging from 43% in music students to 60% in Sound Design Only students. Those who had studied only sound design did not report physics or writing in their response, whereas these were well represented in the music cohorts, with rates ranging from 14%-15% and 8%-20% respectively. Since some of the music cohorts are Art and Performance majors, an interdisciplinary degree that requires history and literature, it is likely that affected the response rate, as they take more of those kinds of classes. Sound design students, on the other hand, are mostlyArts and Technology majors who have no requirement to study the humanities to any great extent. A surprising number of students reported language as the subject, and given there is no language requirement at UT Dallas for undergraduates, it is likely the say the connection between music and language was a result of using the analogy in the question.

Discipline, Time Management and Academic Skills

Students were asked about practice and discipline as a result of music or sound design study in Question 35 as regards discipline and time management. Results are tabulated in Table 3.32.

Only one sound design only student strongly disagreed with the statement and less than 25%

Table 3.32. Responses to: Studying music or sound design has enhanced by skills as concerned time management and discipline, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Strongly Disagree	0.02	0.00	0.02	0.00	0.07	0.00
Disagree	0.20	0.20	0.23	0.18	0.20	0.25
Agree	0.45	0.44	0.36	0.51	0.47	0.31
Strongly Agree	0.33	0.35	0.38	0.31	0.27	0.44

disagreed in any cohort. Ranges for "agree" or "strongly agree" feel between 74% and 82%, a significant percentage of respondents, for all cohorts. Those students were asked to describe an experience where music or sound design had helped their discipline or time management skills. Answers varied greatly and some were quite detailed, but generally fell into the categories and responses listed in Table 3.33.

Table 3.33. Describe an experience where music or sound design affected other academic skills in discipline and time management, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH	CODES
planning	0.44	0.43	0.50	0.40	0.60	0.47	STC
dedication	0.04	0.04	0.00	0.06	0.00	0.00	SC
focus	0.08	0.09	0.04	0.12	0.00	0.05	STC
awareness	0.04	0.04	0.00	0.06	0.00	0.00	SC
efficiency	0.04	0.04	0.00	0.06	0.00	0.00	STC
motivation	0.11	0.10	0.13	0.10	0.20	0.11	SC
balance	0.04	0.04	0.08	0.04	0.00	0.11	SC
complex	0.03	0.03	0.04	0.00	0.00	0.05	SC
prioritizing	0.04	0.04	0.08	0.02	0.00	0.11	STC
effort	0.07	0.06	0.13	0.04	0.20	0.11	SC
delayed gratification	0.03	0.03	0.00	0.04	0.00	0.00	SC
patience	0.04	0.04	0.00	0.06	0.00	0.00	SC

Planning was the most common answer for this experience, and all cohorts reported this activity as the highest, with Sound Design Only students answering at a rate of 60%. The second highest

answer was motivation, ranging from 11% to 20%, with again Sound Design Only students having the highest response in that area. The third area for sound design students was effort at 20%. Sound design students did not, however, respond about dedication, awareness, efficiency, delayed gratification or patience, all features mentioned by music students. It would seem that sound design students answers were more "generic" in nature and less detailed, leading to no responses in the more detailed categories. They did, however, mark "effort" much more highly. The lack of mention of dedication for sound design students may be a feature of their pursuit as a part of their academic degree, whereas music students are pursuing music outside their degree plans, and hence it requires more dedication. Only music students mentioned the benefit of delayed gratification, which comes after much study. Given that sound design students don't have the numerous years of study that music students do, it is likely that influenced the response rate in that area. In any case, both music and sound design students felt the discipline and time management skills required helped them in other fields, but differed in the way they described the experience beyond simple planning.

Maintaining Attention to Aural Information

In Question 37, students were asked if studying music or sound design had required them to maintain attention while listening to a stream of aural information. Table 33 tabulates the answers by cohorts. They were then asked if they agreed that that study had affected their ability to maintain attention. Those results are listed in Table 3.35.

Looking at the aggregate answers from Question 37 for "agree" and "strongly agree", responses

Table 3.34. Responses to “Do you agree that music or sound design requires one to maintain attention?”, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Strongly disagree	0.01	0.00	0.00	0.00	0.00	0.00
Disagree	0.05	0.04	0.09	0.03	0.13	0.06
Agree	0.46	0.46	0.38	0.52	0.47	0.34
Strongly agree	0.48	0.49	0.53	0.45	0.40	0.59

Table 3.35. Responses to “Has the need to maintain attention affected your academic skills?. cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.73	0.74	0.69	0.75	0.62	0.72
No	0.27	0.26	0.31	0.25	0.38	0.28

ranged from 87% (Sound Design Only) to 97% (Music Only students). Clearly, most students felt that music and sound design required high attention skills as regards aural information. Of those students, most felt that it had also affected their academic skills, with response ranging from 62% (sound design students, again the lowest percentage) to 74% for Music Only students. These students were then asked to describe an experience where the increased need to maintain attention in the music or sound design studies had affected other skills. The answers were categorized and the results are listed in Table 3.36.

Table 3.36. Maintaining attention skills, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH	CODES
listening	0.35	0.35	0.32	0.37	0.40	0.32	STC
multitasking	0.19	0.19	0.18	0.18	0.20	0.18	STC
focus	0.30	0.30	0.32	0.29	0.20	0.36	SC
details	0.07	0.06	0.14	0.04	0.20	0.09	SC
memory	0.09	0.10	0.04	0.12	0.00	0.05	SC

It should be noted that the small number of responses in Sound Design Only (five) makes any analysis of that area somewhat questionable. While over 13 students in that cohort responded positively to Question 39, only a handful described the experience. The more robust numbers in the other cohorts do allow for some analysis. The range of those who answered with the generic "listening" were about one third of the sample, with multitasking (a common feature of students and their study habits in the 21st century) was about one-fifth of the sample in all cohorts. In fact, except for the Sound Design Only cohort, there was surprising agreement among the cohorts, with one notable exception: the sound design students mentioned paying attention to details at a much higher rate (14%) than the other cohorts (eliminating the Sound Design Only students). This is a function of the kind of tasks required in sound design, which requires a great attention to details. On the other hand, sound design students reported a much lower percentage in memory tasks (4%), which was highest (12%) in the Music Only students. This is also not unexpected, as music performance often requires memorization, whereas sound design does not.

Segmenting and Academic Skills

"Segmenting" is the principle of breaking up larger information into "chunks" or "segments". In Question 41, respondents were asked if they had experienced "segmenting" while studying music or sound design. The results are listed in Table 3.37.

Table 3.37. Responses to "Have you experienced segmenting in music or sound design?", cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.87	0.88	0.96	0.84	0.93	0.97
No	0.13	0.13	0.04	0.16	0.07	0.03

In this question, the sound design students answered in a more positive fashion than the music students, with students who had taken both types of courses answering Yes at 97%. Sound design, by its very nature of breakings sounds into tracks and short temporal sections, requires segmenting. Those students when then asked to describe that experience in Question 42. Surprising, students also answered whether they had experience segmenting in a horizontal fashion (i.e. temporally) or in a vertical fashion (i.e. looking at the parts in a choral or orchestral scores, or tracks in a sound project). The experiences were categorized and the results are shown in Table 3.38. Table 3.39 shows percentages for horizontal versus vertical responses.

Table 3.38. Segmenting experiences, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH	CODES
learning	0.41	0.41	0.34	0.46	0.33	0.34	AC
analyzing	0.33	0.31	0.40	0.25	0.50	0.38	STC
memorizing	0.03	0.03	0.03	0.02	0.00	0.03	STC
listening	0.16	0.18	0.14	0.17	0.00	0.17	AC
other	0.08	0.08	0.09	0.10	0.17	0.07	N/A

Table 3.39. Horizontal versus vertical segmenting, cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Horizontal	0.59	0.58	0.55	0.63	0.60	0.56
Vertical	0.41	0.42	0.45	0.37	0.40	0.44

While the majority of response were in general “learning”, sound design students showed a greater preference for “analyzing” than music students, both in the sound design and the sound design only cohorts. Memorizing, which is far more prevalent in music study, was only listed by a small percentage of respondents; hence, memorization is an activity that is not enhanced by breaking up the work into parts. Rather, memorization is a more holistic activity. Listening was

listed by all cohorts except Sound Design Only (which had only six responses). Music students reported this more often than sound design students, perhaps because when one listens to a piece of music, it is required that you either break it into temporal pieces (horizontal) or listen to a certain part or the choir or orchestra (vertical). Horizontal segmenting, the expected type of segmenting over time, was listed by more than half of the respondents, but vertical segmenting was still well represented, with sound design students mentioning it the most, followed by students who had taken both. It should be mentioned that several respondents mentioned both types of segmenting and felt both approaches were equally valid.

Alumni Responses

Since the sound design program is relatively new, it was not expected that alumni would fall into the sound design cohorts. In fact, all had taken at least one music course during their time at UT Dallas, but of the 22 alumni that responded, eight had taken a sound design course as well. Therefore, we could analyze the alumni data from a cohort comparison approach. But, given that all had taken a music course, there is no Sound Design Only cohort; and the cohort Both is identical to the sound design cohort, since they had all also taken a music course.

Question 43 asked the respondents if they had graduated with an undergraduate degree; and Question 44 asked them what the degree was. All degrees were awarded between 2012 and 2015. Table 3.40 shows the percentages of graduation and Table 3.41 shows the degree areas.

The number of alumni respondents was 22, with one double major. Only one student had

Table 3.40. Respondents answers to "Have you graduated with a degree", cohort comparison

	FULL	MUSIC	SD	MO	SDO	BOTH
Yes	0.20	0.22	0.17	0.21	0.00	0.25
No	0.80	0.78	0.83	0.49	1.00	0.75

Table 3.41. Degrees for those who have graduated cohort comparison.

	FULL/MUSIC	MUSIC	SD/BOTH	MO
Art and Performance	1	1	0	1
Neuroscience	4	4	0	4
Accounting	1	1	0	1
Arts and Technology	3	3	3	0
Interdisciplinary Studies	1	1	0	1
Business Administration	1	1	0	1
Biology	1	1	0	1
Computer Science	1	1	0	1
Physics	2	2	2	0
Biochemistry	1	1	0	1
Child Learning & Development	2	1	2	0
Global Business	1	1	1	0
Literary Studies	1	1	0	1
Psychology	1	1	0	0
Unspecified	2	1	0	1

Note: Since all students had taken a music course, the Full and Music cohorts are identical. None had taken Sound Design only. The Both cohort is identical to the Sound Design cohort.

graduated with a degree in Art and Performance, and had taken no sound design classes. The three that had graduated with degrees in Arts and Technology had all taken some sound design. Since we solicited students in those areas, this was expected. What is surprising is that of those who had taken sound design, three were ATEC majors, two were in physics (perhaps an analogous area) but two were in child development and one in global business, areas that are unrelated to sound design. So while more alumni took music for general interest and not as a part of their degree plan, a few had taken sound design also.

The fact that there were still three cohorts to example led to further analysis of the alumni. Students were asked what they were doing post-graduation. The results are in Table 3.42.

Table 3.42. Post-graduation activity, cohort comparison

	FULL/MUSIC	SD/BOTH	MO
working	0.33	0.71	0.14
seeking work	0.14	0.14	0.14
graduate/medical school	0.33	0.00	0.50
research asistant	0.05	0.00	0.07
taking a break	0.05	0.14	0.00
applying to med/grad school	0.10	0.00	0.14

The students who had studied sound design were more likely to be working, while those who were in graduate or medical school (or even applying) had not taken sound design. A full 50% of the music only respondents were in graduate and medical school and had taken no sound design. More sound design students spoke of "taking a break" (14%) than music students (5%).

Students were then asked if they felt studying music or sound design had helped them with their post-graduation activities. There were 54 students who answered this question, but many had not graduated. In order to isolate just those students who had actually graduated, we applied a filter to isolate just alumni. As before, all students had taken a music class and some had also taken a sound design class. The results are listed in Table 3.43. Those that did were asked to describe the experience. The results were coded and are displayed in Table 3.44.

In the full/music sample, 87% agreed that their music or sound design studies had helped post-graduate. The numbers were similar for Sound Design/Both students at 88% but drop slightly to

Table 3.43. Alumni sample, studying music or sound design helped post-graduate, cohort comparison.

	FULL/MUSIC	SD/BOTH	MO
Strongly disagree	0.04	0.00	0.08
Disagree	0.09	0.11	0.08
Agree	0.57	0.44	0.69
Strongly Agree	0.30	0.44	0.15

Table 3.44. Experiences of those who felt studying music or sound design helped post-graduate, cohort comparison

	FULL/MUSIC	MO	SD/BOTH	CODES
enjoyment	0.07	0.14	0.22	AC
time management	0.15	0.07	0.11	STC
listening	0.04	0.07	0.11	AC
well-rounded	0.07	0.00	0.11	SC
stress relief	0.22	0.29	0.11	STC
resume	0.07	0.14	0.00	SC
critical thinking	0.11	0.14	0.11	AC
social connections	0.04	0.07	0.00	SC
current work	0.07	0.07	0.22	SC
other	0.15	0.00	0.00	n/a

84% for Music Only students. This reflects that sound design students were generally working in a field that used their sound design and/or music skills, while many students who had taken music only had gone into other fields, or medical and graduate school. Those students feel it helped them most in stress relief, particularly for music students, (29%) but the percentage dropped to half of the full sample (22%) for sound design students (11%). Again, sound design students are often working in the sound design area, and they use other means for stress relief; whereas, music students are in post-graduate study or other fields, and music is a source of both stress relief and enjoyment. It is of some interest that sound design students did not feel that their coursework had enhanced their resume (even though some were working in that field) but

they did report it helped with current work – perhaps an indication they are not actively seeking work and hence not concerned about their resume. Time management skills were mentioned more by music students than any other group. Finally, sound design students did not see their coursework as helping in social connections or networking, but this was mentioned by music students at a high rate. Music-making is often a more collaborative activity and hence they felt it helped them with relationships.

Music and Sound Design and General Benefits

Finally, we asked students if they wished to describe any other benefits that music and sound design had given them in Question 48. Most respondents felt the survey had covered all the material, so they responded with N/A or something similar. Keywords and phrases for those that responded are listed; answers were so varied they were not categorized. Responses that said "it's all been said" were eliminated. The six cohorts are listed in Tables 3.45 to 3.50.

A few students used this question as an opportunity to say they felt music or sound design study had a negative affect, in that it distracted or took time away from their other studies. The three most interesting cohorts are the music only, sound design only and both cohorts. The music only cohort talked about joy, networking, delayed gratification, emotional grounding, cooperation, confidence in being on stage, self-esteem, and self-confidence. The sound design only students talked about analysis of music, and actively studying the works of other composers to enhance their own work. Those who had studied both spoke of the ability to discern quality work, creativity, persistence, cooperation and memory.

Table 3.45. Full sample, general benefits (43 responses)

I make music, mix, and master tracks everyday
joy, relieving stress.
sharpen my senses and discern quality work.
programming.
creation.
networking skills
analyzing music made it easier for me to analyze the emotional content of literature
Practicing make you realize the work you have to put in to achieve greatness.
focus more when I move on to other work.
keeps me grounded.
The process of how to learn music is integral to being able to work on my school work. how I write my programs.
f the "right" music to help me either concentrate or de-stress.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
cooperation. Working, especially in a small ensemble, is very similar to coursework done in a group project setting.
gotten used to performing onstage
The people in music change who you are
creativity needed to solve problems
obsessively producing digital music, devoting many hours listening to music affecting my work studies by not letting me focus
negative affect. I can't concentrate on my other academic classes
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me succeed in coursework
I like to analyze each voice, instrument, or section of audio
helped my self-esteem and self-regulation, interact with the most diverse groups of people, using a large team of students from various backgrounds and skill set
have helped me develop a photographic memory
confidence that i use to reach my goals
music programs, singing, writing, producing
time management, rhythm and patterns
better understanding of my own work, patterns and techniques in other subjects
progress my skills and a fundamental education

Table 3.46. Music sample, general benefits (38 responses)

I make music, mix, and master tracks everyday,
joy, relieving stress.
sharpen my senses and discern quality work.
programming.
creation.
networking skills
analyzing music made it easier for me to analyze the emotional content of literature
Practicing make you realize the work you have to put in to achieve greatness.
focus more when I move on to other work.
keeps me grounded.
The process of how to learn music is integral to being able to work on my school work, how I write my programs
The "right" music to help me either concentrate or de-stress.
persistence and patience. Stress relief and mindfulness
cooperation. Working, especially in a small ensemble, is very similar to coursework
done in a group project setting.
gotten used to performing onstage
The people in music change who you are
creativity needed to solve problems
obsessively producing digital music, devoting many hours listening to music affecting my work studies by not letting me focus
negative affect. I can't concentrate on my other academic classes
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me succeed in coursework
I like to analyze each voice, instrument, or section of audio
helped my self-esteem and self-regulation, interact with the most diverse groups of people, using a large team of students from various backgrounds and skillset
have helped me develop a photographic memory
confidence that i use to reach my goals
music programs, singing, writing, producing
time management, rhythm and patterns
better understanding of my own work, patterns and techniques in other subjects
progress my skills and a fundamental education

Table 3.47. Sound Design sample, general benefits (21 responses)

I make music, mix, and master tracks everyday,
sharpen my senses and discern quality work.
creation.
analyzing music made it easier for me to analyze the emotional content of literature
The process of how to learn music is integral to being able to work on my school work, how I write my programs.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
done in a group project setting.
negative affect. I can't concentrate on my other academic classes
using a large team of students from various backgrounds and skillset
have helped me develop a photographic memory
time management, rhythm and patterns
better understanding of my own work, patterns and tiechniques in other subjects
progress my skills and a fundamental education

Table 3.48. Music Only sample, general benefits (22 responses)

I make music, mix, and master tracks everyday,
joy, relieving stress.
sharpen my senses and discern quality work.
programming.
creation.
networking skills
analyzing music made it easier for me to analyze the emotional content of literature
Practicing make you realize the work you have to put in to achieve greatness.
focus more when I move on to other work.
keeps me grounded.
The process of how to learn music is integral to being able to work on my school work
I write my programs.
The "right" music to help me either concentrate or de-stress.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
cooperation. Working, especially in a small ensemble, is very similar to coursework
done in a group project setting.
gotten used to performing onstage

The people in music change who you are
creativity needed to solve problems
obsessively producing digital music, devoting many hours listening to music affecting my work studies by not letting me focus
negative affect. I can't concentrate on my other academic classes
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me succeed in coursework
I like to analyze each voice, instrument, or section of audio
helped my self-esteem and self-regulation, interact with the most diverse groups of people, using a large team of students from various backgrounds and skillset
have helped me develop a photographic memory
confidence that i use to reach my goals
music programs, singing, writing, producing
time management, rhythm and patterns
better understanding of my own work, patterns and techniques in other subjects
progress my skills and a fundamental education

Table 3.49. Sound Design Only sample, general benefits (3 responses)

analyzing music made it easier for me to analyze the emotional content of literature
time management, rhythm and patterns
better understanding of my own work, patterns and techniques in other subjects

Table 3.50. Both sample, general benefits (16 responses)

I make music, mix, and master tracks everyday,
sharpen my senses and discern quality work.
creation.
The process of how to learn music is integral to being able to work on my school work, how I write my programs.
persistence and patience. Stress relief and mindfulness
done in a group project setting.
negative affect. I can't concentrate on my other academic classes
sing a large team of students from various backgrounds and skillset
have helped me develop a photographic memory
progress my skills and a fundamental education

Cohort Comparison: STEM versus Non-STEM Majors, Results

The University of Texas at Dallas consists of eight Schools, four of which have STEM-related majors, and four which do not:

Stem Major Schools:	Arts, Technology and Emerging Communications (ATEC) Behavioral and Brain Science (BBS) Natural Science and Mathematics (NS&M) Electrical Engineering and Computer Science (EECS)
Non-stem Major Schools:	Arts and Humanities (A&H) School of Management (SOM) Economics, Political and Policy Science (EPPS) Interdisciplinary Studies (IS)

By using Qualtrics filters and the "contain" feature, it was possible to create reports that identified all those students within a certain major, and to aggregate them into STEM and non-STEM fields. The resulting Qualtrics reports allowed a comparison of answers to the survey questions.

The number of STEM students was 114; the number of non-STEM students was 33. There were four students who listed "undeclared" as a major; they are not included in these samples. There was also one double major in both STEM (speech pathology) and non-STEM (Art and Performance). All students gave their consent, and all had been registered at UT Dallas in the last ten years and had taken a music or sound design class.

Demographics: Gender

The STEM students in the sample were fairly evenly split between male (48%) and female (52%) but the non-STEM students were more predominantly female (64%) than male (36%).

The gender of the full survey was again fairly evenly split (48% male, 52%). The higher number of females in non-STEM fields gives the survey a more even distribution. The general UT Dallas population is 57% male and 43% female.

Demographics: Ethnicity

The highest reported ethnicity in all areas (STEM, non-STEM and the full sample) was White/Caucasian, with a higher percentage in non-STEM students (55%) than STEM students (44%). This difference can be explained by the second largest ethnic group, Asian students, with 32% in the STEM cohort but only 21% in the non-STEM cohort. When you combine the percentages of those two ethnic groups, the percentages are equal, with 76% in both groups. The third largest group was Hispanics with 10% in STEM fields and 14% in non-STEM fields.

Demographics: Majors and Minors of Participants and Interviewees

Since the analysis split students into the STEM and non-STEM majors, there were 114 STEM majors and 33 non-STEM majors. Of greater interest is what majors were most predominant in each group. Because of the nature of the survey, the School of Arts, Technology and Emerging Communication had the greatest percentage of STEM majors (29.47%) followed by Natural Science and Mathematics (22.08%) and Behavioral and Brain Science (14.94%, partly due to eight students in neuroscience), with Electrical Engineering and Computer Science in fourth (10.53%). In the non-STEM fields, again the nature of the survey weighted the majors in Arts and Humanities at 48.57%, with most of the students coming from Art and Performance, and the rest from Literary Studies. There were no Historical Studies majors in the survey. The next

largest group was the School of Management (the largest school at UT Dallas) with 37.34%, followed by Economic, Political and Policy Sciences at 11.43% (with most majors in Political Science) and just one student in the School of Interdisciplinary Studies at 2.86%.

Students who take music courses are encouraged to take the music minor by faculty at UT Dallas. In the STEM area, only 25% are doing so, in spite of anecdotal evidence that having a minor in music will increase your chances of admission to medical school and graduate schools in the sciences. In the non-STEM area, 36% of students were pursuing the minor in music. One factor may be the higher number of required courses in the STEM majors, leaving little room in students' schedules for the minor. The music faculty has discussed the general problem of students reporting they can't "take any more music classes" and are experimenting with lowering the credit hours in instrumental ensembles from three credits to one credit to allow students to take those courses for more semesters. It remains to be seen if this will impact enrollments in a positive way. The first semester of the experiment will be Fall of 2016; early enrollments (as of July 2016) indicate that it has not had a positive impact on enrollments in those classes. The other upper level ensembles that remained at three units have approximately the same enrollments as previous semesters, while the instrumental ensembles are markedly lower. However, July is too early to make predications as to what final enrollments will be.

Experience in Music and Sound Design

The difference between STEM students and non-STEM students was very interesting here. In all areas except one, the non-STEM students had more experience, with an average of 7.54 years in

choirs, 7.00 years in band, 8.00 years in piano and 6.63 years in orchestra. This compared to STEM students with 5.70 years in choir, 6.42 years in band, 6.44 years in piano and 5.24 years in orchestra. Only in one area – voice – did STEM students have more experience, an average of 6.42 years versus 3.80 years in non-STEM students. There were 12 students that listed voice in the STEM students and 19 students in the non-STEM students, a smaller number than responses in the other areas (some of which had over a hundred responses). The vocal program is run by the researcher and she has experienced a larger than average number of STEM majors in her classes. Many are in the natural sciences (biology and biochemistry) and brain science (neuroscience) and this researcher writes three to four letters of recommendation every spring for students who are pre-health and applying to medical and graduate schools in the medical sciences. This factor may have influenced this result. This result also runs counter to anecdotal evidence by the faculty in the orchestra (both winds and strings) and the piano program, who report large numbers of science majors in the courses. A study of the actual majors in those courses is in order.

In sound design, the percentages of STEM and non-STEM students who had participated in sound design in an informal capacity (since it is not a formal pre-college subject) was approximately equal, with 52% of STEM students reporting previous experience and 58% of non-STEM students. This researcher was surprised that these percentages were not higher, as it seems that many college age students are participating in the kinds of activities that were reported here, particularly recording and mixing. The actual types of activities varied greatly. By far the largest reported activity of STEM students was composition (45%), with audio

engineering second (15%) and all other activities (arranging, digital music, recording, participating in band or an a cappella group, private study and podcasting) at less than 8%. However, non-STEM students reported much higher activity in other areas. While composition was still the highest (25%), other areas were nearly as high with recording and playing in a band at 19%. It should be noted that college age students have a rather broad definition of "composing" as opposed to the more strict definition in the classical word (composing for orchestra, opera, etc. by producing a score that is then used for performance). In one interview, a student reported that he "composed" on the keyboard by improvising, and then posted the recording to SoundCloud, an audio platform that allows the sharing of personal recording. He considered this (and perhaps rightfully so) his "compositions" and broadly boasted of the number of hits they had received. In this digital world, the term "composition" has a broad meaning, which probably accounts for the large number of respondents who say they had participated in this activity.

Courses Taken at UT Dallas in Music and Sound Design

Students asked what courses they had taken in music and sound design at UT Dallas. Both STEM and non-STEM students reported they had taken music history and appreciation at the same percentage of 12%. Of the courses in that area, one (MUSI1306) satisfies the state requirement for a course in arts appreciation; and the other upper level courses are required by the minor. Other courses showed a greater variation between the two groups. STEM students had a much higher percentage of instrumental ensembles (20%) versus non-STEM students (6%) but a lower percentage of voice and choir (38%) than non-STEM students (58%). This is in

contract to the previous result, where more STEM students had prior experience in voice and choir. More STEM students had taken music theory (11%, versus non-STEM at 8%), which is also required for the music minor. Almost all of the guitar students were STEM majors (10 out of 11 in the study). Not surprisingly, more STEM students took digital music (which is similar to sound design), with 12 students versus two non-STEM students. No non-STEM students took Creating Music (similar to composition) which correlates with the large number of STEM students who report composition as an interest. Finally, the number of responses for STEM students was 216 (recall that many students report multiple courses) for the 113 in the survey, almost two courses per student. For non-STEM students, there were 120 responses for the 33 in the survey or almost four courses per student. Clearly non-STEM students are taking more music courses during their time at UT Dallas.

The situation in sound design was quite surprising. Not a single non-STEM student had taken a sound design class. Students apparently do not see sound design as an elective activity or possibly, giving the newness of the program, simply do not know that is an option. The respondents who had taken sound design courses were all STEM majors and in fact, most were EMAC majors (where the introductory course was required) or ATEC (where upper level sound design courses are an option). Several identified themselves as “sound design” majors in the survey in spite of the fact that is not only no major, but no concentration in sound design. There were 62 responses in the STEM students, but 33, almost half, had taken the introductory course. The upper level courses had just 29 responses, in spite of the large number of ATEC majors in the survey (36). Historically, the areas in ATEC with the most enrollment are game design and

animation. The sound design area is in a period of growth now and new hires and courses are being considered. It remains to be seen if it will remain as a "majors only" area or if students from across the UT Dallas will begin to take these courses, as they do in music. There are, however, some advantages to having courses with only majors enrolled. Students tend to take elective courses less seriously; and the curriculum can be geared more tightly to those taking the course who are majoring in the area.

Prior Experience in Music and Sound Design

STEM students had a lower percentage of prior music experience (80%) versus non-STEM students (89%), but the difference in musical experience prior to attending UT Dallas between STEM and non-STEM students was striking. In every area except band (choir, voice, piano and orchestra), STEM students reported a much higher number of years of study. Averages were at almost one year higher in choir (6.14 versus 5.57), voice (4.63 versus 3.29), piano (8.77 versus 7.38) and the greatest difference, over two years in orchestra (7.42 versus 5.33). Only in band did non-STEM students report more experience (6.50 years) than STEM students (5.57 years). Band in Texas high schools is associated with marching band during the fall semester, implying that STEM students may gravitate towards other areas, such as choir and orchestra, and private study.

STEM students reported more experience in sound design prior to attendance at UT Dallas also, at a rate of 15%, whereas very few non-STEM students reported this experience (only 4%). For those that did report experience, the STEM students responded nearly identical to the full sample

with a few exceptions. One had 20 years of professional experience; other responses were from one to four years. Only one non-STEM student reported prior experience, and this was only "one year in high school". Clearly, students do not have much prior experience in sound design in high school, and the informal nature of their prior study led to low reporting in this area.

STEM students have more experience due to taking formalized courses in ensembles, and more so in orchestra and choir than band. This may reflect the additional hours of practice required by marching bands, in addition to the formal in-class practice, and may discourage STEM students from pursuing this activity.

Music and Sound Design and General Academic Skills

The number of STEM and non-STEM students who felt music and sound design had affected their general academic skills was generally the same (80% versus 76%). For those that described the experience, STEM students report the highest level (17%) in stress relief, followed by an enhanced ability to focus (14%) and mathematics and critical thinking skills (10% for both). Non-STEM students reported the highest percentage in public speaking skill (20%), followed by focus (15%) and stress relief (15%). Given that mathematics is a common requirement for STEM students, it was not surprising to see that area reported. Also, it is likely than STEM students have less need for public speaking skills in their curriculum and that non-STEM students are participating in majors where that skill is more necessary. STEM students reported a higher effect in critical thinking skills, again a common requirement of STEM subjects, but this

was not reported highly (5%) by non-STEM students. Further evidence of reporting in focus and critical thinking was addressed in later questions.

Music and Sound Design and Flow

STEM students reported experiencing flow (at least sometimes) at 91%, whereas non-STEM students reported it slightly less at 88%. Of those that described the experience, both STEM and non-STEM students reported "perception of time" as the most common experience (47% and 50%, respectively). No other category had a higher reportage than 10%. STEM students reported "free and easy" (7%), and "feeling the emotion" (8%) as the next highest responses. Non-STEM students reported "embodiment" (8%) and "joy" (8%) as the next highest responses. Student taking music and sound design report feeling flow at about equal levels and it seems to have little relation to their other courses, other than the general impression that the "flow state" was a desirable one. They were than asked about flow in other activities. Again, STEM and non-STEM students reported having this experience at about the same rate (82-83%). For those that described the experience, the most common experience for STEM students was sports (21%), following by artistic/creative activities (17%) and reading for pleasure (13%). For non-STEM students, artistic/creative was the highest (33%), following by sports and entertainment (video games, being with friends), both at 19%. One wonders if STEM students are spending their leisure time in more solitary pursuits than non-STEM students (although video games can, at times, be a solitary pursuit as well).

Form, Structure and Academic Abilities

Students were asked if they had studied the "form" of a music work, and STEM students responded positively at 64%. The response from non-STEM students was higher at 87%. They were then asked if they felt it affected their academic skills, and 76% of STEM students did feel that way. 70% of non-STEM students felt it had helped. For those that described the experience, STEM students reported the ability to detect structure (23%) and recognize patterns (21%). Non-STEM students reported critical thinking (46%) and recognizing patterns (38%). Students were also asked what subject they had studied where they felt this helped. STEM students reported mathematics (38%) and the natural sciences (33%), both STEM subjects, followed by literature (21%). Non-STEM students reported literature (67%) followed by writing (33%), both subjects more useful in non-STEM majors. It is interesting that non-STEM students, who are required to take both mathematics and science courses as a part of their core curriculum in the state of Texas, did not report any effect in those areas. However, the sample size was small (13 students responded to the question, but only three listed actual areas) so the findings are not significant. It is more significant that ten of the non-STEM students did not report any area. Since the question did not specifically ask for it, one area for possible research is whether or not students tend to report enhanced skills in courses in their major, or whether it helps them more in those courses they are required to take that are outside their major, and in particular, outside STEM or non-STEM courses. STEM students are also required to take a course in the arts (but only one three-unit course) and some writing courses, but at a lower rate than non-STEM students take math and science courses. The current requirement at UT Dallas is nine units of math and science, six units of communication, and only three units of creative arts. Additionally, some Schools create

courses within their own School to satisfy some requirements. The School of Electrical Engineering and Computer Science has students take EECS3390, a technical writing course. The courses that fulfill the Creative Arts requirement reside completely within the School of Arts and Humanities. These stated requirements are from the 2014 catalog, which students in the survey would use for their degree plans. There is a transition in core requirements currently underway that allows far greater choices in the Communications area, including courses in Arts and Technology, Biology, Chemistry, and even Mathematics, which will allow students to stay within their chosen field of study. No changes were proposed within the arts requirement.

Rubato and Academic Skills

As reported in the general survey, the question about rubato was the least useful in determining whether music and sound design affected other academic skills. While 76% of STEM students reported experiencing rubato, as well as 86% of non-STEM students, the responses were not strictly within the definition of rubato (which was stated in the question) but had more to do with using tempo as an a way to impart emotion. “Emotion” and “expression” were the most common STEM responses (at 34% and 23%, respectively), while non-STEM students reported “emotion” at 50%, but also “technique” (14%) and “individual creativity” (14%). However, the sample size in the non-STEM students was small (14 students), still over the threshold for phenomenological study, but statistically a small sample (less than 30). These two areas were reported by STEM students but at a lower rate (15% and 14%, respectively). The presence of this response, however, does indicate that some students did correctly report the experience of doing rubato,

because it requires a certain technical level (students do not study it until they are advanced) and it is used to add emotion to a work of music.

Music Theory, Mathematics and Language

A slightly higher percentage of non-STEM students (73%) than STEM students (67%) reported that they had studied music theory. Of those that did, 63% of STEM students felt it had affected their academic skills, whereas 56% of non-STEM students felt that it had. Of those students who described the experience, STEM students report general learning (31%), pattern recognition (22%) and critical analysis (19%) as the main ways it had affected their skills. Non-STEM students reported four areas in equal measure (22%): critical analysis, pattern recognition, analyzing form and general learning. No STEM students reported analyzing form as a way music theory had affected their skills. When asked to identify where they used these skills, STEM students reported mathematics (44%) and language, writing and physics in equal measure (16%). Non-STEM students reported language (50%) and then mathematics, writing and physics (all 25%) but again the low level of reporting (five students) calls these numbers into question. It is likely that music theory (which is required for the minor) has the same effect for both STEM and non-STEM students, affecting their ability to analyze large structures and recognize patterns, and course in mathematics, languages and physics seem to draw most directly on those skills, with a slightly higher percentage in non-STEM students.

Discipline, Time Management and Academic Skills

Both STEM and non-STEM students agreed that music and sound design enhanced their discipline and time management skills at about the same rate (79% versus 82%) and those that agreed described their experience. STEM student mentioned planning (51%) most frequently, with all other categories at less than 10%. Non-STEM students had a greater variety of experiences, with planning still first (25%) but other skills more present, with focus at 21%, and motivation at 16%. Since STEM majors often have fewer electives in their degree plans, it is likely that continuing their interest in music and sound design requires them to plan more carefully in their daily work load.

Maintaining Attention to Aural Information

Both STEM and non-STEM students agreed that music and sound design required maintaining attention to aural information, and at the same percentage (95%), one of the strongest reactions in the survey. When asked if music and sound design had affected those skills, however, only 71% of STEM students felt it had, as opposed to 85% of non-STEM students. Of those that described the experience, STEM students mention listening (35%), focus (28%) and multi-tasking (28%). Non-STEM students mentioned listening and focus at the same level (26%) and multi-tasking lower (16%), and had significant percentages (11%) for memorization and general learning. STEM students mentioned memorization at a lower percentage (8%), a skill one assumes is necessary for many STEM fields. Students also mentioned two activites they felt were affected, lectures and studying. STEM students responded with 68% on lectures and 32% on studying, whereas non-STEM students responded with 83% on lectures ad 17% on studying.

It is of some interest as to whether or not STEM students or non-STEM students are learning in the lecture-only mode more often (sometimes referred to as “the sage on the stage”) and in what group more interactive learning is taking place. This would be a good topic for further research, as there is some discussion in higher education as to the efficacy of the old “lecture only” format in this highly digital age.

Segmenting and Academic Skills

Both STEM and non-STEM students had experienced “segmenting” in the auditory realm (breaking up information into small segments), at a rate of 88% and 86% respectively. The experiences they described fell into two categories: horizontal versus vertical segmenting, and a specific activity such as learning, analyzing, etc. STEM students reported that they segmented horizontally at 60% and vertically at 40%; non-STEM students reported these equally, both at 50%. In both groups, general learning was reported (42% for STEM, 35% for non-STEM), followed by analyzing (34% for STEM, 24% for non-STEM) and listening (17% for STEM, 18% for non-STEM). The major difference in the two groups was that non-STEM students also reported other activities such as languages and time management at 18%, responses that were not really pertinent to the question. This lowered their percentages in other categories. Without those responses, the STEM and non-STEM students would have looked more similar, as non-STEM percentages were lower across all subjects due to those responses.

Alumni Responses

Twenty-two students had graduated from UT Dallas with a bachelor's degree. Of those students, 14 were in STEM areas and seven were in non-STEM areas and one did not specify the degree they earned. The STEM degrees were in BBS (four, all in neuroscience), ATEC (three), NSM (three, biology, physics and biochemistry), EPPS (two, child learning and development, denoted CLD, and a double major with CLD and psychology) and EECS (one in computer science). The non-STEM students had more diversity in their degrees, with three in AH (two in Art and Performance, one in Literary Studies), three in SOM (Accounting, Business Administration and Global Business) and one in Interdisciplinary Studies. Students were asked what they were doing post-graduate and the STEM students were mostly in graduate or medical school (six), working (three) or seeking work (two), or applying to medical or graduate school (two). One was a research assistant and one was "taking a break". For the non-STEM students, most were working (four), one was seeking work, one was in graduate school and one did not specify. This was an expected result, as most STEM majors go on to the next level of education, whereas non-STEM students are more likely to go into a work environment.

Only 54% of STEM students felt that music or sound design had helped them post-graduate, but 74% of non-STEM students felt it had helped. Of those that described the experience, STEM students mentioned stress relief (14%), time management (12%) and enjoyment (12%) the most. Non-STEM students mentioned stress relief (38%), and time management (38%) the most. Given that students in medical or graduate school (clearly a stressful environment) have a high level of

stress, the STEM result was not surprising. What was surprising was that non-STEM students reported stress relief at a higher level.

Music and Sound Design and General Benefits

For the last question, students were asked to report any other benefit to their academic skills. The great majority felt the survey had covered it all, but a few did report other things. Since the answers were quite varied, they were not categorized. STEM students reported "sharpening my senses", delayed gratification, it "keeps me grounded", persistence, patience, and social effects such as "the people in music change who you are." A few reported the negative affect of having music distract from their other studies. Non-STEM students reported networking skills, learning cooperation, self-esteem and self-regulation, learning to work with a team of students from diverse backgrounds and skill sets.

ATEC/EMAC Students Versus Other STEM Students

The University of Texas at Dallas consists of eight Schools, four of which have STEM-related majors:

STEM Major Schools:	Arts, Technology and Emerging Communications (ATEC) Behavioral and Brain Science (BBS) Natural Science and Mathematics (NS&M) Electrical Engineering and Computer Science (EECS)

By using Qualtrics filters and the "contain" feature, it was possible to create reports that identified all those students in the School of Arts and Technology and those STEM majors

outside ATEC and EMAC. The resulting reports allowed a comparison of answers to the survey questions. We hope to ascertain whether ATEC/EMAC majors differ significantly from the other STEM majors in the behavioral and brain sciences, natural sciences, electrical engineering and computer science. There were 45 students who identified themselves as ATEC/EMAC majors and 68 students who identified themselves as STEM majors from the other three schools. We will refer to this cohort as STEM no ATEC/EMAC in our discussion.

Demographics: Gender and Ethnicity

The ATEC/EMAC cohort was more significantly male at 53%, whereas the STEM no ATEC/EMAC cohort was only 44% male, a difference of nine percentage points. We observe that ATEC is more predominantly male in our sample than female, whereas the general STEM population (including both cohorts) was 48% male. Therefore, there are more females in STEM in the non-ATEC/EMAC sample.

Students were asked their ethnicity in accordance with the collection procedures of the University of Texas at Dallas. The ATEC/EMAC sample was 53% white/Caucasian, 20% Asian and 16% Hispanic. The STEM no ATEC/EMAC sample was 38% white/Caucasian, 41% Asian and 6% Hispanic. It has been noted before that the natural sciences and engineering draw more Asian students, who also participate in music. This fact is borne out by the large number of Asians in the STEM no ATEC/EMAC sample. Asian students are more likely to pursue traditional STEM areas, rather than the newer and more experimental subjects in the School of Arts and Technology.

Demographics: Majors and Minors of Participants

As noted, there were 45 ATEC/EMAC majors in the sample, with 36 students identifying as ATEC majors and 9 students identifying as EMAC majors. The STEM no ATEC/EMAC majors were from the three other schools as follows: Behavioral and Brain Science had 23 majors (with eight in neuroscience), Electrical Engineering and Computer Science had 12 majors (with six in computer science) and Natural Science and Mathematics had 34 majors, the largest group, with 14 in biology and 9 in biochemistry. ATEC/EMAC students were not in general pursuing the music minor, with only 18% responding that they were. STEM no ATEC/EMAC majors were pursuing the minor at 29%. As we have seen before, students in the natural sciences tend to pursue music as an avocation, and many take music courses at UT Dallas. The anecdotal evidence that music on your transcript will improve your chances of being accepted to medical and graduate school may be driving some of this enrollment.

Experience in Music and Sound Design

Students were asked about their previous involvement in music, and 76% of ATEC/EMAC majors responded they had previous experience; 90% of STEM no ATEC/EMAC majors responded positively. The ATEC/EMAC students had on an average 4.9 years of prior experience in music, with the largest (5.4 years) in choir and the lowest (4.00 years) in orchestra. The majority had played only one instrument (73%), with 23% having played two instruments. By contrast, STEM no ATEC/EMAC students had an average of 6.2 years, with the largest in voice (6.5 years) and the lowest in orchestra (5.4 years); all averages were over 5 years. Note that the lowest level of experience of STEM no ATEC/EMAC students was equal to the highest

in ATEC/EMAC students, and the general difference was more than one year. Many STEM no ATEC/EMAC students had played only one instrument (61%) but a significant number had also played two instruments (35%). STEM no ATEC/EMAC students have more experience in both the years of study and their experience in multiple instruments.

Students were then asked about prior experience in sound design. While 59% of ATEC/EMAC majors responded positively to this question, only 48% of STEM no ATEC/EMAC students did, a difference of 11 percentage points. As noted before, students tend to take courses and major in subjects where they have prior experience, so it is not surprising that ATEC/EMAC majors have more experience in sound design. The average number of years for ATEC/EMAC students was 1.64 years, still quite low, with the most responses in composition (5 responses) and audio engineering (6 responses). The STEM no ATEC/EMAC majors who responded positively to this question had more reported experience, on the average 2.88 years, with the greatest responses in composition (six responses) and arranging and playing in a band (4 responses each). As noted before, the definition of "composition" varies from student to student and can include doing music for games, videos, podcasts, etc. as well as traditional classical or ethnic music.

Courses Taken at UT Dallas in Music and Sound Design

Students were asked to list the music courses they had taken at UT Dallas. ATEC/EMAC students responded that they had taken 46 courses, with the highest percentage in instrumental ensembles (28%), followed by music theory and vocal/choral, both at 17%. Eleven percent had taken music history, and 9% had taken piano. For STEM no ATEC/EMAC students,170 courses

had been taken, with the highest percentage in vocal/choral (43%), followed by instrumental ensembles (18%), music history (12%) and music theory (9%). The number of ATEC/EMAC students taking music theory is of note, as this is a subject that we feel is of great benefit to sound design. It was not surprising that instrumental ensembles had the highest percentages, as that is a very popular area for STEM majors at UT Dallas in general.

Students were then asked to list the sound design courses they had taken at UT Dallas. It was expected that ATEC/EMAC majors would list more courses and they did, with 58 courses taken over all. As previously noted, half (29) were at the introductory level, a course required of EMAC majors, with the remainder at the upper level. Only four of the STEM no ATEC/EMAC students had taken a sound design course and they had all taken the introductory course. As noted before, sound design is not perceived as an elective course at UT Dallas and is not taken to any great extent by non-majors. (A previous analysis of non-STEM majors indicated that no sound design courses had been taken by that group.)

Prior Experience in Music and Sound Design

Students were asked about their prior experience in music. ATEC/EMAC students responded positively at a rate of 73%; STEM no ATEC/EMAC responded positively at 83%. Again the ATEC/EMAC students had less overall experience with an average of 5.28 years, with only two years in voice but over seven years in orchestra. STEM no ATEC/EMAC students had 6.32 years of experience, with again the highest in orchestras (7.7 years) and the least in voice (5.0 years) but all averages for choir, voice, band, piano and orchestra were over five years. Again, STEM no ATEC/EMAC students had more music experience.

Students were also asked about their experience in sound design, and the response rate was quite low. Only eight ATEC/EMAC students said “yes” and listed responses such as “very little”, and “one year in high school”. All responded they had done it informally and independently. For STEM no ATEC/EMAC there were only three responses. One had four years of experience and another had two years of formal study. One can conclude, as with other cohort analyses, that sound design is not pursued as a formal activity prior to college, so those that have, pursued it informally and on their own time.

Music and Sound Design and General Academic Skills

This first question about skills asked students if they felt music and sound design had affected their other academic abilities. ATEC/EMAC students felt it had with 70% responding “Agree” or “Strongly Agree”. A higher percentage of STEM no ATEC/EMAC students responded, with 82% marking “Agree” or “Strongly Agree”. They were then asked to describe an experience where they felt their skills had been affected. For ATEC/EMAC students the most prominent answer was “knowledge” (7%) followed by concentration/focus (3%), but no one answer had more than 7%. For STEM no ATEC/EMAC, the highest percentage was “stress relief” (20%) followed by concentration/focus (15%) and “mathematic skills” (12%). No ATEC/EMAC students responded “mathematics” and only one marked “stress relief”. One assumes that STEM majors outside ATEC have more stressful majors, and that those majors require considerable mathematics skills. The types of activities in ATEC/EMAC, with the majority of majors in games and animation (for ATEC majors) are more arts-based, and less based in mathematics.

One also assumes the ATEC/EMAC students do not find their activities as stressful as other STEM majors .

Music and Sound Design and Flow

Students were asked if they experienced "flow" during music or sound design activities. Ninety percent of ATEC/EMAC students responded they had sometimes (22%), most of the time (49%) or all the time (19%). Ninety-five percent of STEM no ATEC/EMAC students responded they had sometimes (38%), most of the time (36%) and all of the time (18%). When asked about their experiences, ATEC/EMAC students mentioned perception of time (67%), and that it felt "natural" (7%) and "joyous" (3%). STEM no ATEC/AMEC students also rated perception of time as highest, but only at 37%; their other notable responses were "feeling the emotion" (7%), and "focus" (7%). The responses were quite varied to this question, but it was interesting that most ATEC/EMAC students did not respond with "emotion" (only one student) and did not respond with "fun", "focus", "confidence" or "embodiment", as STEM no ATEC/EMAC students did.

Students were also asked about whether they had experienced flow in a non-musical or sound design activity. ATEC/EMAC students responded positively at 84%, and STEM no ATEC/EMAC students at 80%. Most common activities for ATEC/EMAC students were artistic/creative at 50% followed by sports/exercise at 29%. All other areas were less than 10%. STEM no ATEC/EMAC students responded in all areas, with sports/exercise at 20%, reading for pleasure and writing a 14% and studying or doing science/math, both at 10%. Therefore, STEM

no ATEC/EMAC students are more likely to experience flow in academic non-artistic activities, but ATEC/EMAC students experience it more in artistic activities.

Form, Structure and Academic Abilities

Students were asked if they had studied the form of a piece of music. As this is more typically done in music courses, we expected a lower response from ATEC/EMAC majors, and indeed only 57% had studied form either occasionally or frequently. In contrast, 68% of STEM no ATEC/EMAC majors had studied form. Those that had were asked if they felt it affected their other academic tasks. ATEC/EMAC majors agreed or strongly agreed at a rate of 67%; STEM no ATEC/EMAC majors agreed or strongly agreed at a rate of 78%, again a significantly higher level.

Those that had responded positively were asked to describe the experience. ATEC/EMAC majors felt studying form had most helped with seeing structure (38%), and discerning patterns (25%). Another 13% identified critical thinking; 13% mentioned seeing details as well. STEM no ATEC/EMAC students identified other topics at 30% (giving a very diverse set of responses that were not codified, as there was only one response per item), critical thinking (22%) and seeing patterns (19%). They also mentioned structure (15%). Subjects mentioned by ATEC/EMAC students were mathematics (80%) and literature (20%) but only five students listed subjects. STEM no ATEC/EMAC students listed natural sciences (42%), mathematics (26%), literature (21%) and writing (11%). There were 19 responses. It is not surprising that both groups mentioned mathematics, which is a required subject for all majors at UT Dallas.

Rubato and Academic Skills

As before, the answers to this question were not very illuminating. Most students, as in the full sample, did not understand the concept of rubato. However, a much lower rate (58%) of ATEC/EMAC students responded they had experienced rubato; the STEM no ATEC/EMAC students said they had experienced rubato at a rate of 85%. This is probably because the ATEC/EMAC students have less musical experience; rubato is not a concept used in sound design, at least not with that particular terminology. The ATEC/EMAC students that had experienced rubato said it was to add emotion (45%), expression (18%) and individual creativity (18%), but the response rate was only 11 students. STEM no ATEC/EMAC students had a higher response rate at 33 students, and listed emotion (33%), expression (24%) and technique (18%). Again, we surmise that these students have more musical experience and that rubato as a purely musical activity is more familiar to them. The "technique" response indicates a more musical understanding of the term and was not reported by ATEC/EMAC students.

Music Theory, Mathematics and Language

Students were asked if they had studied music theory and if it had affected their academic skills. In the full sample, this was a compelling result. The interest here was not whether it affected their skills, but if ATEC/EMAC majors and STEM no ATEC/EMAC majors felt differently about music theory and skills transfer. Both groups reported that they had studied music theory at about the same rate (69% for ATEC/EMAC students, 65% for STEM no ATEC/EMAC students). They did not respond similarly when asked if they felt it had affected their skills: ATEC/EMAC students agreed or strongly agreed at a rate of 89%; STEM no ATEC/EMAC

students responded at only 66%. ATEC/EMAC students saw the usefullness of music theory in their studies at a much greater rate. In their responses to the skills they felt were affected, ATEC/EMAC students mentioned general learning and detecting patterns (both at 27%). Five of the seven respondents mentioned mathematics as the subject matter. STEM no ATEC/EMAC students mentioned general learning also at the same rate (28%), but also critical analysis (20%) and detecting patterns (16%). Six of the fourteen students mentioned mathematics, with three mentioning physics and writing. Since physics is not a required subject at UT Dallas except for a few majors, it was not surprising that ATEC/EMAC majors did not mention it. There seems to be a higher agreement among ATEC/EMAC students that music theory helps with academic skills, but they responded with similar tasks and subjects as the STEM no ATEC/EMAC students. Given these results, coupled with the previous results from the full sample, clearly music theory is one of the most helpful subjects for students to study, whether they are ATEC/EMAC or STEM students in other areas.

Discipline, Time Management and Academic Skills

Given that time management is such a common feature of both music and sound design, it was expected that both groups would respond similarly here. However, the ATEC/EMAC students felt that studying music and sound design had affected their discipline in other subjects at a rate of 70%. The STEM no ATEC/EMAC rate was much higher, at 85%. Perhaps STEM subjects in the other areas require more discipline; or the ATEC/EMAC students have less music experience and felt sound design did not engender that skill. In any case, their descriptions were somewhat similar. ATEC/EMAC students reported “planning” as the highest percentage at 59%; STEM no

ATEC/EMAC reported planning at 49%. All other percentages for both groups were under 10%, with both groups reporting focus, awareness, efficiency, motivation, complex thinking and prioritizing at 6 - 8%. The STEM no ATEC/EMAC students reported motivation higher at 9%; all other percentages were similar. So, while STEM no ATEC/EMAC students felt they had received more benefit from the time management skills they pursued, both groups felt it had enhanced their skills in the same way.

Maintaining Attention to Aural Information

This question was geared more toward sound design students and we expected a greater response from the ATEC/EMAC group. While the positive response rate was quite high at 91%, the STEM no ATEC/EMAC rate was even higher at 98%. Clearly both groups felt music and sound design required them to maintain attention to aural information. When asked if it affected their other skills, ATEC/EMAC students responded positively at 70%, whereas the STEM no ATEC/EMAC group was similar at 72%. When asked to describe the experience, ATEC/EMAC students mentioned focus (38%), followed by listening skills (25%), multitasking (17%) and details (13%). This question got a higher response rate (24 ATEC/EMAC students) than previous questions. STEM no ATEC/EMAC students also responded with listening skills (38%), focus (22%) and multitasking (19%) but also mentioned memorization (11%), a skill very much needed in many science courses, but not as much in ATEC/EMAC courses where production is often more emphasized. Both groups mentioned “lectures” as the main way it had enhanced their skills, at 67% for ATEC/EMAC and 69% for STEM no ATEC/EMAC students, followed by smaller responses in general studying.

Segmenting and Academic Skills

Again, segmenting is such a general skill that we expected similar results here for the two groups. However, the ATEC/EMAC students responded that they had experienced segmenting at a much higher rate (97%) than STEM no ATEC/EMAC students (83%), likely due to the nature of the work in ATEC/EMAC. When asked to describe their experiences, the ATEC/EMAC students responded in the vertical (temporal) direction and horizontal (tracks or voices) direction at about the same rate (55% to 45%). The STEM no ATEC/EMAC students responded more in the horizontal direction (64%) than the vertical direction (36%). Again, the activities in ATEC/EMAC, and particularly in sound design, encourage students to think in both directions. For example, creating a sound design requires breaking sounds up into their component parts (vertical) and then tracking them in time (horizontal). In music, only students in vocal ensembles tend to look at music vertically, whereas students who play instruments are often given only their part and do not see the whole score, encouraging horizontal thinking only. The two groups described the experience differently. ATEC/EMAC students talked about analyzing (45%) and general learning (41%) and listening (14%). STEM no ATEC/EMAC students talked about general learning (44%), analyzing (25%) and listening (19%) but also again mentioned memorization (but at only 3%).

Alumni Responses

Of the 15 STEM students who had graduated, only three were ATEC/EMAC (all in ATEC) and the other 12 were in Neuroscience (4), Biology (1), Biochemistry (1), Computer Science (1), Physics (2), and Child Learning and Development (2). One did not list the major area. Of the

three ATEC/EMAC majors, two were “working”, one was “taking a break”. This matches earlier results that showed ATEC/EMAC majors tend to work after graduation, rather than immediately pursuing graduate school. The STEM no ATEC/EMAC majors were in medical or graduate school (6), applying (2), working (2) or seeking work (1). One did not reply.

When asked if music or sound design had helped with their post-graduate activities, many ATEC/EMAC students responded who had not yet graduated, but felt it would at a rate of 60%; STEM no ATEC/EMAC majors responded at a rate of 71%. The activities listed were quite varied and ATEC/EMAC students listed time management (19%) and enjoyment, listening skills, and critical thinking (all at 13%). STEM no ATEC/EMAC students responded with stress relief as the highest effect (18%), social connections (14%) and enjoyment and enhancing their resume as the next highest (11%). Clearly those majors are more stressful, and those students who experienced music at UT Dallas enjoyed the social nature of their experiences.

Music and Sound Design and General Benefits

The last question asked for any general benefits that students wish to mention. As in the full sample, most responded that the survey had covered “all the bases”. Only ten ATEC/EMAC students responded and most responses were similar to the survey questions; one did mention it had helped him “discern quality work”. One mentioned that sound design had adversely affected his ability to work on other subjects because he was “obsessively producing digital music”. One other felt music and sound design were “fundamental” to their education. Sixteen STEM no ATEC/EMAC students responded, again mostly within the parameters of the survey. One said

“the people in music change who you are”. Another remarked that it gave them a “photographic memory”, or “the confidence to reach my goals.” One said “the vigor required to succeed inspired me to cultivate and maintain a drive that lets me succeed in coursework.”

CHAPTER FOUR

NARRATIVE SUMMARIES OF INTERVIEWS

All interviews were conducted between February 27, 2015 and April 21, 2015 by the primary researcher. They are listed here in the order they were conducted. All subjects spoke enthusiastically about their experiences and some at great length about its connection to their studies in their major.

Subject 010663
February 27, 2015
Major: Neuroscience
Courses: Chamber Singers I and II

Subject 010663 was interviewed on February 27, 2105. She is a freshman neuroscience major. She has been participating in choir since first grade and has sung, by her estimation, for 13 years. She also plays the piano. She has taken Chamber Singers I and II, during her freshman year.

Music and General Skills

Her general thoughts about music and academic skills focused mainly on the discipline required to pursue both music and academics. She had experienced having difficulty in "feeling the rhythm" in some pieces, stating it "did not come naturally" and that she had to practice it "over and over again. She stated there was "something to be gained just from practicing a skill." She then related this to learning calculus, where she had experienced the same effort. She felt "practicing and … perfecting something will always enhance that ability."

Form

She had a little experience with form and had not taken a music theory class. Her experience was limited to a choral class, and using the notion that you have to know "who has the melody, who's in the background, being able to identify when that shifts". She was curious to try and figure out ways composers "use those parts to enhance each other" but was not able to relate that to other courses.

Practice and Discipline

This subject spoke most cogently when she talked about the practice and discipline it takes to do music "three or four hours a day" as she had in high school. This taught her to be "proactive and communicate with teachers" and she learned the value of "doing work ahead of time. She stated again:

> "Being proactive about it is probably the biggest thing that I learned. It's so much easier to try and catch up before rather than after."

Attention and Listening Skills

When queried about her listening skills, she gave the example from her choral experiences of listening to details: "listening to recordings, so you have to pick out your part, definitely an important skill" and learning to pick up on "smaller and smaller details." She related this to her chemistry class, in that you must "pick out what is the concept that is being taught and then what is the formula" and try to find the "over-arching concept, and then a simple formula or mechanism" that applies to it. You then need to "distinguish between those two things."

Segmenting

When asked about the concept of segmenting, she related that she had done this in her choral class by learning to first "go to a section that is repeated throughout the song" and then analyzing the "repetition and then a very little bit of variation". She also related that it was important to learning beginnings and endings and then compared that to a neuroscience concept she knew:

> "You remember the first thing, you remember the last thing" … (and in the) "middle, well maybe if you hear something really spectacular, really interesting or really bad", then you remember it.

Music Helped in Other Classes

Her general impression of how music had helped her in other classes was focused mainly on segmenting and being proactive. She stated in most classes you learn the "first half of this chapter and then the second chapter" and that by "being proactive" she had managed to study for two important exams during a musical theatre production. She stated "I think those are the two exams I did the best on!" and credited it to being proactive. "I expected it to be difficult", she said. "I repeatedly looked at the material. When you expect things to be hard you just get into that mindset and really, really practice." The other benefit of being proactive was a shift in how she experienced lectures in her science classes:

> "It's nice to be able to walk into the room and have it be review as opposed to trying to learn during the lecture. It's really true with music too."

More About Listening Skills

We then discussed how music had enhanced her listening skills. She stated that you

"get more in depth, you can pay attention to the note, that syllable, that triplet or whatever." She was currently studying neuroscience which has very "dense material." She said "I read the textbook once if not twice before the lectures. Practicing is always beneficial; and then that ability to look at details." She compared learning any subject to a pyramid:

> "The more you know the basics the more you can really kind of indulge in the details; the stronger the foundation is, the more, you can build towards the top"

Other Benefits

Finally we discussed the other benefits of studying music in a formal setting. She said it had given her the "opportunity to travel, to perform, to just hear beautiful music and to be able to create. It is a powerful emotional experience". And she mentioned that she had both a sense of accomplishment and achievement. "It was self fulfilling" she said.

After the interview ended, this subject confided that she had been diagnosed as autistic as a child and had no language at the age of three. Her mother worked with autistic children and she had intense therapy that she says "cured" her autism. This subject shows no signs of any autistic behavior and is an excellent student. Her research interests will include studies of autism from a neurological basis. One of her greatest accomplishments, in light of her autistic background, was making all-state choir in high school.

Subject 180363
March 3, 2015
Major: Biochemistry
Courses: Wind Ensemble and Pep Band (tuba)

This subject is a freshman biochemistry major who plans to pursue a Ph.D. in biochemistry and do research. He is not a music minor, but is considering it. He was enrolled in wind ensemble and pep band and plays the tuba. He has played the tuba, with a short time on trombone, since sixth grade. He continued playing through high school and has studied tuba, including private lessons, for seven years. He played in the marching band and symphonic orchestra in high school. He has done some transpositions for his instrument but has not really studied theory. His lessons focused mainly on technique.

Music and Other Academic Skills

His major comment about how music has affected his other academic abilities, which came up several times in the interview, is summed up by his statement "long hard work pays off." He feels that playing an instrument or doing anything well requires "continuous development" that is "probably never-ending". This has helped him in other courses that he finds tedious. He stated "You just have to go through it if you want to master the course and do well." Music has taught him patience and the value of delayed gratification and the lesson that "you're going to be better later on than you are now", as this was his experience in learning the tuba. (It should be noted that low brass instruments are more difficult to learn for children, in that it takes more time to create a sound.)

Flow

He had experienced flow in doing music, saying "it feels like nothing", you "don't feel time passing" when you are "in the zone". He had experienced "practicing for hours and hours a day"

and then stated “you start to be able to translate that into schoolwork”. He had experienced flow in schoolwork “even if it’s something really boring.” His experience in music was that he focused more on “on exactly what I'm trying to do to improve” but in schoolwork “If it's tedious you just have to go through it.”

Form and Rubato

He had not studied form and had limited experience there. Because he had played solo tuba, he had more experience with doing rubato than other subjects. He stated “It's kind of like flow but different in the way that you know what you doing” and that you created “something emotional”. He had learned this from teachers as he was “told to do something” but added his own interpretation, stating “but for a lot of it I just did what felt right.” Rubato was like breaking the rules in that he was just questioning things, like things that are set, wondering ‘why they are the way they are’, why they did it this way or that way. Why they stay the same for a hundred years and then change.”

Discipline and Maintaining Attention

He felt music had taught him discipline and the ability to maintain attention, particularly in listening to recordings:

> “You have to do that when you listen to recordings of solos or recordings of pieces in general, just to get every detail. And the thing about music is. There's a lot of repetition or semi-repetition. It's almost the same but it's different. Like variation. Or modification maybe to a note. The style stays the same but so, attention, yeah I've had to listen to things over and over.”

This had helped his abilities in other things. He felt he had "gotten pretty good at holding my attention on things, trying to focus on all the details." He gave an example from Spanish class where he had to give a speech with no notes in either Spanish or English. "I had to really pay attention to what I was saying to stay focused on that" he said.

Segmenting

He had experienced segmenting in learning some passages in tuba (although he admitted that the tuba often gets the "easy part") "There are some runs that you have to break down into chunks" and then related how he had used this to study polyatomic ions in chemistry: "You isolate one and figure out a system to remember that one and then to remember each one in a main category and then you could verge off." He felt he had done this first in music study.

Practice Habits

Because he is not enrolled right now, his practice habits have changed, and he remarked that he plays much less than he did in high school. He currently practiced about an hour or so on the weekends, and maybe thirty minutes during week when he can "squeeze it in". He turns his phone off unless he is listening to a recording. In general the most valuable lesson he felt music had taught him was "patience", which he mentioned several times during the interview.

Subject 017185
March 6, 2015
Major: Biology (pre-med) with a Performing Arts minor
Courses: Chamber Music Ensemble (violin)

In spite of his young age, this subject, a freshman premed biology major, gave some very sophisticated and thoughtful responses in all the major areas of study. He is also a performing arts minor. He is a member of the Partnership in Advancing Clinical Transition (PACT) program, where students study a pre-med major for three years and then have automatic acceptance to the School of Medicine at UT Southwestern. He has studied piano and violin since the age of 5 and 11, respectively, and played in various orchestras and chamber music ensembles, as well as studying privately. He is enrolled in Musica Nova, the top chamber music ensemble at UT Dallas and is the concertmaster, quite an achievement for a freshman student. He also plays in the UTD Symphony Orchestra, String Orchestra and chamber music on the side with friends. Because of the nature of his responses, I have quoted many of them *in toto.* He felt that studying music heightened his skills in mathematics, especially in terms of sub-dividing rhythm, and he was good at fractions from an early age.

Music and Academics

He spoke of learning music skills at an early age:

> "…a lot of music skills that you learn, you grasp things quicker when you are younger and then you have a better foundation on things, because it's more applicable to different types of things. So instead of just applying to math, you can apply it to music or to art or whatever and it builds a strong educational foundation."

Memorization is an "intrinsic part of music", requiring you to "pay attention to finer details." It is

> "… very disciplined in the fact that you have to know what you are playing, what notes to play, also the composer's intent, pay attention to musicality. So it allows you to multi-task and do multiple things at once, but also you must not leave out any details. I guess that helps me in studying."

It is also requires focus, and it requires that you are actively

> "… not losing a meticulous care for attention that you can often lose when you are trying to read something, listen to the lecture on it, study, do all these things at once. That's part of the University experience."

Flow

His description of flow in music was "go with what's written on the page and you let yourself observe that." He found the experience quite amazing:

> "It's very indescribable what music does to me. When I pick up my violin and play music, it makes me think there has to be something different, something else. I don't think I am actively looking for it, I think it just occurs when good music is made. At one point, when you are playing in an ensemble, everything clicks and then you can focus on … as opposed to what are the notes am I playing, am I playing right, what's written on the page, the technical details. What was Beethoven thinking when he wrote this, or what is our goal musically, or technically, or what we are trying to show to an audience, because it's a performance".

He had written on the survey "music necessitates non-verbal communication" and I asked him to elaborate on that. He replied

> "Well that's more of a chamber music thing…you can't speak while you make music, or make audible noises while you are playing, so you have to form a new kind of communication, in your gestures, in the way you play, different cues and indications of how to control people. I guess that allows me to work on social skills. I fell like because of music, I'm better with people and I'm a very typical first violinist, almost chauvinistic kind of personality, so in terms of playing in an ensemble, I know how to get the sound that I want and I feel like that translates to the way I deal with people. If I want something, it's easier for me to get what I want socially."

Form

While he had music theory when in piano and had studied form, he did not have a lot of experience or interest in it other than to say "I think it's complete necessary, if you are going to

give a performance and interpret what this composer has to say, you have to know how he wrote it. There are rules of course, that's often overlooked in music." He then compared it to his studies in biology:

> "Well, there are two ways to go about that, like in my biology studies. One of the central tenets of biology is that form and structure relate through purpose. So, if you look at the cell, everything has its own purpose and through evolution, it's come to take a form that is so specialized to its purpose. For example, a cell membrane is made of phospholipid, so on the outside it's waterproof, on the inside it's hydrophilic, loves water. So in that way that form is so perfect. Bernstein talked about how Beethoven's music was so perfect in its form, so that's one way to look at it. In the non-science part of my education, which is about 50%, when we look at poetry, (and) literature, that also has form. Especially looking at poetry, that form, meter, is such an important part of it, and that's exactly like music. So an artistic freedom within the stricture of what constitutes it as music or poetry. I think it gives order to freedom so we can enjoy it."

Rubato

He understood the concept of rubato (unlike many other subjects) and spoke quite a bit about that experience:

> "It's stretching what's written on the page, to the extent of tossing away what the metronome says…I feel like it's almost giving complete freedom in how one would play something. You would perform something in a way that's not what the composer wrote. For example, I studied the Sibelius concerto, and there are so many things on the page that violinists never do, but once you really study it and see where he wanted to give you these moments of freedom, it's very clearly written so, when I want to do rubato I take it very carefully. I don't want to disrespect the musical purists."

He then compared that freedom to scientific research:

> "I do research in the chemistry lab. So we have freedom but of course there are lots of laws, who is giving you the money, what you are allowed to do and what you are supposed to do. You have a purpose, but within that purpose you can really try whatever you want."

Music Theory

While he had not studied music theory very seriously, he did compare it to mathematics and philosophy: "Music theory is: the whole basis of rhythm is subdivision, values of time." Studying music had given him a more historical view of the world and his philosophy:

> "Well, that's more of a historical view, like where does everything come from. When I study music, it's not only the notes on the page, but I want to know how this came to be, so philosophy bored me at the beginning of it, but when I find these connections to what really interests me, it just enhances my love for knowledge, school".

Time Management Skills

In particular it had enhanced his time management skills and he spoke extensively about that.

> "I only have 24 hours in each day, so I have to find time to be able to practice, to be able to perform, and also keep up with my real goal to be a doctor. The discipline in music as I perceive it to be, what's written on the page, what the composer intended, it's like I follow that when I am planning my day, or planning what I should do in the next month or the next year. For example, I want to be a doctor, I have to do an internship this year, shadow this doctor then, and talk to these people, do this research. If I want to perform music well, I have to learn my skills, do some etudes, do some sonata work, study all these things, so it's really…I feel like it's just another thing I have to manage if I want to do it. It's just putting it on my list essentially and it's just one more thing to organize so that's just how I do it. It betters me."

Segmenting

He understood segmenting in music: "You listen to a symphony, it has clear sections, that are delineated by the composers as movements that are literal segments." He extended this concept to biology:

> "Of course, you can't take biology as a whole, you have to segment it into – the most clear one is cell biology versus organistic biology, like evolutionary biology and under that you have sub topics. So if you look at the way a textbook is written, it has chapters

> and each one has section headings and those go into vocabulary words and their definitions."

I asked him if he had applied this to his own studying.

> "Yes, I think all the time. You can't take things all at once, you have to break them into smaller pieces you can understand completely so it builds a good foundation, so at the end when you take the test, which is at the end of that journey, you know everything."

Practice habits

His practice habits were quite distinct and he had a very precise system of practicing:

> "I live at home so I practice at home in our music room. I start with scales and then I start right in the music. I do – there is the violinist Ivan Galaymian, he is the big pedagogue and his method book has different practice rhythms you use. I usually look through the hard parts and when it gets to something hard, I'll go through different rhythms to bolster myself technically and then run through it then and be done with it. But I'm actively looking, I'm never not thinking about something, so in class I might look up the composer and then see what the piece is about. Before I study a piece I always listen to it, so that's a big part how I think about practice. Looking at different interpretations. I think that's also a part of practice. I don't think practice is limited to hands on time with your instrument. In a sense, I'm never not practicing. You are always thinking about 'this might be interesting'. I think I've reached a point in my musical studies where I can, if I think of a sound I can produce. So in that sense I don't always have to be playing my violin physically. I can be thinking 'this would be a good idea to do here' and that sort of thing."

His usual practice was 30 minutes or until "I have done what I need to do." He uses his phone to take calls and in spite of his rather advanced abilities and experiences in violin, does not take his practicing very seriously: "I'm not going to be a violinist and my practice doesn't have that much urgency to me."

Studying Music and Academic Skills

Finally, he spoke in general about what studying music had done for him.

> "... going back to the discipline, of course. Most kids are free to do whatever they want, do sports, go outside. But that's not how school works. It's all discipline. So I guess when you start that culture shock of having in primary school seven hours a day separated up into a thing you study, I was acclimated to that environment at an earlier age due to music. By then I could sit down, like for 15 minutes and practice and play and focus on something at once. It helps your attention span. It helps my organizational skills, definitely. Not in terms of science, I don't think it helps tremendously. It helped more when I was younger which has repercussions to now. But I guess in the study of something like philosophy or literature you can make those connections between music and literature because they are not different things. It's not like someone wasn't writing something when Beethoven was writing. They didn't have these different spheres of existence. When I can find that big picture view of how the world was, or how the world is in terms of music and the whole scope of the arts in general, then I feel like I can understand something."

Music and Science

Since he had talked so much about the connections between music and science, I asked if he felt the arts and the sciences are connected. He replied "But in more obvious ways than not. When you listen to music it's a stream of auditory information." When I asked for deeper connections, he mentioned the affect of his playing on other people:

> "Definitely a lot of brain (and) behavioral science, how it affects you, how it affects other people. How I can do something on my violin and it moves someone. There is some type of feelings, or something that is going on in the brain that I can't completely understand yet. Certainly."

I was very impressed with this subject, both in his ability to articulate his feelings and beliefs and the maturity of his answers.

Subject 080793
March 6, 2105
Major: Biology (pre-med)
Courses: String orchestra, Guitar I

This subject is a biology pre-med major who is not pursuing a music minor. This is his senior year. He has played the violin for nine years, starting in fourth grade and through middle school and high school. He played in his city's Chamber Orchestra II, the Symphony honor orchestra and his high school symphony orchestra. He took the string orchestra class at UT Dallas in the fall and is taking Guitar I now. He indicated some recording experience, mostly to record himself to prepare for auditions. His major benefit of music is to relieve stress.

Flow

He likes to "connect with the music more and I see how it flows along and I reminisce and it connects with and it connects with how I was when I was playing it." He composes himself and removes himself from the "current situation". He indicated that when he listened to violin music, he fingered along, an embodiment technique he mentioned later in the interview about sports. He experiences flow whenever he is practicing or rehearsing, but emphasizes he must be enjoying the music: "… playing that really gives me enjoyment and let's me relieve myself and that's when I lose track of time." He differentiates that kind of playing from practicing, saying he must be "playing whatever I wanted, that was when I had the sense of enjoyment and complete losing of time." It depended on "how deeply I connected with it emotionally and how much I really enjoyed it." He experienced flow in other activities, most specifically sports. While this was outside the scope of this study, his comments relating sports to embodiment were of interest:

> "(It's) the feeling when the ball comes off your racket or the ball off your hands. So really I think the common factor between music and something else I do where I have the sense of flow was when I was really enjoying myself."

Form

He had only studied form informally, when the director gave indications about style and repeated sections.

Practice and Discipline

He mentioned the value of practice in both music and sports, and how music had helped him see that:

> "This is a big thing when you're going into upper or advanced levels of a certain sport, the same routine, hesitation, and then start swinging and execute the acceleration of it. It helped me see the rhythm, and because I had developed the rhythm through violin and learning to count, I really get a feeling for the beats. I could extend it and apply it in tennis."

He then extended this idea of having a practice routine to his other studies, comparing it to when he practiced his violin:

> "…in developing another routine and being in your own comfort zone to study. Really being able to set yourself down in your own apartment where it's comfortable, not new scenery. A quiet place where I can sit down and not worry about anything else, how it smells, of people walking by. I think developing that routine and even the regimen of practicing my violin, I applied it and brought it to my academics for example. And just school skills and really just getting into the routine of going home from class, eating something and then sitting down, putting in a good hour, and then doing something else, and then coming back and doing that same thing. grind through it."

Maintaining Attention

Studying music did help him in maintaining attention:

> ".. helped me hold my ability to focus. It helped me really in different things. For example, sometimes your arm gets really tired and takes your focus away from the music. You need you have to take your focus away from the pain and towards the music … And academic skills: for me I compartmentalize a lot. Sometimes your family issues, issues with your roommate, friends, and sometimes you just have to put that on the shelf and

> leave it for later. The same thing for music, even if you make a mistake you just move on, you stay focused and you keep going at it and continuing on."

Segmenting

He used segmenting in his rehearsing and practice and then compared it to academic study:

> "Definitely whenever we were rehearsing most likely (we were) not going to be able to play the whole piece, all the notes, at the right rhythms in the right dynamics. (you must) break something down and play in small pieces, small sections like maybe four or five measures, and also to really slow it down, slow down, until you can play it that slow and then makes it a little bit faster once you can get it at that tempo you can play it faster. The same thing with academics, where if you don't understand a certain concept."

He mentioned how he planned to study anatomy in medicine:

> "You don't learn about the whole body all at same time. You learn about body systems, then you interconnect all the systems…you have a pretty good knowledge of the body and how the systems work together and how they come together to help each other out."

Practice habits

His practice habits had changed since he entered college, no longer the way his parents dictated, but short periods daily:

> "I try to practice every other day at least 10 to 15 minutes to get it down. I think it really kicks in for me is when I really start enjoying it and can succeeded a certain difficulty level. Once I get over a certain chord, I keep on, that's motivation for me to keep on going, to improve and practice more."

He puts his phone on mute. In his practice he particularly looked at it as a way to overcome a big obstacle and enjoyed that feeling. He felt the same way about his studies:

> "In the same way when I hit an obstacle, I just keep working at it. I get frustrated. But once you have that epiphany moment, for me personally, it's a big, big motivation to keep on applying that to see if I really understand and to use it to prepare for a test. But sometimes it's just hard and you need to take a break, so I can study more consistently, but not all in the couple of days before the test. I had a test today and I've been studying

> this whole week. In molecular genetics you have certain chromosomes, a crossover which creates genetic variety so that you have diversity in the gene pool. It was hard for me to grasp that concept and finally see why certain things… I would understand the concept but I didn't know how to, which numbers to take and use in the equation. Eventually I kept on looking at it and once I got it, really understood, that was motivation for me and I lost myself in being able to do it. So from ther,e it was the same way. I just keep on working at it, I get frustrated, and then I take a few minutes off and then I come back at it again."

Music and Benefits

Music had helped him learn to overcome frustration and learn he could accomplish things:

> "Every experience in life is interconnected with something else. So music has given me the experience where I had an obstacle, a hardship, and then I worked through it and I was really able to succeed at it. I use that now and if I could play violin that well, it's because I knew where I started, where I sounded really bad, to where I sound now. I feel it's motivation for me that if I can do that, then I can do this. I can accomplish something if I really set my mind to it. I set my mind to explore the violin and from there, I think I can really do anything with my ability."

Finally, he also felt that there was something higher at work in music and that it helped him connect with other people:

> "God's given gift. It's nice and I haven't personally studied music theory but I think there's a reason why certain chords work and certain chords don't. The human body has its own abilities to connect with certain things, you have a preference for certain chords and certain sounds, in the human ear. Music overall is… it has taught me a lot about my life experiences. It has really helped me channel my life experiences in music and apply it somewhere else where I've had difficulties, in academics or playing a sport. Or even a different hobby."

I was impressed by the maturity of this student and his very thoughtful answers.

Subject 190969
March 6, 2015
Major: Computer Science
Courses: Vocal Instruction I, Best of Broadway, Advanced Voice

This subject is a junior computer science major who was planning to declare a music minor, but could not fit all the required courses for both his major and a minor into his schedule. He came to the United States from Vietnam and spent two years in a program in Sedona, Arizona. He started music about five years ago when he first came to the United States. He took part in the International Baccalaureate program and they required music. He took the standard level for two years which included music history and required an instrument. He chose vocal performance, which included vocal lessons occasionally and a senior recital. He has taken vocal classes every semester since spring of 2013, including Vocal Instruction I, Best of Broadway (twice), a musical and advanced voice.

Music and Academic Skills

When asked about music and other academic skills he stated:

> "I would start off and I realized the more you concentrate the better you become aware of what you are doing and the better you get, because you realize what is your weakness and what you need to improve to work on. I think that skill set transfers to other academic areas."

He then gave an example from his studies in computer science:

> "For example, I am doing a computer science project. And I am aware that I am not really good at designing the user interface part. So I will first ignore that part and focus on working on the source code, the back end, and later I will do some extra research. In anything you do, if you focus your mind on what you're doing you will get a good result in the end. And I think that music is one of the ways for me to improve that."

His survey had mentioned "practicing smart" so I asked to tell me more about that. "Practicing smart in music is basically that you are aware again of what you doing." He mentioned the need to "Be aware of how you practice and whether you are doing it right or not." He applied that to a programming project he was working on:

> "I really like to finish one thing. I could spend five or six hours hitting one spot…. I realized, is you shouldn't do that at all. Take a break, let your mind relax, recover enough and then pick some time later to work on it and if you feel like that, then you can extend your limits every now and then."

Flow

He had experienced flow in music, especially in singing:

> "I think it happens especially when I really enjoy singing my favorite piece, either in performance or doing practice. I sit down, I open my notebook or I open my laptop and I lock up my phone and I start singing, warming up and when I sing I don't really pay attention to the time at all. You just keep doing it until you perfect it and by the time you realize, it's already like an hour is over."

He had not really experienced flow often in other contexts, except for a few times. He did mention the value of flow for getting a good result. If you have that kind of experience it means that you really enjoy doing it. And I think if you really enjoy doing something, it will yield a good result no matter what academically."

Form

He understood form, not only in music but the relation to other courses. He spoke quite extensively about this:

> "Not only music, but in all other courses because I think that being able to analyze the structure of any topic, it really helps you grasp the general picture of what is going on and if you can analyze the details, you can use this skill set and apply it to similar situations later on in life. For example, I know this piece of music has this kind of form and when I listen to other music I can think about the form and try to fit that music into this form. I know what to expect. Something like that. For other academic courses, I think that if I study science courses, this is more common because you need to understand structure and form. It's either right or wrong in science, there's nothing in between, so you really need to find the template, the structure of the form, so you can use that template or form to apply to other areas."

Initially he did not understand the concept of rubato (and mistook if for a similar term in vocal study, *vibrato)* but did understand when I restated the concept as "stylistically changing the tempo". He described using a recording to learn this technique:

> "I picked the recording that musically changed the tempo every now and then, I think if people do it, it must be for a reason and I think that's because they want to add their own personality to it, their flavor, make it sound different from the original recording. People have different interpretations of the same piece…it turned out well, because the speeding up really helped me working on the articulation."

He compared it to a similar experience he had in his programming projects, where programmers can use naming conventions to individualize their programs:

> *"*Yes. I think that in my programming, in coding, some people they have different conventions of naming, filenames, of a variable, or functions. I have my own kinds of conventions of naming, so I feel like I do it in my own style. It's something you do differently from people because you don't want to follow the conventional path."

Music Theory

He had taken one semester of music theory and related it to other contexts in terms of memorization and understanding:

> "Other than music, I think it's a skill set I can use to apply, most likely, to discipline the structure because there a lot of rules in a music theory course, and you have to learn them, you have to memorize them, but understand them. And be able to use them and apply it in other contexts. If I'm able to do it in music, I can use that same mindset or skill set and apply it to other academic courses."

He described the experience he had in learning to practice music and then using it in other courses:

> " (The) more I learned music, the more I am aware of the process, how to do this right or that right. The more I practiced, the more I used what I learned from other music courses and I put it into my practice. And then I just became better. And it is the same thing with other academic courses. Usually I start off learning something new without a formal structure or a formal process or procedure. Just go out and do it and that accounts for

> frustration, because you do it and you think you're doing it right, but it comes out wrong and you don't know what to do. From my experience, you just keep going with it, doing reading, doing research can help so that you know what you're supposed to do. And when I have the general picture of what the problem is going to be like, I apply it to the actual practice schedule and experience it. If it's not true, then try something different. If it's right for you, then stick with it. And you can come up something that works for you that is not out there."

He then gave an example of how he had done this in his computer science classes, in developing an application for the android operating system.

> "I have no experience with that app, so I just started out doing something, sketching out my ideas and trying to look up a specific part of the code that I don't know about it and do research on that part. And that normally doesn't help. I get to the part where I think my approach is right, then I keep doing research, I only had to make my approach work. And it doesn't. So then I move back up, looking at it from above perspective, looking down and try another, different approach. I Googled it and I used a whole different perspective that I'd never thought of before. There are many explanations and libraries out there that I can use to implement this approach. So I think that's really good. Something that you never thought about sometimes works better than something that was your initial approach."

Segmenting

He was familiar with the concept of segmenting to learn music, dividing the learning process into

> "...melody, tempo, words, dynamics and a lot of things so, first I look at the song and I cannot try to copy exactly what it is, so I need to break it down. Either I try to go over the melody first or I try to do the tempo first or the meter and I think that once each component is perfect then I can put it together everything and it will sound better in my opinion."

He then again spoke about how he did the same thing in programming:

> "I think this is really true in programming… you have source code and the interface, so you cannot work on both at the same time, you have to start somewhere. Say I just need to figure out the source code, like the algorithm and how certain parts of the software are running. I want to have a part figured out. The interface basically means how it appears to the audience, to the user so you cannot work at both on both at same time because you really get distracted. So my approach for coding a program is first figure out the source code, make the interface very simple. Once I got get the software working, I will move on

> and work on the interface and when that part is done you then pull together everything and finish the project and see the final result."

Practice Habits

His practice schedule varied but he usually practiced two or three times a week for an hour to an hour and a half. He uses his phone and laptop to practice, to read lyrics and play audio. He had not thought about studying as the same kind of activity but reflected:

> "I think I have never used that. Setting an interval of time dedicated to studying is really important because you tend to either go overboard, you might finish too early and either way is no good. I realize that setting up an interval of time for study is better because it helps your schedule."

Music and Its Benefits

This subject spoke passionately about what music had done for him in his life and his dedication.

> "I think it is very personal. I think music means a lot to me. It is different for other people but personally I feel that I'm a sensitive person so one of the ways to express emotion is through music. I think if you do something and I feel emotionally about it, I tend to like it and music is like that. Singing, listening to music, anything related to music, makes me feel, it does something so great. It connects. I think music is the ultimate one. Even if programming, you know, I like coding and programming. I still feel like it doesn't give me the same sensation as music does. Feeling is something inside that I cannot use words to describe it. I mean you can but not black-and-white."

It was clear that he had chosen programming at the behest of his parents describing it as a "non-risky career" rather than go into music, but that had not dimmed his zeal for it.

> "I feel like I'm going to die if I don't study music! … My parents want me to have a safe path for me first and then I can go back and continue wherever I left off in music. Even though I cannot fully committed to music, I still make it part of my study because it's the thing that I enjoy. I do like programming. There was a time when I was thinking should I just switch my majors, should I double my major, but then I realized that I would just go with one direction first and then sometime later when I'm not too old, I can always go back and continue my music."

He felt it had helped to have a “safe” place to show emotions:

> “I'm kind of a shy person outside. I don't usually show my emotions but when I listen to music or I go to musical, for example, or listen to a piece I try to fit myself into the characters. My feelings are just bursting, tears running down and it comes naturally. At first I was a little confused but later I think that's good, because I feel things that way and it makes me makes me feel alive. I think no other thing can make me feel that way. I don't really cry outside watching a musical. If you relate to piece that speaks to your soul, your inner mind, then it will find a connection with you.”

This subject’s passions and love of music was evident in his remarks.

Subject 090756
March 10, 2105
Major: Biochemistry with a music minor
Courses: Understanding Music, Vocal Instruction I and II, Music Theory, Orchestra (violin)

This subject is a biochemistry major, with a minor in music, who has taken Understanding Music, Vocal Instruction I and II, Music Theory I and String Orchestra. He has played the piano since elementary school, and violin since middle school. He felt these experiences were “pretty significant in terms of making me an all-around student”, a theme he returned to several times in the interview. He has played in the UT Dallas string orchestra, the Arlington Youth Symphony and participates in the student organization Musician’s Network. Because he spent this year in a research internship at UT Southwestern, he did take any music courses this year. He had done some composition in digital music, using a computer program called “Shape” and one of his songs got eight million hits on Youtube.

Music and Academic Abilities

He feels music has affected his academic abilities by giving him a "different aspect of my education" and allowed him to "take different routes with different perspectives of topics, as opposed to just being very linear."

Flow

He has experienced flow more often with singing, than with violin, since he focuses more on technique with violin. In singing, he can do "song after song and lose track of how many songs I've actually sung or how long I've been singing." He has also experienced flow while studying, particularly in science and expressed that he can be "reading a chapter for a chemistry or a biochemistry class and then there's four hours gone." He also has experienced flow in the research laboratory, saying he was "completely immersed in it."

Form

He studied form in both his entry level music theory and a course in music history, describing a project he did that was analyzing music and surgery. In that study, he discussed how forms of music can help surgery outcomes or patient satisfaction. He felt he used it in his academic classes because he is

> "… really structural and logical so seeing that even something like music, which is almost completely oral, has some kind of form to it. It lets me think that everything has to have some kind of form. It helps me figure everything more logically and more linearly I guess."

Rubato

He has used rubato during some jazz pieces and applied it to his teaching in organic chemistry, where he would

> "… selectively shorten some topics and speed things up depending on what was needed for the students. If I thought something was particularly easy, then I would speed it up."

Discipline

Music has a way of giving him an idea that something oral has form and that all things are inter-connected or inter-related in some way. He describe the value of practice in that "If you want to become proficient in something you have to put the time in" and extended to academic skills by stating "If you don't understand the concept the first time you have to just keep drilling it, going over it until you finally get it."

Segmenting

He described segmenting in music, as there are

> "… certain sections where I can't get it right away so even within the next section I have to break it up into smaller phrases and just drill those individual pieces over and over again. I remember whenever I was still studying piano you have to just take it measure by measure."

And then talked about the same thing in science:

> "Usually they are like a huge general concept that I was to go over, but they're all these little components, constituents, that we have to individually understand until we can finally grasp or master the concept."

Music and Its Benefits

He felt music was a positive force in his life because "sometimes if I'm feeling really bogged down from studying, I can always use music as a sort of relaxant, even a stimulant as well, depending on what I need at the time." It also felt it was a "nice distraction" or "side hobby" to do singing, as well as his instrumental study.

Practice habits

He practices usually 15 to 30 minutes at a time, but often ten times a week and multiple times during the day. He uses his phone to listen to tracks and lyrics. Even though he is a pre-med major, he feels doing music is important.

> "I enjoy it. It helps me distract myself from the daily grind. Despite of it being not completely different, but the difference from science, it still motivates me to do more science I guess. If I only studied, I would get tired of it but because of music I can be back in something else."

He concluded by saying he missed playing music this year and looks forward to returning to it next year at the conclusion of his internship.

Subject 230970
March 12; 2015
Major: EMAC (Emerging Media and Communication)
Courses: Sound Design I, Understanding Music

This subject is a freshman EMAC major whose major focus is sound design and music. He is not a music minor. He is a drummer and percussionist who is also learning the guitar. He has played drums for about five years and also sings. He is starting a band and working with the UT Dallas Musician's Network. He has played in marching band and also rock shows. He has not

taken much in the way of lessons, saying “nothing serious”, but did have a few lessons about five years ago as a freshman in high school. He is taking the beginning level sound design class and hopes to get into the higher level courses. He has also taken MUSI1306 Understanding Music and worked the soundboard for his high school marching band for four years. He records himself. He writes music, primarily rock songs, anything from ballads to fast songs, and writes his own lyrics. His performance experience is mostly with bands. He picked his major because the music program did not offer drums (in fact, UT Dallas does offer drums, through both pep band and jazz ensemble), but also felt EMAC would help him market himself as a musician so that he can earn enough money to attend the Berklee School of Music (a private institution in Boston) and pursue his music major there.

Music and Academic Studies

He feels music has helped him to be more focused and flexible, so I asked him separately about those two areas. He felt that rock music required a level of focus, since you listen to everything at the same time, each instrument both individually and as a part of the mix.

> “You hear the guitar, you hear the drums, you hear the vocals, you hear the bass, and you hear each one of them separately but together. And that's a level of focus that a lot of people don't have. Especially when I play music, I have to separate what each instrument is doing to understand how it works together so that's a weird level focus maybe. So that's helped me a lot because while we are addressing one task or something in the class you are still connected to other things because you're used to separating everything into subsections.”

In terms of flexibility, he stated

> “Nothing is set in stone in music. Every show you play is different from the others and you have to learn how to adjust on-the-fly. You have to learn how to adjust to that on the spot and still be able to play without doing what you can't do. That helps in school because sometimes nothing works the way you want it to at all and some people just get

> stuck in trying to figure out how to make it, go back to the way they expected it to be. But instead of doing that I just kind of say, okay, well, let's just move on now to something different."

He did feel that music was such a high priority in his life that it took away from his other studies.

Flow

He did experience flow in doing music, saying that he could play a six minute song and "get into the groove and you let go and you don't feel it but you experience everything. It's a very weird sensation in my opinion." I asked him to explain what he meant by weird. He replied

> "…you feel everything one million times over. It's a 'musician high', would be a way to put it. And then it's over and you look back and you say I don't know what's just happened. But it's the coolest feeling ever. It's like that moment when you are in your music and connect on a different level. There's a difference between hearing music and playing it and being in the spot. And somehow the music really connects with you as a person. You feel everything and you can feel the crowd whether you're playing or you're in the crowd, you feel what everyone else is feeling and what the band is feeling and everything gets conveyed and it's with you on a totally different level."

He had experienced flow also while riding his motorcycle but not in any other academic experience. He is so immersed in music that he thinks about it constantly:

> "I think about music all the time. I go to sleep with music playing, I take showers with music playing, i.e. with music playing with my headphones on. I'm the guy that never takes them off and always has speakers nearby."

He hears music in his head also:

> "I go to class and the teacher will say something and it will remind me of the lyric of the song and then I'm thinking about the song instead of whatever else is going on."

Rubato

He understood the concept of rubato, but as a drummer in rock music, he is often required to keep a steady beat so he remarked: "I try to avoid it because I know you have to lock down on the beats" but did admit that the tempo changed sometimes:

> "…when you get excited you say let's play faster and the band looks at you like 'don't play faster', but we're playing best so there are some parts which I guess are a little more difficult to play slowly rather than fast or they are more difficult to play the speed so you slow them down a little bit or you just do it because it fits the mood."

He did feel that rubato was like "breaking the rules" and remarked: "I don't believe in the rules or something that you should follow all the time. I see them as more general guidelines. So yes I do kind of break the rules a lot. He related a story in one of his EMAC classes where

> " The professor was trying to tell us that we have to do the reading and write about them and we have to post tweets about our readings. And so I was like how about instead of tweeting we just discuss it in class."

Apparently the professor adopted his suggestion.

Time Management Skills

He felt his time management skills needed improvement because he had so many obligations:

> " (I) have to get into my schedule which already involves full-time college study, 15 hours, and social obligations that I have such as clubs. I also to find time to practice. Also need time to just relax and listen to music. I also need writing time. I need time to do my homework and to do everything else that a normal teenager would be doing."

He then related that he dealt with his academic assignments by working in advance:

> "I don't have the luxury of putting the essay off to the last minute. So I have to make plans way in advance. I finish my essays about a week in advance so in case I don't have time that week, for whatever reason, it's mostly done or I can just finish it off and it's not writing the whole thing, it's writing two paragraphs or something. "

He felt that working in advance resulted in a better final product:

> "It's not rushed as much. I have everything earlier so I have more time to do it. I also find that practicing and doing other musical activities to be relaxing and it's the whole thing where you don't think about it and then you come up with better ideas. So because I have somewhat of an outline or something written down when I'm doing something else it comes to me, like I could change that or I can do something else and it's already written down, so I don't have to start from the very beginning and get to it, so I can change it."

Attention Span

He believed that music did take a heightened attention span, mentioning a 21-minute piece he was working on that contained "very complicated things". He felt he was probably a student with "ADD or something" and that he had to work on holding his attention on a task. Music had helped him do that:

> "For me that's why I like music because it's interesting and it holds your interest and it changes and it's not static. Party music has a steady beat for three minutes and then it's over and then the next one is on. Rock music has courses in verses and breaks and they do other things in between them. So it's something that changes. So for me I guess I find ways to take breaks or find something interesting to latch onto."

He used this in his academic classes because he had trouble with attention there also:

> "I can't sit still for five minutes and I have three-hour lectures. That's a struggle for me. Just like I did with that song, you find something that changes, something to keep your interest going. So if I'm bored, I will change my position, like the way I sit or get up a little bit, stretch or do something to kind of refresh myself and say, all right, next five minutes, let's go. And then I will change my position again for the next five minutes. I shift a lot but it keeps me going."

Segmenting

He understood the concept of segmenting and gave an example in music:

> "For example, whenever you notice the melody changes it's like the next subsection, especially in very long songs, they do a lot. I listen to the intro and then I play the intro over and over until I know what's going on. Then I go on to the first verse, whatever

> comes after that. And that's the way I divide it when I'm trying to learn a song, especially if it's complicated. You can't expect to listen to even three minutes of something very complicated and know it's going on. You have to break it down and listen to each bit a few times over until you know what's really happening."

He used this in his other academic classes, using a principle he called" shifting", from his experience in lectures "…the whole shifting-positions things like that. Shifting now, when ever we change topics to kind of refresh my mind. You have to focus again." This translation of a physical technique to a mental one is interesting.

Music and Its Benefits

Music has given him a wider world:

> "It's made me go out there a lot more than I expected. It's made me meet a lot of really cool people that I didn't expect to meet. It's really opened my mind to whatever you want to do. Many kids are into, they wanted to be rock stars but that wasn't me when I was a kid, I wanted to be an engineer. And now I want to be a rock star."

When I mentioned that sound design is also an engineering activity he remarked:

> "Sound design is very detail oriented and it's very technical and it's very technological and we use the word design in sound design like engineers design things. And music itself in my opinion is very detail oriented, very technical. You're not necessarily dealing with numbers and lines but it's still very structured in its own way and very detailed. You're always finding a way to make it more interesting, to make it better. Music is like a living thing, it's always growing and it's always changing. Even when you play someone else's work, because we do a lot of covers, even then we don't play the song like they do. You change it and find a way to make it different and it's like you have to have what they built, decompose it and see what is really going on and then find how you can put your own style to it even a pop songs that have very basic drum parts."

He credited his music again for giving him opportunities to go places and meet people:

> "It's really opened my world to a lot of different things. In my opinion, musicians are not like most people in that we have to go through a lot of different things that most people don't have to. I'm 18, some folks say like I've lived everything but I definitely live through a lot of things that most people haven't even in their whole life. They won't experience certain things. It makes me keep an open mind and be very open to new experiences."

I strongly feel that this student would major in music if we offered that degree, but his plan to use the EMAC program to teach him to market himself is quite pragmatic and may be a way for him to realize his goal of being a professional musician. This, accompanied with his plan to take more sound design classes, may be the best avenue for him right now.

Subject 240956
March 12, 2015
Major: Biology
Courses: Wind Ensemble (clarinet)

This subject is a freshman biology major who is not pursuing a minor in music. She wishes to be a microbiologist. She has a background in clarinet since the fourth grade and tenor saxophone since her junior year of high school. She has taken courses in high school in jazz band, pep band and concert band, and also select choirs and jazz combo. She has taken the wind ensemble course for two semesters.

Music and Academic Abilities

She does feel that music had helped her other academic abilities, particularly in mathematics with an early introduction to fractions provided by learning quarter notes, eighth notes, etc. She mentioned that the Italian markings in music give you an introduction to languages and also cultural insight into other places. She mentioned analyzing form and related it to form in poetry.

Flow

She had experienced flow more in singing than in playing, but said it had happened when she was "really into practicing and really focused on it." Her feelings during flow where "calm" and "liberating, mentioning that 'you don't have worry about other things' ". She had also experienced flow in reading and doing sports.

Form

She had studied form but not as "extensively as other people necessarily but I have learned about it in music that I have taken." And again mentioned the parallels to poetry and stated "…if you can master one section you understand the style, even if it's not the same notes, so you can use that in the next section as well" and that writing had similar demands. She did find it helpful in other areas.

Rubato

She understood the concept of rubato and had done this in several solos. She stated

> "It's more calm and more emotional because you can put in the emotion and have that portrayed as like the length of notes and the quality of notes and how you played them instead of having to be so dictated by what's on the page."

She said that "everybody breaks the rules and that was key to getting emotion in there. She also described it as "nerve-wracking" on her survey. When I asked about that she said "Because you had to pick what you were doing and it was your responsibility."

Music Theory

She also related music theory to English classes:

> "… when you analyze music you can analyze it in several different ways. You can analyze the key, the tempo, and from that you can gain what the composer was trying to get out and what he was trying to express. I think with English it's the same thing. You can analyze a short story, a novella or a poem and you can take a bunch of criteria that may be different than what you analyze music with, but still comparable and gauge what the author is trying to say in the poem - whatever artist it is."

When I asked about math or science she said " … it's just basically acquiring the skills to evaluate something based on a certain set of criteria. And it can be different criteria but it's still a skill of evaluation." *Discipline and Time Management*

She was one of the few students who felt music had nothing to do with discipline and time management stating "I don't think it's really affected my time management much. If I hadn't been doing music, I probably would have been doing something else. I'm happier with music in my life but I probably would have found something else to fill the time." I was surprised by her lack of passion about music given the number of years she had participated in it.

Segmenting

She understood segmenting in music and said:

> "You have to chunk it. You can't play it all over and over again; you have to take it into smaller pieces. So yes I would say I've done that before. But more to learn it then when I'm listening to it I guess. I think that's just a natural way to learn things. I don't think it's necessarily that it originates in music but it originates from the way you learn and then it's applied to music."

She did not give examples from any other field, but did mentioned that she had started music so young (and said she could read at age three) that she had no memory of learning the basics.

Music and Its Benefits

One benefit of music she did see was that it

> "… helped shaped relationships with different people. If I wasn't involved in music, I wouldn't have had any of the same friends that I had so that definitely shapes things. One of the first questions you ask people when you get to know them is what type of music do you listen to. For me at least it's one of my first conversation starters."

She felt it was important for music to be a point of connection and it told you something about the person:

> "I think it's more important whether they listen to music or not because some people just don't listen to music. But I think that it tells you… If they listen to classical music in their spare time or if they listen to very slow tempo music in their spare time then perhaps they're more relaxed. But if there listening to "screamo" or something then maybe they're more energetic."

Practice Habits

She also was one of the few participants who was practicing more (or so she thought) in college than during high school. Her responses indicated that she learned most of her music during class in high school (which meets far more than college courses) and now she was having to practice outside class. But her practice is currently limited to once a week, for about an hour or less (which would probably be insufficient for most students in the wind ensemble). She tries to turn off her phone and practice in the dorms while her roommates are sleeping – which probably also limits her practice time. She does not use the university practice rooms, claiming that they were always busy. I asked her if she planned to continue doing music at the university since she seemed somewhat ambivalent about it. She replied

> "Yes. I think I'll continue. I'm not sure whether I'll continue to be in an ensemble or whether I'll continue to play clarinet or go into tenor sax or whether to sing more. I definitely enjoy singing a lot but I haven't really found a place for it here yet."

I did point out to her we had two choirs, musical theatre, and three levels of voice classes, so my general impression is that she had not really looked at the program at any level. Again, I was surprised by how little invested this subject was, compared to the other interviewees.

Subject 060269
March 13, 2015
Major: Computer Science
Course: Digital Music

This subject is a sophomore computer science major, taking digital music. He is not a music minor. During the interview he spoke about his compositional techniques and his autism. He became interested in music at a young age when he received a digital keyboard, but did not take a piano class until high school. He then took classes in piano every year and was admitted to a senior level music theory class as a sophomore. He started writing music at the end of that year. His compositions are instrumental in nature, using such instruments as violin, harp, piano and percussion. (It must be noted that he uses digital equivalents of these instruments, but does not write music for live players.) He says his music is "not complex", mostly chords and a melody line; he calls them "songs" but most of them do not have lyrics. He uses a program called FL Studios and turned down an internship at a sound studio in Dallas to attend UT Dallas.

Music and Other Academic Skills

While he initially said he did not think music had helped his other academic skills, he then replied "I think it's more complex than a yes or no. I actually think my academic ability affects my music more than my music affects my academics." His music-making is primarily

improvisation and he does not play "other people's pieces". He uses a "lot of math and science" to write his music, feels that his skills in that area affects his music "heavily". He then described a program he was working on:

> "I'm currently working on a program that algorithmically generates music. It uses an understanding of probability between notes and scales and an understanding of how that probability affects writing music. I'm using a lot of math to generate music in that way. The melody is going to be the complex part because I am going to have to use what is called 'large body Markov chains'."

Flow

He had experienced flow in high school during piano class, claiming

> "I fell asleep and continued improvising. When I woke up, I was drooling and was still playing. I don't think I was completely asleep, I was still kind of aware, but it felt like I was asleep maybe."

In his compositional process he feels "a lot of the time the math is just subconscious. A lot of the time when I am writing melody lines I just start placing notes and it works.", somewhat similar to flow. He then described flow in a programming project:

> "Whenever I get into the flow, when I was working on the audio project on Wednesday night, in that time span, it went from just writing to no errors and then just continuously writing code. (I was) pressing play and then it made music, started playing."

Rubato

His concept of rubato was in his own improvisation, since he does not use a fixed tempo:

> "When I improv, my tempo changes pretty much every measure. It's gradually speeding up, slowing down, speeding up. It just changes as it goes. In digital music, we were supposed to do an improv piece but we were supposed to use a metronome or a drum beat. I said 'I can't do this because I can't change the tempo' so I ended up getting permission to take that off. It's too restrictive, I don't like it."

Music Theory

He did study music theory in high school and felt it had "increased my ability to do analytical thinking. It's most helpful in coding, because that requires a lot of analytical thinking." He felt computer science was more of an art than a science, and similar to music theory:

> "Because a lot of time people – computer science, a lot of people see that as a misnomer, where it's really not a science but more of an art. Code has something we follow that is the best coding practices, which is essentially the same thing as music theory."

Segmenting

When he writes, he uses segmenting in the various parts of his pieces: "I am thinking of verse, chorus, verse, solo, chorus, however it would go. And when I am listening to songs that how I am segmenting them too". He said the video game "Guitar Hero", because of its feature of showing the music visually, "got him into music" and showed him the various parts of music: "Guitar Hero also had that split – if you were in practice mode, you could see verse, solo, chorus and every kind of part that branches out." He had a clear conception of the parts of music in his audio works:

> "It's segmented into progression, harmony, melody. And then each of those has its own small segments, usually called functions or methods. Those are stored within classes which are the bigger segments of progression, harmony, melody."

He then related it to types of programming and how everything is connected and segmented:

> "There's other kinds like entity programming, where analogous to real life, it's where you have objects which are called entities, like a person, a plant, and then you have components, which is stuff that defines them, like hair color or something, and then you have systems which is like physics, things that govern how those bodies work and how they interact. And then you have what's called the world, which is like the real world, that holds everything and has them all connected. And so each time the program wants to do

> something it just loops through all the systems, the systems contain each object it needs to work on and it processes them, going system by system."

Practice and Discipline

He did not feel music took practice or discipline, since he does not engage in those kind of activities, but rather plays when he feels like it, but it did take "passion". He did admit though

> "It's something that 'practice made perfect'. If I write music I get better at music and there it goes. I didn't have to worry about OK, do I need to continue to get the chord progression. Just having fun."

Music to him is a kind of language in that it can "communicate ideas, especially like emotion, but it can be even more complex than emotion."

Practice Habits

Since he had no set practice schedule, I asked him about how often he did his improvisation. He replied that mentally, he was doing it all the time:

> "Can it be mental? Then 24-7. There is always a new melody line going in my head. It's very much a background event unless I don't want it to be a background event. Often when I am sitting around I treat different parts of my body as notes, I'll tap or hit my teeth together in different spots, so that's different notes. I'll have different instruments going with my feet, tapping, and my fingers and then my mouth for all the different instruments as they play."

He silences his cell phone. Since he does not write musical scores, but rather does improvisation and records it, I asked him about his other musical experiences. He considers himself a composer because he posts these improvisational pieces to the internet, with the goal of having someone else "listen to and enjoy it". He has over 25,000 likes on his music channels. The idea of creating a score and having someone else play his pieces was foreign to him.

Music and Its Benefits

He then spoke frankly about his autism and how it affects him.

> "I have autism, so I wonder if somehow my autism affects my ability to write music and see the patterns and my coding abilities. Pretty much all talents that I've gained, I've wondered if somehow those are influenced by autism. I'm at level-one autism, which is the weakest level. It affects anxiety levels, it makes that pretty heavy. It affects my ability to socialize and stuff. Like when I am speaking, I have to see that as a system too, just like music theory. So OK this person has the facial expression with these movements down to a very fine detail, my body actually sees it. I've been able to predict people's past based on their bodily movements. When you meet someone, their facial expression gains a very subtle expression for a very split second. But that's on a much smaller scale than looking to the right or the left."

One of his reasons for pursuing computer science, rather than music or our arts and technology program (he has not taken any sound design classes) is his inability to speak in public. He felt his current degree would allow him to avoid that, as his autism precludes doing that kind of work. He clearly demonstrated some autistic tendencies during our interview, but was articulate, clear and quite passionate about his music making. While this subject does not fit the traditional concept of a "composer", in that it is primarily improvisational, he is very passionate about his music and the works of art he creates, either through improvisation or a computer program.

Subject 190560
March 17, 2015
Alumni, Biochemistry BA, 2012
Courses: Vocal Instruction I and II, Guitar I

This subject was a biochemistry major, who did not minor in music and graduated with a B.A. in biochemistry in 2012. He studied piano from the age of eight to twelve and did not have any other formal training in music prior to coming to UT Dallas. During his college years, he took Vocal Instruction I and II, Chamber Singers and Guitar I.

Music and Academic Skills

He felt music had helped him to become a more analytical person:

> "I was never musically inclined, so it was another form of thinking and analyzing and studying that I had to get used to. It helped me learn new ideas and learn new modes of thinking better, so when I got into higher-level science classes and the classes were more complicated, with new ideas that I was not introduced to yet, I was better equipped to think analytically about something I did not yet understand."

Flow

He had not experienced flow in music, but had when he was writing, doing crafts, math or something that was a visual arts activity. He felt that the work of constructing or creating something was essential to "getting into the flow" in an activity. Hence "learning someone else's music" was not a flow-inducing activity.

Form

He had studied form during his classes and felt it helped him to

> "… develop the ability to recognize patterns and it applied in math for me because you do practice problems and you see a pattern of how equations are used, patterns of how physics are used and the same with music. I see a pattern and I know that it's going to build here, so it helps you memorize the piece and perform it. You only have to glance at a section and realize this next parts coming up and your brain clicks into the next part of the song."

He compared the textures in music to the characters in a story, something he attributed to Aaron Copland's book *How to Listen to Music*, required in many of our entry-level music courses: He talked about the different textures of the orchestra like flutes, the other woodwinds, versus the percussive instruments or the strings.

> "To play the same melody, they would play it differently and of course the timbre of each instrument sounds different. So it's like the different characters in a play. You have the comic relief, the angry person, the happy little kid, and the orchestra. The pieces in the textures themselves in songs or compositions all play a different role in carrying that melody in comparing what the composer had written originally and then expanded on."

Rubato

He understood the concept of rubato (though he did not know the term until he took the survey). "I think I used it instinctively… when I performed music on my own, like singing in the shower without anyone carrying the tempo."

Practice and Discipline

He did not think a lot about his practice skills because he felt he "struggled a lot with keeping up with the other students that had taken choir classes before or eight years of piano or they were just musically inclined and really talented singers." But he then reflected that he had learned discipline.

> "For me, I had to schedule time to go to practice rooms and hammer out notes on the piano, because I wasn't familiar with reading these notes and hearing them in my head. So I had to learn and memorize the notes and really listen to the songs and listen to CDs that were given, in the car, all the time I was studying music to keep up."

He did feel that had helped him develop the same discipline in other subjects:

> "So, studying music helped me learn how to manage time or helped me build a passion for trying to achieve and succeeded at something that I was struggling with. I think that was something I had done previously, but it definitely changed the setting in which I had to apply the skills. And so, it made those skills more concrete and reinforced that."

Attention span

He learned to have a longer attention span with music: “You definitely had to study the music and be on top of every single point for breathing, making sure that you carry your tone clearly, and be really focused because your performance, like professional singers, really depends on the details.” And he felt it was something he then did in other classes and outside academics:

> “It’s something that I value in all my classes and all the things that I do outside school. Being able to focus and stay focused for long periods of time, you have to actively keep doing it. I think with music in particular, I was so far behind that discipline was less of a struggle for me because I was motivated by fear of failure. So, I think for me in particular, discipline wasn't something I learned from music. Discipline was from other classes.”

Segmenting

He understood the concept of segmenting, having learned it at an early age in piano lessons, learning his music

> “… one measure at a time, one bar at a time. And then you repeat it over and over again until you don't make mistakes and then you had the next bar, the next measure and you continue until the whole piece is done and then you continue so you can do it without looking at the music. Segmenting was definitely a technique I used a lot.”

He went on (without prompting)

> “A lot of curriculum is based on segmenting … the curriculum was already written in a segmented form. But it took critical thinking skills, maybe early adolescent skills to realize that it was presented that way, when they would give you an outline. Okay, these are the things we’re going to cover, but we have to cover these things first, to get to the next thing. In academia and science a whole lot of things are segmented, for example, the basics of biology. You then go deeper and learn more specifics from each end and will eventually get that they taught you in biology. Particularly in biochemistry, when you have a long following chain of pathways and you have to do it in segments, in segmented form, because there's no other way to memorize that.”

Music After Graduation

This subject is currently applying to graduate school in medical science and medical school. As for how he feels about music after graduation he remarked

> "I listen to music daily. I definitely don't critically think about music as I did when I took classes. But the classes have definitely helped me enjoy the music more and since I listen to music daily, I tend to sing daily. I feel that singing and listening to music raises my mental health and I handle stress better. I handle my days better and I feel more energetic."

Music and Its Benefits

He felt music had helped his life in several ways and that it was important to be a

> "… diverse well-rounded individual is very important. Sticking to your major alone doesn't make you a well-rounded individual. The interdisciplinary skills and learning how to apply those from doing different things other than your major help you think of problem-solving from more angles than just one direct path that you were taught in one major."

He mentioned segmenting again, saying

> "Segmenting helps me break down large problems into manageable pieces and make progress instead of being overwhelmed by the big problem. You can tackle big problems by making small progress until you have the whole thing solved. That's been a pretty important skill to have."

Music had impacted his life:

> "… for the better. It's developed my mind and skills in a different mode in a different scenario. I learned the function of each individual piece, each individual character, each individual texture, and it helps me recognize the problems that arise in say the laboratory or in the workplace. What is the problem? How can we how can we fix it, how can we supplement the problem with a different answer?"

He then mentioned it even helped his personal life:

> "Music brought my girlfriend and me together actually. I started going to concerts together and started dating. And to this day, we have the same favorite bands we talk about when we met. Prior to these classes, I was never interested in going to concerts or

> symphonies ever. I was happy with listening to my music on my iPod and my headphones on my speakers and then I learned the beauty of live music, with performed live music, or musicals, and just concerts and symphonies. So since then I have gone to more, I would say at least four performances a year, which is more than I did before."

He credited the concerts he attended during college with giving him a love of live music. This subject was eager to talk about his experiences at UT Dallas and the impact they had made on his life.

Subject 290661
April 21, 2015 (phone interview)
Alumni, BA from UT Dallas in 2011 in neuroscience (MS in Social Science, U of Chicago in 2015)
Courses: Music Theory, Piano, Community Chorale, Musical Theatre Workshop

This subject's interview was conducted by phone, as she is an alumna living in Chicago, while completing her MA degree in Social Science at the University of Chicago. Her focus of study is speech and sound. Her major was neuroscience, and she received her BA in 2011. She started a music minor but did not finish it. In the fall, she will move to the University of Minnesota to start her PhD in the psychology department. She had piano lessons weekly, from an early age, and in second grade was placed in an ear training and "performer's circle" once a month, that encouraged exploration and composition. She was in choir in middle school, and both the top band and the top choir in high school. She also participated in a student-run a cappella group. She started composing in middle school and continued through high school. Her compositions were mostly contemporary and classical and she described them as "very straight-forward." She usually wrote piano solos or folk songs with guitar. She did arranging for the a cappella group, with three to six parts and a beat-boxer part. She took music theory, piano courses three times, community chorale, and instrumental performance III, where she described her experience in

accompanying singers and the musical theatre workshop Best of Broadway class. She spoke at length about the experience, saying it was "sort of an empowerment thing for me to get out of my anonymity of standing in the row with everyone and to learn how to sort of own the stage for 2-1/2 minutes." She related that she had experienced youth theatre in the fourth grade so "putting that together with the singing was a quandary for me so that was a really great experience and I'm glad that I did it because I never would have gotten to in any other capacity." She played bass clarinet and guitar in middle school and had guitar lessons for several years in high school. She related that she like playing the guitar because "you can feel it in your whole body and that's a pretty nice experience."

Music and Academic Skills

She did feel music had helped her in her other academic courses and spoke at length about it:

> "I think for me mostly it's the patterns, that everything in music is organized. Notes in scales, they are chords made out of those notes, the chords relate to each other in various specific ways which, if you don't remember, you can always calculate if you know the relationships, you can always figure out what the whatever chord this G is. When you get into rhythm it's all hidden, math like doing fractions. So I think for me really learning music at a young age before I had learned a lot of different things in school helped me learn how to organize new information and see the patterns and say that this is how things relate to each other, this is how I can construct a complete system with only a few pieces of information. So that's on a really basic cognitive level. I think that was helpful for me but in other aspects. I almost always had usually more than one song playing in my head and that helped take up my extra attention to make it easier for me to sit through a lecture. When I was performing frequently I would be rehearsing my songs in my head while sitting in class, unrelated classes, listening to the lectures. The things like the timing out of phrases and then whole pieces helped me sort of keep track of what was going on in the lecture. Paradoxically, it really helped with my multitasking, learning how to read music at a young age where you have to keep a lot of things in your head at once, and read ahead, and try to remember what was in the measure that your currently playing even though you're looking at a measure a couple ahead. Everything that you would do to be a good musician helped to be a good student."

Flow

She said she had experienced flow often in music, during improvisation and composition and said that she would often remark about her writing “that sounded cool, what was that, that I just did” and

> “,,,if I thought about it too much, what I was doing, then I wouldn't do anything new. And so I kind of just had to shut off my eyes and shut off my ears and put my fingers places on the keyboard and see what happens. Not be too aware of it.”

It seemed an essential part of her creativity to go into flow and felt it was “more like the universe was playing my body. I felt like I was on the receiving end, rather than on the building and of whatever notes had just been strung together.” She did not feel that she had experienced flow in any other area except theatre and not in her science activities.

Form

She had studied form in her piano lessons, where they would discuss the structure of the piece and felt it helped to identify “the largest structure of the pattern.” She then gave a rather detailed explanation of how form helps in her scientific research, likening the steps of the process to sections of a musical work. It should be mentioned that the pattern ABACA is called “rondo” form in music, and it’s likely she was familiar with it, as it is a common form in piano music.

> “Well, this is my research definitely. It's like a flowchart, To see an effect, that's like section A and when you get to the end of that you go on to section B which is follow-up and then you look at that incident in a different way. If that ends this way, then you go back to A; if it ends poorly, where the effect disappeared or sometimes you go back to A. You look for something else and maybe that will be a slightly different version of A, A prime where it ends a little differently because it's an unrelated effect or maybe you will see something. Then you get to go on to B, which is the complete statistical analysis and C, where you write the paper and maybe in a very basic rudimentary way. I guess mostly were structure is helpful in chemistry, where it's tables and you can match up the rows and the columns of the table with the idea of different types of pieces of things that you

> would use in music. But I guess most academic subjects are rote learning rather than a system like that."

Rubato

She was familiar with rubato and used it frequently in her playing to give it "identity and emotion" and that it gives you a "common ground to connect with your audience." She remarked if "you play robotically then your audience can't connect." She mentioned using it at the end of sections or the piece and gave the analogy of driving a car:

> "It's kind of like being a driver on the road, you have to go with what's happening around you. And definitely in a piece it just feels right to you. When you're parking you slow the rate down before you go into a parking spot. Usually we just feel right to mess with the tempo in certain ways."

Music Theory

She had studied music theory and said it was not like a language, which has an arbitrary nature to it, but more like mathematics:

> "There's always a non-arbitrary structure going on that the people feel is the right way for music to be done. And there's always a pattern to it that rules the sound. It's not like 'oh we just decided that this thing means that thing'. I would call it math. And in that way I would associate music form with things that have a lot of structure like chemistry where everything is single-structured systems."

Practice Habits

She did not feel like she had a sense of discipline or practice habits, as she always wanting to be playing the piano. It was located in her home in a central location, and whenever she passed by, she would sit down and play. Therefore,

> "I do not think there was a discipline to my practicing. I just wanted to be always playing and doing it. In that way, I don't think I learned discipline from practicing and I don't think that help me get the more discipline in other ways because I just wasn't as excited about other things that I was doing."

But she did relate that in piano pieces, she would have trouble when she hit a difficult section, and did have to learn to go through that: "When it came to actually learning a piece, that would be difficult for me. It starts out …'well I like how it begins' and then I really care enough to get through this to the end. And then I would have to decide that yes, I was motivated through the challenge." After some thought, she did relate that to other studies, saying

> "It helped me in other ways. Yes I think so. It taught me the lesson that it could be worth it to do something that was really hard, because then when it was finished 'look at I've done this whole big piece'. So, that will be a thing for me 'is this really worth it, do I have to go through and learn all this extra stuff just to be able to get what I want to out of it?'. Yes, yes, I do because then it will be finished, a complete package, tidy, tied up a little bow. It's worth it then. Even though this is the messy part that I'm less confident about if, I can just stumble through this part of it then it will make the rest of it all worthwhile."

Attention

She felt she did not have a strong attention span, but that music had given her a

> "… rather high auditory working memory. I know this because I work in a lab which studies, among other thing, music perception and language perception so I have taken the test in real-time. I think that having spent so much of my time and childhood learning music has made my auditory working memory so high and that definitely helped, not just in lectures and in all academic settings, but when you're having a conversation with somebody about a topic that you don't understand and you're asking them for help … The fact that I can maintain like five seconds worth of information in my head at once is really helpful. I think having a high auditory working memory makes it clearer longer or something and so I guess in a way it doesn't necessarily make my attention span better but it's like a compensatory tool."

Again she returned to the concept of flow and how it helped her other studies, remarking

> "Training yourself to get into that calm zen state of mind where you can start and go through the entire thing and not get demoralized in the middle when it you're in the challenging section and not think this is so I'll start over because I'm not doing this well… If you can get yourself to finish it anyway I feel like that does help especially since I listen to songs in my head while I'm in class. I feel like that helps in attention to a really long lecture. If you have a three-hour class with a single ten minute break in the middle, that's a long time to sit and just listen to a thing happening, so I feel like having learned how to adjust, to let something happen for a long time and listen to it and not miss any of the gist of it, I feel like that has helped me at least know what to expect when I have to go listen to a long lecture."

Segmenting

She was familiar with the concept of segmenting and said

> *"*... when there was a part I just couldn't get through easily there was a place where I was always hesitated where was always stopping. I was getting frustrated. Then I would segment that bit out and I would learn that measure. I would do over-kill, teaching myself that measure. This is a strategy that was taught to me by the director of this piano studio where I played as a kid. I don't remember what she called it, but for me it was always like I have to force myself to fall in love with this little measure and it's so challenging and always gives me a headache. But if I can get myself to love it and appreciate it, then I will want to do it well. I think that helped me when I'm learning anything."

Music and Its Benefits

As to the overall effect of studying music, she said she could not really tell "what parts of why I am today are unique because of my music." It had helped her with relationships because "I feel like I have a sort of membership in a not-secret society. You're part of this international group of people that love music and that like to do music themselves." She had even taken this into consideration when she chose her PhD program. She had

> "… offers from a couple of different PhD programs and the one that I chose, most of the graduate students that are in the lab are dancers or musicians. My advisor-to-be but supports them. He appreciates that sort of extra-big-picture kind of creativity that people in the arts are encouraged to allow themselves to do … That kind of insight, that kind of

> creativity, is fostered in the arts and we don't foster creativity in the sciences. And almost everybody that I work with in my current lab is an artist in some way or has been. It's really important if you want to have any exciting "a-ha" moments in your scientific research. You need to be encouraged to let other thoughts into your head."

This interview was one of the most insightful, particularly because this subject had knowledge of the psychology of music and speech. She was very clear about how she related the two, both in her personal life and her research.

CHAPTER V

CONCLUSIONS

Initial Conclusions: Full Sample and Interviews

The students who answered the survey were articulate and answered many of the open-ended questions in great detail. The interviewees spoke at great length about their experiences in music and sound design and how it had affected not only their lives in general, but their academic experiences. They were eager to speak about their experiences and many said they had never been asked about this particular topic. The level of passion and dedication these students expressed about their studies and their experiences in music and sound design was extraordinary.

Survey Response Rate

The Qualtrics survey was sent to over 750 students taking music and sound design, plus 73 alumni. By January of 2016, 174 had taken the survey, including 21 alumni. Over 27% opened the mail and over 23% finished the survey. The response rate of 23.2% is higher than is normally expected in surveys of this type, which is typically 20-25% for surveys that take only ten minutes (Conoscenti and Zimmer 2016). However, the survey was too long (at 50 questions) and a shorter survey with either fewer topics or two surveys that divided the questions into music and sound design may have gathered more data.

Demographics and Ethnicity

Given the higher male population at UT Dallas (57% for Fall of 2015), it was expected that a similar demographic would occur in the survey. There is some anecdotal evidence that more women take music, but more men take sound design. In fact, the survey population did have a slightly higher number of female respondents (52%). Many of the UT Dallas music faculty had expressed that they had a disproportionate number of Asians students enrolled in classes, but the survey sample was only slightly higher (30%) than the general population at UT Dallas (29%). The White/Caucasian sample was also slightly higher (43%) then the general population (37%). This difference is caused by a markedly lower sample of Hispanics (11%) in the survey than in the general population (18%). Some universities offer courses that particularly appeal to the heritage of Hispanics, such as mariachi bands, but UT Dallas does not do so. Given the Hispanic population in Texas in general, there is a dearth of music, both in coursework and in the Arts and Humanities events series, at UT Dallas that appeals to this population.

Majors, Minors and Prior Experience

Again, given the anecdotal evidence of music faculty, it was expected that science majors would form a larger portion of the survey respondents than the general population. The director of the Musica Nova ensemble, an organized course, even goes so far as to list the majors of the participants on his programs, and recently they have all been in the sciences. We expected, in fact, a generally higher percentage of STEM majors, particularly given that sound design is an ATEC subject. We also expected a higher percentage of Arts and Humanities majors, given that Arts and Performance majors are enrolled in that school. This was confirmed with 11% in A&H,

29% in ATEC, 16% in BBS, and 22% in NSM. The figures for UT Dallas general population are 3% A&H, 8% ATEC, 13% BBS and 18% NSM. However, the School of Electrical Engineering and Computer Science (EECS) shows a much lower percentage (8% vs. 22%). We attribute that to the highly restrictive degree plans in that school, which allow for few electives. The STEM percentage in the survey was 59% as opposed to 48% at UT Dallas. This percentage would be even higher if the EECS students were enrolling more. Music faculty report that students in those majors often do not enroll after the first few terms, and ask to play in ensembles "off the books" i.e. without enrollment, which is generally discouraged.

Music is a well-established, formal activity in high school, but sound design is not. We expected that the students would have much more music experience, and they did. Texas schools are particularly invested in music, often to provide marching bands for football teams, and students often start in the sixth grade. And indeed the number of years of musical expreince was impressive, some listing over 15 years. Many had played more than one instrument. Sound design experience was much lower, with only slightly more than half listing any experience at all. For those that did, almost all of the experience was informal and self-taught. This was one impetus for examining the difference between music and sound design students. The hope was to conduct an interesting analysis of formal versus informal education through the lens of music and sound design. Those conclusions are listed in a later section.

Courses Taken at UT Dallas

Music was established at UT Dallas in the 1980s and the numbers of students enrolled in courses on an ongoing basis is upwards of 750 students per term. In contrast, sound design is relatively new (in the last ten years) as is the ATEC program in general, and there are fewer course offerings. Additionally, EMAC students were required to taken the lower level sound design course as a part of their major and there are typically four introductory courses offered every semester. It was expected that there would be far larger numbers of students in music courses, and there were, at 320 courses in music versus 68 courses in sound design. Of those 68 sound design courses, 37 were at the introductory level. However, there were enough respondents in sound design to make it possible to analyze these two groups (see later section). A research study of just these groups independent of each other would perhaps yield greater results and is of interest for further study.

The Qualtrics Survey: Major Areas of Interest and Results

The survey was specifically designed to inquire about music and sound design experiences and academic skills. It should be noted that we did not explore many areas commonly associated with musical activities. Numerous websites and articles list many ways music eases pain, increases sports performance, improves health, makes you happier, lowers stress, helps you sleep better, reduces depression, helps with stroke and Alzheimer's patients, etc. etc. This study was designed to look at participating in music (not passive listening but active participation) and/or studying music from a theoretical point of view. We focused the questions on academic abilities and recognized music and sound design principles. However, the more open-ended questions

and even some direct questions did include answers about stress relief, depression, concentration and motivation. Certainly having your stress relieved may contribute to higher academic success.

We conclude that these benefits of music are intertwined with the academic ones and it is not easy to separate them from the academic benefits. This study delineated the more academic benefits but does not attempt to make this separation in any way.

The concept of "flow" was well understood by the students and music and sound design clearly induce this state, as documented by the 85% who responded that they had experienced it in that context. They had also experienced in other contexts (81%). While it is not possible to state that experiencing flow in one state influences it in another, having the experience at all is beneficial. Most considered it a desirable experience and we conclude that music and sound design can induce this state, but certainly not exclusively.

We expected that studying form and structure in music and sound design would be one major area that helped with other studies, given that it requires some knowledge of basic principles and an extension to other concepts. It was therefore disappointing that 29% of respondents in the survey had never studied form and that another 43% had studied it only occasionally. Those that had saw clear benefits, particularly in identifying patterns and critical thinking. The same was true of music theory, a formalized course that includes form, but many other concepts, such as harmonization, chord structure, etc. The percentage here was much higher (67%), probably due

to the fact that the music minor requires this course. We conclude that students did not fully understand what "form" is, in spite of their participation in music theory courses. In any case, these were two areas that we considered most "academic" in their structure and those students who had studied either form or music theory responded positively and with great detail. We conclude that form is a neglected area in most music and sound design courses at present and should have more emphasis in the curriculum. Music theory, as a formalized course, is of even greater use. The current practice in the music program of focusing on strictly performance aspects does not serve our students in the sense that it does not include these more analytical subjects, which would be useful to students in other areas, including their chosen major.

The current music concentration at UT Dallas is being re-written to include more music theory in the curriculum. There is no concentration in sound design at present, but should one be created, music theory should be strongly considered. This will not, of course, serve those students in music and sound design classes that are not doing those concentrations. This instructor does now include form and some theory in all her courses, both performance, ensemble and music history courses, partly as a result of this study.

Rubato is a more sophisticated concept in music, and often is not discussed until students have reached a certain level of technical proficiency. Those that responded to this question clearly did not fully understand the concept and the level of responses was fairly basic, mostly focused on slowing down to add emotion or expression. This question was outside the scope of the level of most students in the survey. However, the few that responded correctly did understand that

rubato is a bit like “bending the rules” since it is not in the written score. This did not extend to other academic subjects to any great extent.

Both music and sound design are time- and labor-intensive subjects. The choice to study them requires a commitment on the part of the students, particularly if the courses are outside the chosen field of study. We therefore expected that music and sound design would enhance time management skills and discipline, given that it demands it. Indeed, most students felt it did, and many (78%) felt they had extended those skills to other subjects. One interviewee spoke at length about being proactive in other courses, and studying for exams or completing assignments early in order to have time for their musical activities. While many students may have learned this earlier than their college years, it is clear that these kinds of skills are of great importance in academic life in general. Many of the students still put in considerable hours in music courses in spite of heavy course loads in their major.

Maintaining attention to aural information is a critical part of both music and sound design, and it was not surprising that 94% of students felt it required that ability, and that 73% of those students felt it had helped in other academic areas. We conclude that it is beneficial to create a situation for students where maintaining attention over longer spans of time, particularly in this “sound bite” and “twitter” generation, is of great importance. We conclude that music and sound design are two of the major ways to encourage students to put down their phones, stop texting or surfing the net, and concentrate on a task at hand. It is difficult to create a sound design while paying attention to other phenomena; it is impossible to play the violin and pay attention to your

phone unless you are so familiar with a piece of music that you can "autopilot" you way through it. We asked in the interviews if students left their phones on during their experiences; the majority said no, but those that did were using applications like the tuner or the metronome. One other conclusion is that many courses these students take are still offered in the basic lecture format, with no interaction with the professor (the "sage on the stage"), since many mentioned it had enhanced their ability to listen to "long, boring lectures", as one put it. One even said he had trained himself to say "just five minutes more."

Segmenting is a common academic concept, since most courses are taught with some type of book that breaks the information into smaller "segments" or pieces. This area of the survey was quite a surprise. We expected a more temporal answer, given that music and sound design deal with horizontal sections (first the A section, then the B, etc.). But many students saw this in another direction: the vertical aspect of multiple voices, instruments or tracks. This was a fascinating revelation and lends credence to the idea that music and sound design require two-dimensional thinking. Of the 87% that said they had experience segmenting, 59% responded in the expected horizontal direction, but another 41% responded vertically, with a few students answering in both directions. They also responded with correlations between music and sound design ("Music has bars, sound design has tracks"). We expected them to see the relation to academic study and they did, but often in surprising ways. On student remarked "You have to understand one measure before moving to the next; the same principle applies to my academic studies and keeps me from trying to learn the broad picture before the individual moving pieces that make it up." We conclude that the skills required to learn a music piece or create a sound

design do encourage students to use these concepts elsewhere. This two-dimensional nature of both music and sound design study are ripe for further research.

The alumni in the survey, for the most part, mirrored the responses of those students still in school, but the longer lens gave them the chance to reflect on how music and sound design had impacted their lives, both in and out of school. Twelve of the 21 students had received degress in the STEM fields. One mentioned that his listening skills were more acute and that had made him more sensitive to "auscultatory nuance, especially cardiac rhythms". This is borne out by the study of Mangione and Niemam (1997) that showed those who could play a musical instrument were statistically significantly more likely to correctly identify heart disease from stethoscope findings.

Finally, a general question about studying music and sound design and academic skills yielded some surprising results, particularly in the interviews. One interviewee related that music had helped her to overcome autism as a child. Another, who freely explained he was on the autism spectrum but at the "low end", felt music helped him understand "small facial expressions" and deal with relationships more effectively. Another felt music had given him "a world view". Another felt music "was one of the ways to express emotion" and that, as a sensitive person, other avenues were difficult for him. It should be noted there were a few negative affects of music and sound design in the responses. Of those listed, the major one was the distraction from other subjects, since they enjoyed music and sound design more.

In conclusion, the positive affects on students' academic abilities was quite pronounced and, in most cases, very cleared defined and explained by the survey participants. This very specific data will lead to further studies that can be more defined and principles that can be tested by scientific means, with a control group.

Cohort Comparison of Music and Sound Design Students

As noted before, the definition of a "music student" and a "sound design student" in the survey is not a binary one. Some students have taken music, but no sound design; some students have taken sound design, but no music; and some have taken both types of classes. We therefore used five cohorts to do the analysis, looking in particular at those groups with experience in one type of course only; and those who had taken both. These are Cohorts III (Music Only), IV (Sound Design Only) and V (Both) in the previous observations. In the conclusions, small differences of percentages (less than 3%) are not considered significant. Also, small sample sizes have been noted when they are deemed too small to allow us to draw any conclusion.

Demographics: Gender and Ethnicity

The full sample was 49% male, but the Music Only cohort was significantly less at 42%. The Sound Design Only was nearly equivalent at 50%, but those would have taken Both was significantly higher at 57% male. We conclude that the sound design students as a whole (those who have taken music and those who have not) are significantly higher male (55%).

The full sample was 45% White/Caucasian and 31% Asian with another 10% of Hispanic origin. The Music Only sample was less White/Caucasian (38%) and more Asian (36%). The Sound Design Only was the most White/Caucasian (55%) and the least Asian (26%). Students who had taken both types of classes were 50% White/Caucasian and 26% Asian. There were no students who identified themselves as Hispanic in the Sound Design Only sample. The 10% in the full population is solely due to music courses. We can surmise that Asian students, having taken music courses in high school at a higher rate than the norm, are more likely to continue to take music courses than sound design courses when they come to UTD. The New York City's famed Juilliard School has a student body estimated to be 25% Asian and Asian-American. Juilliard President Joseph Polisi rejects the view that Asian students are uniquely talented. "It's not just being Asian that makes them good musicians," he says. "It's a matter of dedication, family support and discipline" (Brand 1987). In all cohorts, the combination of White/Caucasian and Asian is above 74%.

Demographics: Majors, Minors and Prior Experience

It would be natural to see the majority of Sound Design students as either EMAC (where the lower level course is required) or ATEC (where students who focus on sound design would major). Indeed, 95% of the Sound Design Only students were majoring in the School of Arts, Technology and Emerging Communication (ATEC). The other 5% were in Behavioral and Brain Sciences (BBS). Music Only students, on the other hand, were distributed across the university, with the highest percentage in the sciences (NSM) at 29% and BBS at 18%. These figures explain the highest percentages in the full sample in ATEC (29%) and NSM (22%). Students

who had taken both were predominantly ATEC as well (43%) and NSM (22%). We conclude that music is an elective for most students at UT Dallas, particularly those in the sciences, but Sound Design is pursued more as a major field of study, and is seldom taken as an elective. We also looked at STEM majors by combining those from the four Schools of ATEC, BBS, EECS and NSM. While 77% of the full sample was STEM students, Music Only was just 68% STEM majors and Sound Design Only was 100% STEM majors. Those that had taken both were 81% STEM majors. Because STEM eliminates the Arts and Performance majors who are in the School of Arts and Humanities, it was expected that there would be fewer AH majors in STEM. The differences between STEM and non-STEM students were examined as separate cohorts.

The minor is pursued most by Music Only Students (29%) and least by Sound Design students (5%), as opposed to the full sample (25%). It is unfortunate, at least in the opinion of this researcher, that sound design students are not pursuing the minor, as the elements of music theory and history that are required there (and with "Digital Music" an elective course in the minor) would be of great value to them.

Since music is a formal course in high school, but sound design is pursued in an informal manner, we expected far more experience in music than sound design. In the full sample, 82%, and 88% of the Music Only students reported prior experience in music. Additionally, 60% of the Sound Design Only students reported prior experience in music. For those who had taken both courses, 85% had music experience. We conclude that prior experience in music is an impetus to take either music or sound design courses at the college level, but a smaller

percentage of sound design students have that experience. This is an important data point for those teaching sound design, as a significant portion of those students have no formal musical experience. The average number of years of experience varied also, but not as much as expected. The full sample was about six years, with Music Only students slightly higher at 6.5 years and Sound Design Only students slightly lower at 4.3 years. Those that had taken both had an average of five years of prior experience. This correlates to approximately the high school years in Texas and was not surprising.

We also looked at informal experience, both in music and sound design. The average years of experience in informal experiences was lower than formal experience for all cohorts, ranging from 2.4 years (Both) to 4.0 years (Music Only). The highest percentages were in the activities of composing and arranging, except for the sound design cohorts. There, the most common activity was audio engineering, followed by composing and arranging. It is possible that the word "composition" is taken to mean different things by different students. Many who listed "composition" may not have thought of it in the strictest, classical sense of a written score to be played by other musicians. Making soundscapes, or music for games or videos can all be considered "composition"-type activities. Many also reported playing in a band or singing in an a cappella group as an informal activity, at fairly equal numbers across the cohorts. One interesting comparison is the "private study" activity, which was reported by 8% of Music Only students, but by no Sound Design students. The lack of one-on-one instruction is a salient feature of sound design, that perhaps should be looked at more closely. Perhaps sound design students would benefit from this type of instructional activity, and it is possible as the sound design culture

develops, that this kind of instruction (probably called “tutoring” rather than “private lessons”) will also develop. We conclude that private instruction is a common part of music teaching (and a considerable income for many musicians) but not in sound design, where salaries are markedly higher, and the additional income may not be as enticing. Additionally, work weeks in the game industry are often much higher than 40 hours per week and may discourage the practice of private instruction as supplemental income.

Courses Taken at UT Dallas: Music and Sound Design

Of students who have taken sound design courses and music courses, the highest listed courses were vocal and choral classes. We conclude that this is an aberration due to the researcher’s main area of focus. Of the remainder, music appreciation, which can be used to fulfill the state requirement in the arts, and instrumental ensembles were common, followed by music theory. The percentage of students taking music appreciation was approximately equal across the cohorts. This was also true for music theory, ranging from 9%, lowest for those who had taken music only, to 14% for those who had taken sound design and some music. Since music theory was shown to be one of the most helpful courses for general academic achievement, and is very useful for sound design, it was gratifying to see that result. One course offered in music, “Creating Music”, which includes digital composition, should be attractive to sound design students, but was not well represented in that population (1%). We conclude that there are ATEC courses that are perceived of by students as similar, and hence, they do not take that course; or that they are not aware of its existence. However, “Digital Music” was taken in a higher percentage by sound design students. It is likely that the actual title of these courses is

influencing enrollment: "Digital Music" is seen as more similar to sound design, but "Creating Music" is not.

The most commonly taken course in sound design is the "Introduction to Sound Design" course, which is required of all EMAC majors and is a prerequisite to upper level sound design courses. Surprisingly, it was also the course most often taken by students who have taken music and sound design (60%). Sound Design Only students represent 67% of the sample. If music students have taken sound design at all, the entry level course is the most likely to be the one they have taken. Of the remaining courses in sound design, which are all upper level, the course "Special Topics in Sound Design" (which is used for a variety of coursework) was fairly consistent throughout the cohorts, with percentages varying from 17% (those that had taken Both) to 24% (Sound Design Only and also the full sample). We conclude that the upper level sound design courses are taken at approximately the same rate, no matter what cohort the students inhabits.

Previous Experience in Music and Sound Design

Again, we expected the students with music experience to have more in terms of years, and in a more formal capacity; and those in sound design to have less and informally. Students who had taken music only reported previous experience at 84%, where sound design students at only 55%, a significant difference of 29 percentage points. We conclude that students with no prior experience in music often do not elect to take music courses in college, even when they are enrolled in a "music-related" area such as sound design. In fact, the highest percentage of

students who had taken music prior to college was those students who were enrolled in both music and sound design classes.

The type of musical experience varied between the cohorts as well. Music Only students reported experience in piano (7.4 years on average), orchestra (7.20 years) and band (6.3 years), whereas Sound Design Only students reported most experience in choir (11.0 years), and band, piano and orchestra (7.0, 6.3 and 6.0 years, respectively). Again, we feel this is an aberration due to the nature of the researcher's primary area of instruction (vocal and choral music). The sound design area of the survey had only ten responses, with only zero to three responses in each area, so no conclusion can be drawn, as the response numbers in each area are too small to be extrapolated.

The great majority of students had not studied sound design prior to entering UT Dallas, with answers ranging from 5% for Music Only students to just 25% for Sound Design Only students, the highest percentage. In fact, the full sample comparison between music and sound design drops from 80% to just 14%. Since students often gravitate to majors and courses that reflect their previous experiences, it is important to note the lack of sound design experience can significantly impact enrollment in that area. Very few students responded to a question about how long they had studied sound design prior to attending UT Dallas, again an indication that it is not a common experience, even for students who then elect to do so in college. This is also an artifact of formal versus informal study. It is easy to answer a question about formal experience,

given that you can say “I took orchestra in high school for three years.” But informal experience is not so clearly delineated and hence harder to ascertain.

Music and Sound Design and Academic Skills

When students were asked if music and sound design enhanced their academic skills, the responses ranged from 70% (the lowest being Sound Design Only students) to 84% (the highest begin Music Only Students). While the numbers still indicate that students in all cohorts feel their studies in music or sound design enhance their other skills, students in music classes had a stronger result. Students were then asked to describe the skills they felt they had obtained through that study. The highest response for all cohorts was “concentration/focus” and it was remarkably even across all the cohorts at 14-15%. In addition, the Sound Design Only group reported knowledge (38%), discipline (15%), time management, new perspectives and critical thinking skills (all at 8%). They did not report stress relief (which was reported by Music Only students at 20%) or memorization, public speaking, mathematics skills or expressivity, all of which were reported by the other cohorts. Memorization and public speaking are not skills much required in sound design, but are an integral part of music. In fact, sound design, with its high degree of detail-oriented activity might be a more stressful activity than music-making. The sound design students did report the highest level for time management and discipline, which speaks to the time commitment required in that field.

When asked about the experience of flow during music or sound design activities, the largest response for “never” was from Sound Design Only students at 11% and there was a 0% rate from

students who had taken Both types of classes; the remainder of the cohorts responded “never” at 3-5%. The Both cohort responded “always” at 24%, far higher than the other cohorts. However, all cohorts experienced flow at least some of the time at 89% and above. The nature of the experience was reported also, and again the Sound Design Only cohort was different than the other cohorts. All other cohorts reported feeling serenity, but Sound Design Only students did not. They were more likely to report that the feeling was natural (at 8%) but not free and easy (0%). Music students reported that the flow experience was free and easy and also fun, but Sound Design Only students did not report either experience. All cohorts reported that flow altered their perception of time (ranging from 41% for Music Only students to a high of 77% for Sound Design Only students). Embodiment was limited to music students, who felt they were “one with the instrument”. Finally, Sound Design Only students did not report feeling joy, confidence focus or emotion, which were reported by music students. All cohorts reported feeling flow in other activities at about the same rate, with responses ranging from 79% (Sound Design Only) to 91% (Both). There were some differences in the type of experiences that induced flow. Sound Design Only students reported artistic activities at a much higher rate (36%) than other cohorts (18%-26%) and study/learning at much higher rate (18%) than other cohorts (7%-10%) but did not report reading for pleasure, programming, or science/math. Music students reported those activities, but since we expected music students to be in majors in science, and sound design students to major in ATEC, this was not a surprise. Music Only students reported sports as the highest (24%) followed by artistic/creative (18%). Those that had taken both classes reported artistic/creative as the higher (26%), followed by sports (19%). All cohorts reported video games/entertainment (9%-15%) but the Sound Design Only and Both

cohorts reported it at the highest level. All reported studying (8%-18%) but again the Sound Design Only students reported at the highest level (18%) and a minimum of 8 percentage points above other cohorts.

Only 24% of Music Only students said that had never studied form, but a large percentage of Sound Design Only students had not (63%). This is a reflection of the curricular content of these classes and the likelihood that in sound design, "form" as it is known in music is referred to in different ways. Those that replied frequently were usually music students (27% for Music Only students) and it falls to only 16% for those who had only studied sound design. Studying the overall structure and its component parts is essential for both music and sound design and this study indicates a need for greater emphasis in the curriculum in both areas. Those that had studied form felt it affected their academic skills, and no cohort reported "strongly disagree" to that question. Surprisingly, the strongest response ("strongly agree") came from the Sound Design Only students (37%) and the lowest from the music only students (15%). When sound design students do study form (in either a sound design class or a music class) they do feel it helps their other studies. The Sound Design Only cohort responded with "recognizing patterns" and "structure" as the ways it enhanced their students, both at 29%. Music Only students agreed (patterns at 23% and structure at 21%) but also mentioned analysis/critical thinking (26%). Music and sound design students may think of form in different ways and this comparison might be useful in further studies. Of the subjects mentioned where form helped their skills, mathematics was the clear favorite with the highest rate in all cohorts (and 100% in the sound design only cohort) but the low number of responses in sound design (less than six) makes any

conclusion untenable. The music cohorts, with more robust numbers, clearly saw the connection between form in music and structure in other subjects.

Rubato is a more sophisticated concept and we expected more answers from music students here. As mentioned earlier, however, students did not fully understand the concept of rubato, and answered that they had experienced rubato at high rates for Music Only students (85%) but considerably lower for Sound Design Only students (39%). When asked about the experience, those students responded with expression, emotion and creativity in all cohorts. Music students responded with "technique", but no Sound Design Only students answered with that experience. Only five sound design students answered this question and most of the answers from all cohorts were not within the general concept of rubato. Music students did consider it a technical skill. All cohorts felt it was a natural part of music, except for Sound Design Only students. Given the small number of responses and the misunderstanding of the concept, these results are not deemed significant, except to say that the concept was beyond the experience of most respondents.

Most students saw a connection between music theory and other academic skills. The students in the Both cohort had taken music theory at the highest rate (75%) whereas the Sound Design Only students reported taking music theory at only 56%, slightly more than half. Of those that had studied theory, all students in all cohorts felt it had affected their skills to some extent. Surprisingly, the sound design students felt it had at the highest rate (40%) and the Music Only students at the lowest rate (24%). Apparently, sound design students feel they derive more benefit from music theory, indicating that this course or the inclusion of music theory in the

sound design courses would be of some benefit. This also makes the case for including music theory to some extent in all music curricula including performance and history classes. When asked to describe their experiences, sound design students responded differently, limiting their answers to pattern recognition and general learning. Given the state requirement to take six units of mathematics, it was no surprise that all cohorts reported that subject. Music students included critical analysis in their answers, as well as form and writing skills. Sound design students listed mathematics as the subject that was affected most (60%) but music students mentioned writing, language and physics. It was surprising to see "language" included, given that there is no language requirement at UT Dallas and students take those courses as electives.

We expected a high degree of students to agree that music and sound design require discipline and time management, and only a few students (7%) in the Sound Design Only cohort did not agree. Ranges for "agree" and "strongly agree" were higher in music cohorts than sound design cohorts but all were within the same range (74%-92%). When asked to describe the experience, Sound Design Only students answered planning (60%), motivation (20%) and effort (20%). Music only students mentioned planning (40%), motivation (10%) and a variety of other responses, including dedication, focus, awareness, balance, prioritizing, patience and delayed gratification. The lack of the response "dedication" from sound design students may be that they are taking their courses as a part of a degree plan, whereas music students are taking their courses as electives, hence requiring more "dedication" on their part. All cohorts felt music and sound design required discipline and time management but described it differently.

We expected sound design students to respond more positively about maintaining attention to aural information, but sound design students responded “agree” or “strongly agree” at the lowest percentage (81%, still high but lower than the full sample at 96%). When asked if it had affected academic skills, sound design students again responded at the lowest percentage (62%) as opposed to Music Only students (75%) and those in Both (72%). When asked about the experience, Sound Design Only students responded most with listening (40%) and multitasking, focus and details (all at 20%). Music Only students responded with those experiences at about the same rate, but also included memory. However, the number of responses by sound design students was low (less than six). However, it is important to note that “attention to details” was reported at a higher rate by both Sound Design Only students (14%) and those who had take sound design and some music (14%). While there is much attention to detail in both music and sound design, those in sound design perceive that it is an integral part of their activity. Memorization, on the other hand, is not as important to sound design study, and was reported more by music students.

When asked about segmenting in music or sound design, Sound Design Only students answered at the rate of 93%, as opposed to Music Only students, who replied at 84%. The highest response rate was in the Both cohort, at 97%. Since sound design requires by its very nature the breaking up of sounds into component parts, tracks or short temporal sections, this was an expected result. Students described their experiences in either the horizontal (temporal) direction or the vertical (tracks or voices) direction. While there was a slight preference for horizontal in all cohorts, the breakdown between the two directions was roughly the same for all cohorts (about 55%

horizontal and 45% vertical). A few respondents listed both vertical and horizontal directions. Most responded that it had helped their “general learning” (34% - 46%), with the lowest percentage (34%) in the Sound Design Only cohort and the highest in the Music Only cohort. Memorization was only listed by music students, as was general listening.

Alumni Responses

We expected the majority of alumni to have experience in music, but not as much in sound design. Of the 22 respondents, eight had taken a sound design course as well as music courses. All had taken at least one music course, so there was no “sound design only “cohort. Three had graduated with degrees in Arts and Technology (while it was still a part of the School of Arts and Humanities). Of those that had taken sound design, three were those ATEC majors, but the others were in physics (two), Child Learning and Development (two) and Global Business (one). More students who had taken sound design were working (71%) or seeking work (14%). The majority of music students were in graduate or medical school (50%) or applying (14%). All cohorts marked “agree” or “strongly agree” that music or sound design had helped them post-graduate, with responses ranging from 84 - 88%. When asked about their experiences, music students reported stress relief as the highest (29%) but sound design students mentioned enjoyment (22%) and their current work (22%). Only one music student mentioned current work. Sound design students did not mention that it had enhanced their resume (probably because it is their field of work) whereas music students did at 14%. Finally, music students felt music study had helped them in social connections and networking, but sound design students did not.

Music and Sound Design and General Benefits

Respondents were given the opportunity at the end of the survey to mention any other benefits they perceived in studying music or sound design. Most respondents felt the survey had covered all the material, but some did report other benefits. All cohorts spoke of the ability to discern quality work (an interesting response that bears further study), creativity, persistence and memory; sound design students spoke more about analysis and studying the works of others. Music students spoke about joy, networking, delayed gratification, presentation, self-esteem and self-confidence.

Cohort Comparison of STEM Versus Non-STEM Majors

After looking at the majors of students, it was clear that there were more STEM students (114) in the survey than non-STEM students (33). Four students who had not declared a major were not included in the analysis of STEM versus non-STEM majors.

Demographics: Gender and Ethnicity

The STEM majors were fairly evenly split between male and female (48% vs. 52%), but the non-STEM majors were predominantly female at 64%. The highest reported ethnicity in both samples was White/Caucasian, with slightly lower in STEM students (44%) than non-STEM (55%), but there were far more Asians in the STEM sample (32%) than in non-STEM (21%). Combining these two ethnicities gives equal percentage (76%) in both samples. The third largest group, Hispanics, was 10% in STEM and 14% in non-STEM.

Within the STEM students, there were more students in ATEC (29%), with NS&M students second (22%) and BBBS (15%, with eight students in Neuroscience). Non-STEM students majored most in A&H (49%, mostly in Art & Performance), and SOM (37%). Only 25% of STEM students were pursuing a music minor, but 36% of non-STEM students were. We conclude that STEM majors allow for fewer electives than non-STEM majors, and many students do not have room in their schedules to pursue the minor. Since the minor requires four courses at the upper level, including music history and theory, we conclude that the anecdotal evidence that music faculty report of students dropping out in later years affects their ability to pursue the minor.

Experience in Music and Sound Design

Non-STEM students had more experience in band, orchestra, choir and piano than non-STEM students, but STEM students had more experience in voice. This is not a significant result, since the sample is skewed towards voice due to the teaching activities of the researcher. The researcher has a significant number of STEM majors in her vocal courses on a regular basis, and this influenced the data as those students were more likely to complete the survey. The experience of STEM and non-STEM majors in music was therefore roughly the same (five to eight years). The experience of students in the informal activity of sound design was roughly the same also. They did, however report different types of activities. STEM students were more likely to report composition and audio engineering; non-STEM students were more likely to recording and playing in a band or singing in an a cappella group. Sound design is mostly taken by ATEC majors, which accounts for this reporting. Composition was still the highest reported

activity in both groups, but as noted before, the students' definition of "composition" is quite liberal and affects the results.

Courses Taken at UT Dallas in Music and Sound Design

Both STEM and non-STEM students had taken music history and appreciation at the same rate, due to the core and music minor requirements in that area. At the upper level, STEM students had a much higher rate in instrumental ensembles (20%) than non-STEM students (6%) but a lower percentage of voice and choir courses (38%) than non-STEM (58%). This is in contrast to the previous result about their experiences prior to attending college. More STEM students had taken music theory (11%) versus non-STEM (8%). Ten out of 11 students who had taken guitar were STEM students. Twelve STEM students had taken "Digital Music", but only two non-STEM students. "Creating Music" had been taken only by STEM students. We conclude that STEM students are more drawn to the theory and composition courses, as well as instrumental ensembles and guitar. The overall reporting of music courses was heavily weighted toward STEM students, with 216 courses reported; therefore, STEM students are taking more than one music course on average as opposed to 120 responses for the non-STEM students, who are taking on the average of four courses. We conclude that more STEM students are enrolled in music courses, but non-STEM students are taking more courses in their individual curriculum, with an average of four courses. This result matched the higher number of Art & Performance majors in the non-STEM population, who will generally pursue more music in their degree plan.

In sound design, there were no non-STEM majors taking any courses at all. We conclude that sound design is primarily taken by ATEC and EMAC majors, and secondarily by STEM students. In fact, several students on the survey identified themselves as "sound design majors" even though there is no major or a concentration in that area. Over half of the students who had taken sound design had taken only the introductory course, which is required of EMAC majors. Upper level courses were taken by students 29 times, in spite of the large number of ATEC majors in the survey (36). Upper level sound design was taken only by ATEC majors (and not EMAC). There is no elective enrollment in these courses from either STEM or non-STEM majors.

Prior Experience in Music and Sound Design

STEM and non-STEM students had prior experience in music at about the same rate (80% versus 98%) but STEM students reported more experience in choir, voice, piano and orchestra. Non-STEM students reported more experience in band. High school band (which includes marching band) is more time-intensive activity, with pre- and post-school practices and games to play. We conclude that STEM students do not have the time to pursue this activity in high school as much as non-STEM students. STEM students also reported more experience in sound design (15%) versus non-STEM students (only 4%).

Music and Sound Design and Academic Skills

STEM and non-STEM students reported academic skills benefits at about the same rate, but described them differently. STEM students reported more stress relief, focus and critical

thinking skills. Non-STEM students reported public speaking skills, focus and stress relief.

The flow experience in music and sound design was reported about equally by STEM and non-STEM students, and both groups reported "perception of time" as the most common experience. They also reported flow in other activities at about the same rate. STEM students reported sports, followed by artistic endeavors and reading; non-STEM students reported artistic endeavors, followed by sports and entertainment. We conclude that STEM and non-STEM students both experience flow, with common experiences.

Non-STEM students were more likely to have studied form in music (87%) than STEM students (64%). For those that reported enhanced skills, STEM students mentioned recognition of structure and patterns. For non-STEM students, critical thinking was mentioned most often, followed by pattern recognition. Students in the two groups differed most in the subjects they mentioned. STEM students were more likely to mention mathematics and the natural sciences; non-STEM students were more likely to mention literature, and writing. In spite of the requirements for students to take several courses in mathematics and sciences, we conclude that the benefits of music and sound design in terms of coursework are most perceived as in courses that are useful to the majors of the students.

While large numbers of students reported rubato, they typically did not report within the concept. Of those that did, it was more likely they were students who understood the technical requirements of rubato. They were more likely to be non-STEM, as that group focused on

technique as well as the emotional aspect of rubato that both groups mentioned. We conclude that rubato is an advanced musical concept and is more likely to be understood by students at a more advanced level. These students are more likely to be in non-STEM majors, and Art and Performance majors in particular.

Music theory was studied at a slightly higher rate (73%) by non-STEM students than STEM students (67%) but both groups felt it was valuable. STEM students reported general learning higher than non-STEM students and did not report analyzing form as a benefit of music theory. We conclude that non-STEM students benefit more from the analytical experiences that music theory provides, as they as less similar in nature to their other courses. STEM students, who are routinely using analysis in their coursework, do not see the benefit of the additional analysis that music theory provides. Subjects were again most reported by those common to their majors. We conclude that music theory has a similar effect for STEM and non-STEM, with non-STEM majors benefiting at a slightly higher rate.

Discipline and time management are common experiences and we expected no difference between STEM and non-STEM students. Again, they reported enhancement of these skills at about the same rate, but described them differently. STEM students were more likely to mention planning, while non-STEM students mentioned other skills, such as focus and motivation.

Both groups felt maintaining attention to aural information had enhanced their skills, but STEM students were less positive (71%) than non-STEM students (85%). Listening and focus were the

most common responses for both groups. Non-STEM students included memorization, which was reported by only a few STEM students. We conclude that the memorization techniques learned in music are creating the effect (since sound design does not usually involve memorization skills) and that STEM students do not see the transfer to their subjects. Both groups reported "lectures" as the most common activity, with STEM students at a lower percentage (68%) than non-STEM (83%). We conclude that maintaining attention does help with listening to lectures, but both STEM and non-STEM students do have non-lecture type activities that may be enhanced by their listening skills.

Segmenting was reported in two directions, horizontal (temporal) and vertical (tracks or voices). STEM students reported the horizontal direction more (60%) whereas non-STEM reported both directions equally. Since there are ATEC majors in the STEM sample, it is likely that sample was influenced by the presence of those students, who reported the vertical direction more than non-STEM majors. In should be noted that orchestra and band instrumentalists are unaccustomed to reading vertically, where they play solely from their part and not from full score. Choral students do see multiple parts. We conclude that the STEM students, with the presence of sound design students in the sample, are more likely to benefit from the two-dimensional nature of sound design than non-STEM students.

Alumni responses

Alumni were twice as likely to be STEM majors (14 respondents) than non-STEM majors (seven respondents). STEM students were more likely to be in graduate or medical school, or applying

(eight respondents). Non-STEM students were more likely to be working or seeking work (five respondents). We conclude that it is more likely that STEM students progressed to the graduate level of education and non-STEM students were more likely to enter the work pool. This dichotomy also influenced their perception that music had helped them post-graduate. More non-STEM students felt it had. Both STEM and non-STEM students who felt it had helped them mentioned stress relief and time management skills.

Additional responses by STEM and non-STEM students differed little except in one area. Non-STEM students reported networking skills, cooperation, self-esteem and self-regulation. STEM students reported sharpening senses, delayed gratification, persistence and patience. A few STEM students felt studying music had taken time away from their other studies and reported that as a negative effect.

Cohort Comparison of ATEC/EMAC versus STEM no ATEC/EMAC

We hoped to ascertain whether ATEC/EMAC majors differ significantly from the other STEM majors in the behavioral and brain sciences, natural sciences, electrical engineering and computer science. There were 45 students who identified themselves as ATEC/EMAC majors and 68 students who identified themselves as STEM majors from the other three schools. We will refer to this cohort as STEM no ATEC/EMAC in our discussion.

Demographics: Gender and Ethnicity

The ATEC/EMAC cohort was more significantly male at 53%, whereas the STEM no ATEC/EMAC cohort was 44% male. Hence there are more females in STEM subjects outside of ATEC/EMAC in the sample. STEM no ATEC/EMAC students had far more Asian students enrolled in music and sound design, at 41%, with 38% white/Caucasian. ATEC/EMAC students were predominantly white/Caucasian at 53%, with only 20% Asian, but had more Hispanics in the sample at 16%. We conclude that Asian students are more likely to take music classes and major in the STEM areas outside ATEC/EMAC.

Demographics: Majors and Minors of Participants

The ATEC/EMAC sample was predominantly ATEC, with 36 majors out of the 45 students in the sample. There were nine EMAC majors. STEM no ATEC/EMAC students were predominantly from NS&M, with 34 majors, followed by BBS with 23 and EECS with 12. Two factors have influenced this distribution: a larger portion of Asian students in the STEM no ATEC/EMAC sample, who generally major in the sciences; and the limited number of electives in many of the EECS majors, which discourages elective enrollment. Only 18% of the ATEC/EMAC students were pursuing a minor in music (a disappointing result, given that a music minor would greatly aid sound design students), while 29% of STEM no ATE/EMAC had declared a minor in music. This fits with anecdotal evidence that having the music minor on your transcript will improve admittance rates to medical and graduate school. We conclude that the music minor is attractive to STEM students in the sciences, but not to ATEC/EMAC students.

Experience in Music and Sound Design

Over 90% of STEM no ATEC/EMAC majors had previous experience, with an average of over six years in a formal ensemble. This compares to 76% of ATEC/EMAC students, with an average of 4.9 years. STEM no ATEC/EMAC students have more experience by over a year and also tend to play more than one instrument. While 61% had only played one instrument, over 35% had played two. The ATEC/EMAC sample tended to have students who had only played one instrument (73%). There was much less prior formal experience in sound design. Only 48% of STEM no ATEC/EMAC reported previous experience, and the average of 2.88 years. All reported informal experience, and primarily either composition or playing in a band (which this research would not necessarily consider sound design experience; some had, however, assisted with mixing, recording, etc.) The ATEC/EMAC students reported experience at a rate of 59%, but with only 1.64 years, quite low for those majoring in Arts and Technology. The number of responses in ATEC/EMAC (11) makes it difficult to extrapolate this result, but as we have seen in other cohorts, the lack of formal instruction in sound design makes it less likely that students will pursue it at the college level. We conclude that the lack of formal training, particularly for STEM students, make it less likely they will take sound design classes at the college level. As before, the most common reported activity was "composition" and as we have seen with other cohorts, the definition of this term is quite broad for students in the 21st century. This creative activity is pursued by both groups at about the same rate.

Courses Taken at UT Dallas in Music and Sound Design

We expected the ATEC/EMAC cohort to have taken fewer courses in music but more courses in sound design than the STEM no ATEC/EMAC cohort. This was borne out by the numbers, as ATEC/EMAC students had taken 46 courses in music, but had taken 58 courses in sound design, with 29 at the introductory level. We conclude that the requirement for EMAC students to take the introductory sound design course influences these numbers, and the upper level course enrollments are fairly low for the number of students in the sample. It was encouraging to see that 17% of ATEC/EMAC students had taken music theory, but we would like to see those numbers rise. The STEM no ATEC/EMAC students reported far more courses, at 170 courses taken, than the ATEC/EMAC group. We conclude that STEM students, some of whom are pursuing the minor, are taking music courses at a much greater rate than ATEC/EMAC students, who are taking, on the average only one to two courses. We conclude that both groups benefit from music enrollment, but that ATEC/EMAC majors should consider taking music more, particularly those who are interested in the sound design area. The STEM no ATEC/EMAC cohort had not taken sound design courses to any great extent. Only four reported any coursework in sound design and all at the introductory level. As noted before, sound design is not perceived by students at UT Dallas in this survey as an elective activity. STEM majors are far more likely to take music as an elective activity than sound design.

Prior Experience in Music and Sound Design

Both groups reported prior experience in music, with 73% for ATEC/EMAC students and 83% for STEM no ATEC/EMAC students. While the ATEC/EMAC students had less overall

experience, it was still considerable at 5.28 years, as opposed to STEM no ATEC/EMAC students with 6.32 years. This, however, did not translate into the high number of courses one would expect. We conclude that ATEC/EMAC students do not, in general, continue to pursue music in a formal capacity through coursework, in spite of their nearly equivalent experience to STEM no ATEC/EMAC students. STEM no ATEC/EMAC students continue to pursue music as an elective. Very few students reported prior experience in sound design, with only eight ATEC/EMAC majors reporting any activity at all. Only three STEM no ATEC/EMAC students reported any prior sound design activity. We conclude that the lack of formal instruction at the high school level impedes prior experience in both groups. Additionally, the informal nature of sound design experience prior to college makes it difficult to get an accurate picture of the nature of the experience and the length of time.

Music and Sound Design and General Academic Skills

Both ATEC/EMAC and STEM no ATEC/EMAC felt studying music and sound design had affected their academic skills, but the STEM group responded at a higher rate of 82%, as opposed to the ATEC/EMAC group at 70%. STEM no ATEC/EMAC students mentioned stress relief most often, and ATE/EMAC students mentioned knowledge. We conclude that the STEM no ATEC/EMAC group uses music for stress relief, but the ATEC/EMAC students see music

Music and Sound Design and Academic Abilities

A high percentage of both groups of students related that they had experienced flow in music and sound design, with percentages 90% and above. Both groups mentioned an alteration in the

perception of time, but STEM no ATEC/EMAC students also mentioned emotion. We conclude that STEM no ATEC/EMAC students are experiencing music as an emotional state, whereas ATEC/EMAC are more likely to see it as productive state. Both groups had experienced flow in other activities, but ATEC/EMAC students were more likely to mention artistic activities, and STEM no ATEC/EMAC students were more likely to mention academic activities.

The use of the word "form" in the musical sense led to a lower response rate from ATEC/EMAC students as to if they had studied form (57%) and a higher response rate from STEM no ATEC/EMAC students (68%). Both groups felt it had affect their academic abilities, but in the ATEC/EMAC students responded at a lower rate (67%) than STEM no ATEC/EMAC students (78%). STEM no ATEC/EMAC students responded with critical thinking. ATEC/EMAC students responded with seeing structure and discerning patterns. We conclude that both groups feel form affects their other studies, but in different ways. ATEC/EMAC students replied more directly about the structure of their designs whereas STEM no ATEC/EMAC students replied about critical thinking. Both groups felt pattern recognition was enhanced.

STEM no ATEC/EMAC students had experienced rubato at the greatest rate in the study (87%), with ATEC/EMAC students at a lower rate (58%). We concluded that the more advanced musical level of the STEM no ATEC/EMAC students led to a greater response to this question, as rubato is an advanced musical technique. Those students listed emotion, expression and technique as the common abilities, again indicating they understood the technical demands of rubato. ATEC/EMAC students, with less musical experience, did nor report technique, but did

mention emotion and expression. We conclude that only those students with advanced musical performance techniques understood the concept of rubato and how it applied to other subjects.

Both groups reported they had studied music theory at about the same rate (60-64%), but responded differently when it was asked if it had enhanced their other academic skills. STEM no ATEC/EMAC students responded positively at 66%, but ATEC/EMAC students at 89%. Many students in both groups responded it had helped their mathematics skills, as well as critical thinking and detecting patterns. We conclude that music theory as a pedagogical tool is of great value to both ATEC/EMAC students and STEM no ATEC/EMAC students, given its analytical nature.

ATEC/EMAC students responded that music and sound design study had affected their skills at 70%; the STEM no ATEC/EMAC rate was much higher at 85%. Both groups described similar activities, such as planning, focus, motivation and complex thinking. We conclude that the discipline required to pursue music and sound design enhances students' skills no matter what area of STEM they are in and that students in both groups acknowledged that fact.

Both groups felt music and sound design had enhanced their listening skills, with STEM no ATEC/EMAC students responding positively at 72% and ATEC/EMAC students at 70%. Reported experiences were listening skills, focus and multitasking, reported by both groups. STEM no ATEC/EMAC students also reported memorization. We conclude that enhanced listening skills were useful to both groups, but that the STEM no ATEC/EMAC need more

memorization skills than those in ATEC/EMAC and valued that more. Both groups mentioned that listening to lectures was a major part of their education.

Both groups had experienced segmenting, but the ATEC/EMAC students responded at 97%, no doubt due to the nature of the kind of work required in those majors. STEM no ATEC/EMAC majors responded at 83%. ATEC/EMAC students described the experience in both the vertical (tracks) and horizontal (temporal) directions. STEM no ATEC/EMAC were more likely to mention the horizontal (temporal) direction, but some and in particular those in choirs, also mentioned the vertical direction (voices). We conclude that both groups received enhanced two-dimension thinking due to the nature of their work, but that sound design enhances the effect more. STEM no ATEC/EMAC students who played orchestral instruments (where only their part is given) were less likely to mention the vertical direction.

Alumni Responses

Three of the fifteen alumni were ATEC majors (there were no EMAC majors in the alumni sample). Another eleven were in STEM fields, and one did not specify. As in the previous analysis of STEM majors, there was a dichotomy between current activites in these two groups. ATEC/EMAC majors were more likely to be working and STEM no ATEC/EMAC majors were more likely to be in medical or graduate school, or applying for admission. We conclude that the nature of ATEC/EMAC work makes it more likely that a student will pursue work following graduation, but most STEM no ATEC/EMAC majors lead to graduate level education. Both groups responded that their undergraduate study in music or sound design had helped them, but

STEM no ATEC/EMAC students were more likely to mention the social nature of music or stress relief and ATEC/EMAC students were more likely to relate it to their current work.

Music and Sound Design and General Benefits

Most responses here, similar to the full survey, either duplicated previous responses or indicated they had nothing further to say. A few additional thoughts from these two groups were in the ATEC/EMAC cohort, were one mentioned "discern quality work" and another that the negative effects of the time commitment to sound design adversely affecting their other studies. The STEM no ATEC/EMAC group remarked that "the people in music change who you are" and felt their music study had inspired them and motivated them to be successful.

Comparison of STEM Results with and without ATEC/EMAC Students

We also wanted to know if the inclusion of ATEC/EMACS in the STEM population had unduly influenced the results in the STEM group in the previous analysis. There were 114 students identified as STEM in the sample and 68 students when the ATEC/EMAC students were removed. General STEM gender was 48% male and 52% female; the exclusions of the ATEC/EMAC students made the sample more female at 52%. This is because ATEC/EMAC majors are more predominantly male in the sample. Eliminating ATEC/EMAC majors also changed the ethnicity, as the STEM sample was 44% white/Caucasian and 32% Asian; eliminating the ATEC/EMAC students, who are mostly white/Caucasian, changed the percentage of Asians in the STEM no ATEC/EMAC sample to 41% Asian and 38% white/Caucasian.

STEM students in general had on average 5.9 years of experience in music; eliminating the ATEC/EMAC part of the sample raised it to 6.2 years, due to the lower experience in music by ATEC/EMAC students. By contrast, STEM students in general had on average 4.0 years of sound design experience. This dropped to 2.8 years when the ATEC/EMAC students were eliminated from the sample. This is also due to ATEC/EMAC students having more sound design experience. STEM students in general had taken 216 music courses; without the ATEC/EMAC students, that figure dropped to 170 courses, indicating there are some ATEC/EMAC students taking music classes. Conversely, STEM students in general had taken 62 sound design courses, which dropped to four students, indicating that only ATEC/EMAC students are taking sound design as a rule and that STEM majors, other than ATEC/EMAC majors, do not take sound design to any great degree.

STEM students in general felt that music and sound design had affected their skills at 80%. The elimination of the ATEC/EMAC majors raised it slightly to 83%. The STEM students had experienced flow at a rate of 96%; without the ATEC/EMAC portion, that rate was almost equivalent at 95%. Studying form was experienced by 64% of STEM majors; without ATEC/EMAC that number rose to 68%. STEM majors had experienced rubato at 76%; that number rose to 85% because very few ATEC/EMAC majors had experience rubato. STEM majors had studied music theory at a rate of 67%; without the ATEC/EMAC majors, that rate fell to 65%, indicating that ATEC/EMAC majors in fact are studying music theory (or what they perceive as music theory). Given that music theory is one of the more analytical subjects in music, it is natural that those students in sound design or other areas of ATEC/EMAC would be

drawn to that subject. STEM students felt the practice and discipline required by music and sound design had affected their skills at 78%; eliminating the ATEC/EMAC students elevated that to 85%. The need to maintain attention to aural information was mentioned by 95% of STEM majors; when ATEC/EMAC majors were removed, the rate fell to 91%. ATEC/EMAC majors reported this at an even higher rate at 98%. Clearly sound design requires this kind of skill to a high degree and that need is recognized by ATEC/EMAC majors. Segmenting was a factor for 88% of STEM students, but fell to 83% when ATEC/EMAC students were eliminated, again due to a high percentage of ATEC/EMAC students reporting this effect (97%).

The perturbation of STEM results by including ATEC/EMAC students was relatively minor, but all the perturbations can be attributed to the difference between ATEC/EMAC majors, who primarily report sound design experience, with less experience in music; and STEM no ATEC/EMAC majors, who report music experience but almost no sound design experience. So to a great extent, these results mirror those of the music versus sound design cohorts previously described.

Final Conclusions

We can therefore come to these conclusions about the experiences of students at UT Dallas taking music and sound design courses.

Students who have taken music and sound design courses feel that music enhances their lives in many ways, and the majority of them feel it enhances their academic abilities.

Students who have taken music and sound design courses come to UT Dallas with varying years of experience, but far more years in music, which is a formal activity in pre-college years. They also have some experience in sound design, but with far fewer years and in an informal capacity.

Students benefit by the nature of their experiences in music and sound design, but they benefit the most from the more analytical aspects of the courses. STEM students were more likely to mention planning, while non-STEM students mentioned other skills, such as focus and motivation.

They benefit most from study in music theory, even if it is rudimentary and limited just to studying the form of a work. Learning to analyze a musical piece or sound design work requires recognition of patterns, analysis and critical thinking and extends to other academic subjects.

They benefit from the experience of listening to aural streams for extended periods of time with attentiveness to detail. The need to listen attentively for long periods of time, and to maintain that attention with focus and concentration, transfers to their other academic tasks, both in the classroom and outside it.

They benefit from the two-dimensional nature of both music and sound design by the requirement of analyzing a score or sound design project in both the vertical and horizontal directions. Both music and sound design are experienced in the horizontal (temporal) plane. But music and sound design are also experienced in the vertical plane: in the design of music scores with multiple voices or instruments, and in sound design, with multiple tracks.

Sound Design Students Versus Music Students

The sound design sample was half male (50%) but the music sample was more female (58%), combining to give a 49% - 51% male - female ratio in the full sample. The music sample was more Asian (36%) than the Sound Design sample (26%). Asian students are typically given music lessons as children and are more likely to pursue music courses in college. In all cohorts, the percentage of White/Caucasian and Asian was above 74%. Hispanics were 10% of the full sample, but this was entirely due to taking music classes; there were no students who identified themselves as Hispanic in the Sound Design Only sample.

A high proportion (95%) of students taking only sound design classes and no music classes are ATEC majors. By contrast, the majors of students taking music classes are highest in the sciences, as elective courses. The music minor is mostly pursued by students taking music courses as electives, as only five percent of sound design students had pursued the music minor.

Prior experience in high school is an indicator for taking courses in college, and the formal nature of music classes encourages more students to pursue music classes when they come to UT

Dallas. The informal nature of sound design prior to college and the general lack of formal classes in high school can lead to lower interest in sound design at the college level. However, those that do enroll in sound design courses report two to four years of experience. Additionally, 60% of the sound design students expressed prior experience in music.

The word "composition" has a much less strict meaning to students in the 21st century than it did in prior eras. The classical definition from music history requires a composer to create a score with the intent that other people will play your music, using that score. Students have a much more digital and fluid definition of the work, including recording improvisational activities, uploading it to an internet site and reporting the number of hits on their "compositions". The definition of "composition" is broadening to include more digital activities that don't require a score or indeed even human performers other than the composer.

If music students take a sound design course, it is most likely the "Introduction to Sound Design" course. Upper level sound design classes are taken primarily by ATEC majors. By contrast, students taking music classes are taking upper level performance and history courses, in addition to the Understanding Music course (which satisfies the state requirement) and they come from across the university.

Music students have more prior experience than sound design students, by about five years. Sound design students explore the area in an informal way, and typically start in high school. Music students, by contrast, often take music lessons at a very young age, some as early as four

to five years of age. Informal experience is harder to report, as it does not have the same temporal nature as formal study.

A higher proportion of music students than sound design students feel that their study affects their other academic skills, but about three-quarters of both populations feel that it does. About the same percentage report enhanced focus and concentration as a benefit. Sound design students do not feel their activity relieves stress, whereas music students feel that it does.

Most students experience “flow” during their activities in music and sound design. Students reported an altered perception of time, but described it differently. Music students were more likely to report feelings of joy, fun and embodiment; sound design students were more likely to report simply a changed perception of time. Most students had also experienced flow in other activities, but sound design students were more likely to report artistic or creative activities; music students were more likely to report sports.

More than half of sound design students have never studied the form or a work, as opposed to only one-quarter of music students. However, of those that had studied form, sound design students were more likely to see the benefit to other courses by a factor of over two. “Recognizing patterns” and ‘structure” were the most common benefits in both groups. Music and sound design students may think of form in different ways and this comparison might be useful in further studies. It helped most in mathematics courses for sound design students, but other courses, such as writing and languages, were mentioned by music students.

Studying music theory affects other academic skills, but more so in sound design students than music students. When asked to describe their experiences, sound design students respond differently, limiting their answers to pattern recognition and general learning. Music students include critical analysis in their answers. Both groups saw the largest benefit in mathematics classes.

Studying music or sound design affects their time management skills in other areas. Music students mention dedication; sound design students do not. Sound design students are taking their courses as a part of a degree plan, but music students are taking their courses as electives, hence requiring more "dedication" on their part. All cohorts felt music and sound design required discipline and time management but described it differently.

Studying music or sound design affects the ability to maintain attention to aural information. Sound design requires attention to details, as does music. Those in sound design perceive that it is an integral part of their activity. Memorization, on the other hand, is not, and was reported more by music students.

"Segmenting" required by music and sound design affects other skills in both music and sound design students. Both groups responded in both the horizontal (temporal) and vertical (tracks or voices) direction at about the same rate. Some responded in both. Both groups responded that it had helped "general learning" while only music students responded that it also helped with memorization.

More sound design students were working post-graduation; more music students were in medical or graduate school, or applying. Over 80% of both groups felt music or sound design had helped them post-graduate, but students who had studied sound design did not respond with social interaction or networking as a benefit. Music students felt it had helped them in those areas.

It has long been reported by music faculty that there are numerous STEM majors taking their courses. This was borne out by the sample, with more STEM students than non-STEM students taking both music and sound design classes. The STEM students were about evenly distributed in gender, but the non-STEM students were more female by a factor of two to one. More non-STEM students pursue the music minor than STEM students and we conclude that the low number of electives in many STEM majors discourage students from pursuing the music minor.

STEM and non-STEM majors have roughly the same experience in music prior to entering UT Dallas and the majority of their experience is of a formal nature. STEM and non-STEM students also have roughly the same amount of informal experience in sound design prior to entering UT Dallas, but STEM majors report more experience in composition and audio engineering. Non-STEM majors reported performance activities, such as playing in a band or singing in a group.

Pre-college experiences do play a factor in undergraduate course selections. Those with experience in music tend to continue to pursue music regardless of major. Those with experience in composition and audio engineering are more likely to be attracted to sound design, as well as other majors.

STEM majors were more likely to pursue instrumental music than non-STEM majors. More STEM majors take courses in music theory, and the two courses “Creating Music” and “Digital Music”. Very few non-STEM majors had taken those courses. More STEM students were enrolled in music courses, with STEM students taking on average two music courses. Non-STEM students, who were a smaller part of the sample, were taking on average four music courses. We conclude STEM students do not have as much room in their schedules to pursue electives and have to limit their enrollment in music. Non-STEM students, which included Art and Performance majors, have more time to take music classes or do so as a part of their degree.

Sound design courses are taken primarily by STEM majors. The observation of no non-STEM majors in the survey taking sound design is a significant result that should be communicated to the faculty. STEM majors outside ATEC do not take sound design in any great numbers, and, given the informal nature of the background of students in that area, do not see it as activity they wish to pursue as an elective. Sound design is a needed subject for many of the areas in ATEC, which is heavily invested in games and animation, and it still needs to be expanded. The upper-level offerings for Fall of 2016 are limited, with only four courses listed. The interest in sound design is present and more courses should be offered to expand this area, and to encourage interested students from other majors to enroll, if the faculty desires.

STEM students and non-STEM students have prior musical experience at about the same rate, but fewer STEM students took band, which requires more hours outside regular class time. We

conclude that STEM majors are more likely to take orchestra or choir, in order to limit their hours of involvement.

For STEM and non-STEM majors, taking music and sound design enhances their academic skills at the same rate but they do not describe their experiences in the same way. STEM students report more stress relief than non-STEM students. Non-STEM students report enhanced public speaking skills. Both groups report enhanced focus.

STEM and non-STEM students both experience flow in music and sound design activities, with common experiences. They describe them in similar ways.

STEM and non-STEM students who have studied form feel it enhances their skills, but STEM students report that enhancement more in mathematics and science courses, and non-STEM in literature and writing. Students tend to see the enhancement more in their major courses of study, rather than in other electives.

Music theory enhances analytical skills in both STEM and non-STEM students, but STEM students reported it more as general learning; non-STEM students reported critical thinking and analytical skills. We conclude that the two groups are benefited by studying music theory, but are describing their experiences differently.

The same was true for time management and discipline; both STEM and non-STEM students reported at the same rate, but used different terms to describe the enhancement.

Non-STEM feel the listening skills obtained in music and sound design were of great benefit to their other studies; STEM students feel this less so, but both groups feel focus is the main benefit. Enhanced memorization skills are a more common benefit in non-STEM students. We conclude that maintaining attention does help with listening to lectures, and that both STEM and non-STEM students also have non-lecture type activities that may be enhanced by their listening skills.

STEM students are more likely to benefit from the two-dimensional nature of sound design than non-STEM students. Students who take instrumental music have less two-dimensional experience than those who take choir, due to the nature of the scores they read. Sound design students benefit from the nature of sound design work, which involves both horizontal and vertical analysis and listening.

After graduation, STEM students are more likely to be in medical or graduate school, or seeking admission; non-STEM students are more likely to be working. Both feel music and sound design enhanced their college years and their post-graduate experiences. STEM students report it as a stress-relieving activity. Non-STEM students value the social aspects more.

Non-STEM students reported networking skills, cooperation, self-esteem and self-regulation. STEM students reported sharpening senses, delayed gratification, persistence and patience. A few STEM students felt studying music had taken time away from their other studies and reported that as a negative effect.

Including the ATEC/EMAC students in the STEM sample perturbed the demographics in somewhat significant ways. Because ATEC/EMAC has more male students, the STEM population without ATEC/EMAC was slightly more female. More Asian students take STEM classes that are not ATEC/EMAC. More STEM students who are not ATEC/EMAC minor in music.

STEM students who are not ATEC/EMAC have more experience in music, with generally one more year than ATEC/EMAC students. They also tend to play more than one instrument, whereas ATEC/EMAC students tend to play only one. ATEC/EMAC students have slightly more experience in sound design, but the informal nature of the activity makes it hard to get an accurate picture of their experience. Students with formal music training are more likely to continue to pursue that area in college.

STEM students who are not ATEC/EMAC take music courses at UT Dallas, but no sound design courses. ATEC/EMAC majors take sound design courses and take music courses to a lesser extent. STEM majors are far more likely to take music as an elective activity than sound design.

Both groups thought studying music and sound design affected their academic skills, but the STEM no ATEC/EMAC group felt so more strongly. These students used music for stress relief, but ATEC/EMAC students do not see that as a benefit.

Both groups reported experiencing flow in music and sound design but expressed the experience differently. ATEC/EMAC students were more likely to mention the artistic nature of their experience, whereas STEM no ATEC/EMAC students were more likely to speak of the academic benefits.

Both groups had studied form and felt it affected their academic skills. ATEC/EMAC students replied more directly about the structure of their design whereas STEM no ATEC/EMAC students replied about critical thinking. Both groups felt pattern recognition was enhanced.

Rubato was reported more by STEM no ATEC/EMAC students than any other group in the study. The nature of rubato and the technique required is an advanced concept and the more musical experience of this group influenced their responses. ATEC/EMAC students did not report technique in rubato, but did mention using it for emotion and expression.

Both groups felt studying music theory had enhanced their skills and both groups mention the benefit in mathematics courses. Music theory as a pedagogical tool is of great value to both groups and is attractive because of its analytical nature.

The discipline to pursue both music and sound design was present in both groups and this discipline enhances their skills no matter what areas of STEM they are in.

Both groups felt music and sound design had enhanced their ability to maintain attention to aural information, particularly in lectures, but STEM no ATEC/EMAC mentioned memorization skills as well.

Segmenting was reported by both groups, but sound design students reported it in the vertical (tracks) and horizontal (temporal) direction about equally, due to the nature of their activities. STEM no ATEC/EMAC students reported the horizontal direction more often.

Both groups received enhanced two-dimensional thinking, but the STEM students who were in orchestra or band did not get the benefit as much, since they often read from just their part and not the whole score.

Alumni in ATEC/EMAC were more likely to be working. STEM no ATEC/EMAC alumni were more likely to be in graduate or medical school, or applying for admission. Both groups felt music and sound design had benefited them post-graduation, but ATEC/EMAC students were more likely to mention current work. STEM no ATEC/EMAC students were more likely to mention stress relief and the social nature of music.

Because the STEM students who were not ATEC/EMAC majors had taken music courses but had not taken sound design courses to any great extent, the elimination of the ATEC/EMAC majors from the STEM cohort produced results very similar to the comparison between music and sound design students. The STEM no ATEC/EMAC group was slightly higher female, more Asian and had more years of musical experience, but fewer years of sound design experience. Eliminating the ATEC/EMAC majors raised the percentages in students who had experienced flow, studied form, experienced rubato, believed practice and discipline was required in music and enhanced their other skills. In three areas, the percentages dropped when ATEC/EMAC majors were eliminated: studying music theory, attention to aural information and segmenting. The ATEC/EMAC students were a higher proportion of the sample in these three areas.

The perturbation of STEM results by including ATEC/EMAC majors was relatively minor, but we conclude that indeed ATEC/EMAC majors differ from the other STEM students in one important characteristic: they take predominantly sound design classes and take music classes to a lesser extent as electives. STEM students from the behavioral and natural sciences, and engineering and computer science take music as electives and do not take sound design classes. So to a great extent, these conclusions mirror those of the music versus sound design analysis.

CHAPTER SIX

PEDAGOGICAL IMPLICATIONS AND FUTURE RESEARCH

Limitations of the Study

When I began this research project, I referred to it as a "toe in the water". The great majority of music education studies focused on majors, and those that looked at non-majors only studied music appreciation courses. But none had looked at the effects that music study, in particular active study such as performance or music analysis, had on students who are enrolled in other majors, and STEM majors in particular. In fact, music instructors at all levels of education should be cognizant of the fact that the majority of the students in their courses will not be going on to music careers; most will enter other fields, and many will become STEM majors in college. Instructors should be aware that their students are gaining many skills through their music studies that will enhance their skills in other courses, and strive to be sure that those skills are included in their pedagogy. The goal of this study was to understand the kind of experiences students were having when taking music and sound design classes and how it affected their other academic classes. This is an important first step before more specific studies can be initiated. We know that music study creates students with higher academic achievement. But what is really going on in their music courses that creates that effect? What are they learning that can be useful to them in other academic settings?

Note that I have been hesitant to use the words "skill transfer". What we have studied is the perceptions students have about how music and sound design help them in other ways. We have

tried to understand the experiences they are having. As such, this is not technically "evidence" of "skills transfer" but rather the perception that students have about what they are learning and how it may transfer to other activities. Evidence of skills transfer would take a much more controlled research study, which we will describe later.

While it is possible that students responded in way that they perceived as the "correct" answer, it should be noted that a fair number did not agree with many of the questions; and that those who did were then asked to describe their experience. They did and often in great detail. One of the most revealing and gratifying aspects of the study was the very thoughtful and articulate responses we received. One must also consider the "self-fulfilling prophecy" effect. It is possible that some of our respondents had never thought about the connection between their music and sound design classes and their other academic tasks. Indeed, a few did respond with "I never thought about it before." A study that looked at over 35 years of empirical research on teacher expectations and student success concluded that the "self-fulfilling prophecy" had a negligible affect on student performance when the expectation was that of the teacher. However, when it was the student's expectations that were higher, the results were more positive (Jussim and Harber 2005). We conclude that there may be a beneficial effect on student performance if the students themselves see the connections between different disciplines.

The sample size was sufficiently large enough to draw important conclusions, but there was more music students than sound design students in the sample by a factor of two-to-one. This is a result of the far larger available student coursework in music than sound design and a larger

population taking music than sound design at UT Dallas at present. The smaller sample size of the sound design students made it difficult to draw conclusions in the cohort comparisons, but was significantly large in the general survey. From a phenomenological point of view, all samples were sufficiently large to obtain saturation and therefore relevant (Guest 2006).

Finally, the length of the survey, at 50 questions, was longer than ideal. For future study, a shorter survey would likely be completed by a higher percentage of respondents. However, the number of students who did finish the survey was statistically high enough to draw conclusions. One consideration would be to survey music and sound design students with different surveys, including different questions more relevant to their study. This would not have allowed us to consistently compare the two populations, so a single survey was preferable at this time.

Pedagogical Implications

This study has important pedagogical implications for curriculum in both music and sound design. In particular, when teaching music to non-majors (one focus of this study) it is important to remember that there are areas in music, beyond simple performance technique, that will benefit the students in their other studies. All music coursework should discuss form, basic music theory and analyze the structure of the works being performed, studied or listened to. Sound design classes should pay more attention to musical structure and form as well, and make sure students have a thorough grounding in music theory and history. Sound design programs are relatively new in colleges and universities and a study of other programs could also help

determine what music curricula are useful to those programs. All courses, in both music and sound design, should emphasize the analytical processes that are used and encourage students to make connections with their other coursework and their major fields of study. Academic skills in segmenting and listening should be stressed. Instructors should be aware of the majors of their students, and how they can best enhance their education with the techniques that are present in both areas. Focusing purely on technique and performance in music courses, as is so often done, ignores these findings and technique should be only one part of the curriculum. It ignores the larger skill set that non-music majors require: observation, critical thinking, and abstracting, to name a few.

Use of the "bridges" specified by Robert Root-Bernstein in Chapter One of this dissertation also lead us to new ways of thinking about how to strengthen the connections between the arts and the sciences, and in particular between music and the STEM subjects (Root-Bernstein et al. 2016c). Bridges run both ways: there are implications not only for music and sound design curricula but for STEM curricula as well. Knowing that many music courses include STEM majors and that they have the need for analytical skills in their major courses, leads us to believe that teaching music analysis will help them. Drawing on the skills in Bridge No. 1 (observing, imaging, abstracting, pattern recognition and pattern forming, analogizing, empathizing, body thinking, dimensional thinking, modeling, playing, transforming and synthesizing), music instructors should endeavor to include activities such as score reading, theoretical analysis, and patterning. Additionally, memorization techniques are vital to both music and STEM areas and the devices used in music can enhance those skills in STEM subjects. But there is also the

implication that the very analytical skills they need in STEM courses make them better musicians. STEM students at UT Dallas take music theory as an adjunct to their music performance courses, probably because they enjoy and understand the analytical processes that take place there, which in turn, enhances their musical performances.

Music students in this study (as defined in Chapter Three of this dissertation) had very little experience in sound design courses, but did indicate some informal experience. Music curriculum in the 21st century needs to be expanded to include the more technological skill sets that musicians now need. It is no longer enough to be able to play your instrument well and go to auditions to get jobs. Every music students should have courses in sound design that teach them the basic skills of creating and manipulating tracks, recording techniques, and music processing. Additionally, they should know how to create and maintain a website. My own program has decided to include music technology courses in the re-design of our music concentration, and the possible creation of courses that are more geared toward technology and the sound design students' interests.

STEM to STEAM Implications

The interest in using the arts to teach STEM subjects has been on the rise for the last twenty years and much has been done to develop curriculum to enhance the teaching of STEM. But greater understanding of the academic tools students receive during arts training is critical to this movement. It is not enough to simply "insert" the arts into STEM classes. We need to

understand the kinds of "thinking tools" that are needed in STEM and what types of interventions would enhance those tools. In particular, this study has highlighted skills that students perceive to be helpful in both areas: concentration and focus through entering the flow state; the ability to develop pattern recognition; the ability to analyze structure from the largest element down to the smallest detail; the ability to listen carefully and meaningfully to aural information; and the ability to memorize large amounts of information by structuring it. If the STEAM movement focuses its efforts on these kinds of specific tools it is likely they will find their efforts are not only more successful, but more accepted by the STEM constituency.

The increasing presence of programs like the new School of Arts, Technology and Emerging Communication has further implications for the STEAM movement. Students in the 21st century do not perceive "boundaries" of technology with other subjects. Indeed, they see technology for the tool that it is, whether they are creating a sound design or working in a chemistry laboratory. The word "composition" is no longer putting pencil to paper to create a score for other musicians to play, but rather a fluid use of technology to create sounds and music in a technological environment that does not involve a score or sometime even the need for human musicians other than the composer. One student, who had a lot of musical experience and interest, and was currently playing drums in multiple environments, chose EMAC as his major so that he could learn marketing techniques. Programs in music entrepreneurship are being created in many universities, combining the skills needed in music with the skills needed in business and media to promote one's career. Such programs will necessarily need to address digital skills. Is there still really as great a divide between the arts and the sciences as there was in the past century? The

students who responded to the survey in this study easily made the connections between music and their studies in neuroscience, chemistry, biology and mathematics. Curriculum that reinforces these connections needs to be created with the specific experiences of students in mind.

Formal Versus Informal Education

While this was not a focus of the study, several differences in formal versus informal study were highlighted by the study of music and sound design students. Sound design is not a formal activity in the K-12 space, yet many students spend individual time in the activities that are needed for formal study at the college level. While they would not necessarily identify themselves as "sound designers", the years many of the students in the survey had spent "playing" with music, computers, keyboards, software and other sound-manipulative programs was impressive. One implication was the difficulty in precisely identifying the kinds of experiences they had and the length of time they had spent on that activity. It was easy for the respondents to say "I played in an orchestra from sixth grade through high school"; it was far more difficult to judge "I played in a band for years" or to evaluate the EMAC student who remarked that he became interested in music and composition when he received a digital keyboard but did not take a formal piano class until high school. He uses computer algorithms (and writes them) to compose music. What skills was he acquiring during those years of "fooling around" on that keyboard? Future studies need to look at how the ubiquity of digital

keyboards, software and websites like SoundCloud are impacting the learning skills of students at an early age.

Implications for Future Research in Skills Transfer

A true study of skills transfer requires much more stringent requirements. A recent review of studies by Robert Root-Bernstein "A Review of Studies Demonstrating the Effectiveness of Integrating Arts, Music, Performing, Crafts and Design into Science, Technology, Engineering, mathematics and Medical Education" called for more specificity and well-defined pedagogical connections for trans-disciplinary transfer. The "gold standard" for skills transfer research would involve a representative sample of students, a well-controlled study with a matched control group, pre- and post-tests of both groups with a well-accepted testing mechanism, clearly defined goals, and an intervention that is instituted to produce a substantive effect (Root-Bernstein et al., 2016a-c). This research could be carried out in the following steps:

1. Using this study, select skills, such as pattern recognition or listening ability, that can be tested and assessed through well-established testing methods, such as those used by Kirklin, et al (2007) and Naghshine, et al. (2008) to test observation. Additional testing methods that could be used are those of Aleman, et al., (2000), who have demonstrated that music training improves the ability of students to recognize themes from songs as well as a variety of everyday sounds; or those of Scheiter, et al. (2009), where students were presented either with multiple observations of musical, dance or theater performances that display one or more common themes or principles, or

students were presented first with an abstract set of themes or principles that are then exemplified by musical, dance or theater performances. Multiple other studies can be accessed to find acceptable testing vehicles.

2. Solicit a sufficiently large sample size of students, both in the test group and the control group to obtain relevant results of the skills.
3. Conduct a pre-test of the selected skills.
4. Design an intervention method, either through curricular changes or additional tasks, such as workshops, using principles from music and/or sound design to design such interventions in those skills represented in this study.
5. Conduct a post-test to see if the required skills have been enhanced more in the students with the intervention than in the control group without the intervention.

One area of interest should be the recurring theme of pattern recognition and its enhancement by the study of music theory. One such possible study could use the work of Wee and Sanderson (2008) to measure pattern recognition. That study was conducted by testing student ability to learn and recognize sets of similar auditory or movement patterns made up from permutations of basic elements. Part of the patterning training could use techniques such as “Isochords” (Bergstrom et al., 2007), which employs graphing techniques to visualize musical patterns. Since all arts require the learning, practice and recognition of patterns, arts-trained students may perform better on patterning tests than students without arts training.

In the summer of 2015, Roger Malina and Kathryn Evans spearheaded a grant proposal to the National Endowment for the Arts Research Lab program that included Robert Root-Bernstein, science educator Eun Ah Lee and psychologist Rosanna Guadagno, plus additional faculty in dance, drama and sound design. This two-phase study would first test what skills are being transferred from arts courses to STEM courses by studying STEM students who have taken arts courses. This would then lead to the creation of arts-based workshops that would incorporate the learning principles into STEM curriculum, with pre- and post-tests to determine if there was evidence of skills transfer, with a control group that would not receive the intervention. For the complete proposal, including the biographies of the research team, please see the Appendices.

Final Thoughts

The research described above will only look at the short-term effects of such intervention. The long-term effects of music and sound design training would require a longitudinal study over far greater periods of time, maybe even years. But not all effects of studies in the arts can be measured. As Elliot Eisner states in "The Arts and the Creation of Mind" (2002), "Not everything that matters can be measured and not everything that can be measured matters." In fact, Eisner felt that the arts had much to offer other curricula in ways that can be difficult to assess. He proposed five areas where the arts are of value to education in general:

1. There can be more than one answer to a question and more than one solution to a problem.

2. The arts teach us our own particular signature is important.
3. The way something is formed matters.
4. The importance of imagination and the refinement and use of sensibilities is useful in all disciplines.
5. Intrinsic satisfactions matter and practices that take the intellectual heart out of learning are to be avoided.

Finally, to paraphrase Eisner (2002), the arts remind us of what life can be at its most vital. While this study has focused on what skills obtained in music and sound design can transfer to other disciplines, these courses should always be taught with an eye towards what makes the pursuit of music and sound design (and any of the arts) important to our students: there is joy and meaning in creating art and this is a worthwhile human endeavor. The arts are among the resources through which individuals recreate themselves and are sources of deep enrichment for all of us.

The possibilities for growth in and through the arts cease only when we do.

--- Elliot Eisner, *The Arts and the Creation of the Mind (2002)*

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

THE UNIVERSITY OF TEXAS AT DALLAS

Office of Research Compliance

800 W Campbell Road AD15 Richardson Texas 75080-3021
972-883-4579 Fax 972-883-2310

Date: 13 November 2014

To: Kathryn Evans
Roger Malina, Ph.D.
Arts and Humanities

From: Sanaz Okhovat
Assistant Vice President, Office of Research Compliance
Office of Research

Re: **MR 14-411**
Does Studying Music Enhance Higher Order Learning Skills in Undergraduate Non-Music Majors?

This letter is notification of Minimal Review Approval of research project listed above. This submission meets the criteria for exemption #2 of Chapter 45 Code of Federal Regulations Part 46.101(b). IRB approval of this research begins as of **13 November 2014** and ends on **12 November 2015.**

The IRB requires all those who have access to research data be trained in research ethics and practices concerned with the protection of the welfare and rights of research participants. These ethical principles are outlined in the Belmont Report.

Investigators and key personnel involved with this protocol must have documented training with this office. The training can be found at http://www.utdallas.edu/research/orc/irb/required_training/

If you have any questions related to this approval, you may contact me by phone at 972-883-4579 or by email at sanaz.okhovat@utdallas.edu.

APPENDIX B

QUALTRICS SURVEY

Music Enhances Academic Skills

Q1 I agree to participate in a research study of "Does studying music enhance higher order learning skills in undergraduate non-music majors?" I understand the purpose and nature of this study is to explore the nature of music study and its effects on academic achievement. I have been solicited because I have taken at least one music or sound design course at the University of Texas at Dallas and I am participating voluntarily. I grant permission for the data to be used in the process of completing a PhD degree, including a dissertation and any other future publication. I understand that a brief synopsis of each participant, including myself, may be used and will include the following information: the fact that I am or was a UT Dallas student enrolled in one or more music or sound design courses; which courses I was enrolled in; and my major course of study. I further understand that at no time will my identity be used or revealed in any way and that participation in this study has no bearing on my coursework at any time during my enrollment at UT Dallas. Your responses will be anonymous. Please do not answer the survey more than once.

- ❍ "I have read the consent form, understand it and I agree to participate." (1)
- ❍ "I do not wish to participate." (direct to end of survey) (2)

If "I do not wish to participa... Is Selected, Then Skip To End of Survey

Q2 In order to protect your anonymity and to prevent duplicate answers, please answer the following three questions, which will be used to generate an ID number for you: What is the day of your birth date? Please answer 1 – 31. (Example, if your birth date is 5/12/72, your answer is 12.)

Q3 What is the month of your mother's birth date? Please answer 01 – 12. (Example: If your mother was born in April, your answer is 04. If you do not know, pick a number from 1 to 12).

Q4 What are the last two digits of the year of your father's birth date? Please answer 00 – 99. (Example: If you father was born in 1958, your answer is 58. If you do not know, pick a number from 00 to 99).

Q5 Are you a currently registered student at UT Dallas or have been in the past ten years?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To End of Survey

Q6 What is your gender?
- ❍ Male (1)
- ❍ Female (2)

Q7 What is your ethnicity?
- ❍ White/Caucasian (1)
- ❍ Asian (2)
- ❍ Hispanic (3)
- ❍ African/American (4)
- ❍ Native American (5)
- ❍ Native Hawaiian (6)
- ❍ Two or more races (7)
- ❍ Don't Know/Prefer Not to Answer (8)

Q8 Have you been enrolled in a music or sound design course in the last ten years?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To End of Survey

Q9 What is/was your major?

Q10 Are you/Were you a music minor?
- ❍ Yes (1)
- ❍ No (2)

Q11 Have you played an instrument or sang in a formal musical experience (classes, private study, ensemble) besides your UTD coursework?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Have you participated in music or sou...

Q12 If yes, for how long and in what capacity? Please include any ensembles (choir, orchestra, band) that you have played in.

Q13 Have you participated in music or sound design in an informal capacity (in a band, composing, arranging, recording, etc.)?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To What music courses have you taken at ...

Q14 If yes, for how long and in what capacity?

Q15 What music courses have you taken at UTD, either now or in the last ten years? Please indicate the name of the course and the MUSI number, if you can recall it, and when you were enrolled. If you were not enrolled in a MUSI course, please respond "none".

Q16 What sound design courses have you taken at UTD, either now or in the last ten years? Please indicate the name of the course and the ATEC number, if you can recall it, and when you were enrolled. If you were not enrolled in a sound design course, please respond "none".

Q17 Have you studied music before you attended UT Dallas?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Have you studied sound design before ...

Q18 If yes, for how long and in what capacity?

Q19 Have you studied sound design before you attended UT Dallas?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Do you agree with this statement: Par...

Q20 If yes, for how long and in what capacity?

Q21 Do you agree with this statement: Participating in music or sound design courses has affected my academic abilities in other courses.
- ❑ Strongly Disagree (1)
- ❑ Disagree (2)
- ❑ Agree (3)
- ❑ Strongly Agree (4)

If Strongly Disagree Is Selected, Then Skip To Some musicians relate experiencing "f...If Disagree Is Selected, Then Skip To Some musicians relate experiencing "f...

Q22 If so, describe one experience that has affected your skills in another course.

Q23 Some musicians relate experiencing "flow" when they study or perform music. One indication of "flow" is the sense that you "lost track of time" during the experience. Have you ever experienced "flow" when doing music or sound design?
- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Most of the Time (4)
- ❍ Always (5)

If Never Is Selected, Then Skip To Have you also experienced "flow" in a...

Q24 If so, please describe the feeling you had during that experience.

Q25 Have you also experienced "flow" in a non-musical activity?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Many music students study the "form" ...

Q26 If so, please describe that experience.

Q27 Many music students study the "form" of a musical work (such as ABA, rondo form, sonata form, etc.) when they study pieces of music. Have you analyzed the form of a piece of music?
- ❍ Not At All (1)
- ❍ Occasionally (2)
- ❍ Frequently (3)

If Not At All Is Selected, Then Skip To "Rubato" is the concept of changing s...

Q28 Do you agree with this statement: Learning to analyze musical structure affected my academic skills in other classes.
- ❑ Strongly Disagree (1)
- ❑ Disagree (2)
- ❑ Agree (3)
- ❑ Strongly Agree (4)

If Strongly Disagree Is Selected, Then Skip To "Rubato" is the concept of changing s...If Disagree Is Selected, Then Skip To "Rubato" is the concept of changing s...

Q29 If so, please describe how it affected your other academic tasks.

Q30 "Rubato" is the concept of changing slightly the tempo of a piece, a slight speeding up and then slowing down of the tempo of a piece at the discretion of the soloist. Have you ever used rubato in a musical piece?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To The study of music theory can be simi...

Q31 If so, please describe that experience.

Q32 The study of music theory can be similar to that of studying mathematics or a language. Have you studied music theory?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Studying music or sound design requir...

Q33 Do you agree with this statement: Studying music theory affected my academic skills in other courses.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Agree (3)
- ❍ Strongly Agree (4)

If Strongly Disagree Is Selected, Then Skip To Studying music or sound design requir...If Disagree Is Selected, Then Skip To Studying music or sound design requir...

Q34 If so, describe how studying music theory has affected your other academic skills.

Q35 Studying music or sound design requires a lot of practice and discipline. Do you agree with this statement: Studying music or sound design has affected my discipline and time management skills in other subjects.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Agree (3)
- ❍ Strongly Agree (4)

Q36 If so, please describe an experience where your study in music or sound design affected your other academic skills as regards discipline and time management.

Q37 Do you agree with this statement: Studying music or doing sound design requires one to maintain attention while listening to a stream of aural information.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Agree (3)
- ❍ Strongly Agree (4)

If Strongly Disagree Is Selected, Then Skip To Studying music or sound design requir...If Disagree Is Selected, Then Skip To Studying music or sound design requir...

Q39 If you agree, has the need to maintain attention through listening to a stream of aural information affected your academic skills?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Studying music or sound design requir...

Q40 If so, please describe that experience.

Q41 Studying music or sound design requires the breaking up of auditory information into smaller segments. Have you experienced this "segmenting" when you studied music or sound design?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Have you graduated from UTD with an u...

Q42 If so, please describe that experience.

Q43 Have you graduated from UTD with an undergraduate degree?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Do you agree with this statement: Stu...

Q44 If so, what degree did you earn and when?

Q45 What are you doing now (graduate school, medical or dental school, working, seeking work, etc.)?

Q46 Do you agree with this statement: Study in music or sound design helped me with my post-graduation activities (school, work, etc.).

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Agree (3)
- ❍ Strongly Agree (4)

If Strongly Disagree Is Selected, Then Skip To Finally, please describe any other mu...If Disagree Is Selected, Then Skip To If so, describe how it helped you.

Q47 If so, describe how it helped you.

Q48 Finally, please describe any other musical or sound design experience you have had that you feel has affected your ability in other coursework.

Q49 We will be following up this survey with in-depth interviews. Participants will be compensated at the rate of $10 for one hour of your time. Interviews will be conducted by the primary researcher at a mutually agreeable time and place. If you are interested, please enter you email below and we will contact you to set up your interview.

- ❍ Yes, I'm interested! Here's my email address to contact me. _____
- ❍ No thanks.

Q50 Thank you for participating in our survey. Your participation is very valuable to our research study about music study and academic skills and we appreciate your time!

APPENDIX C

TRANSCRIPTIONS OF INTERVIEWS

S= subject, R= researcher

Subject 010663 February 28, 2015

R: What is your major?
S: Neuroscience.
R: Neuroscience. Great. And how long have you studied music?
S: Um. I would say 12 to 13 years. I started in a choir club in the first grade and have been doing that consistently, I never stopped. So this would be my 13th year.
R: So for a long time. It says you also are playing the piano, practicing the piano.
S: A little.
R: A little bit, OK, great.
S: And what classes have you taken at UTD? In music.
R: Chamber Singers I, Chamber Singers II.
S: So you've had a year of Chamber Singers. Are you a Freshman, Sophomore?
R: Freshman.
S; You're a Freshman, this is your first year at UTD.
R: And you have not taken any sound design classes.
S: No I have not.
R: Arizona Music Educators Association, very good. So the first thing we are going to talk about is how you feel that studying music has affected your other academic abilities in other courses, ok. I noticed you said on here, you talked about intense practice when you were in the all state jazz choir. Tell me a little more about that experience and how you think it helped you in your other classes when you were doing that.
S: It definitely takes a lot of discipline. It started jazz choir last year, my first year. I was awful! Just being able to feel the rhythm was something that did not come naturally at all to me, so working it over and over and over again. Which is definitely something I've had to do in other courses. Especially math. I took calculus last semester and it's the same thing, you just have to sit there and do it over and over and over until you get it right. Oh so I definitely feel there is always something to be gained just from practicing a skill. It doesn't always matter what it is. Just he act of practicing and of perfecting something will always enhance that ability to kind of generalize that.
R: Great. So let's talk about form in music. Not all students study form, but I think we are all aware of form in music. Form is the structure of music, and you said you had occasionally studied form. Tell me a little bit about that, about analyzing music.
S: It's music from different time periods, a madrigal versus something more pop. Talking about lines sectioned out in the music, who has the melody, who's in the background, being able to identify when that shifts and when I guess parts of the music where it's all unison. Those kind

of differences. Especially with choral music, there are multiple parts for a reason. Trying to figure ways composers use those parts to enhance each other.
R: So how do you think that has helped you in your other academic classes?
S: I mean it's definitely good to be aware especially in a classroom setting, like knowing.I don't know. I always try and think about and I don't really now.
R: That's a fair answer, that you sort of understand how it works in music but you're not quite sure how it transfers. Ok. The next thing was about practice and discipline, also a little about how studying music has affected your ability to have discipline and time management in other subjects.
S: Last year I took two choir classes, so a minimum of two hours a day and then if I had an audition, or if I was learning music for another group, that would go to three or fours a day. That's a really significant amount of time. I would be taking time out of lunch. I would miss other classes so learning to be proactive and communicate with teachers, doing work ahead of time, really figuring out how to sacrifice time and what to take it away from. Being proactive about it is probably the biggest thing that I learned. It's so much easier to try and catch up before rather than after.
R: So you think it helped you learn to do your work ahead of time rather than catch up?
S: Yes.
R: Four hours a day, that's lot during a high school day. The next thing we are going to ask you about is listening skills. One of things we do when we listen to music or learn music is that we have to segment it into pieces. Talk to me about that, about how you listen to music or how you think about music when you prepare to perform.
S; I'm trying to think. We often will listen to recordings, so you have to pick out your part, definitely an important skill. Preparing to perform – I guess you just pick up on the nuances, the vowels, the enunciated syllables. You really have to pick up on smaller and smaller details.
R: So you learned to pay attention to details. How do you think that helps you in your other academic classes. You talked about math a little bit. Paying attention to details. How do you think that helps you with some of your other work?
S: I'm taking chemistry right now. There are so many things that are going on. You have to be able to pick out what is the concept that is being taught and then what is the formula. A lot of times that is what happens, that there is this over-arching concept, and then a simple formula or mechanism to find the thing you are looking for. So to be able to distinguish between those two things when somebody is talking about one or the other.
R: So it helped you focus on the more important parts, sort of like you focused on the important part when you were doing choral music. So again talking a little more about segmenting. Segmenting is taking a large thing and breaking it into smaller parts. And that's very typical in music rehearsals, that you will take a small part of a piece and practice it some more. So have you had that experience?
S: Like relating it to class?
R: Let's talk about segmenting in music first.
S: Oh, absolutely, especially when you are first learning a piece, you will generally go to a section that is repeated throughout the song. A lot of times you will see repetition and then a very little bit of variation, so you will learn the part and then you will say "Now tenors sing these three notes differently" or the altos or whoever, since that is something that definitely happens.

Learning beginning and endings is something you do a lot first, since those parts tend to stay with the listener, so those are parts that you really want to hit correctly, you want the timing, the pitch, you want it to be on.
R: That's interesting, beginning and endings. You are a neuroscience major, right?
S: Yes.
R: So you know about the neurological theory of what the brain can hold and remember? Do you know about that?
S: Yes, we've talked about that, really more in psychology. You remember the first thing, you remember the last thing. The middle, well maybe if you hear something really spectacular, really interesting or really bad, you will remember, but generally the beginning and end is what you remember.
R: Right, that's a pretty well known "first and last, easier to remember". You said you only remember the things in the middle when something special happens.
S: Yes.
R: Do you think that applies to music?
S: Oh yes.
R: Composer understands that?
S: Oh yes.
R: So some of the skills you learned in music was to break things into parts and learn in chunks. Do you use that in your other classes?
S: That seems…usually a lesson will cover one particular thing each time as opposed to…you don't walk into a lecture and have them say "we're going to cover three chapters and we're going to talk about all three of these chapters in every class for the next three weeks. Ok, we're going to the first half of this chapter and then the second chapter and so on and so forth.
R: So you're taking music classes right now, so I can ask you aboutanything you think is happening in your learning skills right now that you can take out of your music class, when you walk out of Chamber Singers, that helps you in your other classes.
S: This is going back just a little bit, but last semester – like being proactive with Best of Broadway – I had two exams that next week. Actually, I think those are the two exams I did the best on!
R: Interesting. Why do you think that is the case?
S: I was proactive, I expected it to be difficult, I repeatedly looked at the material. It probably helped to have a lot of extra sleep that Sunday because the show ended.
R: So you studied well in advance.
S: I did.
R: It's interesting that you think you actually did better than you would have otherwise. Tell me why you think that happened.
S: I wouldn't say over prepared but I think when you expect things to be hard you just get into that mindset and really, really practice. One thing I noticed too is that it's nice to be able to walk into the room and have it be review as opposed to trying to learn during the lecture. You are just rehearsing and you can apply the concepts, and you can really listen to the Professor.
R: Since you are studying ahead, you sort of know what's coming.

S: And it's really true with music too. We do the same songs so we learn the notes but the better you learn the notes, afterwards you can get more in depth, you can pay attention to the note, that syllable, that triplet or whatever.
R: So what I hear you saying is that once you have the overall structure you can focus more on the details. That's obviously true in music but do you think that is true in you other academic classes as well?
S; Exactly.
R: I guess we could call it a learning process. Tell me a little more about some of the other classes you are taking and how that's working for you.
S: This semester, I am taking behavioral neuroscience and that's very dense material. You basically have to memorize the textbook. So I definitely found that I read the textbook once if not twice before the lectures. Getting that foundational – here are the big ideas – the professor can expand on the ones that really matter, the specific working of the actual chemicals and where they interact the brain and how it affects su outwardly.
R: Do you do that in music classes too, practice ahead of time?
S: I try.
R: So practicing ahead so you know what is coming.
S: Do you have any other ideas about music study has helped. After all you have been studying music for a long time, since first grade is a long time. Any other thoughts you might have about how you think that has helped you be a better student.
R: I think definitely the two big things that I have already talked about. The act of practicing is always beneficial; and then that ability to look at details. The more you know the basics the more you can really kind of indulge in the details and the smaller things. It's almost like a pyramid scheme, like the stronger the foundation is the more you can build towards the top
R: That's an interesting analogy. It's like a pyramid, not a pyramid scheme, the more you reinforce the foundation and then move up to the details. Very astute observations. Ok, anything else. I think we have covered everything on your survey.
S: I think I've said most of it.
R: So moving outside, what else do you think music has done for you, besides the academic part.
S: So much. Especially last year. The opportunity to travel, to perform, to just hear beautiful music and to be able to create it is a powerful emotional experience. I've met most of my close friends through choir. I was fortunate to really be able to get to know my choir director and see all the way that music can make you fell, that sense of accomplishment. I wouldn't say it was overly competitive environment, but it was definitely intense. We wanted to be the best we could be. We had some really great musicians at my school and we were really blessed with the opportunities we had. Ands I think the sense fo achievement. We think about it more in athletics, that sense of accomplishment. I played sports as a youngster and it was much stronger in music. I wanted to win. I wanted to be first chair, second chair, whatever. That was definitely there. It was self-fulfilling.
R: I think we have everything we need. Thank you for coming in.

R: What is your major?
S: Biochemistry.
R: Are you premed?
S: No.
R: What are you looking at otherwise?
S: Research. A PhD. In biochemistry.
R: Are you a music minor?
S: Not right now. I considered it, but I haven't made any moves on it. I'm a freshman. So no.
R: What courses have you taken here at UTD?
S: I am in the wind ensemble with Greg Hustis and the pep band with Lori.
R: What do you play?
S: I played tuba.
R: How long have you played?
S: Tuba since six grade so about six years.
R: Tell me a little bit about your musical background.
S: I played trombone for the first half of sixth grade but in the spring we were allowed to switch over. They had four beginner instruments.
R: Where did you go to school?
S: Allen, Texas.
R: Did you continue play through middle school and high school?
S: I played the tuba every year. From six grade through 12th grade, so seven years.
R: What kind of groups did you play and in high school?
S: I was in the marching band, I was in the ensemble class and symphonic in the spring.
R: Have you done anything else musically, say composition?
S: Nothing formal. I transposed some pieces, mainly one piece. It was the theme to Band of Brothers.
R: Did you take private lessons?
S: Yes.
R: When you took private lessons did you to theory or just technique?
S: Mostly technique. I had a private lessons teacher for two years and I did some theory but this was early on and then he left the city so I had to get another teacher who just focused on technique.
R: Do you think participating in music courses has had an affect on your academic abilities?
S: Long hard work pays off. When I started out playing trombone and then tuba, you have to practice a lot because at first you sound terrible. I remember with trombone, I just like was spitting into it and it didn't sound good at all. You practice and you get to the point where you're able to recognize what a good sound is but you know you're not there. So you end up having to practice to get to where you want to be and it's a continuous development. Probably never-ending.
R: So how you feel that has helped you in your other courses?
S: I think it's translated through the tedious working in courses. You just have to go through it if you want to master the course and do well.

R: Any other ways you think it has helped you?
S: In that includes patience, patience really helps. I learned that from my first band director the whole delayed gratification thing because nowadays with videogames you get instant gratification but playing an instrument is delayed gratification because while you're playing you know you're going to be better later on than you are now. But you have to put the work in for it.
R: Flow is the experience of when you're so into something that you lose track of time. Have your experienced that in music?
S: Yes. I don't really know what it feels like but to me it feels like nothing. It's enjoyable but it feels like nothing. You don't feel time passing, you don't notice everything, you are doing it just kind of in the zone. You are sitting down on working on a piece and that is it actually… I've never been good before in music, at just sitting down and then doing work for hours. Maybe the most I could do was an hour at first but once I did music and started practicing for hours and hours a day to hours a day, you start to be able to translate that into schoolwork. So you get flow in schoolwork even if it's something really boring, you get into it and you work one problem and then the next and then the next and the next.
R: So you think it's given you the ability to do that?
S: Yes. I noticed that a lot more now when I do work more because I try to focus on exactly what I'm trying to do to improve when I play but in schoolwork if it's tedious you just have to go through it.
R: Have you ever studied the form of a piece of music question mark the structure of the music, the sections?
S: Other than the March?
R: Form is structure, but what sections there are in a piece like the a section A, section B/
S: Other than the March, it has a dogfight (?) in, then other material if that's what you mean, but that's the limit of my experience and knowledge.
R: I asked you about rubato in the survey. Rubato is when you slow down and speed up to express your emotions, to bring something out in the piece and you said that you had experienced that. Tell me about what it feels like to do rubato.
S: It's kind of like flow but different in the way that you know what you doing, at least for me. With this you just kind of do something emotional, you just feel it.
R: Did you play solo tuba.
S: Yes I played solos and that's where you do rubato a lot and even for the Allstate music you do that.
R: And did you come up with that on your own or did your teachers tell you what to do?
S: For some pieces I've had, for the actual band pieces, obviously you're told, but for the solos for some of them, I was told to do something but for a lot of it I just did what felt right.
R: Rubato is a little bit about breaking the rules. You have a set tempo and there's nothing in the music that says speed up or slow down. It’s just something you choose to do. Have you had that experience in your other academic classes, the idea that that you violated the guidelines?
S: Maybe just questioning things, like things that are set, wondering why they are the way they are, why they did it this way or that way. Why they stay the same for the hundred years and then change. Other than that I can't really think of anything.
R: Did you learn discipline through your music?
S: Yes.

R: When you practice music or listen to music it’s an auditory stream over time and it requires you to maintain your attention over a period of time. Have you ever had that experience?
S: For that I've had both where you just listen and you don't pay attention, but you still hear it, you are just not listing for elements. But for paying attention, you have to do that when you listen to recordings of solos or recordings of pieces in general, just to get every detail and the thing about music is, there's a lot of repetition or semi-repetition.
R: What you mean by semi-repetition?
S: It's almost the same but it's different. Like variation. Or modification maybe to a note. The style stays the same but so, attention, yeah I've had to listen to things over and over.
R: Do you think it's affected your abilities to do another things to hold your attention?
S: Yes. I've gotten pretty good at holding my attention on things. Trying to focus on all the details.
R: Can you give me an example say in a biochemistry class?
S: I'm trying to think of a good example. I just had a Spanish speech where I had to speak with no notes, no notes in English or Spanish, so you just had to really pay attention to what you're saying to stay focused on that, to give a five-minute speech. In studying for that, I had to pay attention to what I'm saying while I was practicing and what I was running down and I did change a lot of stuff along the way. Stuff happens a lot but it's almost that happened so much, that it's not important now. You just do it. You don't notice it.
R: Segmenting is breaking things into smaller more manageable pieces. Have you had that experience in music?
S: Oh yes, yes. Playing tuba, you get a lot of easy music but there are always the pieces that are mostly easy. but there are some runs that you have to break down into chunks. It can be six or eight measures long and you have to practice each measure to get better at it.
R: Have you had that experience in your academic courses?
S: Oh yeah, in chemistry, we have to know all these weird things like stuff that doesn't even make sense like polyatomic ions, which kind of makes sense, but there is no set way to remember them. You just have to isolate one and figure out a system to remember that one and then to remember each one in a main category and then you could verge off. It’s the way you have to break that kind of stuff down, there's no way to get around that.
R: Do you find that doing it in music helped you do it in your courses?
S: Well I think I first did it in music, but I never really had to break stuff down before college. I was pretty smart is a kid, like in grade school I didn't have to really focused down on things as much, and certainly not until high school. But by then I'd had music so I don't remember doing that.
R: Tell me about your practice habits?
S: I'm not enrolled right now in music courses, because I had too many hours. I'm a community member in the pep band.
R: But you still have music to practice then?
S: Yes.
R: So tell me about your practice habits, how many times a week, how long?
S: It's not as much as I practiced in high school. Especially this semester, because college is a lot harder. Second semester is a lot harder than first semester. It depends on what you taking.

R: How much you practicing right now?
S: Mostly on the weekends, so that's two days and one or two days more.
R: And how long do practice at one stretch?
S: On the weekends, it will be about an hour or so and during the week it's mostly about 30 minutes, whenever I can squeeze it in.
R: Do you turn your phone off when you practice?
S: Yes. I'm not one of those people who has a tuner on their phones. You know, the metronomes on phones now. I like the actual physical item. I like to see it. I wanted to tuner and a metronome combined.
R: So you like to have the phone off so doesn't distract you?
S: Yes, unless I'm listening to recording or something, but other than that I have it off.
R: So any other experiences you thought about music as it relates to other courses?
S: I don't think so.
R: What is music done for you in your life?
S: It taught me things. It definitely taught me patience. Really help do that. I'm still not very patient but I'm a lot more patient than I was. I used to have a quick temper and used to get upset at little things and it really helped with that and with patience that helps with the work ethic.
R: Thank you

Subject 017185 March 6, 2015

R: The first thing we are going to do is verify your major. You are biology major, are you premed?
S: Yes.
S: And are you a junior, senior?
S: I am a freshman.
R: Are you a music minor?
S: No, I am a performing arts minor.
R: Ok, tell me about your background in music and in particular in violin.
SL I started studying piano when I was five, then dropped that when I was about fourteen. I started violin when I was 11, I've been studying around here with Ron Houston. I'm been continuing my studies until now.
R: So you are still playing.
S: Yes, I have played in various orchestras, chamber music ensembles, really gota taste of what music can offer me.
R And what courses are you in here.
S: Musica Nova.
R: Did you play here in December?
S: Yes. Also the symphony orchestra and string orchestra, those are the three ensembles that I take part in. I play chamber music on the side with my friends, that's something I enjoy doing.
R: No sound design. Nine years of piano. So basically we are going to ask you to talk a little about your experiences when you do music and also how it relates to when you study for

your academic courses. First thing we ask is just kind of general, if you can describe an experience that you've learned in music that has affected your skills in another course.
S: What did I put on the survey?
R: You said being able to study music, focus better, improve memorization and increase my mathematical abilities. Let's take them one at a time.
S: Starting backwards. In terms of mathematics, in terms of subdividing rhythm, I was better at fractions from any early age, it allowed me to tell more later on. I think a lot of music skills that you learn, you grasp things quicker when you are younger and then you have a better foundation on things, because it's more applicable to different types of things. So instead of just applying to math, you can apply it to music or to art or whatever and it builds a strong educational foundation.
R: Tell me about memorization.
S: That's an intrinsic part of music, so it makes me pay attention to finer details, whether I am reading, it, listening to a lecture. Music is very disciplined in the fact that you have to know what you are playing, what notes to play, also the composer's intent, pay attention to musicality. So it allows you to multi-task and do multiple things at once, but also you must not leave out any details. I guess that helps me in studying.
R: The last one on there was focus. So is it the same thing? Multi-tasking?
S: Yes, but not losing a meticulous care for attention that you can often lose when you are trying to read something, listen to the lecture on it, study, do all these things at once. That's part of the University experience.
R: It certainly is. Thank you. We are going to ask you about flow, the principle of losing yourself in an activity, losing your sense of time, being so absorbed in it that you don't pay attention to other things. Have you had that experience in music?
S: I guess so. When you play music, you look at the printed tempo on the metronome, and that's in beats per minute, but you never really pay attention to that, you just go with what's written on the page and you let yourself observe that. It's very indescribable what music does to me. Recently I've been watching to these interviews of Richard Dawkins, the famous evolutionary biologist. It's founded on the whole atheist idea, and as I scientist myself, I think our course, why not atheism. It's obviously the way to perceive things, but you know when I pick up my violin and play music, it makes me think there has to be something different, something else.
R: Did you learn through music to get into flow or have you ever thought about that, that it's allowed you to get there?
S: I don't think I am actively looking for it, I think it just occurs when good music is made. At one point, when you are playing in an ensemble, everything clicks and then you can focus on … as opposed to what are the notes am I playing, am I playing right, what's written on the page, the technical details… and then we can move on to something more like What was Beethoven thinking when he wrote this, or what is our goal musically, or technically, or what we are trying to show to an audience, because it's a performance.
R: You said music necessitates non-verbal communication. Talk about that a little bit.
S: OK, well that's more of a chamber music thing. In the music I'm involved in you can't speak while you make music, or make audible noises while you are playing, so you have to form a new kind of communication, in your gestures, in the way you play, different cues and

indications of how to control people. I guess that allows me to work on social skills. I fell like because of music, I'm better with people and I'm a very typical first violinist, almost chauvinistic kind of personality, so in terms of playing in an ensemble, I know how to get the sound that I want and I feel like that translates to the way I deal with people. If I want something, it's easier for me to get what I want socially.

R: I believe that. Have you studied form at all of music. Technically, form means the sections of the piece and how they are organized. Have your studied that in music?

S: I've touched on it. Yes. I did theory studies when I was in piano.

R: Ok. So do you analyze the form of piece when you play it? Do you think about it?

S: Yes, I think it's complete necessary, if you are going to give a performance and interpret what this composer has to say, you have to know how he wrote it.

R: You have to understand what the composer was doing.

S: Yes, it's not just playing for the sake of enjoyment, do this flow things. There are rules of course, that's often overlooked in music.

R: Have you applied that idea of structure and form to any of your other academic classes?

S: Well, there are two ways to go about that, like in my biology studies. One of the central tenets of biology is that form and structure relate through purpose. So, if you look at the cell, everything has its own purpose and through evolution, it's come to take a form that is so specialized to its purpose. For example, a cell membrane is made of phospholipid, so on the outside it's waterproof, on the inside it's hydrophilic, loves water. So in that way that form is so perfect. Bernstein talked about how Beethoven's music was so perfect in its form, so that's one way to look at it. In the non-science part of my education, which is about 50%, when we look at poetry, literature, that also has form. Especially looking at poetry, that form, meter, is such an important part of it, and that's exactly like music. So an artistic freedom within the stricture of what constitutes it as music or poetry.

R: So form is about what?

S: I think it gives order to freedom so we can enjoy it.

R: Are you familiar with the concept of rubato?

S: Yes.

R: Have you played any Chopin?

S: Yes.

R: So tell me about your experience in doing rubato, what does that feel like?

S: It's stretching what's written on the page, to the extent of tossing away what the metronome says.

R: And how does that feel? Do you like it?

S: If I know what I am doing, yes. I feel like it's almost giving complete freedom in how one would play something. You would perform something in a way that's not what the composer wrote. For example, I studied the Sibelius concerto, and there are so many things on the page that violinists never do, but once you really study it and see where he wanted to give you these moments of freedom, it's very clearly written so, when I want to do rubato I take it very carefully. I don't want to disrespect the musical purists.

R: You talked a little about how you don't have complete freedom, but you have some latitude. Have you found that true in other academic subjects?

S: I do research in the chemistry lab. So we have freedom but of course there are lots of laws, who is giving you the money, what you are allowed to do and what you are supposed to do. You have a purpose, but within that purpose you can really try whatever you want.
R: Ok, good. Have you studied music theory in particular when you did your music study?
S: Yes but it wasn't very serious.
R: You said it helped you grasp mathematics as well as philosophy. What in music did you find translates to math besides fractions?
S: Mainly fractions. The whole basis of rhythm is subdivision, values of time.
R: And what about philosophy? You mentioned the golden ratio, and the Greeks.
S: Yes, that was interesting. I learned …I don't think I can elaborate too much on that, because it was a while ago, in high school. Well, that's more of a historical view, like where does everything come from. When I study music, it's not only the notes on the page, but I want to know how this came to be, so philosophy bored me at the beginning of it, but when I find these connections to what really interests me, it just enhances my love for knowledge, school.
R: Music takes a lot of discipline and time management skills.
S: Yes.
R: Most people would agree if you are going to study music you have to have some discipline. So talk to me a little bit about the discipline in your study of music and how it's maybe translated to other academic areas.
S: I only have 24 hours in each day, so I have to find time to be able to practice, to be able to perform, and also keep up with my real goal to be a doctor. The discipline in music as I perceive it to be, what's written on the page, what the composer intended, its like I follow that when I am planning my day, or planning what I should do in the next month or the next year. For example, I want to be a doctor, I have to do an internship this year, shadow this doctor then, and talk to these people, do this research. If I want to perform music well, I have to learn my skills, do some etudes, do some sonata work, study all these things, so it's really…I feel like it's just another thing I have to manage if I want to do it. It's just putting it on my list essentially and it's just one more thing to organize so that's just how I do it. It betters me.
R: It makes you a better organizer.
S: Yes.
R: When we listen to music we basically listening to a stream of auditory information. We tend to break things into parts, what we call segmenting. Have you experienced that in music?
S: Yes.
R: Give me an example.
S: You listen to a symphony, it has clear sections, that are delineated by the composers as movements that are literal segments.
R: Do you find that you apply that to other academic areas, breaking things into pieces?
S: Of course, you can't take biology as a whole, you have to segment it into – the most clear one is cell biology versus organic biology, like evolutionary biology and under that you have sub topics. So if you look at the way a textbook is written, it has chapters and each one has section headings and those go into vocabulary words and their definitions. Music has the same things I guess. You have a whole symphony, the movements, the sections.

R: Has studying music helped you segment in other areas? I understand when somebody else does the segmenting, writes the book. But in your experience, have you done that yourself to study a subject?
S: Yes, I think all the time. You can't take things all at once, you have to break them into smaller pieces you can understand completely so it builds a good foundation, so at the end when you take the test, which is at the end of that journey, you know everything.
R: Hopefully. Talk to me about your practice habits. Are you playing right now?
S: Yes.
R: You're in Musica Nova this semester. How do you practice, where, how long?
S: I live at home so I practice at home in our music room. I start with scales and then I start right in the music. I do – there is the violinist Ivan Galaymian, he is the big pedagogue and his method book has different practice rhythms you use. I usually look through the hard parts and when it gets to something hard, I'll go through different rhythms to bolster myself technically and then run through it then and be done with it. But I'm actively looking, I'm never not thinking about something, so in class I might look up the composer and then see what the piece is about. Before I study a piece I always listen to it, so that's a big part how I think about practice. Looking at different interpretations. I think that's also a part of practice. I don't think practice is limited to hands on time with your instrument. In a sense, I'm never not practicing. You are always thinking about "this might be interesting". I think I've reached a point in my musical studies where I can, if I think of a sound I can produce. So in that sense I don't always have to be playing my violin physically. I can be thinking "this would be a good idea to do here" and that sort of thing.
R: How long a stretch do you practice?
S: 30 minutes.
R: Do you use a timer, look at your watch or look at your phone?
S: It's more about have I done what at I need to do.
R: It's usually about 30 minutes a day?
S Maybe an hour or to at 30 minute stretches.
R: Do you turn your phone off when you practice?
S No. I think you can have a metronome or a tutor on there. I use my phone.
R Does the phone distract you? Do you stop if you get a message or somebody calls you?
S Maybe. I will answer calls. I'm not going to be a violinist and my practice doesn't have that much urgency to me.
R So you are spending about an hour a day practicing violin. My last question is kind of general. Is there anything in your experience in doing music, you've always been doing music. Do you think it's made you a better student?
S Certainly, going back to the discipline, of course. Most kids are free to do whatever they want, do sports, go outside. But that's not how school works. It's all discipline. So I guess when you start that culture shock of having in primary school seven hours a day separated up into a thing you study, I was acclimated to that environment at an earlier age due to music. By then I could sit down, like for 15 minutes and practice and play and focus on something at once. It helps your attention span.
R: Do you find it helps your academic skills now?

S: It helps my organizational skills, definitely. Not in terms of science, I don't think it helps tremendously. It helped more when I was younger which has repercussions to now. But I guess in the study of something like philosophy or literature you can make those connections between music and literature because they are not different things. It's not like someone wasn't writing something when Beethoven was writing. They didn't have these different spheres of existence. When I can find that big picture view of how the world was, or how the world is in terms of music and the whole scope of the arts in general, then I fell like I can understand something.
R: Do you think the arts and the sciences are connected?
S: Yes. But in more obvious ways than not. When you listen to music it's a stream of auditory information.
R: Do you think there are any deeper connections than that, that music has physics, that's fairly obvious. Do you think there is anything more going on?
S: Yes, but in ways that I don't think I can explain at this point in time. Definitely a lot or brain behavioral science, how it affects you, how it affects other people. How I can do something on my violin and it moves someone. There is some type of feelings, or something that is going on in the brain that I can't completely understand yet. Certainly.
R: Anything else about your music studies and academics you want to share?
S: I don't think so.

Subject 080793 March 6, 2015

R: What is your major?
S.: Biology.
R: Are you premed?
S: Yes.
R: Are you currently doing a music minor?
S: No I am not.
R: It says here you played in the orchestra for nine years. Can you tell me a little bit about that when you started and what your experiences were?
S: I started in fourth grade, as part of the school orchestra program and I continued in that through the city and through middle school and high school. I played in the city chamber Orchestra two, and the city's Symphony honor orchestra which they gathered all the participants from auditions and I continued with that through high school in Symphony Orchestra. They had three tiers of orchestra strings, concert, and Symphony.
R: Are you taking the string orchestra class here now?
S: Not right now, I took it in the fall.
R: It says here at you had some experience in recording? Can you tell me a little bit about that
S: Do whenever we had an audition in our private lessons, we had to be recorded and we use that to improve and to really see what we were playing. We could hear ourselves flying, so I did it because of that. It's nothing official it wasn't to be sold or anything, it was just for auditions for officials, for state orchestras and things like that.
R: So just for your personal use?

S: Yes.
R: On your survey you said music help you relieve stress, and help take your mind off certain things. Can you talk to me a little more about how music helps you relieve stress?
S: When I listen to modern-day songs, I don't listen to the actual notes and to the lyrics. I just naturally lean towards listening to music in that way. I connect with the music more and I see how it flows along and I reminisce and it connects with and it connects with how I was when I was playing it. So just from there it takes a little it helps me compose myself and remove myself from the current situation during studying or reading a textbook. So I focus on that and I kind of finger along. It's something that takes my mind off of things and gives me a break. A nice little break.
R: So you say you finger along? You actually finger, like your playing?
S: Yes I feel like I'm actually playing the violin.
R: Talk to me about an experience you had where you had that sense of flow.
S: Whenever I was practicing or rehearsing, I was really getting into it and I enjoyed the music I was playing. Of course there were some pieces that I didn't really enjoy in school and even when I practice now not officially trying to play songs I really like modern-day songs or modern-day renditions of classical music, playing that really gives me enjoyment and let's me relieve myself and that's when I lose track of time. Especially I was younger really being able to pick up the violin and an explore playing whatever I wanted, that was when I had the sense of enjoyment and complete losing of time. I would practice for one or two hours, when before it would be 15 minutes. That was pretty painful for me
R: It seemed to depend more on the piece you are playing?
S: Yes more on the piece and how deep I connected with it emotionally and how much I really enjoyed it.
R: Did you ever experienced flow in any other type of activity?
S: It tends to be just in my own interests and hobbies. I play sports and I experience it when it’s the sports I really enjoy now or when I just play for fun. That's when I I am getting the groove and really getting into the zone of either making a shot in basketball, or hitting getting a tennis ball. That's when I really start losing track of time, when I'm enjoying myself, not really thinking about the pain for having to lose weight or burn calories or anything like that. It's just really about right then and there, the feeling when the ball comes off your racket or the ball off your hands. So really I think the common factor between music and something else I do where I have the sense of flow was when I was really enjoying myself.
R: Are you playing sports right now?
S: Just for fun. Nothing official. I still play tennis occasionally but I do mostly coaching now.
R: You mentioned twice now the physicality both with fingering and with the actual impact of the ball. So it's a kind of physical thing?
S: yes.
R: It says you occasionally studied form.
S: Yes technique wise.
R: Form is really the structure of the piece. Did you study that when you studied violin?
S: Slightly, more informally. There wasn't an official class on form, but definitely user orchestra director wanted us to really get into playing it and really play it from the cultural

context that it was written in. For example. like in the Baroque era they wanted us to really play it a certain way. That's when she would explain form to us and how it was really structured and why a certain time signature was 4/4 and maybe why was little bit faster. And why it had a sometimes more sustained and concise style and sometimes a more flowing legato like style

R: Form is also about the sections of a piece. Did you ever look at a piece from that point of view?

S: Now that I think about it, she never really explained but we did, but to see certain repeats. That's a good point. I actually don't know the answer why a composer would choose to repeat a certain section unless of course it was the main theme of the piece.

R: You've done two things that take a lot of practice and discipline. Music and tennis. How do you think that music has helped you in your practice skills?

S: This is a big thing when you're going into upper or advanced levels of a certain sport. Basketball is my new sport to pick up but when I was training in tennis, once you get to a certain level (I was about to play Division I tennis parentheses)., they say every stroke you have to hit 1000 balls, and eventually hit a point where it's just muscle memory and you want to develop rhythm and timing. So you want to have the same routine, hesitation, and then started swinging and execute the acceleration of it. It's the same thing but in the violin and I remembered it from when I was a kid and that helped me accelerate my growth in both fields actually. In music, if you want to go for hesitation, you bring your bow up and down in the same way the tennis racket, take it back in and swing through. It helped me see the rhythm, and because I had developed the rhythm through violin and learning to count, I really get a feeling for the beats. I could extend it and apply it in tennis. I tell my kids when I'm coaching you have to make music with your feet and there's a certain rhythm to it. You can tell an excellent player from his footwork. You can hear it compared to someone else where it's choppy. It's very awkward sounding. So you want to have nice and succinct small feet. A player who is more lazy with his feet will just be dragging his feet along.

R: So what about academic skills? Your biology major, so has that sense of rhythm and the idea of the practice it takes helped you in your classes?

S: Definitely, in developing a other routine and being in your own comfort zone to study. Of course.

R: What you mean by comfort zone?

S: Really being able to set yourself down in your own apartment where it's comfortable, not new scenery. Sometimes studies talk about changing study places just to keep you alert, but for me it's more important that I'm in a comfortable place. A quiet place for me personally, a quiet place where I can sit down and not worry about anything else, how it smells, of people walking by. I think developing that routine and even the regimen of practicing my violin, I applied it and brought it to my academics for example. And just school skills and really just getting into the routine of going home from class, eating something and then sitting down, putting in a good hour, and then doing something else, and then coming back and doing that same thing.

R: Is that the way you practice your violin?

S: Yes, yes I just couldn't crank through it. Most the time I didn't have that flow, losing myself, so it was pretty painful and I just had to grind through it personally.

R: So you used these your studying pattern really, you used your pattern from the violin to do your academic work?

S: Yes.
R: In music you have to maintain your attention for a long periods of time, for the time you're playing the piece or for the time you're practicing. How does that affect your academic skills?
S: I think it definitely taught me a lot about it. And help me hold my ability to focus. It helped me really in different things. For example, sometimes your arm gets really tired and takes your focus away from the music. You need you have to take your focus away from the pain and towards the music … And academic skills: for me I compartmentalize a lot. Sometimes your family issues, issues with your roommate, friends, and sometimes you just have to put that on the shelf and leave it for later. The same thing for music, even if you make a mistake you just move on, you stay focused and you keep going at it and continuing on.
R: Segmenting is the idea that you have to break things down into pieces. Tell me a little bit about that experience in music.
S: Definitely whenever we were rehearsing. At first when you look at a piece of music when your sight reading. You are most likely not going to be able to play the whole piece, all the notes, at the right rhythms in the right dynamics. So a lot of my directors and conductors I've been with, what they did was they always recommended to break something down and play in small pieces, small sections like maybe four or five measures, and also to really slow it down, slow down until you can play it that slow and then make a little bit faster once you can get it at that tempo you can play it faster. The same thing with academics, where if you don't understand a certain concept, you start with a certain… The best way I can think about it is when you are in medical school, you don't learn about the whole body all at same time. You learn about body systems, your cardiovascular system, the musculoskeletal system, and you break it down, you slow it down, and if you don't understand you keep on working on it and you start slow. You start with smaller more simple concepts and then you interconnect all the systems and then eventually when you're a physician, and after you complete your residency, you have a pretty good knowledge of the body and how the systems work together and how they come together to help each other out.
R: Tell me a little bit about your own individual practice habits in music. Are you playing right now?
S: No I'm not. Well I'm actually taking a guitar class. I'm taking Guitar One.
R: You're taking guitar instead of violin right now?
S: Yes. It's my last semester and I wanted to try different instrument.
R: So you still have to practice. So tell me about your practice habits
S: I haven't been too good about practicing every day. Before I would always practice, my parents always made me do at least 15 minutes and then you'll have to do any more and you don't have to do more than 30 if you don't want to. They took that practice schedule from Yo-Yo Ma's interview or something. The same way, I try to practice every other day at least 10 to 15 minutes to get it down. I think it really kicks in for me is when I really start enjoying it and can succeeded a certain difficulty level. For guitar, I was trying to play a chord and the fingers would do a chord with some very ugly sounds, so once I was able to get that after maybe an hour of practicing and being frustrated. it motivated me to go and practice even more. It's like a stairwell for me, but sometimes I practice more but sometimes I don't. Once I get over certain chord, I keep on, that's

motivation for me to keep on going, to improve and practice more. Definitely pretty much every other day.
R: Where do you practice?
S: Just in my apartment, in my room.
S: Do you turn your phone off when you practice?
S: I actually don't.
R: Do you answer it?
S: No I don't actually. So usually it's… Usually I don't look at it, it's on mute. So I just don't look at it. So it might as well be often as I have a cover on mine so doesn't even light up.
R: So how do you feel when you practice?
S: Recently when I been practicing I feel pretty good. I managed to get over a big obstacle that, a big personal obstacle and I really want to try different chords and go from there. Of course there's harder chords and I still have to ask my professor how and why certain things happen. I need to know how you're supposed to place your fingers.
R: So how does that relate to the way you study?
S: In the same way when I hit an obstacle I just keep working at it. I get frustrated. But once you have that epiphany moment, for me personally, it's a big, big motivation to keep on applying that to see if I really understand and to use it to prepare for a test. But sometimes it's just hard and you need to take a break, so I can study more consistently but not from it all in the couple of days before the test.
R: Can you give me a specific set specific example of about when you get frustrated in your academics?
S: Definitely when I have to study. I had a test today and I've been studying this whole week. In molecular genetics you have certain chromosomes, a crossover which creates genetic variety so that you have diversity in the gene pool. It was hard for me to grasp that concept and finally see why certain things… So you have your parental gene like your parent genes cross over to create diversity and integrate into completely different new gene recombinants. It was hard for me to really understand that concept and how you use it and apply it in the statistics. I would understand the concept but I didn't know how to, which numbers to take and use in the equation. Eventually I kept on looking at it and once I got it really understood, that was motivation me and I lost myself in being able to do it. So from there it was the same way. I just keep on working at it, I get frustrated, and then I take a few minutes off and then I come back at it again.
R: So is overcoming frustration, hitting the brick wall and instead of just standing there you figure out how to climb over?
S: Yes.
R Did you think music helped you learn that?
S: Definitely. Every experience in life is interconnected with something else. So music has given me the experience where I had an obstacle, a hardship, and then I worked through it and I was really able to succeed at it. I use that now and if I could play violin that well, because I knew where I started where sounded really bad to where I sound out. I feel it's motivation for me that if I can do that than I can do this.
R: So if you can learn to play the violin and guitar than you can accomplish anything?

S: Yes. I can accomplish something if I really set my mind to it. I set my mind to explore the violin and from there I think I can really do anything with my ability.
R: What else has music done for you?
S: I think it has in so many different ways… it's impacted my life in connecting with people, and I personally believe that music is God's given gift. It's nice and I haven't personally studied music theory but I think there's a reason why certain chords work and certain chords don't. The human body has its own abilities to connect with certain things you, you have a preference for certain chords and certain sounds, in the human ear. Music overall is… it has taught me a lot about my life experiences. It has really helped me channel my life experiences in music and apply it somewhere else where I've had difficulties, in academics or playing a sport. Or even a different hobby.
R: It seems like music has really taught you a lot about frustration
S: Yes.
R: is there anything else you want to share?
S: No I can't really think of anything.
R: Thank you.

Subject 090756 March 10, 2015

R: What is your major?
S: Biochemistry.
R: Are you a music minor?
S: Yes.
R: What courses have you taken at UTD?
S: I've taken understanding music, vocal instruction one, and two and music theory one and orchestra.
R: Tell me about your background in playing music.
S: I started piano probably back in elementary school. It was lessons just on and off. I wasn't completely into it but it was still something that was just on the side and I could go back to if I wanted to. I also started violin back in middle school and I played that all throughout middle school and high school. I would say it was pretty significant in terms of making me an all-around student. I did find it's a lot tougher to keep up with it in college but that's why I still tried to keep up with it through the UTD string orchestra and also Arlington Youth Symphony. And a little bit the Musicians Network as well.
R: You also said you've done some composition. Tell me a little bit about that.
S: It's not really composition. It's more like digital music. So in middle school I played around with this computer music Shape. My friend got me into it. And it's basically just, there's a lot of preset tracks and you put them together but you can change chord structures to a limited degree. Just in terms of the program. I would say that it was very enjoyable just seeing how well the music came together. Of course it was of course a limited program in terms of you can't really change the key and only certain chord structures that you can abide by. But I actually got one of my songs to be featured in a YouTube video and that video got up to 8 million users so, sadly because it's more like a third-party website, so I did get royalties from it, from YouTube

but by the time I wanted to cash it they changed their policy to where they can't give me credit in cash anymore. I can only use their credit on their website. It's about $500 worth so of royalties.
R: How do you think music has affected your academic abilities?
S: I have certainly found that a certain type of music helps me study if I desire to listen to music while studying. It has to be classical music and very low volume to the point where I can almost not distinguish the melody. It helps me just drown out any background noise to have something flowing in the background to keep my mind going as well.
R: Do you think any of the things you did studying music help your study skills?
S: I believe that it just gives me a different aspect of my education. It helps me think about certain aspects of education differently. I guess it let me take different routes with different perspectives of topics, as opposed to just being very linear.
R: So let's talk about the concept of flow; flow is generally described as being so lost in an activity that you lose track of time. Have you ever experienced that doing music?
S: Yes. More so with singing than with violin. I think with the violin - it's more mechanical and less enjoyable for me personally than singing. Because singing I can just go song after song and lose track of how many songs I've actually song or how long I've been singing. Oftentimes I'll just find myself during the semester - I get in a singing mood and I just go for like an hour or two and then – I think oh well I should have been studying but…
R: Have you ever experienced flow in a nonmusical way?
S: Yes when studying in general, and science. You can easily be reading a chapter for a chemistry or a biochemistry class and then there's four hours gone.
R: You talked about being in a research lab also. Can you talk a little bit about that about what it's like to do research?
S: So initially research has that kind of flow because for me personally because it's my first time doing it, doing research. I was completely immersed in it. I was down there eight hours a day and in just the first couple of weeks you are learning so many new things every day and you doing all these things running around and it's just… I get in there like at 9:30 to 10 and then I look at the clock and it's already lunchtime. And then after lunch it sorry three then five and then it's time to go.
R: Have you studied the form of music; I mean looking at the structure of the piece? Tell me about your experiences studying form.
S: In entry level music theory and in music and historical context as well.
R: Give me a specific example when you studied form.
S: So, for example, I did a project in Music and Historical Context where I was analyzing music and surgery. I was discussing how forms of music can help in surgery outcomes or patient satisfaction.
R: So you feel that having studied form in a musical context has extended to other academic courses?
S: I would say, yes, because I'm really structural and logical so seeing that even something like , which is almost completely oral, has some kind of form to it. It lets me think that everything has to have some kind of form. It helps me figure everything more logically and more linearly I guess.
R: Do you know what the concept of rubato is?
S: Yes.

R: Have you ever used rubato in a piece?
S: Yes.
R: Can you give me an example?
S: I believe in some of my vocal instruction courses there are some areas where I choose to slow down a little bit or speed up depending on the style. Especially in some jazz pieces where you want to.
R: So since you've you done this stretching, shrinking, breaking the rules, have you applied that anywhere else in your studies?
S: I haven't thought about that. I don't remember what I put (on the survey).
R: You talked about singing. Is there any other subject where you think you change things?
S: I guess the only thing I can relate to is whenever I used to teach organic chemistry, sometimes I would selectively shorten some topics and speed things up depending on what was needed for the students. If I thought something was particularly easy, then than I would speeded up.
R: You studied music theory.
S: Yes.
R: Some people feel music theory is like studying mathematics or a language, with rules and structures. Do you think studying music theory has affected your other academic skills?
S: Like I said earlier, it's just giving myself an idea that something oral has form. So it's just like you said something like mathematics, so that things are all interconnected or interrelated in that way. And it just tells me to become more of an all-around student As I previously mentioned how it affects my studying with other subjects.
R: Music takes a lot of practice and it takes a lot of discipline. So give me an example of how you feel about has affected your studies?
S: I guess I can relate it by saying that at least if you want to become proficient in something you have to put the time in. So I encountered pieces in vocal instruction where I just could not get it the first few times around and I just had to keep practicing a certain phrase over and over until I became proficient at it. It's just like that in other subjects. If you don't understand the concept the first time you have to just keep drilling it going over it until you finally get it.
R: When we study music we have to do is called segmenting segment is taking a longer piece of music and putting it into smaller chunks sometimes it's called chunking. Have you experienced that doing music?
S: Definitely. Just like I said there are certain sections where I can't get it right away so even within the next section I have to break it up into smaller phrases and just drill those individual pieces over and over again. I remember whenever I was still studying piano you have to just take it measure by measure.
R: So how about in your other academic skills, have you had that experience?
S: Definitely so. Usually they are like a huge general concept that I was to go over but they're all these little components, constituents, that we have to individually understand until we can finally grasp or master the concept.
R: A general question always ask everybody: how you think music has affected your academic life?

S: It's just been really positive because sometimes if I'm feeling really bogged down from studying, I can always use music as a sort of relaxant, even a stimulant as well, depending on what I need at the time.
R: Anything else?
S: It's also a nice distraction or side hobby I guess because if you don't want to, you get tired of studying the same thing over and over or any topic in particular over and over, so it's nice to have some other topic to fall back on to study.
R: Talk to me about your practicing habits. How much do practice now?
S: I still sing. I sing in the car and in the shower. There are still some certain aspects I still need to work on and I keep trying to drill those, like working on my head voice.
R: How long do practice at a time?
S: 15 to 30 minutes, it depends on what I'm doing at the time.
R: How many times a week do you practice?
S: I probably say well, those 15 to 30 minutes can be multiple times in a day. I probably say 10 times a week.
R: Do turn your phone off when you practice?
S: Sometimes I'm using my phone.
R: And you use should phone to do what?
S: I listen to backtracks or use it for lyrics.
R: Do you answer it if it rings or answer texts when you are practicing?
S: If I'm in a group, no. If I'm in the middle of an important part of the piece that I really want to work on probably not.
R: Any other experiences? What does music do for you? You’re a biochemistry student heading to medical school. Why do music?
S: I enjoy it. It helps me distract myself from the daily grind. Despite of it being not completely different, but the difference from science, it still motivates me to do more science I guess.
R: How does it do that?
S: Because if I only studied , I would get tired of it but because of music I can be back in something else. I have a cycle I guess, it still reminds me that I have a main goal to accomplish, but that I can still do things on the side.
R: Are you playing right now?
S: I wish.
R: Because you're not taking any classes right now?
S. Yes.
R: Ok, thank you.

Subject 230970 March 12, 2015

R: What is your major?
S: EMAC.
R: And are you specializing in any particular area of eMac?
S: I'm going to go more towards the music side.

R: Should that be sound design?
S: Yes.
R: Are you a music minor?
S: No.
R: You said yes on your survey?
S: I was going to be one, but they don't have my instrument.
R: What is your instrument?
S: Drum set.
R: Yes we do yes we own two drum kits.
S: I looked it up and they said they had guitar, piano and vocals.
R: We do have a percussion ensemble so after we finish the interview I'll put you in touch with that person. How long have you played? And are you strictly a percussionist or do you play other instruments?
S: I'm trying to learn guitar right now. I think I can sing but I don't know what other people think. But I think I can. And I've been playing for about five years.
R: Do you play in a band?
S: I'm getting one started right now and I play with the UTD musician's network. And I played a lot of shows before.
S: What kind of shows?
S: Anything from marching band to rock shows.
R: Have you ever played musicals?
S: No.
R: How long did you take lessons?
S: I've taken and I've given lessons but nothing really serious.
R: How long have you taken lessons?
S: I started about five years ago and I haven't gone in, like, a year.
R: Was that in high school?
S: Yes, freshman year of high school.
R: Did you play any instruments before that?
S: No.
R: No childhood experience?
S: No.
R: Tell me about your experience in sound design, what you've done in that area?
S: Right now I am in a sound design class as part of my major at the 2000 level. So I'm taking that and I'm actually trying to work with the instructor more so I can get into higher-level sound design and all the sound classes. I've taken understanding music last semester, which was mostly music history. I took guitar I last semester as well. I did soundboard for marching band for four years so I have some experience for that but it wasn't very in depth. You learn a little bit. I've been messing with sound stuff for a while now.
R: So recording - are you recording yourself? For your band?
S: I record myself and I've actually gone to studios before and they would say, do this, do that, I did not know the buttons but I pretended like I knew what I'm doing.
R: And it says here you been writing music?
S: Primarily rock songs, anything from ballads to fast songs.

R: Do you write your own lyrics?
S: Yes. Are they good? I don't know. I believe if I'm going to play something either I wrote it, I had a voice. I don't like people writing stuff for someone else, it doesn't seem authentic to me.
R: So you've performed mostly with the band?
S: Yes.
R: Are you getting gigs in town or are you just getting started?
S: I would say just getting started; we're starting to write songs and our bass and our guitar are at UNT, so it's kind of hard to rehearse. So it's kind of hard to meet up, so we are working to try to do things over spring break.
R: Do you think that studying sound design has affected your other academic abilities?
S: I actually picked my major because of music. So I'd say it's kind of a big impact. My goal is to be a professional musician. a full-time musician. That's my plan. The music major is not a good major to have for marketability, so I decided to become an EMAC major so I can market myself. And once I'm done with here, I actually want to go to the Berkeley school of music in Boston to do my music major.
R: The Berkeley school of music is an incredible school.
S: Yes I'm here because I want to get a job and then I can pay for Berkeley. It's very expensive.
R: So talk about how you think studying music has affected your skills in other classes.
S: I believe it's helped me to be more focused and more flexible at the same time.
R: Let's take the separately: talk to me about focus a little.
S: With music you have to- at least with my music - listen to rock and metal and everything at same time. You have to able to listen to each instrument individually at the same time as the other instruments. You hear the guitar, you hear the drums, you hear the vocals, you hear the bass, and you hear each one of them separately but together. And that's a level of focus that a lot of people don't have. Especially when I played music, I have to separate what each instrument is doing to understand how it works together so that's a weird level focus maybe. So that's help me a lot because while we are addressing one task or something in the class you are still connected to other things because you're used to separating everything into subsections.
R: And you also talked about flexibility.
S: Nothing is set in stone in music. Every show you play is different from the others and you have to learn how to adjust on-the-fly. And you have to learn that maybe you forgot something at home instead of bringing it to the concert, so you have to learn to do without it. Or you have to learn that maybe your guitar player can't play something because you heard him say and somehow so you can't play the full speed or he plays the guitar part or whatever so you have to learn how to adjust to that on the spot and still be able to play without doing what you can't do. That helps in school because sometimes nothing works the way you want it to at all and some people just get stuck in trying to figure out how to make it go back to go back to the way they expected it to be. But instead of doing that I just kind of say, okay, well, let's just move on now to something different. Two weeks ago I played a show at the UTD pub and the drum throne wasn't open so it was basically on one leg and you have to balance yourself not to play intervals on the bass drum which is hard especially when it's not the right height and it's not how you're used to it. I was falling off! But you can't stop the song and say, hey guys, wait for me open this

up you can't do that. You just have to go with it. So that's you just go with the flow and you hope it works.
R: You mentioned that you can't do homework and things because of reversals so that's a kind of a negative effect? You don't have the time you want?
S: For me personally, I prioritize my music over pretty much everything else. A lot of my shows are not on the weekends. A couple of months ago, I went to show and it was a Wednesday night, about a 30 minute drive from here. So that wasn't that bad. But I want to be musician so I have to socialize with everyone. So, I go to a show, a three hours set from a really heavy aggressive band. And obviously I'm into mosh-pit because I'm that crazy guy that goes in there. So I'm sore at getting hit all day and then after the show at around midnight, I go socialize because you know you have to meet the owners, the band members, the people there and everything and then I come back. And I have to do homework. So I go to sleep around two in the morning. The next morning I'm up at 8 AM my ears are ringing, my body is in pain, and I then I get up and go to class. So I would call it a negative. I do enjoy it but it's a side effect.
R: We'd like to ask you about the experience of flow. Flow is described as an activity where you lose track of time. Have you ever experienced that playing music?
S: Yes all the time.
R: Tell me how that feels.
S: For me flow is whenever I look at a song and I see that it's six minutes long and I play it and I realized that it's over. And I'm like where did the time go? I guess it's like you just get into the groove and you let go and you don't feel it but you experience everything. It's a very word sensation in my opinion.
R: Why is it weird?
S: On the spot you feel everything 1 million times over. It's a "musician high", would be a way to put it. And then it's over and you look back and you say I don't know what's just happened. But it's the coolest feeling ever. It's like that moment when you are in your music and connect on a different level. There's a difference between hearing music and playing it and being in the spot. And somehow the music really connects with you as a person. You feel everything and you can feel the crowd whether you're playing or you're in the crowd, you feel what everyone else is feeling and what the band is feeling and everything gets conveyed and it's with you on a totally different level.
R: Have you ever felt flow in another experience besides music?
S: I've had it for example when I ride my motorcycle so that's kind of the same thing sometimes.
R: You said thinking about music while doing something else does the same. When you thinking about music but doing something else?
S: I think about music all the time. I go to sleep with music playing, I take showers with music playing, i.e. with music playing with my headphones on. I'm the guy that never takes them off and always has speakers nearby.
R: Is it music in your head or music that you listening to?
S: Either/or. I go to class and the teacher will say something and it will remind me of the lyric of the song and then I'm thinking about the song instead of whatever else is going on.
R: So it triggers music?
S. Yes.

R: Rubato is when you intentionally violate the steady rhythm, you speed up or you slow down. Have you ever had that experience in your playing?
S: It does happen. I try to avoid it because I know you have to lock down on the beats but sometimes when you get excited you say let's play faster and the band looks at you like don't play faster, but were playing best so there are some parts which I guess which are a little more difficult to play slowly rather than fast or they are more difficult to play the speed so you slow them down a little bit or you just do it because it fits the mood or the certain section your playing. Like there are times when you go slower because it's a sad section and you want the audience to really get the message so you slow down so the lyricist can really be with the audience and there are times when it's just the riff in the solo in every things going crazy and now you got the speed up. So I guess it just depends on what is going on at the time.
R: Rubato is really about breaking the rules. Have you ever had that experience in any other courses?
S: Yes. I don't believe in the rules or something that you should follow all the time. I see them as more general guidelines. So yes I do kind of break the rules a lot.
R: Can you give me a specific example?
S: This morning in class! The professor was telling us to discuss in my 2322 class which is the second part of the basic intro to EMAC. The professor was trying to tell us that we have to do the reading and write about them and we have to post tweets about our readings. And so I was like how about instead of tweetting we just discuss it in class.
R: Did you suggest that?
S: Yes I did and she was like that's a better reason, it actually involves a discussion and sometimes with the tweets we forget to discuss them in class. So she said I will cut your contributions and count them the same as the tweets as long as you quote articles that you've read if you just don't want to tweak them because people forget them and really nobody reads those tweets except for the professor and that she may or may not discuss them in class. Sometimes the class is just so busy or she just forgets. So I said I'm going to talk about it and she said okay that works.
R: The next question is about discipline and time management. Talk to me about your time management skills.
S: My skills need improvement, but who doesn't
R: Has doing music improved your skills?
S: Yes. I have to get into my schedule which already involves full-time college students 15 hours and social obligations that I have such as clubs. I also to find time to to practice. Also need time to just relax and listen to music. I also need writing time. I need time to do my homework and to do everything else that a normal teenager would be doing. R: do you think being a musician has major better student in terms of time skills?
S: Yes. Normal students can be like, you know, , I'm can wait till the very last moment to do this whole essay and that's it. I don't have that luxury. Maybe I'm going to have, for example, tonight I have a concert, tomorrow night another concert, that's two nights where I will probably back here around one or two in the morning and I'll be dead tired. So I don't have the luxury of putting the essay off to the last minute. So I have to make plans way in advance. I finish my essays about a week in advance so in case I don't have time that week for whatever reason it's

mostly done or I can just finish it off and it's not writing the whole thing, it's writing two paragraphs or something.
R: Do you find that you do better work then?
S: Yes. Definitely.
R: Why do you think it's better?
S: Because it's not rushed as much. I have everything earlier so I have more time to do it. I also find that practicing and doing other musical activities to be relaxing and it's the whole thing where you don't think about it and then you come up with better ideas. So because I have somewhat of an outline or something written down when I'm doing something else it comes to me, like I could change that or I can do something else and it's already written down, so I don't have to start from the very beginning and get to it, so I can change it.
R: In sound design, or any music in general, you listen to an aural stream over time but you have to keep your attention throughout the stream, which, as you said, can be as long as six minutes.
S: Some of my songs are even longer. The song I'm trying to learn right now is 21 minutes. And it's not 21 minutes of silence it's 21 minutes of very complicated things.
R: Talk to me about how you learn to concentrate, to keep your attention going?
S: At first it's really hard. I haven't tested it but I'm pretty sure I have some sort of ADD or something. For me that's why I like music because it's interesting and it holds your interest and it changes and it's not static. Party music has a steady beat for three minutes and then it's over and then the next one is on. Rock music has courses in verses and breaks and they do other things in between them. So it's something that changes. So for me I guess I find ways to take breaks or find something interesting to latch onto.
R: Do you find learning to hold your attention for that length of time has affected your other academic skills?
S: Definitely. I can't sit still for five minutes and I have three-hour lectures. That's a struggle for me. Just like I did with that song, you find something that changes, something to keep your interest going. So if I'm bored, I will change my position, like the way I sit or get up a little bit, stretch of do something to kind of refresh myself and say, all right, next five minutes, let's go. And then I will change my position again for the next five minutes. I shift a lot but it keeps me going.
R: Segmenting is dividing things into smaller sections. Have you ever had an experience where you have to break things up?
S: Yes, that's what I mean by the whole finding something. For example whenever you notice the melody changes it's like the next subsection. especially in very long songs. they do a lot. I listen to the intro and then I play the intro over and over until I know what's going on. Then I go on to the first verse, whatever comes after that. And that's the way I divide it when I'm trying to learn a song, especially if it's complicated. You can't expect to listen to even three minutes of something very complicated and know it's going on. You have to break it down and listen to each bit a few times over until you know what's really happening.
R: Do you find that you do that in other academic courses?
S: Yes, the whole shifting-positions things like that. Shifting now, whenever we change topics to kind of refresh my mind. You have to focus again.
R: Do you do that with academic material, like things you study?

S: Not really. I probably should.
R: What year are you?
S: I'm a freshman. I was born in Mexico but I moved here when I was 11.
R: Last question I always ask: What other things in your life has music affected?
S: It's made me go out there a lot more than I expected. I'm the guy that is there two or three hours after show in the cold just to meet the band. I've traveled to Oklahoma City for one night to go to concerts. I go to Austin for one night to go to a concert. I traveled to go meet an artist. I actually took a lesson with a drummer that is nominated for several Grammys and a Berkeley graduate, he's like Berkeley's pride and joy. It's made me meet a lot of really cool people that I didn't expect to meet. It's really opened my mind to whatever you want to do. Many kids are into, they wanted to be rock stars but that wasn't me when I was a kid, I wanted to be an engineer. And now I want to be a rock star.
R: Sound design in the way is engineering, so do you think sound design has kept in you that childhood desire?
S: Probably. Sound design is very detail oriented and it's very technical and it's very technological and we use the word design in sound design like engineers design things. And music itself in my opinion is very detail oriented, very technical. You're not necessarily dealing with numbers and lines but it's still very structured in its own way and very detailed. You're always finding a way to make it more interesting, to make it better. Music is like a living thing, it's always growing and it's always changing. Even when you play someone else's work, because we do a lot of covers, even then we don't play the song like they do. You change it and find a way to make it different and it's like you have to have what they built, decompose it and see what is really going on and then find how you can put your own style to it even a pop songs that have very basic drum parts,.
R: Anything else you would like to share?
S: I can talk about music for days! I'm going to concerts every week. It's really opened my world to a lot of different things. In my opinion musicians aew not like most people in that we have to go through a lot of different things that most people don't have to. I'm 18, some folks say like I've lived everything but I definitely live through a lot of things that most people haven't even in their whole life. they won't experience certain things. It makes me keep an open mind and be very open to new experiences.
R: Thank you.

Subject 240956 March 12, 2015

R: What is your major?
S: Biology.
R: Are you a music minor?
S: I am not.
R: Tell me a little bit about your background in music.
S: I was in jazz band, pep band, and concert band, select choruses, of course, and jazz combo in high school.
R: What are you playing?

S: I've been playing clarinet since fourth grade and I played tenor sax since junior year. I don't play that here.
R: So right now you're playing clarinet here?
S: Yes.
R: And what courses have you taken?
S: Wind ensemble.
R: With Greg Hustis?
S: Yes.
R: Are you taking that course now or did you take it in the fall?
S: Both.
R: No sound design courses?
S: No.
R: Do you think participating in music courses and doing music study has helped your other academic abilities?
S: I think so, yes.
R: And how?
S: Music is written with quarter notes, eight notes, half notes, so that gives you an early introduction into fractions and math in general. I read somewhere that it stimulates the same part of your brain as math does. But then there's also other things, like the terms are in Italian, which translates to other languages and so it kind of gives you that and at least at the school I went to you had to learn some different languages so that we would get the cultural insight into other places. You also learn about analyzing the form of the song and that is pretty directly related to the form of poetry. There are a lot of parallels.
R: Let's talk a little bit about the experience of flow. Flow is a term that was coined by Csikszentmihalyi about when you get so into an experience, that you lose track of time. Do you ever experience that in playing music?
S: Yes, more with singing them playing, but when you really into practicing and really focused on it; more when your singing.
R: And how does it feel?
S: it's just calm. Kind of liberating, you don't have to worry about other things not even that even time you just focus on what your singing, playing, or listening to.
R: Have you ever experienced flow in any other activity?
S: I'd say yes. In reading, sports. I played volleyball in high school in Schenectady.
R: You mentioned form already and that's one of our questions. By form what we mean is, in this context, is studying the structure of the piece, the A section the B section. Have you ever done that?
S: I have. I wouldn't say as extensively as other people necessarily but I have learned about it in music that I have taken.
R: And how is it helped you?
S: I think it helps. It has parallels in two things like poetry, writing but it also helps you like if you can master one section you understand the style even if it's not the same notes so you can use that in the next section as well.
R: And have you use that technique in your other academic studies?
S: I mean in English but other than that, less.

R: But not in say biology or chemistry or your science courses?
S: Not really.
R: So here you say you have experience doing rubato. Rubato is a subtle speeding up or slowing down the tempo. Tell me about that experience.
S: I've done it several times when I've had solos and where I had to start a piece with rubato. It's more calm and more emotional because you can put in the otion and have that portrayed as like the length of notes and the quality of notes and how you played them instead of having to be so dictated by what's on the page. And I've also had my conductor conduct rubato and that would be more like having him translate his emotions into the music.
R: So rubato is a kind of where breaking the rules because it breaks the metronomic tempo that we seem to be tied to in the 21st century. Have you ever had that experience in doing anything else in your other studies?
S: In general, I feel like everybody breaks the rules. But I don't know if I connected to rubato since rubato is just - it's just a symptom of an overall trend.
R: So you would say rubato is about emotion?
S: Yes. Why else do we break the rules?
R: You said "nerve-racking" on your survey. Why was it nerve racking?
S: Because you had to pick what you were doing and it was your responsibility.
R: And we talked a little bit already about music theory which you said you studied a little bit. Music theory is basically taking the whole piece and analyzing the structure of the piece. Have you done that in other academic classes as well? Do you think studying theory helped you at all?
S: Again the most direct comparison would be to English because when you analyze music you can analyze it in several different ways. You can analyze the key, the tempo, and from that you can gain what the composer was trying to get out of and what he was trying to express. I think with English it's the same thing. You can analyze a short story, a novella or a poem and you can take a bunch of criteria that may be different than what you analyze music with, but still comparable and gauge what the author is trying to say in the poem - whatever artist it is.
R: And how about in other subjects?
S: I would say yes. Even like science and math, it's just basically acquiring the skills to evaluate something based on a certain set of criteria. And it can be different criteria but it's still a skill of evaluation.
R: Did studying music theory put you on to that idea?
S: it's hard to say because I have been studying music for a long time. Even when it's not called music theory, you're always learning it at some level.
R: You said in your survey you didn't think music at anything to do with discipline and time management. Tell me more about that why do you think that's not true?
S: I guess because I don't think it's really affected my time management much. If I hadn't been doing music, I probably would have been doing something else so I don't think… I'm really busy person, I'm busy all the time. And I plan my time so that I'm busy all the time and so regardless of music or no music, I'm happier with music in my life but I probably would have found something else to fill the time.

R: When we listen to music or when we play music, when we're studying music, we do something called segmenting. Segmenting is basically taking a long string of aural information and breaking it into smaller pieces. Have you had that experience in playing music?
S: Listening to or when you're playing it?
R: Both.
S: I think when you learn music you have to chunk it. You can't play it all over and over again; you have to take it into smaller pieces. So yes I would say I've done that before. But more to learn it then when I'm listening to it I guess.
R: Have you applied that concept of chunking or segmenting to other courses?
S: Yes. I think that's just a natural way to learn things. I don't think it's necessarily that it originates in music but it originates from the way you learn and then it's applied to music.
R: You started studying music when you were fairly young.
S: Yes.
R: Do you think maybe you've learned that through through music but don't realize it?
S: It's entirely possible.
R: Some students who start that young don't remember the process.
S: Yes. I'm told I was three when I learned to read. But I guess even before I was playing an instrument. Somebody asked me once when I learned to sing and when I started singing and I felt like that was an odd question.
R: What year are you?
S: Freshman.
R: What are your career goals?
S: I want to be a microbiologist.
R: Do you have any other ideas about how music and your musical experiences may have affected your life?
S: I think it helped shaped relationships with different people. If I wasn't involved in music, I wouldn't have had any of the same friends that I had so that definitely shapes things. One of the first questions you ask people when you get to know them is what type of music do you listen to. For me at least it's one of my first conversation starters so…
R: Do you have to have the same interests?
S: No, they can introduce you to new music.
R: Do you think the kind of music people listen to tells you something about a person?
S: Yes.
R: What you think it tells you?
S: I think it's more important whether they listen to music or not because some people just don't listen to music. But I think that it tells you… If they listen to classical music in their spare time or if they listen to very slow tempo music in their spare time then perhaps their more relaxed. But if there listening to "screamo" or something then maybe they're more energetic.
R: So it's the kind of music they listen to?
S: Yes. I think you can always learn to appreciate new types of music. Like when I was younger I didn't like country but now I have more appreciation for it. But I don't think you can really be taught to appreciate music if you never appreciated music.
R: I like to ask people about the practice habits. So you're playing in wind ensemble now so you have music to practice. How often do you practice?

S: Not as often as I should. It depends. Right now, coming to college and playing music, I have to practice more than I did in high school. In high school or band was set up so: it was for six grade band and then it was seven through 12th. When I was in seventh grade I was playing in high school and it was a lot different than playing in sixth grade. So I practiced probably half an hour every day. But then after that I didn't really practice at all. Now I'm getting back in the swing of practicing more and more often.
R: How many times a week do you think you practice? One major difference in college is that you meet less. So you only have one three-hour rehearsal a week, so outside class, how much do practice?
S: Probably once a week. If that.
R: How long do you practice
S: An hour or less.
R: And do you turn your phone off when you practice?
S: I try to. I'll try to go somewhere quiet and do it when people are sleeping.
R: Where do you practice?
S: I practice in my dorm and just do without the reed or when I'm home I practice at home or outside.
R: Do you use our practice rooms?
S: I don't because the few times I have come by their generally full.
R: Do you use any other rooms on campus?
S: No.
R: Anything else you'd like to share about your experiences and doing music?
S: I can't really think of anything we didn't cover.
R: Is it important to you to continue to do music?
S: Yes. I think I'll continue. I'm not sure whether I'll continue to be in an ensemble or whether I'll continue to play clarinet or go into tenor sax or whether or sing more. I definitely enjoy singing a lot but I haven't really found a place for it here yet.
R: Thank you.

Subject 060269 March 13, 2015

R: What is your major?
S: Computer science.
R: Are you minoring in music?
S: No.
R: What courses have you taken here at UTD in music?
S: I am currently taking Digital Music.
R: With Kelly Durbin?
S: Yes.
R: Tell me a little bit about your background in music in general.
S: Well, when I was pretty young I got a small digital keyboard, just a cheap one. I liked to mess around on that. But it wasn't until my Freshman year of high school that I took a piano class. And from then I took piano classes every year. During my Sophomore year of high school,

I got permission to take the senior level music theory class. That's when I started right music, at the end of that year.
R: So you have had six years of piano, so you are a sophomore? Is this your second year.
S: Yes.
R: Have long have you been doing music in an informal capacity so you've been wriring music since your sophomore year?
S: Yes.
R: So that would be four years.
S: Yes.
R: What kind of music do you write?
S: Sometimes I write – a pretty broad range. The most common would be general orchestral music.
R: So you write for a full orchestra?
S: No.
R: What instruments do you write for.
S: Violin, harp, piano, percussion.
R: What kind of pieces do you write? Would you call them classical music?
S: No.
R: If you had to pick a style what would you call your style? What kind of music do you write? Tonal, atonal?
S: It's pretty simple. I want to use a better word, like not complex. Chords with a melody line.
R: Are they songs or are they without words/
S: I call them songs but they don't have words. I've done a few songs with lyrics to them, some remixes.
R: Have you ever had any of the played by musicians or do you use a MIDI system?
S: My junior year of high school I got into writing digital music with a program called FL Studios. So that's when I starting learning sound production. Before I came to UTD I was considering going into the audio engineering field. I actually got invited to do an internship at a studio for a year instead of going to college. But I ended up chosing to go with computer science.
R: The internship was with what kind of company? Do you remember?
S: It was a sound studio in Dallas. They offered it to a lot of people.
R: Is digital music the only music course you've taken here?
S: Yes, that's the only music course I've taken so far.
R: You have not taken any sound design courses in our ATEC division?
S: No.
R: On your survey you said you don't think participating in music has helped your other courses. Can you tell me about that?
S: In my digital music course?
R: Or in music in general. It's fair to say you think music has nothing to do with it.
S; I think it's more complex than a yes or no. I actually think my academic ability affects my music more than my music affects my academics.
R: Tell me about that.
S: I do improve and it's a lot of just doing what I feel is right.

R: On the keyboard?
S: Yes. When I play piano, I almost exclusively improv, I don't play other people's pieces. I just like to play new notes with new melody lines and have fun. But a lot like when I'm writing music, there's a lot of math ands science involved, which is something I'm relatively good at, and so I think that affects my music heavily.
R: Tell me about how you are thinking about math when you are writing music.
S: I think … One example. I'm currently working on a program that algorithmically generates music. It uses an understanding of probability between notes and scales and an understanding of how that probability affects writing music. I'm using a lot of math to generate music in that way.
R: Are you writing your own code?
S: Yes.
R: So you use math when you write your music. There have been composers who have done that in the past. Have you run the program yet, is it working?
S: Yes. I only started it two days ago so it does stuff. Currently it can write chord progressions and it can generate rhythms for a secondary harmony. You have the simple chord rhythm and the simple block chords and then you have a simple back and forth in a rhythm.
R: No melody yet?
S: The melody is going to be the complex part because I am going to have to use what is called "large body Markov chains".
R: Let's talk about what we call flow. Flow is the sense that you are so into an activity that you lose track of time. You said you always experience flow. Tell me about that feeling.
S: To give an example, one time in high school during piano class I was playing piano and I was just improvising and I fell asleep and continued improvising. When I woke up, I was drooling and was still playing.
R: That's very interesting, because you could not have been completely asleep.
S: I don't think I was completely asleep, I was still kind of aware, but it felt like I was asleep maybe. So that maybe it wasn't really sleep but it felt that way. I was just…all I could hear was the music, and that was my entire.
R: That's probably flow. Do you have that experience when you compose music?
S: Yes. A lot of the time the math is just subconscious. A lot of the time when I am writing melody lines I just start placing notes and it works.
R: Have you ever experience flow doing something else, like when you are writing code?
S: Yes.
R: Tell me how that feels.
S: Whenever I get in to the flow, when I was working on the audio project on Wednesday night, in that time span, it went from just writing to no errors and then just continuously writng code. Pressing play and then it made music, started playing.
R: How many lines?
S: About 300. It's not that long but it should grow pretty heavily … converting it to a MIDI file is already done.
R: How long do you think it took to do those 300 lines?
S: Maybe four hours.

R: Let's talk about rubato. It's more of a performance technique. It's not a composer's technique. Do you think of yourself more as a composer?
S: Yes.
R: Rubato is when a performer slows down or speeds up in a piece of music, particularly for emotional effect. Are you familiar with that?
S: When I improv, my tempo changes pretty much every measure. It's gradually speeding up, slowing down, speeding up. It just changes as it goes.
R: So you are doing it continuously?
S: Yes.
R: Rubato is often breaking a steady tempo, taking away that sense of speed.
S: In digital music, we were supposed to do an improve piece but we were supposed to use a metronome or a drum beat. I said "I can't do this because I can't change the tempo" so I ended up getting permission to take that off. And so in the program that showed the MIDI notes, nothing conformed to the measures, it was just constantly changing shape and size.
R: So you have a fluid sense of beat and tempo, then.
S: Yes.
R: Is there no steady beat when?
S: Almost not, no. It's too restrictive, I don't like it. When I right my electronic music, then I have to have a tempo, because electronic music relies on its drumbeat, its tempo unlike other forms.
R: Would you change it afterwards and make tempo changes?
S: Not really in electronic music, no.
R: So you don't add rubato to it.
S: Electronic is just the steady tempo, steady beat.
R: The next question is about music theory, which you have studied in high school. Has it affected your academic skills in other courses.
S; I would actually say yes, since it helped increased my ability to do analytical thinking.
R: Can you give me a specific example in another class where you thought of it that way?
S: It's most helpful in coding, because that requires a lot of analytical thinking.
R: What do you think is similar about music theory and coding?
S: Because a lot of time people – computer science, a lot of people see that as a misnomer, where it's really not a science but more of an art. Code has something we follow that is the best coding practices, which is essentially the same thing as music theory.
R: Tell me what coding practices are. What features does it have?
S: It's something like – you know it when you see it.
R: Is shorter code better?
S: The more readable it is. If you can look at it and understand what the code is doing within 10 seconds.
R: Are comments important?
S: Yes. Comments are pretty important too.
R: When you look at a music score do you get the same sense?
S: I'm really bad at reading music.
R: So that doesn't happen. You studied theory so you know how to read music?

S: I do know how to read it, but I'm really slow at it and so I just avoid it. I would rather have it as a MIDI file, so I can see what the notes are, instead of letters.
R: Do you print a score for your pieces?
S: No. It just stays in its digital form.
R: There are programs that would do that.
S; Yes. Even if FL Studios could turn it into sheet music, I don't do that.
R: So you are not asking other people to play your pieces.
S: No.
R: Some composers print score and hand it to a flute player, a violin, you know. MIDI has created other options.
S: Having a live performance would be so cool, because I could write an orchestra piece and have real people play it.
R: Segmenting is when we take a long auditory stream, when we listen to a long piece of music, we have to mentally break it up into pieces to process it. Do you have that experience when you are either listening to or writing music?
S: Very much so. That's pretty much when I am writing music I am thinking of verse, chorus, verse, solo, chorus, however it would go. And when I am listening to songs that how I am segmenting them too.
R: Verse, solo, verse, chorus, that's a jazz way of thinking of music. Do you do it when you listen to music also?
S: Yes, very much so. I should also point out what really got me into music – this is probably not a common thing – what got me into music was Guitar Hero. I got really good at Guitar Hero, so seeing those five buttons as notes. That is what me got into seeing there is a theory behind notes.
R: How old were you when you played guitar hero?
S: I was in middle school. In seventh and eighth grade. In eighth grade I actually got a guitar but I didn't really learn it. That's when I thought maybe I can play piano, because I heard piano is a lot more like guitar hero.
R: So it made you think about the theory behind the music.
S: Yes. Guitar Hero also had that split – if you were in practice mode, you could see verse, solo, chorus and every kind of part that branches out.
R: So you can see those segments.
S: Yes.
R: Have you thought about segmenting in other academic courses, in your computer science courses?
S: Yes. In computer science, if you are not segmenting it, it is kind of bad.
R: What are the segments when you write a program?
S: In my audio one, it's segmented into progression, harmony, melody. And then each of those has its own small segments, usually called functions or methods. Those are stored within classes which are the bigger segments of progression, harmony, melody.
R: So that's really analogous to music.
S: That specific kind of programming is called object oriented programming. There's other kinds like entity programming, where analogous to real life, it's where you have objects which are called entities, like a person, a plant, and then you have components, which is stuff that

defines them, like hair color or something, and then you have systems which is like physics, things that govern how those bodies work and how they interact. And then you have what's called the world, which is like the real world, that holds everything and has them all connected. And so each time the program wants to do something it just loops through all the systems, the systems contain each object it needs to work on and it processes them, going system by system.
R: Those are two different kinds of programming. Do you prefer one over the other? What did you use for your audio program?
S: The audio program is actually part of a bigger project that is a self animating system where you give it a dialog script and commands on how they are to move and it animates that for you. But also you can say this segment of the animation needs happy music and it will make the happy music for it.
R: So you are talking about animation as in visual animation, like what you do in a game?
S: It's really simple like 2D animation with dialog boxes, but still it's what I was going for.
R: Is that the next step?
S: I've actually already done the animation. The audio is strangely the more complex part. That's probably because the animation is really simple. It would be really complex if you made an animation that did like full 3D animation algorithmically.
R: Music study takes a lot of practice and discipline. Piano study, studying music theory. Is that true for you?
S: It takes a lot of passion.
R: How does that passion get translated? It's one thing to love doing something, but then you have to do it.
S: I don't know if discipline is it for me, because it wasn't something that I just sat down and studied. It's something that "practice made perfect". If I write music I get better at music and there it goes. I didn't have to worry about ok, do I need to continue to get the chord progression.
R: So you don't really think of it as practice.
S: Yes, it's just doing.
R: Just having fun.
S: Yes.
R: Practice implies doing something over and over again.
S: Yes, like in high school my piano teacher could not get me to do anything, I would just improv. I was still her favorite student.
R: Do you think of music as a kind of language?
S: Yes. Well, it can communicate ideas, especially like emotion, but it can even more complex than emotion. It can communicate …
R: What more complex things than emotion?
S: In movies, the songs sometimes don't just tell you have to feel, they complement the actions themselves. Like, for example, in Bambi, the music wasn't restricted to just measure, they restricted it to what was happening on screen to emphasize different actions. Bambi falling down would have a good hit to it.
R: You don't really think of it as practicing, so let's talk about your experience of doing music. How often do you sit down and improve or write music? Every day, several days a week.
S: Can it be mental? Then 24-7. There is always a new melody line going in my head.
R: You are always hearing music.

S: I never do not have new music going on.
R: Does it interfere with you other activities?
S: No. It's very much a background event unless I don't want it be a background event. Often when I am sitting around I treat different parts of my body as notes, I'll tap or hit my teeth together in different spots, so that's different notes. I'll have different instruments going with my feet, tapping, and my fingers and then my mouth for all the different instruments as they play.
R: Do you turn off your cell phone when you are working on your music?
S: I leave my cell phone on silent a lot.
R: If you are working on a piece of music or improvising, you just don't answer it/.
S: My flow doesn't get interrupted that easily. If it's improv at a piano, then it's easier to interrupt it than writing music, than if I am composing music. If I am writing music on the computer with typing and a mouse, then if a phone goes off, I can still hear the song that I am planning on writing in my head. And so I just go answer the phone, it's still playing in my head while I talk, but the phone back down and I start placing notes again.
R: So it doesn't really bother you.
S: No.
R: So any other experiences in music that you would like to talk about and particularly how it relates to computer science?
S: There are a couple of things. One thing is I almost exclusively write music if someone is going to listen to and enjoy it. That's why it's usually just in my head. I don't write it down if I don't have a plan to send it to someone and have them tell me it was enjoyed.
R: So you send your music to your friends?
S: Yes. Friends or family.
R: Do you publish it on line, YouTube?
S: Yes, I have on my music channel over the course of all my songs I think I have like 25,000 uses. I have also done some in the cloud with a lot more users. We've uploaded to SoundCloud and YouTube.
R: So you are a composer who published on line.
S: Yes.
R: Do you get feedback?
S: Yes.
R: What kind?
S: For the most part, pretty positive. There was one incident that was the last time I wrote a dubstep song, and then said I'm done. I got pretty good at writing dubstep. It was all good until there was one song that was a remix of someone else's music that wasn't dubstep, it was gabber, was the original genre. That's kind of out there, so the people that ended up listening to the new dubstep song were people who were fans of the original song, so I ended up with people who had disagreements with the genre. They did not like how different the song was from the original.
R: Anything else?
S: Something I have wondered. I have autism, so I wonder if somehow my autism affects my ability to write music and see the patterns.
R: When were you diagnosed?
S: We've known for a long time, but I wasn't actually diagnosed until last year. My parents did not want me to be labeled, to put in special classes when I didn't need it.

R: So you were never in special ed. Are you filed with disability access now?
S: Yes. I got pretty good grades, so they (parents) did not see a reason.
R: So you wonder if your autism is related to your musical abilities?
S: Yes, and my coding abilities. Pretty much all talents that I've gained, I've wondered if somehow those are influenced by autism.
R: Autism is a spectrum, so when they diagnosed you was it Asberger's or what?
S: Well, the definition of autism has changed and Asberger's technically doesn't exist any more. I'm at level one autism, whch is the weakest level.
R: High functioning?
S: Yes. Most would say I'm closer to Asberger's.
R: Does you autism affect your other academic classes?
S: It affects anxiety levels, it makes that pretty heavy. It affects my ability to socialize and stuff. Like when I am speaking, I have to see that as a system too, just like music theory. So ok this person has the facial expression with these movements down to a very fine detail, my body actually sees it. I've been able to predict people's past based on their bodily movements.
R: Microexpressions? Like in animation?
S: That too, but more like how they move their eyes, where they look. When you meet someone, their facial expression gains a very subtle expression for a very split second. But that's on a much smaller scale than looking to the right or the left.
R: Have you had any treatment for autism, here at UTD?
S: Yes. Through the student help center, the psychology center.
R: Thank you.

Subject 190560 March 17, 2015

R: What is your major?
S: Biochemistry.
R: When you were here did you do a music minor?
S: I did not.
R: Did you play or sing before you came to UT Dallas?
S: I played some piano before I came to UT Dallas. I did not sing and take any classes before UT Dallas.
R: What courses did you take while you were here at the University in music?
S: I took Vocal Instruction I, Vocal Instruction II, Chamber Singers and Guitar I.
R: And you have taken no sound design classes?
S: I have not taken any sound design classes.
R: In piano, was a private lessons, or were you in a group?
S: Private lessons.
R: How old were you?
S: Between the ages of eight and 12 maybe.
R: Do you think being in music classes affected your academic abilities?
S: I felt I was never musically inclined, so it was another form of thinking and analyzing and studying that I had to get used to. It helped me learn new ideas and learn new modes of

thinking better, so when I got into higher-level science classes and the classes were more complicated, with new ideas that I was not introduced to yet, I was better equipped to think analytically about something I did not yet understand.
R: Flow is generally described as losing track of time. Have you ever had that experience?
S: Yes.
R: And in music?
S: I have not.
R: What about other activities?
S: in writing prose essays, in doing crafts, doing math. I haven't really gotten to flow with music yet. I haven't studied it long enough.
R: What kind of crafts?
S: Painting, going to flow, in arts and crafts, like working on something on paper or planning out something. I'll go into flow working away for six hours and not realizing I haven't eaten or drank.
R: So you have that experience when you're doing a visual arts activity?
S: Right.
R: But not in music so much? Why do you think that's true?
S: I feel if I was a composer or I did sound design, I could go into flow because I'm working at constructing something and you're going with the thought. When I study music in vocal classes, I'm learning someone else's music. Music that maybe I don't connect to or that I'm not inclined to, so I don't really go into flow there.
R: So it’s about your own creation?
S: Right.
R: Form is about the structure of music sections, etc. I know you did that in classes with me. So you said you had studied form occasionally. Do you think learning to analyze music helped you in other studies?
S: Definitely. You develop the ability to recognize patterns and it applied in math for me because you do practice problems and you see a pattern of how equations are used, patterns of how physics are used and the same with music. I see a pattern and I know that it's going to build here, so it helps you memorize the piece and perform it. You only have to glance at a section and realize this next parts coming up and your brain clicks into the next part of the song.
R: You talked here about the textures of a composition are like the characters in the story. Tell me more about that?
S: That actually I attribute to Aaron Copland's book How to Listen to Music. He talked about the different textures and orchestra like flutes, the other woodwinds, versus the percussive instruments or the strings. To play the same melody, they would play it differently and of course the timbre of each instrument sounds different. So it's like the different characters in a play. You have the comic relief, the angry person, the happy little kid, and the orchestra. The pieces in the textures themselves in songs or compositions all play a different role in carrying that melody in comparing what the composer had written originally and then expanded on.
R: Are you familiar with the concept of rubato? Where you speed up or slow down the tempo.
S: We didn’t study that in vocal class but I do see it and hear it in music. I didn't know the term until I actually took the survey.

R: She didn't really use that concept when you performed?
S: I think I used it instinctively. For Michael (*the accompanist*) it was probably difficult for him to follow. It sounded like I wasn't really counting the beats and tempo and keeping it consistent, so it was hard for the accompanist to follow. And that I guess is how I instinctively did it when I performed music on my own, like singing in the shower without anyone carrying the tempo.
R: You haven't studied music theory at all?
S: No.
R: Did you study theory when you studied piano guitar?
S: Just basics. You learn the scales, you learn recordings, or you learn what things mean on sheet music. I did learn theory where this is what the key is.
R: We would like to talk about practice and discipline. Most people agree that studying music takes a lot of practice and discipline
S: I definitely agree.
R: Tell me a little bit about how that affected your other academic skills.
S: In my music classes at UTD, I struggled a lot with keeping up with the other students that had taken choir classes before or eight years of piano or they were just musically inclined and really talented singers. For me, I had to schedule time to go to practice rooms and hammer out notes on the piano, because I wasn't familiar with reading these notes and hearing them in my head. So I had to learn and memorize the notes and really listen to the songs and listen to CDs that were given, in the car, all the time I was studying music to keep up. So, studying music helped me learn how to manage time or helped me build a passion for trying to achieve and succeeded at something that I was struggling with. I think that was something I had done previously, but it definitely changed the setting in which I had to apply the skills. And so, it made those skills more concrete and reinforced that.
R: Listening to music or studying music is aural information over time. So we have to break it into parts and maintain our attention over a long period of time. Have you had that experience in music, having to hold your attention?
S: If I stop paying attention to music, I can get carried by my choir mates. If I run out of breath or forget to take breath at some point, there are three other voices carrying the note. But in vocal classes where you were singing solo, you definitely had to study the music and be on top of every single point for breathing, making sure that you carry your tone clearly, and be really focused because your performance, like professional singers, really depends on the details.
R: Have you applied that to other classes, that ability to focus and pay attention to details?
S: It's something that I struggle with. But it is something that I value in all my classes and all the things that I do outside school. Being able to focus and stay focused for long periods of time, you have to actively keep doing it.
R: And what about discipline? You have to set aside time. Did you find studying music made you think about how you manage your time for other classes?
S: I think with music in particular, I was so far behind that discipline was less of a struggle for me because I was motivated by fear of failure. So, I think for me in particular, discipline wasn't something I learned from music. Discipline was from other classes.
R: When we study music we tend to break big things into smaller pieces called segmenting or chunking. Did you have that experience when you were studying music?

S: Absolutely. Ever since I was a kid in piano classes, we were segmenting from the beginning. You learn one measure a time, one bar at a time. And then you repeat it over and over again until you don't make mistakes and then you had the next bar, the next measure and you continue until the whole piece is done and then you continue so you can do it without looking at the music. Segmenting was definitely a technique I used a lot.
R: And you did that in your studies here at UTD also?
S: Definitely. A lot of curriculum is based on segmenting outside of music.
R: That's my next question. Have you applied it to your other academic classes?
S: I think the other courses, the curriculum was already written in a segmented form. But it took critical thinking skills, maybe early adolescent skills to realize that it was presented that way, when they would give you an outline. Okay these are the things we're going to cover, but we have to cover these things first, to get to the next thing. In academia and science as a whole things are segmented, for example, the basics of biology. You then go deeper and learn more specifics from each end and will eventually get that they taught you in biology.
R: Did you apply the skills that you learn doing music when you were young did that help you study and that when other classes?
S: Yes. Particularly in biochemistry, when you have a long following chain of pathways and you have to do it in segments, in segmented form, because there's no other way to memorize that.
R: You are an alumni from UTD. Tell me when you got your degree in what was in.
S: I got a bachelors of science in biochemistry in 2012.
R: And what if you been doing since then?
S: I've been working for a time and applying to graduate school.
R: Graduate school or medical school
S: Medical school also.
R: Grad school in biochemistry?
S: Medical science actually.
R: Do you think studying music helped you after you graduated? Tell me how music affects you now you've been out to 2 1/2 years correct?
S: Yes. So I listen to music daily. I definitely don't critically think about music as I did when I took classes. But the classes have definitely helped me enjoy the music more and since I listen to music daily, I tend to sing daily. I feel that singing and listening to music raises my mental health and I handle stress better. I handle my days better and I feel more energetic.
R: Looking back at the courses you took, are you glad you took them?
S: Definitely.
R: How do you feel about the music classes you took now looking back?
S: I feel that being a a diverse well-rounded individual is very important. Sticking to your major alone doesn't make you a well-rounded individual. The interdisciplinary skills and learning how to apply those from doing different things other than your major help you think of problem-solving from more angles than just one direct path that you were taught in one major.
R: What about music was something that made a difference?
S: There's segmenting that we already talked about. Segmenting helps me break down large problem into manageable pieces and make progress instead of being overwhelmed by big problem. You can tackle big problems by making small progress until you have the whole thing solved. That's been a pretty important skill to have.

R: The last question we ask is kind of general. How does music make you feel?
S: Great! It's something I looked forward to every week every time I had class. It didn't matter which music class I had, obviously I struggled more than other students but it was still something I look forward to.
R: How has music changed your life?
S: For the better. It's developed my mind and skills in a different mode in a different scenario. I learned the function of each individual piece, each individual character, each individual texture, and it helps me recognize the problems that arise in say the laboratory or in the workplace. What is the problem? How can we how can we fix it, how can we supplement the problem with a different answer?
R: Anything else about music and your life and where you are right now?
S: Music brought my girlfriend and me together actually. So I met her Dragon boating which is a sport that I do and she was on the team already about a year. I noticed on Facebook she liked electronic dancing and she had gone to a huge festival previously so I asked her "I noticed you into this thing, was that awesome? Tell me about your experience there." And then we started going to concerts together and started dating. And to this day, we have the same favorite bands we talk about when we met. Prior to these classes, I was never interested in going to concerts or symphonies ever. I was happy with listening to my music on my iPod and my headphones on my speakers and then I learned the beauty of life music with performed live music, or musicals, and just concerts and symphonies. So since then I have gone to more, I would say at least four performances a year, which is more than I did before.
R: Thank you.

Subject 290661 April 1, 2015

R: Are you a currently registered student or have been in the past 10 years?
S: Yes I have.
R: Have you been enrolled in a music or sound design class in the last 10 years?
S: yes.
R: And what was your major when you were at UT D?
S: Neuroscience.
R: And were you a music minor?
S: I think I was for a semester or two. But I did not graduate with the minor.
R: Do you play an instrument or sang in a formal music experience and if so what?
S: Not currently. Unfortunately but I'm going to remedy that when I move in August. I will again be a student and will have access to University resources.
R: You're music moving in August to do what?
S: I am moving in August to start a PhD in the psychology department at the University of Minnesota.
R: On your survey you talked about your past experience in music and you mentioned both piano and vocal music. Tell me a little more about your experience prior to coming to University.
S: Before coming to UTD I had been taking piano lessons weekly for I guess most of my life. I started in second grade and I was taking lessons for a long time. For a long time I was

taking lessons with the studio where they also taught us ear training, and I guess because I progressed well, I was invited to join, they had like a performer circle that met once a month and we just played extra pieces. We played duets together. I was in a funky ensemble class that met once a week and the goal of that class was to just play around with the keyboard and see how we could transform classical pieces by playing them - for example the dog bark noise or like the electric drill. We just sort of improvised a lot in that class. I did the guild auditions every year. I performed in lots of festivals, competitions and things like that. I was playing relatively seriously.

R: It was all piano right?

S: Vocal things. I started taking choir in middle school and in middle school I was the only student that was in both the top band and the top choir. So that was pretty fun. And then I sang in high school in the choir and a student run a cappella group they had and in madrigals, that was an official class taught by the choral director and she auditioned us to perform at Carnegie Hall a couple of times and then Disney World. So I got to do some extra performing with those groups beyond just the typical high school choir experience.

R: You talked in the survey a little bit about your *compositions*; tell me a little about that.

S: Okay. I started I guess in middle school through all of middle school and high school I would improvise pretty little things and then write them down if I liked them. A lot of it was classical – contemporary, very straightforward, like Pop chords,, nothing terribly highbrow. Some of the pieces were piano solo, some of them had more of a folk vibe with guitar or some of them had lyrics. I recorded them about 35 or 40 minutes worth. I recorded and they're in the Library of Congress and copyrighted. But I haven't been composing really since about my freshman year at UT D. I think I just no longer had the time to sit and fiddle and come up with new melodies that I hadn't heard before.

R: Did you do some composing for the a cappella group or arranging?

S: Oh I arranged, I took Disney songs and 80s pop songs and arranged a couple of top 40 pop songs and arrange them for 3 to 6 parts harmony with solos including a little beat box thing. I'd never arranged before, I didn't know what it was all about, so I kind of learned as I went and I think that much of them the arrangements through on my choral experience so it was score building, mostly at first then I started playing with texture later on. I just sort of realized that there was so much more I could do.

R: I have your survey in front of me it looks like you pretty much covered the music program in all the areas: music theory, piano three times, community chorale, instrument performance III which I guess was musical theater class

S: T hat was a small class of a couple of piano students and a couple of vocal students and a couple of other instrument all folks, there was a trombone player, French horn, I believe and we met about once a month and that was, I think every student in the class had a different experience. As one of the piano students I was assigned to accompany the other soloists and I had good experiences with some of them and less professional experience with some others. Although I guess maybe the definition of professional varies; one particular day with one particular student had a professional capacity and would pick something up at the last minute and sight read through rehearsal and then that would be your one rehearsal before the show and tell. But as a student, I was a little miffed that we hadn't prepared anything for the entire month. So I think that I actually did not accompany him during the class. And since I think I was also

expected to be working on my own pieces separate from accompanying the other students I feel like it was a lot of work but it was definitely a good perspective for what it would be like if I were to perform professionally where it would be sort of a chaotic mass of people different people you rehearse with him perform live, scheduling and where things are not propelled prepared well in advance like in a more academic environment. You just sort of have to pick up the song and play perfectly.

R: It says she did musical theater workshop? Was that Best of Broadway?

S: Yes.

R: Do you remember what that was like?

S: I do, it was sort of unusual because students who were usually auditioning for a community or professional theater would probably be in the chorus but they got to do small parts. The leads were you like one song or two per character instead of the whole show. It gave us the opportunity to learn how to be soloists. At least for me that was the big part of it, because I'd been a piano soloist, but not at all for my vocal work. I'd been in courses in ensembles and a cappella groups. So that was sort of an empowerment thing for me to get out of my anonymity of standing in the row with everyone and to learn how to sort of own the stage for 2 1/2 minutes.

R: I seem to remember a witch in Into the Woods?

S: Yes. And that role was vocally challenging for me. It was… There were notes that would definitely difficult for my range and that was really wonderful for me actually to learn to do that I could do it. I'd had some straight theater background as a kid. I had done a lot of youth theater and I did a kid's production of "Waiting for Godot" actually. When I was in fourth grade.

R: "Waiting for Godot" in fourth grade? Wow!

S: We cut a lot of the lines that were not so relevant but essentially this play was re-imagined as two homeless children waiting for a parental figure to take them in and take care of them. I think that was kind of a beautiful interpretation of the play. Normally it is two men waiting for God I guess. I just really like that metaphor. So I'd had some straight theater experience, and that was just the most interesting of all plays that I did as a kid. So I felt like I was comfortable being a villain on stage and making a creepy but hilarious character. Putting that together with the singing was a quandary for me so that was a really great experience and I'm glad that I did it because I never would have gotten to in any other capacity.

R: We asked you about sound design which you have not done. I don't believe sound design was at the University when you were there. It says you also studied bass clarinet and guitar?

S: I did, yes. In middle school I paid played clarinet and bass clarinet and that was how I was in the top band and the top choir in eighth grade. That was pretty exciting for me. I did not get to the point where we marched because apparently in that school bass clarinet didn't march. We sat with the bassoons. I loved playing the clarinet but I moved from there to a place where I could no longer continue taking lessons and since I was a new player, I'd only played for couple of years at that point, I didn't want to go on by myself and develop bad habits so that got left behind. I actually took guitar lessons for a couple of years in high school. Not classical so much but mostly learning chords and learning specific songs building repertoire and learning a few solos, learning how to solo. But I haven't really played much since. It would be really nice to. Playing guitar feels really different from playing the piano or playing the clarinet or even from singing because you can feel it. You're hugging the instrument and you can feel it in your whole

body and that's a pretty nice experience. I'm just so busy with all my scientific endeavors that I don't even find the time to sing as often as I would like to order to play guitar.
R: We asked you about studying music and academic abilities and then asked you to describe an experience of anything in music that helped you in your *other academic courses?*
S: I think for me mostly it's the patterns, that everything in music is organized. Notes in scales, they are chords made out of those notes, the chords relate to each other in various specific ways which, if you don't remember, you can always calculate if you know the relationships, you can always figure out what the whatever cord this G is. When you get into rhythm it's all hidden math like doing fractions. So I think for me really learning music at a young age before I had learned a lot of different things in school helped me learn how to organize new information and see the patterns and say that this is how things relate to each other, this is how I can construct a complete system with only a few pieces of information. So that's on a really basic cognitive level. I think that was helpful for me but in other aspects. I almost always had usually more than one song playing in my head and that helped take up my extra attention to make it easier for me to sit through a lecture. When I was performing frequently I would be rehearsing my songs in my head while sitting in class, unrelated classes, listening to the lectures. The things like the timing out of phrases and then whole pieces helped me sort of keep track of what was going on in the lecture. Paradoxically, it really helped with my multitasking, learning how to read music at a young age where you have to keep a lot of things in your head at once, and read ahead, and try to remember what was in the measure that your currently playing even though you're looking at a measure a couple ahead. Everything that you would do to be a good musician helped to be a good student.
R: We asked you about flow. Flow is a term coined by chicks from a high about 10 years ago and it refers to the kind of experience you have when you're so into something you lose track of time. So we asked you if you'd ever experienced flow why you are studying music and you said sometimes. Tell me a little bit about flow.
S: It's hard to describe. So usually rather than doing it when studying music, I would feel flow when I was improvising and composing and tried tp remember “that sounded cool, was that what was that that I just did”. And then added onto something I had played a few minutes before. I feel like that's were flow most likely to happen where if I thought about it too much what I was doing then I wouldn't do anything new. And so I kind of just had to shut off my eyes and have shut off my ears and put my fingers places on the keyboard and see what happens. Not be too aware of it.
R: Do you think that's an element of creativity?
S: Yes, definitely. It always felt less like I was doing it and more like the universe was playing my body. I felt like I was on the receiving end rather than on the building and of whatever notes had just been strung together.
R: Have you ever experienced this same feeling flow in a nonmusical activity?
S: Sometimes. Definitely when I was on stage and doing straight theater. I would stop being me and I would be this character. It's always an exciting experience to rehearse some lines and some background information into a complete character, a person. And get to know them and be them for how many hours a week, for however many months, and then at the end of the show. It's not like I'm sad because the show is over and now I don't get to do it anymore; it's I'm sad because I don't get to play with this character anymore. It's like losing a person in your life. So I would

definitely feel this same kind of thing where I lose myself and I'm not really controlling being the character it's just sort of happening and I get to be brought along for the ride. I don't know if I've ever felt flow in a non-artistic way though.

R: How about when you were doing experience experiments or your *science activities*?

S: Yes, I love doing research but I don't think I flow with it. I think it's not that kind of activity. If I don't stay controlled then I'll mess something up and there are prescribed rules and policies about what's acceptable to do. I just can't do some random statistical analysis because I feel like it or because I'm not thinking about it. It has to be believable to other people. I have to be able to justify it so I can't just have as much freedom.

R: You had music theory I. They probably talked about form. Have you ever studied form? Do you remember doing that when you were studying a piece of music?

S: I mean when I was really young, when I started my piano lessons, there would be some talk about the structure of the piece, section A, section B, whatever. . But it never struck me as all that exciting. Well, yes, there are parts of songs, just like every song I've ever heard on the radio. It never struck me as something that was earth shattering but I guess it's helpful is the largest structure of the pattern it can be recognized.

R: Have you extended that to other academic subjects? The idea of structure and form?

S: Well, this is my research definitely. It's like a flowchart, To see an affect, that's like section A and when you get to the end of that you go on to section B which is follow-up and then you look at that incident in a different way. If that ends this way, then you go back to A; if it ends poorly, where the effect disappeared or sometimes you go back to A. You look for something else and maybe that will be a slightly different version of A, A prime where it ends a little differently because it's an unrelated affect or maybe you will see something. Then you get to go on to B, which is the complete statistical analysis and C, where you write the paper and maybe in a very basic rudimentary way. I guess mostly were structure is helpful in chemistry, where it's tables and you can match up the rows and the columns of the this table with the idea of different types of pieces of things that you would use in music. But I guess most academic subjects. But I guess most academic subjects are rote learning rather than a system like that.

R: That was a very analytical response, thank you. Another concept in music that you often experience would probably be more likely in your piano studies is the concept of rubato. Rubato is where you slightly change the tempo either faster or slower to reflect and emotion in a certain part of the piece is you ever have any experience with *rubato*?

S: Oh yes, that was my whole thing. I have never been a perfectionist with notes. I obviously like the notes to be right, but that doesn't happen, so be it. I would rather it have identity and emotion to it. One of the things that I've always loved most about performing is that it gives you a sort of common ground to connect with your audience. It's all about the empathic connection for me and if you play robotically then your audience can't connect with it necessarily unless that's what you're going for. You should be all artistic about it and you can play a piece like it's apocalyptic or something but I've always been about come closer if they let me change the tempo on you, so that you have to pay attention. It never had to try or decide where to put rubato, it just would feel right to go say at the end of a particular section and I would just do it. I think a lot of performers will use rubato at the end of the section to buy them some time to think about what they're going to do next. And maybe it can be a crutch. I may very well have done that, but if it seems right to go there you, can't argue with it. You do to a certain extent have to do

what's expected of you as a performer in order to maintain the trust of your audience. It's kind of like being a driver on the road, you have to go with what's happening around you. If you do something unexpected it could be like all “that was unbelievable and surprising” or it could be a train wreck. Or a car wreck. So that's why would use rubato where people expected to be at the end of a section or maybe at the end of the section and particularly before a repeat of that section. And definitely in a piece it just feels right to you. When you're parking you slow rate down before you go into a parking spot. Usually we just feel right to mess with the tempo in certain ways.

R: You studied music theory in college and you studied it before. Some people have said music. Similar to a language or mathematics. How you think studying music theory extended into your other academic courses?

S: I don't think it's like a language necessarily there is certainly jargon, but languages have arbitrary associations between words, sound and its meaning and its written form. There is nothing arbitrary about music theory. You can get into the ethnocentrism, some saying that Western music theory is what we teach when in fact there are lots of other kinds of musical scales used around the world and those are interesting too. But no matter whose music theory you are talking about, there's always a non-arbitrary structure going on that the people feel is the right way for music to be done. And there's always a pattern to it that rules the sound. It's not like “oh we just decided that this thing means that thing”. I don't know if I would call it a language so as much as I would call it math. And in that way I would associate music form with things that have a lot of structure like chemistry where everything is single structured systems and I would associate music less with more language-based plans where the signs and the semiotics arbitrary. I guess you do have to have structure and literature and definitely in poetry but even in poetry there are arbitrary decisions that apart can make. You are arbitrary in music. It's pretty clear which things go where if you're going to find any kind of structure at all. If you're going to use music theory to construct a piece

R: Studying music takes a lot of discipline and practice. How did learning music, learning to have discipline and learning to practice, affect your other academic skills? S: I'm not that I had to learn how to practice because you couldn't tear me away from my piano when I was a kid. It was in the middle of the house between the kitchen and the stairs. When I was going upstairs, I would sit and play for a few minutes; when I was going downstairs I would sit and play for a few minutes. If I was eating dinner and I was going to go to the bathroom, I would sit and play for a few minutes. So I do not think there was a discipline to my practicing. I just wanted to be always playing and doing it. In that way, I don't think I learned discipline from practicing and I don't think that help me meet the more discipline in other ways because I just wasn't as excited about other things that I was doing.

R: On your survey, you talked about when you first learned a piece of music once it got harder it was a little more difficult for you to stick to it.

S: Oh yes. So when I would play, I would just mess around and do whatever it felt like. When it came to actually learning a piece, that would be difficult for me. It starts out “well I like how it begins” and then I really care enough to get through this to the end. And then I would have to decide that yes, I was motivated through the challenge. So yes, when it came to actually learning something that was written, that I was supposed to be doing, an assignment, yes that required a lot of discipline. I can't remember what that felt like and whether that helped me in

other ways. Yes I think so. When I was six or seven and I started playing, it was a lesson that it could be worth it to do something that was really hard, because then when it was finished "look at I've done this whole big piece". When my Masters thesis would get difficult, I would say "do I really have to go through this" and I did my Masters thesis on a topic that I was very interested in half of and not the other half, I didn't know anything at all. I still don't really. Actually, that's what I am going to when I go to work after this. I'm going to learn more about the part of the topic that I don't know anything about. So, that will be a thing for me "is this really worth it , do I have to go through and learn all this extra stuff just to be able to get what I want to out of it?". Yes, yes, I do because then it will be finished, a complete package tidy tied up a little bow. It's worth it then. Even though this is the messy part that I'm less confident about if, I can just stumble through this part of it then it will make the rest of it all worthwhile.

R: Listening to music requires you to maintain an attention span for certain length of time. You are processing a stream of oral information. Has the need to maintain attention through listening affected your academic skills?

S: Definitely. I have a rather high auditory working memory. I know this because I work in a lab which studies among other things music perception and language perception so I have taken the test in real-time. Not always, it does vary by the day, because sometimes you just better concentration than on other days. But I can get almost a perfect score and on the three-back test where you have to listen to stream of letters and then register ahead when the letter you just heard is the same the letter is the same as the on you heard three before, you heard that letter, so you have to keep at least four letters in your mind at any time. And they come by not terribly slowly. I think that having spent so much of my time and childhood learning music has made my auditory working memory so high and that definitely helped, not just in lectures and in all academic settings, but when you're having a conversation with somebody about a topic that you don't understand and you're asking them for help. You're asking them questions. The fact that I can maintain like five seconds worth of information in my head at once is really helpful. Stuff I didn't quite get it the first time. I have a little secret weapon: I can replay it. I'm aware that everyone has a phonological loop but I think having a high auditory working memory makes it clearer longer or something and so I guess in a way it doesn't necessarily make my attention span better but it's like a compensatory tool. If my attention wasn't good, then I can try again before I have to fess up I got distracted and it takes a lot of self-control to start something at the beginning and go all the way through to the end, specially if it's if the pieces longer than about 3 1/2 minutes. Training yourself to get into that calm Zen state of mind where you can start and go through the entire thing and not get demoralized in the middle when it you're in the challenging section and not think this is so I'll start over because I'm not doing this well… If you can get yourself to finish it anyway I feel like that does help especially since I listen to songs in my head while I'm in class. I feel like that helps in attention to a really long lecture. If you have a three-hour class with a single 10 minute break in the middle, that's a long time to sit and just listen to a thing happening, so I feel like having learned how to adjust, to let something happen for a long time and listen to it and not miss any of the gist of it, I feel like that has helped me at least know what to expect when I have to go listen to a long lecture

R: Another thing we do in music is called segmenting. It has to do with how we learn music, where we learn small chunks of it and then put chunks together. Have you had that experience in

music where you broke things into pieces and if you have, how does that affect the way you look at other academic things?
S: I tended mostly to start at the beginning and learn each bit and play to the end. But when there was a part I just couldn't get through easily there was a place where I was always hesitated where was always stopping. I was getting frustrated. Then I would segment that bit out and I would learn that measure. I would do over-kill, teaching myself that measure. This is a strategy that was taught to me by the director of this piano studio where I played as a kid. I don't remember what she called it, but for me it was always like I have to force myself to fall in love with this little measure and it's so challenging and always gives me a headache. But if I can get myself to love it and appreciate it, then I will want to do it well. I think that helped me when I'm learning anything. If I get to a spot where I can say but "hey this is actually really cool and this is really interesting and it matters so much". And I can use that to kind of self-motivate, myself boost my morale or something to get over that activation energy of "yes I really do need to do this". And then once I decided that I really care about this thing that was hard, it no longer seems hard, anymore. Now it's a friend. I look forward to getting to that piece of it because that I can do well and be proud of it and it's something to be proud of not something to be afraid of doing.
R: So you're not making music right now?
S: No, unfortunately. I'd like to.
R: What was your degree and when did you graduate?
S: I graduated with a BS in neuroscience 2011 and a Masters I have an MA in social science in 2013 from the University of Chicago.
R: And you're going to do a PhD in at the University Minnesota. This is a general question that we ask to see if there's anything else you wanted to add, anything else specifically. Because you're an alumni, we have a question about what has helped you post graduation? Anything music has helped you? You mentioned scientific research because you study speech in sound. That's pretty relevant.
S: Yes, I do study I do study speech in sound. I don't know. It's so hard to talk about this because I started learning music I was so young. To me it's just like second nature. I don't know what parts of why am today are unique because of my music. I feel like I have a sort of membership in a not-secret society. Being a musician is something that anybody can join informally. Anybody can anybody can pick up the guitar and start flowing around and then you're part of this international group of people that love music and that like to do music themselves instead of just listening to it. I feel like that sort of get you into and get you a connection with strangers and helps you make new friends. I will say I had offers from a couple of different PhD programs and the one that I chose (I don't know how much this factored into my decision) but the one that I chose most of the graduate students that are in the lab are dancers or musicians. My advisor-to-be not only allows them to have these hobbies but supports them. He goes to see their shows. I feel like that sort of a supported mission and encouragement for these not-so-strict disciplines is really important and we actually talked about it during my interview. He appreciates that sort of extra-big-picture kind of creativity that people in the arts are encouraged to allow themselves to do as opposed to the very robotic flowcharts expert of "did this work, now go back in this work, now go back." Sometimes you have to step away and think "Well, it could be this other thing that we weren't even thinking about. That kind of insight, that kind of creativity, is fostered in the arts and we don't foster creativity in the sciences. Which I

think is ridiculous. There's no reason not to, but for some reason we don't at traditional schooling. And almost everybody that I work with in my current lab is an artist in some way or has been. One of our post-docs was an art student for both his bachelor's and for his Masters degree and he didn't get interested in psychology until his late 20s. We have almost nobody in the lab has never did any kind of art. I think that something it's really important if you want to have any exciting "a-ha" moments in your scientific research. You need to be encouraged to let other thoughts into your head.

R: Is there anything you'd like to add?

S: I've probably talked enough.

R: I think you've done a great job, thank you very much.

APPENDIX D

RESULTS AND ANALYSIS OF SURVEY TEXT RESPONSES

FULL SAMPLE

The first 20 questions of the Qualtrics survey were designed to get the required consent (Question 1), create a unique identifier for each participant (Questions 2 – 4), verify that the student was registered at UT Dallas in the last ten years (Question 5), gather demographic data on gender and ethnicity (Questions 6-7), ascertain the participant's major and minor (Questions 8-9), and their background in music (Question 13-14), courses taken in music and sound design (Questions 15-16), background in music and sound design prior to entrance to UT Dallas (Questions 17-20).

The next section of the survey delved into the participants' attitudes about music and/or sound design and how they felt it had affected their other academic skills. The first was a general question (Questions 21-22), followed by questions about flow (Questions 23-26), form in music (Questions 27-29), rubato (Questions 30-31), music theory (Questions 32-34), practice and discipline (Questions 25-36), maintaining attention (Questions 37-40), and segmenting (Questions 41-42).

The reminder of the questions were targeted to alumni (Questions 44-47), with one final open-ended question where participants could share any other experience (Question 48). Question 49

gave participants a chance to sign up for a one-hour interview and Question 50 thanked the participant for their time.

Consent Form and Identifier Codes

The first question was a consent form. The great majority of participants marked Yes (97%), whereas as 3% marked No and were directed to the end of the survey.

Questions 2 -4 were identifier questions, so that each participant would have a six digit identifier code to protect their anonymity. The questions were:

2. What is the day of your birth date? Please answer 1 – 31. (Example, if your birth date is 5/12/72, your answer is 12.)

1. What is the month of your mother's birth date? Please answer 01 – 12. (Example: If your mother was born in April, your answer is 04. If you do not know, pick a number from 1 to 12).

2. What are the last two digits of the year of your father's birth date? Please answer 00 – 99. (Example: If you father was born in 1958, your answer is 58. If you do not know, pick a number from 00 to 99).

Six digit codes were used for all interviewees in order to expunge their name and emails from the responses.

Demographics of the Survey Sample

Question 5 asked if students were currently registered at UT Dallas or had been in the last 10 years. 98% answered Yes. 2% answered No and were directed to the end of the survey.

Question 6 asked for gender. In this survey, 48% were male and 52% were female. This contrasts with the gender makeup of the UT Dallas student population (as of Fall 2015) of 57% male and 43% female. Therefore there were significantly higher female respondents than the general UTD population. Question 7 asked for ethnicity.

Question 7. Ethnicity of respondents

#	Answer		Response	%
1	White/Caucasian		69	43%
2	Asian		49	30%
3	Hispanic		17	11%
4	African/American		6	4%
5	Native American		1	1%
6	Native Hawaiian		1	1%
7	Two or more races		15	9%
8	Don't Know/Prefer Not to Answer		3	2%
	Total		161	100%

UT Dallas's ethnicity statistics for Fall 2015 are as follows (note I did not include the "international" designation);

White/Caucasian	37%
Asian American	29%
Hispanic	18%
African American	6%
Native American	< 1%
Pacific Islander	<1%
International	3%
Two of more races	4%
Don't Know	2%

(Source: UT Dallas Office of Strategic Planning and Analysis, 2015)

Therefore there was a higher representation of White/Caucasian participants in the survey, as well as a significantly higher proportion of Asian participants. There were slightly fewer Hispanics, African Americans and more of those of mixed race.

Question 8 asked if the participants had been enrolled in a music or sound design course in the last ten years. Ninety eight percent answered Yes; two percent answered No and were directed to the end of the survey.

Question 9 asked for the major of the participants. The numbers include those who listed double majors.

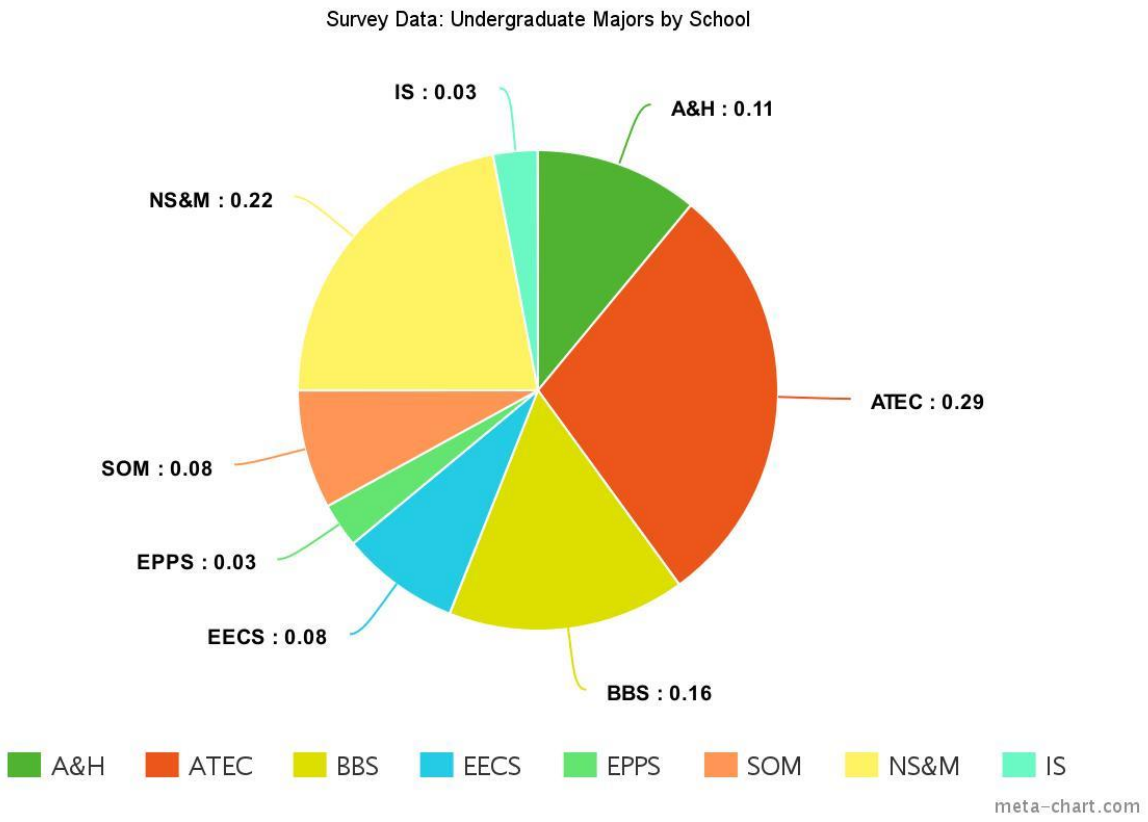
Question 9. Majors of respondents

Arts and Humanities (A&H)	**17**	**11.04%**
Art & Performance	12	
Literary	5	
Arts, Technology & Emerging Communication (ATEC)	**45**	**29.22%**
Arts & Technology	36	
EMAC	9	
Behavioral and Brain Science (BBS)	**24**	**15.58%**
Child Learning and Development	4	
Communication disorders	1	
Psychology	6	
Speech-language Pathology and Audiology	5	
Neuroscience	8	
Electrical Engineering & Computer Science (EECS)	**12**	**7.79%**
Computer Engineering	1	
Computer Science	6	
EE	3	
Software Engineering	2	

Economic, Political and Policy Science (EPPS)	**4**	**2.60%**
International Political Economy	1	
Political Science	3	
Interdisciplinary Studies (IS)	**1**	**0.65%**
Interdisciplinary Studies	1	
School of Management (SOM)	**13**	**8.44%**
Accounting	2	
Business Administration	4	
Finance\Economics	1	
Global Business	1	
Information System	2	
Marketing	3	
Natural Science & Mathematics (NS&M)	**34**	**22.08%**
Actuarial Science	1	
Biochemistry	9	
Biology	14	
Chemistry	3	
Math	3	
Phsyics	4	
Undeclared	**4**	**2.60%**
TOTAL (including double majors)	154	**100.00%**

Majors for UT Dallas for Fall 2015 are also displayed.

The higher levels of ATEC majors is a result of soliciting sound design students who are typically ATEC majors. Music students who major in Art & Performance are A&H majors. Note the much higher number of NSM students in the survey than majors at UT Dallas. STEM majors (Science, Technology, Engineering and Math, which reside in EECS, ATEC and NSM) majors in the survey were 59%. This is significantly higher than STEM majors at the university, which was at 48% for Spring of 2015.

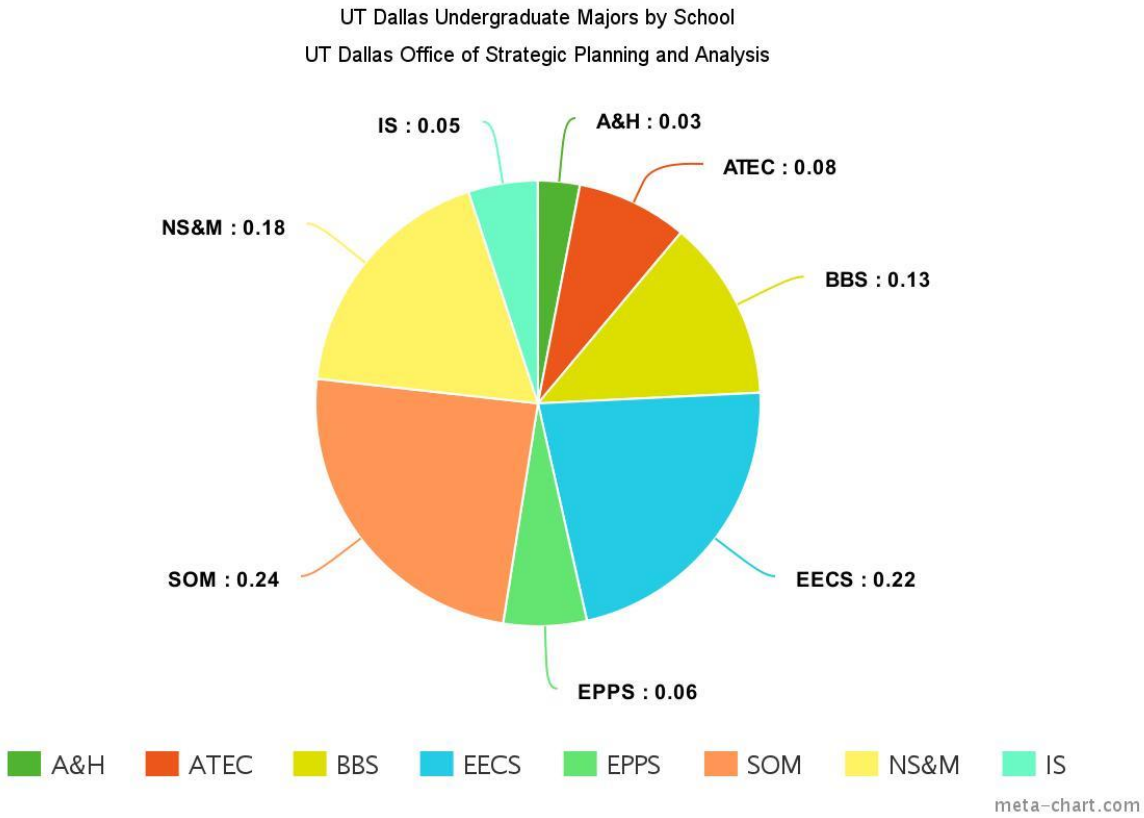


Question 9. Majors for respondents of survey by School

Question 10 asked if participants were music minors during their study at UT Dallas. The music minor requires six courses, two at the lower level and four at the upper level and requires students to take music history and theory in addition to performance ensembles. Twenty-five percent of participants responded Yes; 75% responded No. Since the minor does not have to be declared until graduation, some participants may elect to do the minor at a future time.

Prior Experience in Music and Sound Design

Questions 11 – 20 were designed to ascertain the musical and sound design experience of participants, both in formal settings before and during their college years and informal settings.



Majors for UT Dallas by School for Spring 2015

Question 11 asked if participants had played an instrument or sang in a formal musical experience (classes, private study, ensemble) besides their coursework at UTD. Eighty-two percent responded Yes and were directed to Question 12 to list that experience; Eighteen percent responded No and were directed to Question 13.

A summary of the years of playing and instrument or singing (either solo voice in or a choir) are listed. Nine respondents did not list their instrument.

Question 12. Number of years of musical experience

	choir	voice	band	piano	orchestra
total trs	278	96	199	148	238
responses	44	16	35	22	43
average	6.32	6.00	5.69	6.73	5.53
range	1 to 20	1 to 15	1 to 20	1 to 15	1 to 22

Several things are noteworthy. The majority of participants had played an instrument or sang for an average of over five years; and some had played since early childhood, for 15-20 years.

Additionally, many participants had played multiple instruments or sang in a choir, in addition to playing an instrument. Several respondents had played three instruments; one had played four.

Question 12. Number of instruments played

	number of instruments		%
	1	67	0.57
	2	34	0.29
	3	6	0.05
	4	1	0.01
	no res	9	0.08
		117	1.00

Question 13 asked if participants had engaged in a music or sound design experience in an informal capacity. This question was to elicit activities in playing in a band, composing, arranging, recording, etc. that are not typical courses at the high school level. Responses were nearly evenly split, with 51% responding Yes and 49% responding No. Those that responded Yes were asked to describe that experience in Question 14 and the number of years they had engaged in it. Other responses were community theatre and Indian classical music. The average number of years of engagement was 3.69, with a range of 1-14 years. Of 81 responses, only 39 participants indicated the number of years of engagement.

Question 14. Informal music and sound design activities

	responses	%
composition	14	0.17
arranging	7	0.09
digital music	4	0.05
recording	10	0.12
sound/audio engineer	13	0.16
band	14	0.17
a cappella group	6	0.07
private study	6	0.07
Pod casting	2	0.02
no response	5	0.06
	81	1.00

Question 15 asked participants to list the music courses they had taken at UT Dallas. Some responded with course titles, others with course numbers. Appropriate course title and numbers were obtained from the UT Dallas course catalog for the last ten years. Courses are listed with collation when course numbers changed due to catalog revision. Errors in course numbers or titles were corrected where possible.

Because UT Dallas does not offer a music major, there are no courses in composition or advanced theory. Many respondents have taken multiple courses at UTD, often taking different courses in different semesters. The "Understanding Music" course satisfies the state core requirement in the arts; other courses do not. "Music Theory I and II", and "Understanding Music" are required courses for the music minor. Students who minor in music must also take the upper level music history course, MUSI3322 "Music in Historical Context" or MUSI 3324/3325 "Jazz History". All courses are currently offered for three credit hours with the exception of "Independent Study" (variable) and "Pep Band" and "Community Chorale" (1 credit hour).

Question 15. Music courses taken at UT Dallas by course number

COURSE NO	TITLE	number	%	category
1306	UNDERSTANDING MUISC	25	0.08	HIST
2113	PEP BAND	6	0.02	INSTR
2127	COMMUNITY CHORALE	6	0.02	VOC
2315	GUITAR I	10	0.03	GUITAR
2317	PIANO 1	8	0.03	PIANO
2319	DIGITAL MUSIC	14	0.04	DIGITAL
2322	MUSIC IN WESTERN CIV	0	0.00	HIST
2324	VOCAL INSTRUCTION I	13	0.04	VOC
2328	MUSIC THEORY I	25	0.08	THEORY
3312/4312	ADV MUSIC ENSEMBLE	2	0.01	INSTR
3316/4316	GUITAR ENSEMBLE	1	0.00	GUITAR
3318/4318	STRING ENSEMBLE	17	0.05	INSTR
3320/4320	WIND ENSEMBLE	10	0.03	INSTR
3322	MUSIC IN HIST CONTEXT	8	0.03	HIST
3324/3325	JAZZ HISTORY	6	0.02	HIST
3328	MUSIC THEORY II	9	0.03	THEORY
3381	INSTRUMENTAL ENSEMBLE	1	0.00	INSTR
3382	BEST OF BROADWAY	28	0.09	VOC
3382	VOCAL INSTRUCTION II	14	0.04	VOC
3385/4385	CHAMBER SINGERS	58	0.18	VOC
3386/4386	JAZZ ENSEMBLE	7	0.02	INSTR
3388	PIANO II	3	0.01	PIANO
4345	MUSIC PERF III	17	0.05	VOC
4347	VOCAL ENSEMBLE III	15	0.05	VOC
4348	CREATING MUSIC	1	0.00	CREATE
2V71	INDEPENDENT STUDY	1	0.00	IS
4V71	INDEPENDENT STUDY	11	0.03	IS
4346	INSTRUMENT ENSEMBLE III	4	0.01	INSTR
		320	1.00	

Question 16 asked for similar data about Sound Design classes. Because the Sound Design area is relatively new and has only three dedicated full time faculty members (two of which teach graduate level courses also), the offerings are few. Again, course titles and numbers were collated and errors corrected. Introduction to sound design is a required course for Emerging

Question 15. Music courses taken at UT Dallas taken by genre

Music History and Appreciation	39	0.12
Instrumental Ensemble	47	0.15
Vocal and choral	151	0.47
Piano	11	0.03
Guitar	11	0.03
Music Theory	34	0.11
Independent Study	12	0.04
Creating Music	1	0.00
Digital Music	14	0.04
	320	1.00

Media and Communication (EMAC) majors. Other listed courses are electives in the ATEC major. As of 2014-15, no minor in ATEC has been created.

Question 16. Sound design courses taken at UT Dallas

		NUMBER	%
2385	INTRO TO SOUND DESIGN	37	0.54
3310	AUDIO TECHNOLOGIES	9	0.13
3312	AUDIO PRODUCTION LAB	1	0.01
3354	SOUND DESIGN FOR GAMES	5	0.07
4375	SPECIAL TOPICS IN SOUND DESIGN	16	0.24
		68	1.00

Question 17 asked if participants had studied music prior to coming to UT Dallas. 80% answered Yes and in Question 18 they were asked how long and in what capacity. Twenty percent had not studied music prior to attending UT Dallas. A summary of the answers by genre is listed. The table includes total years, the number of responses, average number of years in each genre and the range of the answers in years. It is significant that some respondents listed many years of experience, up to 21 years in piano, 16 years in orchestra, 15 years in voice and 16 years in band. This indicates that many respondents participated in music as a child.

Question 19 asked a similar question about sound design experience prior to attending UT

Question 17. Years of experience in music prior to attending UT Dallas

	choir	voice	band	piano	orchestra
total yrs	125	60	91	157	112
responses	21	15	16	21	16
average	5.95	4.00	5.69	7.48	7.00
range	1 to 13	1 to 13	1 to 9	2 to 16	1 to 13

Dallas. Since sound design is not a formal activity in high schools, it was expected that fewer participants would have experience. 18% answered Yes and they were asked about their experience in Question 20. 72% responded No. There were only five responses to Question 20; two responses said "none" or "very little". Three answered with formal experiences, ranging from one to two years; one had taken a high school course in sound design for one year. Two answered four years, specifying audio engineering. One participant's answer was not pertinent (music theory). One participant had worked in the field professionally for 20 years.

Music and Sound Design and Academic Abilities

Questions 21 and 22 asked about participating in music or sound design courses and how it affected their other academic abilities. These questions were intentionally open-ended and gave participants a chance to reflect about the major topic of the study and also gave them an entry point for consideration of the topic. Question 21 asked if the participants agreed with this statement: "Participating in music or sound design courses has affected my academic abilities in other courses." Note that the word "affected" was carefully chosen to be neutral, not biasing the participant towards a negative or positive answer. One hundred seven participants (82%) marked agree or strongly agree. In Question 22 they were asked to describe one experience that had affected their skills in another course. Text responses were gathered in a Word document and

then keywords were identified that captured the salient features of the response. Not all 108 participants responded and some responded with text that did not answer the question. Several participants responded in several categories.

Question 22. One experience that affects academic skills, keywords and categories

Key Words	Category	
writing	Communication	
communication disorders, speech	Communication	
more diligent, more relaxed	Relieve stress	Discipline
confidence builder	Other	
hear differences in sound for language	Communication	
how parts works together	Interrelationship	
relieve stress	Relieve stress	
theory of production and design	Knowledge	
learning patterns and rhythm	Knowledge	
discipline	Discipline	
motivation	Concentration, focus	
visualization	Knowledge	
concentration, more self-aware, practice smart	Concentration	Discipline
organizational, time management skills	Time management	
social	Other	
focus, memorization, mathematical abilities	Concentration, focus	Memorization
		Mathematical skills
prioritize, accomplish tasks in an expedient manner	Discipline	
efficiency	Discipline	
express emotions	Expressivity	
knowledge of time periods and cultures	Knowledge	
hard work pays off, delayed gratification	Other	
escape, refreshes	Relieve stress	
perception of sound	Other	
pay attention to detail	Concentration, focus	
concentrate	Concentration, focus	
more relaxed, relieved stress	Relieve stress	
knowledge	Knowledge	
time management	Time management	
mathematics, overcoming frustration,	Mathematics	Expressivity
		Concentration
achieving success, emotional connection	Mathematics	Relieve stress
mathematical thinking, helps relax	Relieve stress	
n/a		
retain focus	Concentration, focus	
discipline	Discipline	

connections, critical thinking,	Interrelationship	Critical thinking skills
different perspectives	New perspectives	
different perspectives	New perspectives	
happier	Relieve stress	
knowledge	Knowledge	
attention to detail, think in new ways	Concentration, focus	New perspectives
calms me down, focus	Relieve stress	
express yourself, reduce stress	Relieve stress	
knowledge	Knowledge	
relieve stress, focus	Relieve stress	
public speaking skills	Public speaking skills	
go with the flow, never too late to learn	Concentration, focus	
knowledge	Knowledge	
public speaking skills	Public speaking skills	
enjoy tedious activity,	Concentration, focus	
better mood and mindset	Relieve stress	
mathematics, knowledge	Mathematics	knowledge
perception, knowledge	Knowledge	Perception
mathematics	Mathematics	
stress relief	Relieve stress	
cooperation, perspective	Other	New perspectives
critical thinking skills, drive and focus	Critical thinking skills	Concentration, focus
repetition and memorization, learning parts	Memorization	
knowledge	Knowledge	
flexible mind set	Critical thinking skills	New perspectives
focus, memorization, mathematical abilities	Concentration, focus	Memorization
		Mathematics
escape stress	Relieve stress	
practicing to gain perfection	Discipline	
speed reading	Other	
mathematics, creative thinking, structure	Mathematics	Critical thinking skills
		Interrelationship
escape, express yourself	Relieve stress	Expressivity
understand generalities, memorization	Interrelationships	Memorization
creative thinking	Critical thinking skills	
mathematical skills, easy of learning	Mathematics	Other
public speaking skills	Public speaking skills	
concentration	Concentration, focus	
categorize and compute	Interrelationships	
knowledge	Knowledge	
critical thinking, time management	Critical thinking skills	Time management
thinking skills	Critical thinking skills	
historical perspectives, focus	New perspectives	Concentration, focus
new ideas	New perspectives	
focus, relieve stress and depression	Concentration	Relieve stress
calmer, more focused	Relieve stress	

organization, analyze deeper meaning	Time management	Critical Thinking skills
De-stress	Relieve stress	
public speaking skills, memorization	Public speaking skills	Mathematics
keeps me focused	Focus	
numbers make sense	Mathematics	
knowledge	Knowledge	
adds another dimension	New perspectives	
better my abilities	Critical thinking skills	
multiple subjects	Interrelationship	
video production	Video production	

After examination of all responses, the key words were grouped into categories, tabulated, and coded as situation codes (SC), Process codes (PC), activity codes (AC) or strategy codes (STC) based on the following criteria:

Situation codes: the way subjects define an issue
Process codes: words or phrases commonly used
Activity codes: regularly occurring types of activities
Strategy codes: the means by which subjects accomplish objectives

The three most common areas were concentration and focus (15%), to relieve stress (16%) and increasing knowledge base (12%). Two of these are strategy codes, and the third is a situation code. Strategy codes represented 42% of the sample, situation codes represented 24%, activity codes represented 26%, and process codes represented 3%. The category "other" (4%) was not coded. Therefore approximately 96% of the sample fell into three code categories: strategy, situation and activity. This was expected, given that the question was non-specific in nature.

Question 22. One experience that affects academic skills, categories and context codes

Categories	responses	percentage	code
Concentration, focus	16	0.15	STC
Memorization	3	0.03	AC
Relieve stress	17	0.16	STC
Time management	4	0.04	STC
Public speaking, communication	5	0.05	AC
New perspectives	8	0.08	SC
Knowledge	13	0.13	SC

Mathematics skills	10	0.10	AC
Interrelationship of parts, connections	4	0.04	SC
Discipline	7	0.07	STC
Critical thinking skills	9	0.09	AC
Expressivity	3	0.03	PC
Other	5	0.05	*
	104	1.00	

Question 22. One experience that affects academic skills, summary of context codes

STC	0.42	strategy codes
AC	0.26	activity codes
SC	0.24	situation codes
PC	0.03	process codes
other	0.04	n/a

It is significant that 15% of participants spoke of concentration/focus, which is required of music and sound design activities to a high degree.

(Music) improves my concentration skill, because when I sit down and practice my favorite music, it really helps me stay focused with what I'm doing. Also I became more self-aware of my own limits and what I'm capable and incapable of, so that I don't stretch too hard and hurt my voice. Not just practice but practice smart.

It gave me perception on the importance of sound in many instances of entertainment business. This has helped me understand to pay attention to detail, even in visual aspects that can make a difference, like my imaging class.

Music has been known to relieve stress and anxiety and was mentioned by 18% of participants.

Music is an escape for me when I feel swamped by coursework. So it is more of a fresh breath of air, something that refreshes or revitalizes.

Having a music course (specifically orchestra or vocal instruction) generally put me in a much better mood afterwards allowing me to go into other coursework with a better mindset.

Any course in a subject will increase the knowledge base of the student. This was mentioned by 13% of participants.

Programming. The audio technology class combined with other music classes has given me a visual to the sine waves produced by instruments and what makes the tone. I would say that brought programming to a new light for me on the ability to program sound and incorporating

digitally produced sound patterns to create a sequence or even to be produced by actions in a game.

Music theory aided my knowledge of time periods and culture in history classes.

There were numerous points in my final semester where topics in one class would overlap with topics in another class, and while many of these were primarily literary, historical placement of both literature and music was important in several instances.

It was surprising that the often-held belief that music education's main affect is in time management and discipline was not mentioned as often (11%) as expected. One can theorize that the parental influence on discipline and time management has fallen away at the college level, as many students at UT Dallas to not live with their parents, and that they are less focused on that aspect of their musical activity at this point. These topics were explored in later questions.

Several other respondents spoke of learning languages:

I am able to hear differences in sound when learning a different language, making pronunciation easier.

or learning to express emotions:

Learning to express emotions through playing music and singing has helped me express emotion in drawing and animation.

or realizing that hard work can pay off:

Music has helped me to realize that long hard work pays off. Studying for hours and hours a week with improve my grade just as practicing my instrument improves my sound. Music has given me a sense of delayed gratification.

Finally, several spoke directly about specific instances and other academic courses:

Participating in the Arizona All-State Jazz Choir in the fall of 2013 allowed me to intensely practice the skills that are needed in jazz singing, which requires a great amount of physical and mental connection to rhythm and pitch. It increased my critical thinking abilities as well as my determination, both of which have benefited me in courses such as calculus or chemistry.

When you take any Neuroscience or broad Psychology course, you always end up studying different sections of the body that are related to sensation and perception. Whenever we studied

the ear, and how sound travels through it and is processed in the brain, because of my musical training, I was always able to grasp it more definitely than most of my non-singing counterparts. I was lucky in my musical training that my teachers found it important to teach the actual mechanics of sound to help us better understand how to control it.

Music helped me develop my studying technique by learning compositions in pieces and repetition that build upon the previous measures and bars. This carried over into my science studies like in biochemistry when I would learn the first few parts of a pathway through recitation and repetition until I would move on to the next few steps of a pathway.

It is important to note that while several participants spoke of topics that are addressed later in the survey, they had not at this time seen those questions or were aware that those topics would be addressed later.

Flow and Experiences

Questions 23 – 25 explored the concept of "flow". Participants were asked in Question 23 if they had ever experienced flow in a musical or sound design activity and, if so, to describe it in Question 24. Question 25 asked if they had experienced flow in another activity.

85% of participants responded they had experienced flow; 15% said they had rarely or never had that experience. Most respondents expressed that they "lost track of time", "that time flies", or something similar. Those that expressed feelings talked about how the experience made them feel, using words such as soothing, uplifting, freeing, natural, blissful, serene, joyous, euphoria, fun, energetic, peaceful, relaxing, calming, creative, free and reassuring. Others expressed an embodiment concept of feeling they "became the music", "got absorbed in the music", "music takes over you and you become the instrument", getting "wrapped up in the world of music", telling "a story through my instrument", being in a "trance-like state", or feeling as if they were "in the sheet music…the notes on the page." Others spoke of focus, being able to "shut down

my mind", and how "effortless" it seemed. Other respondents talked about emotion, confidence, muscle memory, non-verbal communication, hyper-awareness, pure thought, and productiveness. Since descriptions of feelings are primarily situation codes, it is not surprising that 83% fell into that category. Embodiment was coded as activity, and Focus as a strategy.

Question 24. Experience of "flow", keywords and categories

Soothing, uplifting, natural, reassuring.	serenity	natural
fun and easy	fun	easy
I just become the music, time out of mind	perception of time	
lose track of time, absorbed in the music	perception of time	
	immersed	
until I was done	perception of time	
do not notice that time is passing	perception of time	
the music takes over and you become the instrument	embodiment	
as if time flew	perception of time	
bliss and serenity, "shut down" my mind	serenity	
focus	focus	
you feel the emotion conveyed	feeling the emotion	
losing myself , expressing my feelings	feeling the emotion	
brings me joy	joy	
a few hours have already passed	perception of time	
time is moving by more quickly, focus, muscle memory	perception of time	
nonverbal communication	feeling the emotion	
not realizing how much time has passed	perception of time	
would not actually feel like a long time	perception of time	
time exists in a separate dimension , hyperaware	perception of time	
focus	focus	
a lot of time had passed	perception of time	
how quickly the three hour had passed by	perception of time	
fun	fun	
euphoria, when the sounds beautifully come together	joy	
3 hours of class pass strangely fast	perception of time	
lose track of time	perception of time	
rarely feel like I need to go home	perception of time	
15 minutes and it's actually been 3 hours	perception of time	
nothing else can matter. Then time flies by.	perception of time	
pure thought and emotion, drama or joy or	feeling the emotion	
sadness are unfolding in me		
energy and peace	energy	serenity
long periods of time	perception of time	
been several hours	perception of time	

satisfying	satisfaction	
was surprised at the amount of time that had passed	perception of time	
thinking only five minutes had passed.	perception of time	
that time seems to be irrelevant	perception of time	
not keeping track of time, focusing	perception of time	
want to keep doing it	joy	
intense amount of concentration/ highly focused on the music	focus	
in the zone and I knew exactly how I wanted my project to be.	perception of time	
mesmerizing, that all track of time is completely lost,	perception of time	
the music surrounds you		
everything comes naturally	natural	
very happy, makes time pass very quickly, fun,	perception of time	
stress-relieving, relaxing, and free	fun	free
Time flies by	perception of time	
time passes so quickly, having such a good time	perception of time	
wrapped up, forget the tasks at hand,	perception of time	
lose track of time		
in another world	immersed	
Natural	natural	
focused, in the "mood", lose track of time	perception of time	
find what the music can mean to myself	feeling the emotion	
lose track of how many times you've listened	perception of time	
Utter calm	serenity	
My focus was split, and yet not; I was working on minute	focus	
details and yet it felt like I was focused on the piece as a whole		
Relaxation	relaxation	
you feel the music	feeling the emotion	
Happy, concentrated, almost out of body	joy	focus
	out of body	
natural confidence, the creative ideas forming s	confidence	
in your thought		
are being directly and easily translated into experience		
focus, felt more like telling a story through	focus	storytelling
my instrument.		
feel the music	feeling the emotion	
Time flies	perception of time	
peaceful	serenity	
the creativity of my mind	creativity	
lose track	perception of time	
lost in the moment	perception of time	
time flies when you're having fun, passion	perception of time	
trance like feeling, playing while half asleep	trance	
Engulfed by the enjoyment of music,	perception of time	

losing sense of time		
without inhibition. I felt more productive	free	productive
Time didn't matter	perception of time	
in the zone	perception of time	
lost track of time, realize your work is done	perception of time	
lost track of time, nothing else mattered	perception of time	
Nothing makes time go faster, everything seems easy.	perception of time	
confidence in a performance	confidence	
euphorically good	joy	
lose track of time, lost in the music	perception of time	
lose track of time	perception of time	
I'd lose track of time when I combined music and math,	perception of time	
put myself on auto-pilot		
focus on my musical activity	focus	
I "exist" in the sheet music. As if I really am those	embodiment	
notes on the page.		
losing hours of time	perception of time	
effortless, the hands making the music weren't mine	embodiment	
time just passed by so quickly	perception of time	
effortless, stopped worrying, really emotional,	free	confidence
confidence	feeling the emotion	
lose track of time	perception of time	
class would pass by very quickly	perception of time	
lose track of time	perception of time	
go on forever	perception of time	
excitement, concentration	excitement	concentration
speeds up sense of time	perception of time	
lost track of time	perception of time	
nice	natural	
faster rate than normal, focused	perception of time	
lose track of time	perception of time	
isn't a forced focus	free and easy	
timeless	perception of time	
experimentation	experimentation	
elation	joy	
lot of time	perception of time	

Question 24. Experience of "flow", categories and context codes

Categories	responses	percentage	code
Serenity	5	0.04	SC
Natural	5	0.04	SC
Free and easy	6	0.05	SC
Fun	4	0.03	SC
Perception of time	56	0.48	SC
Immersion	3	0.03	SC

Embodiment	4	0.03	AC
Joy	7	0.06	SC
Confidence	2	0.02	SC
Focus	7	0.06	STC
Feeling the emotion	8	0.07	SC
Other	9	0.08	SC
	116	1.00	

Question 24. Experience of "flow", summary of context codes

STC	0.06	strategy codes
AC	0.03	activity codes
SC	0.83	situation codes
PC	0.00	process codes
other	0.08	n/a

Question 25 asked if the participants had experienced flow in another activity. Eighty-one percent of respondents answered Yes. Question 26 asked them to describe that experience. Since these are all activities, a code analysis was not performed.

Question 26. Non-musical flow activities, keywords and categories

KEYWORDS	CATEGORY		
writing	writing		
learning about something interesting	learning		
acting, presenting my scientific work, sex.	artisitic	presentation	sex
Film editing	artistic		
soccer	sports		
paint, playing video games	entertainment		
sports	sports		
mindless office work	working		
rock climbing, dancing, and acting	sports	artistic	
writing lyrics for music, writing a classical work	writing		
drawing, creating mini polymer clay models, designing	artistic		
preparing my Physics session, coding or programming.	programming	science	
Hanging out with friends, games, studying	entertainment		
running long distances	sports		
Art and carpentry	artistic		
Typing essays	writing		
running, climbing trees, near-car-accidents, etc.	sports		

presentation	presentation		
technical theater classes	artistic		
drawing	artistic		
working with programs	programming		
Soundscape	artistic		
Reading books or textbooks	reading		
studying	studying		
drawing, painting, sculpture.	artistic		
reading	reading		
when seeing patients	science		
creative writer	writing		
programming	programming		
program applications	programming		
softball	sports		
reading.	reading		
draw, design, or watch movies	artistic	entertainment	
sports, reading a book, cleaning, cooking	sports	reading	
writing	writing		
competitive swimming.	sports		
talking with friends	entertainment		
caught up in a book	reading		
studying	studying		
Working out	sports		
Exercise	sports		
drawing or designing.	artistic		
read a book	reading		
in the research lab	science		
Sports, writing, math, science	sports	writing	science
math	math		
sports	sports		
Making art	artistic		
writing	writing		
sports, a repeated task,	sports		
painting or drawing	artistic		
writing	writing		
Crafting sound effects	artistic		
Reading	reading		
read	reading		
video games	entertainment		
Reading	reading		
sound design project	artistic		

studying	studying		
fun in the mall	entertainment		
drawing, working on puzzles	artistic		
studied math	math		
managing a project or directing a performance	artistic		
reading or studying	reading	studying	
reading and writing	reading	writing	
running long distances	sports		
painting.	artistic		
video game	entertainment		
When I run	sports		
swimming, sewing to cooking to conversations with friends	sports	entertainment	
on the Internet	entertainment		
studying	studying		
cross country meet	sports		
video games	entertainment		
sports	sports		
writing	writing		
doing homework that I understand	studying		
reading	reading		
runner's high	sports		
read books	reading		
Figure drawing	artistic		
games, homework, design, art	entertainment	studying	artistic
Tuning the world out	other		
adrenaline	other		
3D modeling	artistic		
running	sports		

Question 26. Non-musical flow activities, summary of categories

	number	%
Sports/exercise	20	0.21
Artistic/creative	20	0.21
Entertainment (video games, friends)	11	0.11
Reading for pleasure	12	0.12
Studying/learning	8	0.08
Writing	10	0.10
Programming	4	0.04
Science/math	6	0.06
Presentation	2	0.02
Other	4	0.04

While most respondents mentioned the common feeling of “losing track of time”, some delved more deeply into their experience, talking about becoming one with the music:

I lose myself, like I don't really have an identity, I just become the music, and I'm not really aware of being the person making the music, it is just happening.

I guess it feels like the music takes over and you become the instrument. During a performance this will happen and you can hear the ensemble more coherently and be really in tune with everything that you're hearing. Suddenly it all stops, and the concert is over feeling like almost no time has passed.

Others spoke of a paradoxical feeling that time had both slowed down and sped up:

Hard to describe, but it feels as though time is moving by more quickly, yet your actions themselves are slowed down and you're able to focus on them more precisely. For example, in drum line with the marching component, I always felt like I was in a state of "conscious autopilot" during performances where muscle memory took over for the most part, but I retained ultimate control.

When deep enough into character, it can feel like time exists in a separate dimension from what I am saying/doing, and so I simultaneously am hyperaware of my words/notes/movements and everything blurs together into a stream of unconscious instinct.

Others spoke of having a great sense of focus and attention to details, as well as the whole:

The world around you exists, but just barely enough for the laws of physics to keep everything flying in the air. My focus was split, and yet not; I was working on minute details and yet it felt like I was focused on the piece as a whole, but at the same time. And time ran at a different speed that seemed much slower than what it actually was.

Others felt flow was essential to creativity and confidence:

I've found this kind of "flow" to encompass a natural confidence and a sense that the creative ideas forming in your thoughts are being directly and easily translated into experience, with very little resistance from things like mechanical inability, feelings of fear or hesitation, and similar roadblocks.

When I got to the bridge of the song, my favorite part, everything became effortless. I stopped worrying about staying with the accompaniment. I forgot I was being watched. I forgot about everyone in the room or why I was even there. I felt this surge of confidence I never had before, let alone under the pressure of a competition. Usually, I would walk out of a competition and criticize myself on every mistake. This time I finished my solo with confidence.

When asked about other activities that induced flow, many mentioned sports or video games. A significant number mentioned reading and studying. Many also spoke about other academic activities, such as artistic activities like painting or drawing, writing, programming, working on science problems or medicine. (It should be noted that UT Dallas has a pre-medical program for undergraduates that includes internships at UT Southwestern Medical School in patient care.)

In writing. It's so easy to get lost, to let the words and emotions carry you.

Whenever I become really concentrating and focused on what I'm doing: I find peace and ultimately joy. Usually this happens when I'm doing my job of preparing my Physics session where I lead a group of students to study, or whenever I work on coding or programming.

Usually when working with programs. I tend to get caught up in writing an algorithm or a block in the most efficient manner I can think of at the time.

When writing things down, I get a beat in my head and I have pencil meet paper on the "strong beats."

I experience flow when seeing patients. It just doesn't seem like work. With pediatrics, I walk into a room, and the kids and the parents become my friends...my family. With adults, once we've met once, I feel like each subsequent visit is one with an old friend. Most days it's energizing. Rarely do I ever find it tedious.

Form, Structure and Academic Abilities

Questions 27 to 29 explored the area of musical form. The first question define "form" as follows: "…the 'form' of a musical work (such as ABA, rondo form, sonata, form, etc.)" and then asked if they had ever analyzed the form of a piece of music. 27% answered "frequently", 42% answered "occasionally" and 31% answered "not at all". Those that said "frequently" or "occasionally" were asked to agree or disagree with the statement "Learning to analyze that structure affected my other academic tasks." 22% answered "strongly agree" and 56% answered "agree. The remaining 33% said "strongly disagree" or "disagree" and were directed to the next

section. Those that agreed were asked in Question 29 to describe how it affected their other academic tasks. Since all of these are strategies, no code analysis was conducted.

Question 29. Form, keywords and categories

Keywords	Category	Field
ideas of structure as metaphors	structure	neuroscience
neurotransmitter receptors		chemistry
periodic table		
lit studies		literature
commonalities and structure	structure	
patterns	patterns	
observant to micro details	details	
structure of essay writing	structure	writing
repetition and variation	*repetition and variation*	
well thought out paper or project	structure	
ability to analyze the material	analysis	
mathematical and logical	*logic*	mathematics
allow for creativity within bound	*creativity*	
recognition of patterns	patterns	
patterns and mathematical relationship	patterns	mathematics
narratives structure	structure	
structural patterns	patterns	
	structural	
another perspective	*perspective*	
pay attention to detail	details	
show you the entire concept of something	structure	
analytic skills	analysis	
learning to analyze literature	analysis	literature
express complex emotions	*expressivity*	
patterns	patterns	
patience	*patience*	
look beyond the surface	details	literature
English and literature classes writing		writing
patterns	patterns	
pattern recognition	patterns	
find patterns	patterns	
mathematical		mathematics
finding the patterns	patterns	
look for the small details	details	
structure in organic chemistry or biology	structure	organic chemistry
		biology
how you learn poetry	learning	*poetry*

how I solve mathematical equations	*solving*	mathematics
patterns in literature	patterns	literature
pattern finding	patterns	
better at listening	*listening*	
pay closer attentions to what others area saying		
most things fit into a category	structure	mathematics
Calculus and physics		physics
		chemistry
critical thinking	analysis	
critically read passages		literature
breaking down physiology into pathways		physiology
helped in math related courses	learning	mathematics
break down stories	analysis	literature
anaylze with a critical eye	analysis	
take a part the model and study it	structure	
patterns in story lines	patterns	
call and reply in math	learning	mathematics
recognizing patterns	patterns	
mathematics		mathematics
analyze other aspects of reasoning	analysis	
form or a paper or essay	analysis	writing
analyze literary works	analysis	literature
critical thinking	analysis	
attention to details	details	
look at the big picture and the individual elements	structure	
	details	
critical analysis skills	analysis	
problem analysis to interpersonal conflict resolution		psychology
patterns in math	patterns	mathematics
analyze form to see ABA	analysis	literature
rhythm/repetition in order, memorization skills	analysis	
	memorization	
knowledge		
pattern recognition	patterns	mathematics
		art classes
listening while working, motivation	analysis	

Question 29. Form, summary of categories and context codes

Categories		number	%	code
patterns		15	0.26	STC
analysis/critical thinking		14	0.25	STC

structure		11	0.19	STC
details		5	0.09	STC
learning		3	0.05	STC
other		9	0.16	
total		57	1.00	

Question 29. Form, summary of academic subjects

Subjects	number	%
Mathematics	10	0.36
Literature	7	0.25
Natural sciences	8	0.29
Writing	3	0.11
total	28	1.00

It is significant that 70% of respondents felt that studying form in music helped them identify patterns, or analyze structure or helped their critical thinking skills. The remainder felt it helped them see details or assisted in general learning. While not all participants listed specific academic subjects, those that did listed mathematics or natural sciences 65% of the time; the rest listed literature or writing. Many participants listed several subjects.

Many participants mentioned how analyzing structure in music assisted them in analyzing structure in other subjects, particularly in the sciences and mathematics:

I guess I use ideas of structure as metaphors for understanding different types of neurotransmitter receptors, or how different elements in the periodic table can have similar properties within columns.

Analyzing form helped me to realize that most things fit into some sort of category, and subjects overlap. Calculus is used in physics, Spanish sentence structure is almost like a math problem using words, etc. Being able to know the form of a jazz chart so I can improv to it is just like knowing what is water-soluble, so I can answer basic chemistry questions.

Analyzing musical structure has helped me help me organize how I solve mathematical equations.

Others mentioned how it helped in their ability to organize papers, or critically analyze texts:

It helps, as a lit studies major, to get used to finding commonalities and structure in a very abstract form.

It helps relate to the structure of essay writing, and how repetition and variation can get your point across persuasively.

Learning to analyze music and learning to analyze literature go hand in hand. There is the same balance between the intent of a composer/musician/author and the interpretation of the listener/reader. They also tend to have many of the same forms in terms of things like exposition, development, climax, resolution, etc., which made learning the structure of stories and essays easier. Music and writing are both ways we use to express complex emotions, and learning to hear and use emotion in music helped me to do so in writing, as well. I had to learn what I wanted to express, and then practice expressing it in ways that allowed other people to understand me and feel what I felt.

Others mentioned other subjects, such as business management and history:

It helped me become observant to micro details and micromanaging an organization.

By analyzing music, you begin to analyze other aspects of reasoning. In music, composers and lyricists always have a reason for the melodies and lyrics they choose. Similarly, businessmen have reasons for why they make certain strategic moves. It's easier to ask the right questions in other courses because you learn about history and psychology in music.

Others mentioned that it helped their critical thinking in all subjects:

I think it's a common skill that is used in almost all subjects of study. In other term, I would call it my critical thinking skill - ability to analyze the material to better understand it, and gain experience so that I can apply to similar situations/scenarios in the future.

Studying the form of music is an extension of critical thinking that is used when reading or writing an argument. When studying the form of a composition, the different textures of a composition can represent the different characters of a story or sides of an argument. Learning to break down music into its more basic components helped me critically read through passages and understand what purpose each paragraph was serving to help the thesis. In my science courses, breaking down physiology or a pathway into its basic components helped to visualize and memorize the purpose of each substrate and enzyme.

Helped me learned the ability to look at everything simultaneously as a big picture and as individual elements, while examining the harmony that unifies them.

Rubato and ":Bending the Rules"

Rubato is an advanced musical technique that requires the performer to "bend the rules", i.e. go outside the proscribed tempo and markings to add their own individual element to the performance. Questions 30 and 31 asked about this concept. Rubato was defined as "changing slightly the tempo of a piece, referring to expressive and rhythmic freedom by a slight speeding up and then slowing down of the tempo of a piece at the discretion of the soloist." This experience is common only with more advanced study. Surprisingly, 75% of participants responded "Yes" and were asked to describe that experience. The remaining 25% responded "No" and were directed to the next section. While rubato can be considered "bending the rules" of the markings on the page, most participants either did not understand the concept or did not see it as deviating from the score.

The great majority of students who responded correctly mentioned expression (12) and emotion (22) as the primary reason for doing rubato and the experience they had. Several others mentioned it as a technique (9) and a way to add individual creativity (8). Five (5) students mentioned that it felt "natural" and three (3) said it was to hold interest. Twenty-four (24) students did not answer the question within its scope; most merely answered with a piece of music where they had used rubato, or an instance (band, solo, etc.) but did not describe the experience. Given that rubato is a technique in music, the majority of answers are either activity codes (describing the technique) or strategy codes (using rubato to express emotion or creativity).

Question 31. Rubato, keywords and categories

KEYWORDS	CATEGORY	
felt natural, music takes on a life of its own	natural	
dramatic effect, feeling the emotion	*drama*	emotion
individual performance qualities	individual creativity	
it feels right	natural	
emotional pieces	emotion	
interpret the piece	individual creativity	
conveys the emotions	expression	
freedom and expression	*freedom*	expression
keep the listeners interested	interest	
personalize the piece to display emotion	individual creativity	emotion
techniques	technique	
expression of emotion	expression	emotion
enhance the creativity	individual creativity	
performance art	individual creativity	
focus on the seductive intent, feelings	expression	emotion
the feeling the notes convey	emotion	
emotional expression	emotion	expression
emotional feeling	emotion	
went quite well	natural	
most difficult, most challenging	*challenging*	
feel of the music	emotion	
changing the mood	expression	
conveying emotion	emotion	
focus more on the words	technique	
expresses something	expression	
music if outside of one's range	technique	
emotional cues	emotion	
overall effect, making it your own	individual creativity	
emotion	emotion	
bond with other performers	*social connection*	
style purposes	expression	technique
gets more intense	emotion	
according to my mood, personal touch	individual creativity	emotion
creative license	individual creativity	
more energized	expression	
invest your soul into the music	emotion	
resemble the rhythm of speech	technique	
feeling not a sience	emotion	
keep people interested in the game	interest	
emotion, emphasis, clarity	emotion	technique
natural, not forced	natural	
stylistic	expression	

express emotions	emotion	
performance technique	technique	
impart emotion	emotion	
second nature, express the emotion	natural	emotion
musical	technique	
add expression	expression	
add expression	expression	
challenging	technique	
awesome	emotion	
changes, establishing new idea	interest	
not very successful		
fulfilling	emotion	

Note: Non-applicable responses have been removed.

Question 31. Rubato, categories and context codes

	number	%	code
natural	5	0.08	SC
expression	12	0.20	STC
emotion	22	0.37	AC
technique	9	0.15	AC
individual creativity	8	0.14	AC
add or hold interest	3	0.05	STC
	59	1.00	

Question 31. Rubato, summary of context codes

code	%
Situation codes	0.08
Activity codes	0.66
Strategy codes	0.25
	1.00

It was clear from responses that many of the participants did not understand the concept of rubato. But those that did mentioned the difficulty of doing it well and the importance of a teacher to help with the process:

*It took a lot more skill and concentration to do this than I expected, but when done well it really conveys the emotions in a piece***.**

I often used rubato in marimba solos that I would play for competitions. Occasionally such changes were written in the piece, but usually I would add it in at the advice of a lesson teacher to enhance the expressivity of my playing.

As the bassist, Rubato is probably the most difficult of styles to produce. Because our position is used mainly as a metronome for the rest of the orchestra, following a soloist who constructs their own tempo can be very challenging, but the music created from it is one of my favorites.

Many participants mentioned that it allowed them to add their own creativity and expression:

I particularly love using rubato when performing a piano piece, and it expresses something that human words cannot.

Wonderful experience. You get to really invest your soul into the music and become one with your instrument.

When you compose pieces in rubato, it isn't so much as a song as it is an expression of emotion. It's somewhat similar to telling a story - you read fast when scenes are intense and you read slow when scenes need some reflection.

Others mentioned that it was a way to add or hold interest:

It seems to be in almost all music that I can think of. Changing the tempo is a common way to keep the listeners interested.

Despite being only a slight variance in bpm, the effect of rubato I found was very effective in signifying a change and establishing a new musical idea.

Music Theory, Mathematics and Language

The next three questions were focused on the study of music theory. Question 32 posited that the study of music theory can be similar to studying a language or mathematics and asked participants if they had studied music theory. 67% responded Yes, while 33% responded No. Those that had studied music theory were asked if they agreed with the statement "Studying music theory enhanced my academic skills in other courses." Only 38% disagreed (no participants marked "strongly disagree"), while 62% marked "agree" or "strongly agree". They were then asked in Question 34 to describe how studying music theory affected their academic skills. Text responses were analyzed as to key words, categorized and codes were applied to the

categories. Other responses for skills were symbolism, details, discipline, sound, focus, translation, performance, and perception.

Question 34. Music theory, keywords and categories

keywords	category	
think in a more rational way	critical analysis	
critical analysis	critical analysis	
patterns, emergent propoerties	patterns	
finding order	form	
learning a new language	learning	language
see patterns, mathematics	patterns	mathematics
analytical, math or chemistry	critical analysis	mathematics, *chemistry*
translating, programming something	*translation*	*programming*
enhance personal perfomrance skill	*performance*	
mathematical and logical	critical analysis	mathematical
more focused, general knowledge base	*focus*	*general knowledge*
mathematics and philosophy	learning	mathematics, *philosophy*
patterns and relationships	patterns	
grasp cultural time periods	learning	history
flow of sound	*sound*	
reading , arithmetic, physics of waves	learning	*reading*, math, physics
learn mathematical concepts	learning	mathematics
discipline	*discipline*	
physics, reference point	learning	physics
patterns	patterns	
speech, acoustics, perception	*perception*	acoustics,
math and fractions		mathematics
small details	*details*	
wriring, math, historical implications	thinking	mathematics, history
writing skills, develop essays	writing skills	writing
pattern recognition	patterns	
intuitive physical explanations	learning	physics
geometry, apply all of my other classes	learning	mathematics
critical thinking, language	critical analysis	language
patterns and trends	patterns	
mathematical thinking, patterns,	learning	mathematics
better understand processes.		
language, patterns	patterns	language
structure and organization	patterns	
critical thinking, logical, analysis	critical analysis	
analytic skills	critical analysis	
mathematical concepts	learning	mathematics

form and order, writing essays	form	writing
symbolism, language, writing essays	*symbolism*	language, writing
math and analytical skills	critical analysis	mathematics
vocabulary, writing skills	writing skills	writing
studying practices	learning	
mathematics courses		mathematics
knowledge in creating music	*creating*	
pattern recognition	patterns	mathematics, art
what type of work is around	learning	

Question34. Music theory, summary of categories and context codes

SKILLS		resp	%	codes
critical analysis		8	0.19	STC
patterns		9	0.21	STC
form		2	0.05	STC
learning		12	0.29	SC
writing skills		3	0.07	STC
other		8	0.19	n/a
total		42	1.00	

Question 34. Music theory, summary of academic subjects

SUBJECTS		number	%
mathematics		12	0.44
language		4	0.16
writing		4	0.16
physics		4	0.16
history		2	0.08
total		26	1.00

Question 34. Music theory, summary of context codes.

CODES	%
STC (Strategy codes)	0.52
SC (Situation Codes)	0.29
other	0.19
	1.00

Many respondents mentioned the connection between music theory and mathematics:

It helped me to think in a more straight-forward and rational way. Music theory is, in a way, a lot like mathematics, at which I've never really excelled. Music theory engaged that part of my brain in a way that it understood and enjoyed.

Music theory is very analytical with many rules and exceptions and this can be applied to many courses such as math or chemistry, where equations and variables are used and must be constantly remembered to perform the equation correctly.

Music theory has helped with my mathematical thinking. Like mathematics, music theory is based around patterns and numbers that, when recognized, can be used to speed up and better understand processes.

Others mentioned the connection between music theory and physics:

Studying music has improved my reading comprehension and early arithmetic skills. It also gave me a basis for understanding the physics of waves.

It hasn't had a strong effect; however, music theory is, in large part, based on physics, and it was fascinating and revealing to see how common musical principles have intuitive physical explanations, often related to what I had been studying in other classes.

Many mentioned that see patterns through music theory enhanced their academic skills:

Having to learn huge patterns and all the various pieces that make up those patterns helped me learn about the different levels that anything can have, and emergent properties. Because I was so young when I first started learning about chords and harmonic progressions and transposing, I think about almost everything I've ever learned in terms of patterns of pieces made up of smaller pieces.

Studying music theory helped me see patterns more easily, specifically in mathematics.

Music theory has helped with pattern recognition and understanding sequences of information, as well as analyzing pieces of information relative to one another. It bases itself in a recognition of rules and then applying those rules to instances, which personally has been easily relatable to mathematics and art.

Others mentioned the connection to language and writing skills:

Music theory, through studying harmonization and progression patterns, has actually really helped my writing skills. I have legitimately used theory devices (in full knowledge at the time because I was just stuck with nowhere to go) to help me write and develop essays.

Studying music theory always leads to critical thinking. In a way, music theory is like a second language. Learning this language has led me to think more deeply about everything.

Discipline, Time Management and Academic Skills

Questions 35 and 36 explored the areas of time management and discipline. Participants were asked if they felt that studying music or sound design had enhanced their skills in other subjects. Only 2% indicated “strongly disagree, and 20% indicated “disagree”. The remaining 78% indicated “agree” or “strongly agree”. Those that did were asked to describe an experience where study in music or sound design had affected their other academic skills as regards discipline and time management.

Answers varied here, but the great majority referred to planning, scheduling, setting time aside, etc. Others mentioned the dedication it takes, heightened focus, awareness of what you were doing, learning to be more efficient, increased motivation, finding balance between activities, learning a complex subject, prioritizing tasks, learning to expend great effort, understanding delayed gratification and learning patience . Single responses were recognizing deficiencies, independences, managing expectations, the value of repetition and compartmentalizing tasks. Responses that were not pertinent to the question have been removed.

Question 36. Discipline and time management, keywords and categories

KEYWORDS	CATEGORY	
engaging, listening, understanding,	dedication	
dedication, passion		
arrange time, grades improved,	planning	
planning	planning	
be ok with starting in the middle, pleasing others	planning	
focus, how I need to treat my body	focus	awareness
prioritize and study better	prioritizing	
not expecting to know everything at once	*expectations*	
motivation to be productive	motivation	
complex, no right or wrong	complex	
applying the skills all at once	complex	

studying ahead of time for classes	planning	
persistence and effort	effort	
avoiding procrastination	planning	
manage participation	planning	
schedule time	planning	
work ethic	*work ethic*	
manage time better	planning	
recognize deficiencies	*recognize deficiencies*	
time and effort	effort	
payoff coming at the end	delayed gratification	
more work	effort	
independence	*independence*	
practice time had to increase	planning	
commitment, schedule	planning	
pushing through frustration, setting aside time	delayed gratification	planning
value of repetitious practice	*value of repetition*	
spend a little time every day	planning	
time and effort	effort	
impactful, piece can always be improved	effort	
minimize wasted time	planning	
don't fall behind on tasks	planning	
do things more efficiently	efficiency	
patience	patience	
never a waste of time	dedication	
awareness, schedule time to study	planning	awareness
prioritizing	prioritizing	
manage time better	planning	
focus, productivity	focus	
budget time, warm up to the idea	planning	
self-motivated, fitting in practice time	motivation	planning
increased in college	motivation	
a good grasp of time	planning	
practice every day, find balance	planning	balance
budget time	planning	
manage time to not get overburdened	planning	
balance	balance	
set aside time on particular days	planning	
seta side time to practice	planning	
more than minimal investment	motivation	
reserve certain hours to compose	planning	
practice until ready to perform	motivation	
compartmentalize tasks	*compartmentalize*	
have sound recorder ready all the time	planning	
keep and maintain a schedule	planning	
work daily, music awakens the brain	planning	motivation
more detailed and efficient	efficiency	

stay focused and be aware of time spent	focus	awareness
balance	balance	
focus, patience	focus	patience
overcame learning disabilities	motivation	
concentration	focus	
dedication, patience	dedication	patience
needed break from studies	planning	
studying efficiently	efficiency	
want to get better at something	motivation	
focused, concentration, studying better	focus	
finding time, music theory, scheduling	planning	
pay attention to a lot of things, prioritize	prioritizing	
assignments cannot be done overnight	planning	
carefully budget time, pace my work	planning	
keep time allocated for music	balance	

Question 36. Discipline and time management, categories and context codes

	resp	%	code
planning	32	0.44	STC
dedication	3	0.04	SC
focus	6	0.08	STC
awareness	3	0.04	SC
efficiency	3	0.04	STC
motivation	8	0.11	SC
balance	3	0.04	SC
complex	2	0.03	SC
prioritizing	3	0.04	STC
effort	5	0.07	SC
delayed gratification	2	0.03	SC
patience	3	0.04	SC
	73	1.00	

Question 36. Discipline and time management, summary of context codes

STC (strategy codes)	0.60
SC (situation codes)	0.40
	1.00

The great majority of respondents mentioned enhancing planning and time management skills as a major benefit of studying music and sound design:

Again this is also a chance to work on these skills: time management and personal discipline. The difference is that I work on music, which is my favorite subject. Hence the improvement process is easy to go through. One example would be studying to sing in another foreign

language: Waldesgespräch - a classical piano-voice solo written in German by Schumann. This time I'm required to apply all skills to learn the piece: learn how to speak the words correctly, get the right pitch and get together these two along with proper tempo. This requires a lot of work and hence time management and discipline is key.

Being able to manage participation as concertmaster of an orchestra while my career path points towards medicine allows me to better manage my time with any events

There is no "perfect" when it comes to music. Something can always be improved, or a more difficult piece can be tackled. There's really no "acing" a musical piece, and the discipline that that promotes is much more significant and impactful than what non-musical academics can promote, in my opinion.

Being in musical productions requires time management, especially when it is time for a performance. I had to find ways to do my other work outside rehearsal times, which was difficult but necessary. It has helped me learn to manage time now that I have a job.

Anytime I am engaged in my rig at home, I am absolutely focused at all times. There is a level of concentration and discipline that I have to have in order to complete simple or challenging projects. Any musician can attest to that. These skills alone have transcended to the way I study and prep for my classes at UT-D. It's pretty cool now that I think about it.

Others mentioned the passion and dedication that music and sound design inspire:

Music is so much more than singing or playing an instrument. It's engaging, it's listening, it's understanding, and it's dedication. To truly study music, you must study all aspects of music, and I think that applies to anything in life. All passion requires discipline.

Making quality music takes time. It's an art form, and it takes time, persistence, and effort to make a piece the best it can be.

It taught me that if I want to get better at something, I need to work on what I'm bad at.

Several participants mentioned that doing music or sound design taught them about delayed gratification:

Marching band and music ensemble class teaches delayed gratification and this is helpful when studying for a class, it teaches one to study for while, not expecting to know everything all at once.

It lets me know that there is a payoff coming at the end of the road.

Studying music is often an exercise in pushing through frustration in order to achieve success. It requires setting high but reasonable goals, setting aside time to practice every day, and having

the discipline to do things that are boring or banal in order to achieve good results. These are all skills I use a lot in school, as past successes make current studying and work seem worth it because I know I am capable of future success.

Maintaining Attention to Aural Information

Question 37 asked if participants agreed with the statement "Studying music or doing sound design requires one to maintain attention while listening to a stream of aural information." Only 6% disagreed with the statement, with the other 94% marking "agree" or "strongly agree". They were then asked if they felt that maintaining attention through listening to a stream of aural information had affected their academic skills. 73% marked Yes and were asked to describe that experience in Question 38; 27% marked No and were directed to the next question. Most responses here tended to emphasize an increase in critical listening skills, enhanced ability to multitask, increased focus and concentration, picking out details, and enhancing auditory memory. Activities most mentioned were listening to lectures and studying . All of the categories were deemed to strategy codes STC (listening, multitasking, focus, details, and memory) and fell into two activities, AC (listening and studying). It is pertinent to our study that a number of participants mentioned listening to "long, boring lectures" and how they felt they had better skills to maintain attention during those lectures.

Question 38. Maintaining attention to aural information, keywords and categories

KEYWORDS	CATEOGRY	SUBJECT
trains my ears, forced to pay attention	listening	
working memory, replay in my head	memory	lectures
audio reservoir for playback	memory	lectures
better attention to lectures		
gather and retain information	memory	lectures
helps me study		studying
focus longer and harder	focus	
discern minor bits of info, tuning out unneeded	details, focus	

concentration, stay engaged	focus	
multitasking, able to do more	multitasking	
music distracts, cannot concentrate		
need to listen	listening	
abundance of stimuli helps learning	learning	
need additional stimuli helps attention	listening	
focus on heard lectures	focus	lectures
listen closely to lectures	listening	lectures
recall more easily	memory	
focus more	focus	
better concentration	focus	
increased multitasking, need stimuli to focus	multitasking	
split my attention	multitasking	
critical thinking while listening	listening	
easier to listen and take notes at the	multitasking	lectures
same time		
more observant visually and audibly	listening	
focus	focus	
get distracted by noise without music	listening	
tune out unnecessary noise	listening	
focus on many different things	multitasking	focus
focus	focus	
can listen and still do tasks	multitasking	
listening, focus	listening, focus	
better listener, more attention to details	listening, details	
really listen to teacher during lectures	listening	lectures
better listener, retain information	listening, memory	
listening to long lectures	listening	lectures
pay attention to details in lectures	details	lectures
focus on what the lecturer is saying	focus	lectures
better multi-tasking, concentrate better	multitasking, focus	
constant focus, deconstruct listening	focus, listening	
multi tasking and detailed attention	multitasking, details	
lectures, listening and analyzing	listening	lectures
multitasking, listening	multitasking, listening	lectures
listening to complex lectures, focus,	listening, focus	lectures
grasp new concepts		
applying music to other subjects		studying
learn in multiple ways	learning	studying
multitasking	multitasking	
pick out details, mathematical processes	details	studying
easier to multitask	multitasking	
focus, communication	focus, communication	
focus despite distractions, multitasking	focus, multitasking	
concentration	focus	

math and music are similar, easy to get lost		
need to stay attentive in lectures	focus	lectures
lectures, active listening and focus	focus, listening	lectures
listening, process for running experiments	listening	
lectures, critical listening skills	listening	
listen to others more carefully	listening	
more of a working memory, focus	focus, memory	
lots of information at once	multitasking	
lectures, pay attention longer, retain more	listening, memory	lectures
professor lectures	listening	lectures
absorb information	focus	
critically evaluate a sound	focus	
focus to listen to a lecture	listening, focus	lectures
tend to multiple tings	multitasking	
Selective hearing of instruments	listening	

Question 38. Maintaining attention to aural information, categories and context codes

category	resp	%	strategy
listening	26	0.35	STC
multitasking	14	0.19	STC
focus	22	0.30	SC
details	5	0.07	SC
memory	7	0.09	SC
total	74	1.00	

Question 38. Maintaining attention to aural information, summary of context codes

strategy codes	%
STC	0.54
SC	0.46
	1.00

Question 38. Maintaining attention to aural information, categories for activities

activity	resp	%
lectures	18	0.72
studying	7	0.28
total	25	1.00

Many respondents mentioned that studying music and sound design had enhanced their ability to listen, particularly as regards lectures in other subjects:

I can pay in better attention to lectures my classes and I do not zone out as much.

Difficult or monotonous classes take a lot of concentration to get through but music has taught me to stay engaged.

I am a much better listener and can retain information for longer periods of time, rather than focusing on other thoughts as I'm listening. Learning to listen fully to music has made me a better listener in other areas of my life, personal and academic.

Several mentioned that it had enhanced their ability to remember what they had heard, a kind of

"auditory playback mechanism":

When playing a piece, it's not enough to just do what you have to do next, you have to know what it's going to sound like in just a moment, and it's kind of like playing along with a memory you've made through the lengthy rehearsal time you've used to prepare the piece. This has given me an incredibly high auditory working memory capacity. I can listen to academic lectures, conversations, presentations, talks, virtually anything, while also playing at least one song in my head at the same time. If I miss something, or get confused, I can replay those last few seconds in my mind while still following what's currently being said, and catch up.

Lectures...I've found I can keep an audio reservoir for playback if I fall behind in writing notes.

I went from having a majority of my learning come from visualizing to being an auditory learner. I have more of a working memory when I take notes in class, so I can focus and memorize longer phrases of words.

Many mentioned that it had enhanced their ability to focus and pick out important details during

lectures:

By learning to listen and pick up on subtle nuances of music and sound design aural information, I have learned to discern minor bits of information that can be crucial later on. It has also assisted me in "tuning out" unneeded information.

It's necessary to have a certain focus to really hear and understand a piece. This focus transfers to other difficult academic concepts.

Focusing on many different things at the same time, noticing each and every small detail in most situations.

Finally, many felt it had enhanced their critical thinking skills:

It's critical thinking while actively listening. It takes effort to do.

Aural input is the primary input when listening to a complex lecture in any course. Studying music has helped me build my focus and attention span to follow a speaker's train of thought and grasp new concepts more quickly.

Most traditionally taught classes are taught in lecture style which requires students to acquire information aurally. I am not by nature an aural learner, so I've had to consciously strengthen those skills. The critical listening skills required to perform music have been key.

When working with audio, you must be concerned with both the parts of the work, as well as the whole of the work. This kind of mindset has helped with taking information I am given and immediately applying to given tasks and current situations.

Segmenting and Academic Skills

Question 41 explored the concept of "segmenting" or "chunking" information, in particular breaking up auditory information into smaller segments. 87% of participants responded they had experienced this phenomena in studying music or sound design. They were then asked to describe that experience in Question 42. This was one of the surprises in the study: the researcher had imagined that respondents would talk about segmenting in a temporal i.e. horizontal fashion. But because music and sound design are primarily two-dimensional subjects, there were two basic responses to this question. Some respondents broke up the music or sound in a horizontal, temporal way, referring to the sections of a piece or a sound design. Others broke up the music or sound into vertical segments, referring to different voices or instruments in a piece of music (choral or orchestral) or in a mix. Some respondents referred to both. We therefore analyzed the responses to include this feature: horizontal vs. vertical approaches. Responses that did not pertain to the question have been removed. Other responses were avoiding distraction, constructing, arranging, focus, efficiency and language skills. While the intended horizontal perspective was predominant, there were a significant number of responses that consider the vertical perspective. Two participants mentioned both.

Question 42. Segmenting and academic skills, keywords and categories

KEYWORDS	CATEGORY	ACTIVITY
learned segments at a time before going on to master	horizontal	learning
the entire piece.		
section out of context, smallest meaningful parts, fuse	horizontal	learning
sections together again.		
separate the music into individual instruments	vertical	analyzing
trained to do only one thing while hearing at least three	vertical	*avoid distraction*
others without getting them confused.		
break it up and learn it in segments.	horizontal	learning
listening to one note	vertical	listening
then incorporate the segment back into the whole.	horizontal	learning
break it apart	horizontal	learning
music has bars, sound design has tracks.	horizontal	analyzing
play it on repeat many times in a row	horizontal	learning
do it separately and combined at the same time.	vertical	learning
through ear-training, bass line	vertical	learning
smaller pieces and work on every bit,	horizontal	learning
divide and conquer in other academic courses		
chunks of music instead of all of it at once	horizontal	learning
edit deep into the music (time-wise),	horizontal	learning
section by section	horizontal	learning
lectures outside of music class into sections much like I	horizontal	listening
do with music		
studying and memorizing music.		memorizing
learn the A part of an ABA song first and then focus	horizontal	learning
on the B section/bridge.		
more difficult parts.		learning
Pod cast project, break sounds down into chunks	vertical	analyzing
particular part	horizontal	learning
problem sections	horizontal	learning
isolate specific things you want to work on	horizontal	learning
hard run of notes	horizontal	learning
easier to absorb massive amounts of information		learning
measures that fit into phrases that fit into larger	horizontal	learning
ideas or sections		
analyze and enhance		learning
play each part until i know it	horizontal	learning
In sound design, crucial to constructing a valuable		*constructing*
end product.		
learned to pick out part X, as well as Y and Z.	vertical	listening
Separate sounds and listening to each individual	vertical	listening
I often try to listen to different layers of harmonization in a piece of music and analyze them individually.	vertical	listening

arranging music, Listen to small chunks of music over	horizontal	*arranging*
and over again (measure by measure).		
passages and practice those parts individually,	horizontal	learning
small segments of your audio		
smaller sections	horizontal	learning
focus on one thing that I'm hearing, focus only on	horizontal	*focus*
what the professor is saying		
analyze what is important		analyzing
understand one measure before moving to the next,	horizontal	learning
applies to my academic studies		
know what you're listening for in the other parts	vertical	listening
long and/or complicated, broken up in order to fully	horizontal	learning
grasp the piece		
break the difficult sections of a piece down	horizontal	learning
analyze pieces in terms of phrases	horizontal	analyzing
super useful when studying subjects that contain a		analyzing
lot of information		
study parts more carefully.	vertical	analyzing
listen to each sound	vertical	listening
targeting but with your ears		*targeting*
Temporal segmentation, splitting the music into sections,	horizontal	analyzing
each instrument as a separate "segment,"	vertical	
how the music is created		
better use of practice time, I am able to segment	horizontal	*efficiency*
homework topics for better use of study time,		
putting everything all together		
several different levels and segments like all of the actions	vertical	analyzing
of all of the characters in a play		
listening and then splitting between multiple layers of	vertical	listening
different instruments		
specific phrase to understand what is going on	horizontal	analyzing
split into parts, you have to study it as such.	vertical	analyzing
instrument separation	vertical	analyzing
single out different voices of a piece and hone in	vertical	listening
examine each voice and instrument	vertical	listening
pinpoint sounds that need to be deleted in a piece	vertical	analyzing
or enhanced		
isolated one to three measures	horizontal	learning
break up track as and edit clips	vertical	analyzing
break up a project into multiple parts, seamlessly	horizontal	analyzing
put them together.		
Segmenting also helps with languages		*languages*
based on form or by separating instruments	vertical	analyzing
certain triggers, recall the memory of those segments	horizontal	memorization
Breaking up information, similar to math and	horizontal	learning

statistics classes		
more than one instrument and more than one minute	vertical	analyzing
	horizontal	
listening to four part harmony	vertical	listening
measures allows me to master it, bit by bit.	horizontal	learning
analyze it for patterns and form		analyzing
master one little section	horizontal	learning
themes	horizontal	analyzing
counting is segmenting	horizontal	analyzing
divide the information and summarize each division	horizontal	analyzing
time management		*time management*
learning solo and ensemble		learning
focus in the different instruments, whole music	horizontal	analyzing
	vertical	
taking topics courses		learning
break down the music, maintain organization	horizontal	analyzing
clear understanding of the construction		
break down the components of a sound	vertical	analyzing
break up sound into instruments, noise	vertical	analyzing
listening		listening
mix in sub-stems	vertical	analyzing
listening		listening

Question 42. Segmenting and academic skills, horizontal vs. vertical perspective

CATEGORY	number	%
horizontal	41	0.59
vertical	29	0.41
	70	1.00

Question 42. Segmenting and academic skills, activities and context codes

ACTIVITY	number	%	code
learning	32	0.41	AC
analyzing	26	0.33	STC
memorizing	2	0.03	STC
listening	13	0.16	AC
other	6	0.08	
	79	1.00	

Question 42. Segmenting and academic skills, summary of context codes

AC	0.57	activity codes
STC	0.35	strategy codes

other	0.08	
	1.00	

Horizontal responses tended to talk about looking at a particular smaller segment and how they had used this in other courses:

When I get to a difficult section in any piece, but especially when playing the violin, I take that section out of context, break it up into the smallest meaningful parts and practice each separately until I can fuse sections together again.

Happens mostly in every time I learn a new song/piece. I can't simply listen to the entire piece many times and attempt to sing it through without problems. Best way is to break it down to smaller pieces and work on every bit. Once that bit is mastered, move on and then pull together all the pieces. This method is also called divide and conquer in other academic courses.

You have to really pay attention to certain sounds you make or record, so sometimes you have to go back and isolate specific things you want to work on. It's very tedious, but sometimes it's well worth the time investment.

When learning music, you have to understand one measure before moving to the next. The same principle applies to my academic studies and keeps me from trying to learn the broad picture before the individual moving pieces that make it up.

Thanks to music practice, where segmenting etudes and excerpts for better use of practice time, I am able to segment homework topics for better use of study time. The best part of segmenting is putting everything all together, and being able to see, or hear, the segments work together to make a big idea, or an entire piece of music!

I often break down music and sound in instances, patterns, riffs, and smaller sections to maintain organization and a clear understanding of the construction of my work. If I did not break apart information, I would be lost.

Those that looked at the question vertically mentioned listening to several parts at ones, either in an orchestral or choral setting, or looking at multiple tracks in a sound design project:

I can choose to follow one melody within an orchestral piece, or one synth track in a pop song, while still hearing/singing the song. As an alto, I have always sung harmonies, and I am particularly trained to do only one thing while hearing at least three others without getting them confused.

I often try to listen to different layers of harmonization in a piece of music and analyze them individually.

A few participants mentioned both horizontal and vertical directions:

Music has bars, sound design has tracks. Within each of these sections, it must be further subdivided, because the individual parts make a greater whole. It is impossible to listen to an entire track and then attempt to fix it in one pass, it requires focusing on each part and integral moments.

The exact "segments" that you break a piece up into can vary. Temporal segmentation tends to be a fairly obvious approach - splitting the music into sections, phrases, bars, etc. in order to better study repetition and variation over the course of the piece - but you can also treat each instrument as a separate "segment," following its individual melody or harmony; and in a recording/production environment it's typical to treat different regions of the sound spectrum (treble, bass, etc.) as separate "segments" to listen to, set aside from the rest of the spectrum to be studied on their own. The process of breaking down a piece into segments allows you to analyze pieces of the music at a basic level, without being overwhelmed by the whole thing "at once." It also tends to better approximate how the music is created in the first place - in separate sections, with individual instrument parts written out, repeated phrases, etc.

Some saw the similarity between listening and breaking up pieces of music and academic lectures:

I can easily distinguish my lectures outside of music class into sections much like I do with music.

Alumni Responses

Questions 43 through 47 were targeted at alumni, in order to obtain data on students who were looking back at their experience from a temporal distance. Participants were asked if they had graduate with an undergraduate degree. 80% had not and were directed to the last question of the survey; 20% indicated they had graduated with a B.A. All degrees were earned between 2012 and 2015. Question 44 asked what degree they had obtained and when. All participants had earned degrees between 2012 and 2014. The ATEC School (Arts, Technology and Emerging Communication) was formed from the School of Arts and Humanities in the Fall of 2015.

Question 44. Alumni degrees earned

Degree		school
Art and Performance	1	A&H
Neuroscience	4	BBS
Accounting	1	SOM
Arts and Technology	3	ATEC
Interdisciplinary Studies	1	IS
Business Administration	1	SOM
Biology	1	NSM
Computer Science	1	EECS
Physics	2	NSM
Biochemistry	1	NSM
Child Learning & Development	1	EPPS
Global Business	1	SOM
Literary Studies	1	A&H
Art and Performance	1	A&H
Psychology/Child Develop.	1	EPPS
Unspecified	1	
	22	

Question 44. Alumni degrees earned by school

Arts and Humanities		3
Arts and Technology		3
Behavioral and Brain Science		4
Econ., Political & Policy Science		2
Electrical Eng. & Computer Science		1
Interdisciplinary Studies		1
Natural Science & Mathematics		4
Management		3
		21

Participants were than asked what they were doing since they graduated (working, or graduate, medical or dental school, etc.). One respondent replied “taking a break”.

Question 45. Post graduate activity, categories and types

	CATEGORY	TYPE
full time writer.	working	writer
graduate school	graduate school	
research assistant	research assistant	
graduate school at UTD	graduate school	

Taking a break	break	
Working	working	
Seeking work	seeking work	
medical school	medical school	
Graduate school	Graduate school	
applying to graduate and medical school,	apply to grad/med school	
seeking work	seeking work	
seeking work and seeking medical school	apply to med school	
Physician Assistant school	PA school	
Working	working	
Medical student	medical school	
Working as a Staff Accountant for a small company	working	staff accountant
graduate school	graduate school	
Working as a QA Tester Intern at id Software.	working	game company
seeking work	seeking work	
working	working	
working	working	

Question 45. Summary of postgraduate activities

working	7	0.33
seeking work	3	0.14
graduate/medical school	7	0.33
research assistant	1	0.05
taking a break	1	0.05
applying to med/grad school	2	0.10
	21	1.00

Question 46 and 47 explored whether undergraduate study in music helped their post-graduation activities. Participants were asked to agree or disagree with the statement “Study in music or sound design helped me with my post-graduation activities”. 32% marked “disagree” or “strongly disagree”. The remaining 68% marked “agree” or “strongly agree” and were asked to describe how it had helped them in Question 47. Other responses were communication, knowledge, confidence, discipline, culture, delayed gratification, and creativity. It is significant that alumni had more wide-ranging responses to this question than previous questions in the survey and many gave multiple categorical responses, with 15% of responses in the “other” category.

Question 47. Music or sound design helps post-graduate activities, keywords and categories

KEYWORDS	CATEGORY
do what you love and what you enjoy,	enjoyment
communication, stress relieving	*communication*, stress relief
scientific research, acoustics,	work, *knowledge*
helped my resume, networking	resume, social connections
managing work	time management
confidence	*confidence*
discipline	*discipline*
well-rounded, talk radio	well rounded, work
connection	social connections
excess energy separate from the work	stress relief
appreciate culture	*culture*
Delayed gratification	*delayed gratification*
my study habits , time management skills	time management
time management skill, relieves stress, focus	time management, stress relief
hearing is more sensitive	listening
time management,	time management
more well-rounded	well-rounded
relaxing, calming	stress relief
happier, free of stress	stress relief
peace, helped me cope	stress relief
common ground	social connections
personal enjoyment and motivation	enjoyment, *motivation*
problem solving skills as well as interpersonal skills	critical thinking, social
hobby and fun.	enjoyment
employment in the field of music.	work
to raise my mood, analytical skills	enjoyment, critical thinking
think critically	critical thinking
I do audio work	work
well-rounded	well-rounded
stress relief, creative expression, manage my tasks	stress relief, *creativity,* time man.
time management skills	time management
stress reliever	stress reliever
study better, but also to relax	stress reliever. Critical thinking
analytical skill and focus listening.	critical thinking, listening
well rounded.	well-rounded
my resume	resume
inspire me	inspiration

greater love of music	enjoyment
better understanding, budget my time	critical thinking, time management
another avenue	enjoyment
multitasking	time management
skills as a sound mixer	resume

Question 47. Music or sound design helps post-graduate activities, categories and context codes

	CATEGORY	%	code
enjoyment	6	0.11	AC
time management	8	0.15	STC
listening	2	0.04	AC
well-rounded	4	0.07	SC
stress relief	9	0.17	STC
resume	3	0.06	SC
critical thinking	6	0.11	AC
social connections	4	0.07	SC
current work	4	0.07	SC
other	8	0.15	
	54	1.00	

Question 47. Music or sound design helps post-graduate activities, summary of context codes

AC (activity codes)	0.26
STC (strategy codes)	0.31
SC (situation codes)	0.28
other	0.15
	1.00

Many participants mentioned stress relief as one of the major factors in doing musical or sound design activities:

Relaxes the mind and calms the soul.

It makes me happier person. Whenever I am feeling free of stress and in a good mood, it is easier for me to empathize with people and show love to others. Since music helps me feel relieved of stress and puts me in a good mood, I end up being more pleasant to work with, and I enjoy my job more.

Gives me an outlet for stress relief and creative expression and allows me to manage my tasks well.

Others mentioned specific activities in their scientific research or medicine:

Well, for one, it has helped me with my scientific research (I study emotional speech/sound, and almost everyone in my lab has been a performer or artist). It has helped me understand acoustics in general. It has helped my resume be not so boring. It has helped my networking by being a sort of global community that I belong to -- when you walk into a room and hear someone say that they're a musician, you have an excuse to connect with them, like membership in a fraternity or something. And we all know that getting jobs is 30% qualification, 30% luck, and 40% networking.

My hearing is more sensitive to auscultatory nuance, especially cardiac rhythms. Just having a song or tune on the tip of my tongue at all times keeps me upbeat during long work hours.

Several alumni were using those skills directly in the current work:

In general, studying music has made me a more well-rounded person, but specifically and more recently it has helped me in my talk radio pursuits.

The bulk of my employment after graduating has been in the field of music. I've also been actively writing and recording music since graduating, which, while not particularly profitable financially, has been a great boon in my life in more subjective ways.

I do audio work out of school and help edit video for people. Things I learn in school help me out of school.

I have a better understanding of sound design and I'm able to effectively podcast and do sound work for film projects.

Several alumni also mentioned time management skills and discipline:

It has primarily helped me organize my study habits for future education as well as time management skills.

Music has been such an important part of my life, that I think it overall just helps me understand things quicker and has trained my brain to invoke logical reasoning. I don't know why exactly, but I think that somehow the different aspects in music have helped me in my learning skills and time management skills to make me a smarter individual. I graduated Summa Cum Laude and was part of the Management Honors Program.

Finally, several felt it had enhanced their resume or gave them a connection to other people who had studied music:

I have been able to use music as an extra skill that I have on my resume. I want to work with children and employers for this field like that I am able to sing to their child or able to help children in the music classes. I have also used music to make lessons more entertaining my swim lessons classes.

When I talk to other people, I can find a common ground in music and, if the other party does not know much about music, I can teach them some small things.

One participant mentioned the value of music to life in general:

It reminded me each and every day that it's important to do what you love and what you enjoy, but it's equally important to give it your best 110% of the time. You must live your passion, study it, and know all aspects of it. Respect it. And it will be worth it.

Final Question: General Thoughts

Question 48 gave participants the opportunity to add anything they felt the survey had not covered as regards music or sound design and the benefit to their academic skills. Because this question was open-ended, there was a large variety to the answers. Many respondents had no response and felt the survey had already covered most areas (34%). The remaining answers mentioned relieving stress, sharpened senses, creativity, networking, critical thinking, keeping grounded, learning, persistence and patience, cooperation and social skills, stage presence, drive to succeed, self-esteem, memorization skills, and confidence. Because of the large variety of responses, these were not categorized or coded. There were a few negative responses, since this was one area of the survey were that could be entered in text form. In general, there did not seem to be responses here that were not covered in earlier questions. The responses that said the survey had covered it, or had nothing to add have been deleted.

Question 48. General benefits, keywords

make music, mix, and master tracks everyday,
joy, relieving stress.
sharpen my senses and discern quality work.

programming.
creation.
networking skills
analyzing music made it easier for me to analyze the emotional content of literature
Practicing make you realize the work you have to put in to achieve greatness.
focus more when I move on to other work.
keeps me grounded.
The process of how to learn music is integral to being able to work on my school work, how I write my programs.
the "right" music to help me either concentrate or de-stress.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
cooperation. Working, especially in a small ensemble, is very similar to coursework done in a group project setting.
gotten used to performing onstage
The people in music change who you are
creativity needed to solve problems
obsessively producing digital music, devoting many hours listening to music affecting my work studies by not letting me focus
negative affect. I can't concentrate on my other academic classes
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me succeed in coursework
I like to analyze each voice, instrument, or section of audio
helped my self-esteem and self-regulation, interact with the most diverse groups of people, using a large team of students from various backgrounds and skillset
I have helped me develop a photographic memory
confidence that I use to reach my goals
music programs, singing, writing, producing
time management, rhythm and patterns
better understanding of my own work, patterns and techniques in other subjects
progress my skills and a fundamental education

Offer to Participate in an Interview and Final Thanks

Question 49 offered participants the chance to engage in a private interview with the researcher and asked the participant to list an email address to be contacted. Over 113 responses were received and interviews were scheduled with those who were able to attend. Eleven interviews

were conducted as of June 2015 and those results are listed in the appendices. Question 50 thanked respondents for their participation and the survey concluded.

APPENDIX E

RESULTS OF COHORT COMPARISON: MUSIC VERSUS SOUND DESIGN STUDENTS

Initially, we decided to look at the population from the survey in two related areas:

"Music students" defined as those who have taken one or more music classes; and

"Sound design students" defined as those who have taken one or more sound design classes.

Question 1. Consent form number of respondents
Full: 159
Music: 127
Sound Design: 83

Therefore, there appear to be 51 students in the survey who have taken both music and sound design classes. It was suspected that in fact, this was not the case (as many who did the consent form did not finish the survey). However, there was potentially a significant number of students who had taken courses in both areas that would influence the results. Therefore, we needed a finer distinction between students and some idea of how to "label" them. With no major in either music or sound design, students can take courses in one area or both. Therefore, labeling a student a "music" student or a "sound design" student was not possible without looking at the actual courses they had taken.

By looking at Questions 15 (Have you taken a music course?) and 16 (Have you taken a sound design course?), we determined the number of participants who answered these questions in either the positive or negative sense and divided them into the five cohorts. This encouraged a finer selection of cohorts, in order to study these different populations, as follows with the determining response to Questions 15 and 16. The five groups are:

Cohort I. Music students who may have also taken sound design courses ("Music")
Yes to Question 15, any response to Question 16

Cohort II. Sound design students who may have also taken music courses ("Sound Design")
Yes to Question 16, any response to Question 15

Cohort III. Music student who have not taken sound design courses ("Music only")
Yes to Question 15, "none" for Question 16

Cohort IV. Sound design students who have not taken any music courses ("Sound Design only")
Yes to Question 16, "none for Question 15

Cohort V. Students who have taken both music and sound design courses ("Both")
Yes to both Questions 15 and 16

The number of students in these cohorts varied from question to question. The number of responses for text entry questions is listed with the results.

Questions 2- 4 were to establish identifier codes.

Question 5: Are you a currently registered student at UT Dallas or have been in the past ten years? (Students who were not registered were sent to the end of the survey)

All students were currently registered or had been in the last 10 years.

Question 6: What is your gender?

Full:

#	Answer		Response	%
1	Male		75	49%
2	Female		79	51%
	Total		154	100%

Music:

#	Answer		Response	%
1	Male		65	49%
2	Female		69	51%
	Total		134	100%

Sound Design

#	Answer		Response	%
1	Male		43	55%
2	Female		35	45%
	Total		78	100%

Music only:

#	Answer		Response	%
1	Male		32	42%
2	Female		44	58%
	Total		76	100%

Sound design only:

#	Answer		Response	%
1	Male		10	50%
2	Female		10	50%
	Total		20	100%

Both:

#	Answer		Response	%
1	Male		33	57%
2	Female		25	43%
	Total		58	100%

Question 7: What is your ethnicity?

Full:

#	Answer		Response	%
1	White/Caucasian		69	45%
2	Asian		47	31%
3	Hispanic		16	10%
4	African/American		5	3%
5	Native American		1	1%
6	Native Hawaiian		0	0%
7	Two or more races		14	9%
8	Don't Know/Prefer Not to Answer		2	1%
	Total		154	100%

Music:

#	Answer		Response	%
1	White/Caucasian		58	43%
2	Asian		42	31%
3	Hispanic		16	12%
4	African/American		3	2%
5	Native American		1	1%
6	Native Hawaiian		0	0%
7	Two or more races		12	9%
8	Don't Know/Prefer Not to Answer		2	1%
	Total		134	100%

Sound Design:

#	Answer		Response	%
1	White/Caucasian		40	51%
2	Asian		20	26%
3	Hispanic		7	9%
4	African/American		2	3%
5	Native American		1	1%
6	Native Hawaiian		0	0%
7	Two or more races		7	9%
8	Don't Know/Prefer Not to Answer		1	1%
	Total		78	100%

Music only:

#	Answer		Response	%
1	White/Caucasian		29	38%
2	Asian		27	36%
3	Hispanic		9	12%
4	African/American		3	4%
5	Native American		0	0%
6	Native Hawaiian		0	0%
7	Two or more races		7	9%
8	Don't Know/Prefer Not to Answer		1	1%
	Total		76	100%

Sound Design Only:

#	Answer		Response	%
1	White/Caucasian		11	55%
2	Asian		5	25%
3	Hispanic		0	0%
4	African/American		2	10%
5	Native American		0	0%
6	Native Hawaiian		0	0%
7	Two or more races		2	10%
8	Don't Know/Prefer Not to Answer		0	0%
	Total		20	100%

Both:

#	Answer		Response	%
1	White/Caucasian		29	50%
2	Asian		15	26%
3	Hispanic		7	12%
4	African/American		0	0%
5	Native American		1	2%
6	Native Hawaiian		0	0%
7	Two or more races		5	9%
8	Don't Know/Prefer Not to Answer		1	2%
	Total		58	100%

Question 8: Have you been enrolled in a music or sound design course in the last ten years?

Full:

#	Answer		Response	%
1	Yes		153	99%
2	No		1	1%
	Total		154	100%

Music:

#	Answer		Response	%
1	Yes		133	99%
2	No		1	1%
	Total		134	100%

Sound Design:

#	Answer		Response	%
1	Yes		77	99%
2	No		1	1%
	Total		78	100%

Music only:

#	Answer		Response	%
1	Yes		76	100%
2	No		0	0%
	Total		76	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		20	100%
2	No		0	0%
	Total		20	100%

Both:

#	Answer		Response	%
1	Yes		57	98%
2	No		1	2%
	Total		58	100%

Question 9: What is/was your major? (Responses are listed by School; more detailed data is available.)

Full:

Arts and Humanities (A&H)	17	11.04%
Arts, Technology & Emerging Communication (ATEC)	45	29.22%
Behavioral and Brain Science (BBS)	24	15.58%
Electrical Engineering & Computer Science (EECS)	12	7.79%
Economic, Political and Policy Science (EPPS)	4	2.60%
Interdisciplinary Studies (IS)	1	0.65%
School of Management (SOM)	13	8.44%
Natural Science & Mathematics (NS&M)	34	22.08%
Undeclared	4	2.60%
TOTAL (including double majors)	154	100.00%

Music:

Arts and Humanities (A&H)	16	12.03%
Arts, Technology & Emerging Communication (ATEC)	26	19.55%
Behavioral and Brain Science (BBS)	23	17.29%
Electrical Engineering & Computer Science (EECS)	12	9.02%
Economic, Political and Policy Science (EPPS)	4	3.01%
Interdisciplinary Studies (IS)	1	0.75%
School of Management (SOM)	13	9.77%
Natural Science & Mathematics (NS&M)	34	25.56%

Undeclared	4	3.01%
TOTAL (including double majors)	133	100.00%

Sound Design:

Arts and Humanities (A&H)	7	9.46%
Arts, Technology & Emerging Communication (ATEC)	41	55.41%
Behavioral and Brain Science (BBS)	7	9.46%
Electrical Engineering & Computer Science (EECS)	3	4.05%
Economic, Political and Policy Science (EPPS)	0	0.00%
Interdisciplinary Studies (IS)	0	0.00%
School of Management (SOM)	3	4.05%
Natural Science & Mathematics (NS&M)	12	16.22%
Undeclared	1	1.35%
TOTAL (including double majors)	74	100.00%

Music only:

Arts and Humanities (A&H)	10	13.16%
Arts, Technology & Emerging Communication (ATEC)	4	5.26%
Behavioral and Brain Science (BBS)	14	18.42%
Electrical Engineering & Computer Science (EECS)	9	11.84%
Economic, Political and Policy Science (EPPS)	4	5.26%
Interdisciplinary Studies (IS)	1	1.32%
School of Management (SOM)	9	11.84%
Natural Science & Mathematics (NS&M)	22	28.95%
Undeclared	3	3.95%
TOTAL (including double majors)	76	100.00%

Sound Design Only:

Arts and Humanities (A&H)	0	0%
Arts, Technology & Emerging Communication (ATEC)	19	95%
Behavioral and Brain Science (BBS)	1	5%
Electrical Engineering & Computer Science (EECS)	0	0%
Economic, Political and Policy Science (EPPS)	0	0%
Interdisciplinary Studies (IS)	0	0%
School of Management (SOM)	0	0%
Natural Science & Mathematics (NS&M)	0	0%
Undeclared	0	0%
TOTAL (including double majors)	20	100.00%

Both:

Arts and Humanities (A&H)	5	9.26%
Arts, Technology & Emerging Communication (ATEC)	23	42.59%
Behavioral and Brain Science (BBS)	5	9.26%
Electrical Engineering & Computer Science (EECS)	3	5.56%
Economic, Political and Policy Science (EPPS)	2	3.70%
Interdisciplinary Studies (IS)	0	0.00%
School of Management (SOM)	3	5.56%
Natural Science & Mathematics (NS&M)	12	22.22%
Undeclared	1	1.85%

TOTAL (including double majors)	54	100.00%

Question 10: Are you/Were you a music minor?

Full:

#	Answer		Response	%
1	Yes		39	25%
2	No		115	75%
	Total		154	100%

Music:

#	Answer		Response	%
1	Yes		37	28%
2	No		93	72%
	Total		130	100%

Sound Design:

#	Answer		Response	%
1	Yes		16	22%
2	No		58	78%
	Total		74	100%

Music only:

#	Answer		Response	%
1	Yes		22	29%
2	No		54	71%
	Total		76	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		1	5%
2	No		19	95%
	Total		20	100%

Both:

#	Answer		Response	%
1	Yes		15	28%
2	No		39	72%
	Total		54	100%

Question 11. Have you played an instrument or sang in a formal musical experience (classes, private study, ensemble) besides your UTD course?

Full:

#	Answer		Response	%
1	Yes		126	82%
2	No		28	18%
	Total		154	100%

Music:

#	Answer		Response	%
1	Yes		113	87%
2	No		17	13%
	Total		130	100%

` Sound Design:

#	Answer		Response	%
1	Yes		58	78%
2	No		16	22%
	Total		74	100%

Music Only:

#	Answer		Response	%
1	Yes		67	88%
2	No		9	12%
	Total		76	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		12	60%
2	No		8	40%
	Total		20	100%

Both:

#	Answer		Response	%
1	Yes		46	85%
2	No		8	15%
	Total		54	100%

Question 12. If yes, for how long and in what capacity? Please include any ensembles (choir, orchestra, band) that you have played in.

Full: 117 responses

	choir	voice	band	piano	orchestra
total trs	278	96	199	148	238
responses	44	16	35	22	43
average	6.32	6.00	5.69	6.73	5.53
range	1 to 20	1 to 15	1 to 20	1 to 15	1 to 22

	number of instruments		%
	1	67	0.57
	2	34	0.29
	3	6	0.05
	4	1	0.01
	no response	9	0.08
		117	1.00

Music: (107 responses)

	choir	voice	band	piano	orchestra
total trs	225	91	182	134	211
responses	37	16	30	20	38
average	6.08	5.69	6.07	6.70	5.55
range	1 to 20	1 to 15	1 to 20	1 to 15	1 to 22

	no. of instruments		%
	1	48	0.63
	2	21	0.28
	3	6	0.08
	4	1	0.01
		76	1.00

Sound Design: (50 responses)

	choir	voice	band	piano	orchestra
total yrs	105	19	86	62	89
responses	18	5	16	9	18
average	5.83	3.80	5.38	6.89	4.94
range	1 to 12	1 to 8	1 to 10	1 to 14	1 to 16

	no. of instruments		%
	1	29	0.64
	2	12	0.27
	3	4	0.09
		45	1.00

Music Only: (37 responses)

	choir	voice	band	piano	orchestra
total trs	160	77	114	102	114
responses	26	12	17	14	20
average	6.15	6.42	6.71	7.29	5.70
range	1 to 20	2 to 15	2 to 20	1 to 15	1 to 16

	no. of instruments		%
	1	34	0.60
	2	20	0.35
	3	2	0.04
	4	1	0.02
		57	1.00

Sound Design Only: (12 responses)

	choir	voice	band	piano	orchestra
total yrs	57	0	18	14	15
responses	7	0	4	2	5
average	8.14	0	4.5	7	3

range	1 to 14		1 to 7	1 to 13	1 to 7

no. of instruments

		%
1	6	50.00%
2	5	41.67%
3	1	8.33%
	12	100.00%

Both: (40 responses)

	choir	voice	band	piano	orchestra
total trs	67	14	63	49	78
responses	13	4	12	8	15
average	5.15	3.50	5.25	6.13	5.20
range	1 to 12	1 to 8	1 to 10	1 to 14	1 to 16

	no. of instruments		%
	1	22	0.63
	2	9	0.26
	3	4	0.11
		35	1.00

Question 13 Have you participated in music or sound design in an informal capacity (in a band, composing, arranging, recording, etc.)?

Full:

1	Yes	77	51%
2	No	73	49%
	Total	150	100%

Music:

#	Answer	Response	%
1	Yes	67	53%
2	No	59	47%
	Total	126	100%

Sound Design:

#	Answer	Response	%
1	Yes	38	54%
2	No	32	46%
	Total	70	100%

Music Only:

#	Answer		Response	%
1	Yes		39	51%
2	No		37	49%
	Total		76	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		10	50%
2	No		10	50%
	Total		20	100%

Both:

#	Answer		Response	%
1	Yes		28	56%
2	No		22	44%
	Total		50	100%

Question 14. If so, how long and in what capacity?

Full:

	responses	%
composition	14	0.17
arranging	7	0.09
digital music	4	0.05
recording	10	0.12
sound/audio engineer	13	0.16
band	14	0.17
a cappella group	6	0.07
private study	6	0.07
podcasting	2	0.02
no response	5	0.06
	81	1.00

Average years (39 responses) 3.69

Range 1 - 14 years

Music:

	responses	%
composition	12	0.18
arranging	5	0.08
digital music	3	0.05
recording	10	0.15
sound/audio engineer	11	0.17
band	9	0.14
a cappella group	3	0.05
private study	5	0.08
podcasting	2	0.03
no response	5	0.08

	65	1.00

Average years (32 responses) 3.78
Range 1 - 11 years

Sound Design:

	responses	%
composition	4	0.13
arranging	1	0.03
digital music	3	0.09
recording	4	0.13
sound/audio engineer	9	0.28
band	6	0.19
a cappella group	1	0.03
private study	2	0.06
podcasting	2	0.06
	32	1.00
Average years (17 responses)	3.65	
Range 1-9 years	years	

Music Only:

	responses	%
composition	11	0.29
arranging	6	0.16
digital music	1	0.03
recording	4	0.11
sound/audio engineer	6	0.16
band	5	0.13
a cappella group	2	0.05
private study	3	0.08
	38	1.00

Average years (39 responses) 4.04
Range 1 - 11 years

Sound Design Only:

	responses	%
composition	3	.30
arranging	2	.20
digital music	0	.00
recording	1	.10
sound/audio engineer	3	.30
band	1	.10
a cappella group	0	.00
private study	0	.00
	10	1.00

Average years (12 responses) 3.92
Range 0 - 3 years

Both:

	responses	%
composition	2	0.06
arranging	0	0.00
digital music	0	0.00
recording	9	0.29
sound/audio engineer	3	0.10
band	3	0.10
a cappella group	4	0.13
private study	2	0.06
podcasting	8	0.26
	31	1.00

Average years (19 responses) 2.38
Range 0 - 8 years

Question 15. What music courses have you taken at UTD, either now or in the last ten years? Please indicate the name of the course and the MUSI number, if you can recall it, and when you were enrolled. If you were not enrolled in a MUSI course, please respond "none".

I have listed the number of respondents, since many students have taken multiple music courses over their undergraduate curriculum at UT Dallas.

Full: 127 responses

Music History and Appreciation	39	0.12
Instrumental Ensemble	47	0.15
Vocal and choral	151	0.47
Piano	11	0.03
Guitar	11	0.03
Music Theory	34	0.11
Ind Study	12	0.04
Creating Music	1	0.00
Digital Music	14	0.04
	320	1.00

Music: The responses will be identical to the full sample above, as "music students" were defined as those that had taken music classes.

Sound Design: 51 responses
The analysis here will represent what music courses sound design students have taken.

Music History and Appreciation	15	0.17
Instrumental Ensemble	12	0.14
Vocal and choral	30	0.34
Piano	1	0.01
Guitar	7	0.08
Music Theory	12	0.14
Ind Study	2	0.02
Creating Music	1	0.01
Digital Music	7	0.08
	87	1.00

Music Only: 101 responses

Music History and Appreciation	23	0.11
Instrumental Ensemble	32	0.15
Vocal and choral	115	0.53
Piano	10	0.05
Guitar	2	0.01
Music Theory	20	0.09
Ind Study	9	0.04
Creating Music	0	0.00
Digital Music	8	0.04
	219	1.00

Sound Design Only: Since this cohort is sound design students who have not taken music courses, all responses were "none".

Both: 31 responses

Music History and Appreciation	16	0.16
Instrumental Ensemble	15	0.15
Vocal and choral	36	0.36
Piano	1	0.01
Guitar	9	0.09
Music Theory	14	0.14
Ind Study	3	0.03
Creating Music	0	0.00
Digital Music	6	0.06
	100	1.00

Question 16. What sound design courses have you taken at UTD, either now or in the last ten years? Please indicate the name of the course and the ATEC number, if you can recall it, and when you were enrolled. If you were not enrolled in a sound design course, please respond "none".

Full: 121 responses

			NUMBER	%
2385	INTRO TO SOUND DESIGN		37	0.54
3310	AUDIO TECHNOLOGIES		9	0.13
3312	AUDIO PRODUCTION LAB		1	0.01
3354	SOUND DESIGN FOR GAMES		5	0.07
4375	SPECIAL TOPICS IN SOUND DESIGN		16	0.24
			68	1.00

Note that over half the survey respondents who had taken sound design course were in the entry level course, ATEC2385. This course is required for EMAC majors.

Music: 101 responses

The responses here will represent what sound design courses are being taken by music students, in addition to their music classes. The great majority of students reported “none”. The numbers included repeated courses.

			NUMBER	%
2385	INTRO TO SOUND DESIGN		19	0.58
3310	AUDIO TECHNOLOGIES		5	0.15
3354	SOUND DESIGN FOR GAMES		2	0.06
4375	SPECIAL TOPICS IN SOUND DESIGN		7	0.21
			33	1.00

Over half of the students who had taken sound design had taken the introductory course, ATEC2385.

Sound Design: The responses will be identical to the full sample above, as “sound design students were defined as those who had taken sound design classes.

Music Only: Since this cohort is music students who have not taken sound design courses, all responses were “none”.

Sound Design Only: 20 responses

					NUMBER	%
2385	INTRO TO SOUND DESIGN				18	0.67
3310	AUDIO TECHNOLOGIES				3	0.11
3354	SOUND DESIGN FOR GAMES				1	0.04
4375	SPECIAL TOPICS IN SOUND DESIGN				5	0.19
					27	1.00

Both: 25 responses

					NUMBER	%
2385	INTRO TO SOUND DESIGN				18	0.60
3310	AUDIO TECHNOLOGIES				5	0.17
3354	SOUND DESIGN FOR GAMES				2	0.07
4375	SPECIAL TOPICS IN SOUND DESIGN				5	0.17
					30	1.00

Question 17. Have you studied music before you attended UT Dallas?

Full:

#	Answer		Response	%
1	Yes		108	80%
2	No		27	20%
	Total		135	100%

Music:

#	Answer		Response	%
1	Yes		96	86%
2	No		15	14%
	Total		111	100%

Sound Design:

#	Answer		Response	%
1	Yes		96	86%
2	No		15	14%
	Total		111	100%

Music only:

#	Answer		Response	%
1	Yes		64	84%
2	No		12	16%
	Total		76	100%

Sound Design only:

#	Answer		Response	%
1	Yes		11	55%
2	No		9	45%
	Total		20	100%

Both:

#	Answer		Response	%
1	Yes		32	91%
2	No		3	9%
	Total		35	100%

Full: 101 responses

	choir	voice	band	piano	orchestra
total yrs	125	60	91	157	112
responses	21	15	16	21	16
average	5.95	4.00	5.69	7.48	7.00
range	1 to 13	1 to 13	1 to 9	2 to 16	1 to 13

Music: 91 responses

	choir	voice	band	piano	orchestra
total yrs	90	60	84	132	112
responses	18	15	15	18	16
average	5.00	4.00	5.60	7.33	7.00
range	1 to 12	1 to 13	1 to 9	2 to 16	1 to 13

Sound Design: 39 responses

	choir	voice	band	piano	orchestra
total yrs	54	7	37	64	38
responses	9	2	6	9	5
average	6.00	3.50	6.17	7.11	7.60
range	1 to 12	2 to 5	4 to 7	3 to 13	6 to 9

Music only: 62 responses

	choir	voice	band	piano	orchestra
total yrs	82	30	69	111	72
responses	13	11	11	15	10
average	6.31	2.73	6.27	7.40	7.20
range	2 to 13	1 to 5	2 to 9	2 to 16	1 to 13

Sound Design only: 10 responses

	choir	voice	band	piano	orchestra
total yrs	22	0	7	25	8
responses	2	0	1	3	1
average	11.00	0.00	7.00	8.33	8.00
range	1 to 12		7	2 to 13	8

Both: 29 responses

	choir	voice	band	piano	orchestra
total yrs	19	11	33	36	33
responses	6	3	5	5	5
average	3.17	3.67	6.60	7.20	6.60
range	1 to 7	2 to 5	4 to 9	3 to 16	4 to 9

Question 19. Have you studied sound design before you attended UT Dallas?

Full:

1	Yes		18	14%
2	No		114	86%
	Total		132	100%

Music:

#	Answer		Response	%
1	Yes		12	11%
2	No		96	89%
	Total		108	100%

Sound Design:

#	Answer		Response	%
1	Yes		13	24%
2	No		41	76%
	Total		54	100%

Music Only:

#	Answer		Response	%
1	Yes		4	5%
2	No		70	95%
	Total		74	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		5	25%
2	No		15	75%
	Total		20	100%

Both:

#	Answer		Response	%
1	Yes		8	24%
2	No		26	76%
	Total		34	100%

Question 20. If yes, for how long and in what capacity?

Sound Design is not routinely offered in high school, so the answers here were quite brief.

Summaries follow.

Full: 14 responses

Responses ranged from 1 year of informal experience, to one response who had studied sound design for 20 years as a professional. Two students t had studied sound design for one year in

high school.

Music: 12 responses

This sample included the two students who had studied sound design in high school; and the professional with 20 years of experience.

Sound Design: 29 responses

These students had also studied music. Many responded with informal recording and engineering for music experiences. Several had composed music using sound design systems. Several responded they used software to edit and mix music. This was the largest population.

Music Only: 4 responses

One students had four years of experience, the rest one or less.

Sound Design Only: 5 responses

Two had four years of experience; the others had used software.

Both: 7 responses

This sample included one student who had taken sound design in high school and the 20-year professional. The rest was informal experience for several years at most.

Question 21. Do you agree with this statement: Participating in music or sound design courses has affected my academic abilities in other courses.

Full:

#	Answer		Response	%
1	Strongly Disagree		8	6%
2	Disagree		21	17%
3	Agree		58	46%
4	Strongly Agree		43	34%

Music:

#	Answer		Response	%
1	Strongly Disagree		5	5%
2	Disagree		18	17%
3	Agree		47	44%
4	Strongly Agree		40	37%

Sound Design:

#	Answer		Response	%
1	Strongly Disagree		4	8%
2	Disagree		10	19%
3	Agree		24	45%
4	Strongly Agree		15	28%

Music Only:

#	Answer		Response	%
1	Strongly Disagree		4	5%
2	Disagree		11	15%
3	Agree		34	46%
4	Strongly Agree		28	38%

Sound Design Only:

#	Answer		Response	%
1	Strongly Disagree		3	15%
2	Disagree		3	15%
3	Agree		11	55%
4	Strongly Agree		3	15%

Both:

#	Answer		Response	%
1	Strongly Disagree		1	3%
2	Disagree		7	21%
3	Agree		13	39%
4	Strongly Agree		12	36%

Question 22: Describe one experience that has affected your skills in other classes.

Summaries of keywords and categories are listed.

Full: 83 responses

Categories	responses	percentage	code
Concentration, focus	16	0.15	STC
Memorization	3	0.03	AC
Relieve stress	17	0.16	STC
Time management	4	0.04	STC
Public speaking, communication	5	0.05	AC
New perspectives	8	0.08	SC
Knowledge	13	0.13	SC
Mathematics skills	10	0.10	AC
Interrelationship of parts, connections	4	0.04	SC
Discipline	7	0.07	STC
Critical thinking skills	9	0.09	AC
Expressivity	3	0.03	PC
Other	5	0.05	*
	104	1.00	

STC (Strategy codes)	0.42
AC (Activity codes)	0.26
SC (Situation codes)	0.24
PC (Process codes)	0.03
other	0.04
	0.99

Music: 74 responses

Categories	responses	percentage	code
Concentration, focus	14	0.14	STC
Memorization	4	0.04	AC
Relieve stress	17	0.17	STC
Time management	3	0.03	STC
Public speaking, communication	7	0.07	AC
New perspectives	8	0.08	SC
Knowledge	8	0.08	SC
Mathematics skills	10	0.10	AC
Interrelationship of parts, connections	6	0.06	SC
Discipline	5	0.05	STC
Critical thinking skills	8	0.08	AC
Expressivity	3	0.03	PC
Other	7	0.07	*
	100	1.00	

STC (Strategy codes)	0.39		
AC (Activity codes)	0.29		
SC (Situation codes)	0.22		
PC (Process codes)	0.03		
other	0.07		
	1.00		

Sound Design: 34 responses

Categories	responses	percentage	code
Concentration, focus	6	0.14	STC
Memorization	1	0.02	AC
Relieve stress	3	0.07	STC
Time management	2	0.05	STC
Public speaking, communication	1	0.02	AC
New perspectives	6	0.14	SC
Knowledge	8	0.19	SC
Mathematics skills	3	0.07	AC
Interrelationship of parts, connections	2	0.05	SC
Discipline	2	0.05	STC
Critical thinking skills	2	0.05	AC
Expressivity	1	0.02	PC
Other	5	0.12	*
	42	1.00	
STC (Strategy codes)	0.31		
AC (Activity codes)	0.17		
SC (Situation codes)	0.38		
PC (Process codes)	0.02		
other	0.12		

Music Only: 53 responses

Categories	responses	percentage	code
Concentration, focus	10	0.14	STC
Memorization	3	0.04	AC
Relieve stress	14	0.20	STC
Time management	2	0.03	STC
Public speaking, communication	6	0.08	AC
New perspectives	3	0.04	SC
Knowledge	7	0.10	SC
Mathematics skills	6	0.08	AC
Interrelationship of parts, connections	4	0.06	SC
Discipline	4	0.06	STC
Critical thinking skills	8	0.11	AC
Expressivity	2	0.03	PC
Other	2	0.03	*
	71	1.00	

STC (Strategy codes)	0.42	
AC (Activity codes)	0.32	
SC (Situation codes)	0.20	
PC (Process codes)	0.03	
other	0.03	
	1.00	

Sound Design Only: 13 responses

Categories	responses	percentage	code
Concentration, focus	2	0.15	STC
Memorization	0	0.00	AC
Relieve stress	0	0.00	STC
Time management	1	0.08	STC
Public speaking, communication	0	0.00	AC
New perspectives	1	0.08	SC
Knowledge	5	0.38	SC
Mathematics skills	0	0.00	AC
Interrelationship of parts, connections	0	0.00	SC
Discipline	2	0.15	STC
Critical thinking skills	1	0.08	AC
Expressivity	0	0.00	PC
Other	1	0.08	*
	13	1.00	

STC (Strategy codes)	0.38
AC (Activity codes)	0.08
SC (Situation codes)	0.46
PC (Process codes)	0.00
other	0.08

Both: 21 responses

Categories	responses	percentage	code
Concentration, focus	4	0.14	STC
Memorization	1	0.03	AC
Relieve stress	3	0.10	STC
Time management	1	0.03	STC
Public speaking, communication	5	0.17	AC
New perspectives	4	0.14	SC
Knowledge	3	0.10	SC
Mathematics skills	2	0.07	AC
Interrelationship of parts, connections	0	0.00	SC
Discipline	1	0.03	STC
Critical thinking skills	1	0.03	AC
Expressivity	4	0.14	PC
	29	1.00	*

STC (Strategy codes)	0.31
AC (Activity codes)	0.31
SC (Situation codes)	0.24
PC (Process codes)	0.14
other	0.00

Question 23. Some musicians relate experiencing "flow" when they study or perform music. One indication of "flow" is the sense that you "lost track of time" during the experience. Have you ever experienced "flow" when doing music or sound design?

Full:

#	Answer		Response	%
1	Never		7	5%
2	Rarely		8	6%
3	Sometimes		43	34%
4	Most of the Time		47	37%
5	Always		23	18%
	Total		128	100%

Music:

#	Answer		Response	%
1	Never		3	3%
2	Rarely		6	6%
3	Sometimes		37	35%
4	Most of the Time		40	38%
5	Always		19	18%
	Total		105	100%

Sound Design:

#	Answer		Response	%
1	Never		2	4%
2	Rarely		4	8%
3	Sometimes		12	23%
4	Most of the Time		24	45%
5	Always		11	21%
	Total		53	100%

Music Only:

#	Answer		Response	%
1	Never		3	4%
2	Rarely		3	4%
3	Sometimes		31	44%
4	Most of the Time		23	32%
5	Always		11	15%
	Total		71	100%

Sound Design Only:

#	Answer		Response	%
1	Never		2	11%
2	Rarely		1	5%
3	Sometimes		6	32%
4	Most of the Time		7	37%
5	Always		3	16%
	Total		19	100%

Both:

#	Answer		Response	%
1	Never		0	0%
2	Rarely		3	9%
3	Sometimes		6	18%
4	Most of the Time		17	50%
5	Always		8	24%
	Total		34	100%

Question 24. If so, please describe the feeling you had during that experience.

Full: (100 responses)

Categories	responses	percentage	code
Serenity	5	0.04	SC
Natural	5	0.04	SC
Free and easy	6	0.05	SC
Fun	4	0.03	SC
Perception of time	56	0.48	SC
Immersion	3	0.03	SC
Embodiment	4	0.03	AC
Joy	7	0.06	SC
Confidence	2	0.02	SC
Focus	7	0.06	STC
Feeling the emotion	8	0.07	SC
Other	9	0.08	SC
	116	1.00	

STC (Strategy codes)	0.06		
AC (Activity codes)	0.03		
SC (Situation codes)	0.83		
PC (Process codes)	0.00		
other	0.08		
	1.00		

Music: (93 responses)

Categories	responses	percentage	code
Serenity	5	0.05	SC
Natural	4	0.04	SC
Free and easy	6	0.06	SC
Fun	4	0.04	SC
Perception of time	45	0.44	SC
Immersion	2	0.02	SC
Embodiment	4	0.04	AC
Joy	7	0.07	SC
Confidence	2	0.02	SC
Focus	7	0.07	STC
Feeling the emotion	8	0.08	SC
Other	9	0.09	SC
	103	1.00	

STC (Strategy codes)	0.07		
AC (Activity codes)	0.04		
SC (Situation codes)	0.81		
PC (Process codes)	0.00		
other	0.08		
	1.00		

Sound Design: (44 responses)

Categories	responses	percentage	code
Serenity	1	0.03	SC
Natural	3	0.08	SC
Free and easy	1	0.03	SC
Fun	1	0.03	SC
Perception of time	26	0.65	SC
Immersion	1	0.03	SC
Embodiment	1	0.03	AC
Joy	1	0.03	SC
Confidence	1	0.03	SC
Focus	0	0.00	STC
Feeling the emotion	2	0.05	SC
Other	2	0.05	SC
	40	1.00	

STC (Strategy codes)	0.00	strategy codes	
AC (Activity codes)	0.03	activity codes	
SC (Situation codes)	0.92	situation codes	
PC (Process codes)	0.00	process codes	
other	0.05	n/a	

Music Only: (62 responses)

Categories	responses	percentage	code
Serenity	4	0.05	SC
Natural	1	0.01	SC
Free and easy	4	0.05	SC
Fun	3	0.04	SC
Perception of time	30	0.41	SC
Immersion	1	0.01	SC
Embodiment	2	0.03	AC
Joy	5	0.07	SC
Confidence	2	0.03	SC
Focus	7	0.10	STC
Feeling the emotion	6	0.08	SC
Other	8	0.11	SC
	73	1.00	

STC (Strategy codes)	0.10		
AC (Activity codes)	0.03		
SC (Situation codes)	0.76		
PC (Process codes)	0.00		
other	0.11		
	1.00		

Sound Design Only: (13 responses)

Categories	responses	percentage	code
Serenity	0	0.00	SC
Natural	1	0.08	SC
Free and easy	0	0.00	SC
Fun	0	0.00	SC
Perception of time	10	0.77	SC
Immersion	1	0.08	SC
Embodiment	0	0.00	AC
Joy	0	0.00	SC
Confidence	0	0.00	SC
Focus	0	0.00	STC
Feeling the emotion	0	0.00	SC
Other	1	0.08	SC
	13	1.00	
STC (Strategy codes)	0.00		
AC (Activity codes)	0.00		
SC (Situation codes)	0.92		
PC (Process codes)	0.00		
other	0.08		
	1.00		

Both: (31 responses)

Categories	responses	percentage	code
Serenity	1	0.04	SC
Natural	2	0.07	SC
Free and easy	1	0.04	SC
Fun	1	0.04	SC
Perception of time	16	0.57	SC
Immersion	1	0.04	SC
Embodiment	1	0.04	AC
Joy	1	0.04	SC
Confidence	1	0.04	SC
Focus	0	0.00	STC
Feeling the emotion	2	0.07	SC
Other	1	0.04	SC
	28	1.00	

STC (Strategy codes)	0.00		
AC (Activity codes)	0.04		
SC (Situation codes)	0.92		
PC (Process codes)	0.00		
other	0.04		
	1.00		

Question 25. Have you also experience flow in a non-musical activity?

Full:

#	Answer		Response	%
1	Yes		102	81%
2	No		24	19%
	Total		126	100%

Music:

#	Answer		Response	%
1	Yes		86	83%
2	No		17	17%
	Total		103	100%

Sound Design:

#	Answer		Response	%
1	Yes		45	87%
2	No		7	13%
	Total		52	100%

Music Only:

#	Answer		Response	%
1	Yes		56	80%
2	No		14	20%
	Total		70	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		15	79%
2	No		4	21%
	Total		19	100%

Both:

#	Answer		Response	%
1	Yes		30	91%
2	No		3	9%
	Total		33	100%

Question 26. If so, please describe that experience.

Note: all these are activity codes.

Full: (95 responses)

	number	%
Sports/exercise	20	0.21
Artistic/creative	20	0.21
Entertainment (video games, friends)	11	0.11
Reading for pleasure	12	0.12
Studying/learning	8	0.08
Writing	10	0.10
Programming	4	0.04
Science/math	6	0.06
Presentation	2	0.02
Other	4	0.04
	97	1.00

Music: (83 responses)

	number	%
Sports/exercise	18	0.21
Artistic/creative	17	0.20
Entertainment (video games, friends)	10	0.12
Reading for pleasure	12	0.14
Studying/learning	6	0.07
Writing	7	0.08
Programming	4	0.05
Science/math	4	0.05
Presentation	2	0.02

Other	4	0.05
	84	1.00

Sound Design: (40 responses)

	number	%
Sports/exercise	7	0.18
Artistic/creative	11	0.28
Entertainment (video games, friends)	6	0.15
Reading for pleasure	5	0.13
Studying/learning	4	0.10
Writing	2	0.05
Programming	1	0.03
Science/math	1	0.03
Presentation	0	0.00
Other	3	0.08
	40	1.00

Music Only: (55 responses)

	number	%
Sports/exercise	13	0.24
Artistic/creative	10	0.18
Entertainment (video games, friends)	5	0.09
Reading for pleasure	8	0.15
Studying/learning	4	0.07
Writing	4	0.07
Programming	4	0.07
Science/math	4	0.07
Presentation	2	0.04
Other	1	0.02
	55	1.00
other: sex,		

Sound Design Only: (12 responses)

	number	%
Sports/exercise	2	0.18
Artistic/creative	4	0.36
Entertainment (video games, friends)	1	0.09
Reading for pleasure	0	0.00
Studying/learning	2	0.18
Writing	1	0.09
Programming	0	0.00
Science/math	0	0.00
Presentation	0	0.00
Other	1	0.09
	11	1.00

Both: (28 responses)

	number	%
Sports/exercise	5	0.19
Artistic/creative	7	0.26

Entertainment (video games, friends)	4	0.15
Reading for pleasure	4	0.15
Studying/learning	2	0.07
Writing	1	0.04
Programming	1	0.04
Science/math	0	0.00
Presentation	0	0.00
Other	3	0.11
	27	1.00

Question 27. Many music students study the "form" of a musical work (such as ABA, rondo form, sonata form, etc.) when they study pieces of music. Have you ever analyzed the form of a piece of music?

Full:

#	Answer		Response	%
1	Not At All		39	31%
2	Occasionally		53	42%
3	Frequently		34	27%
	Total		126	100%

Music:

#	Answer		Response	%
1	Not At All		27	26%
2	Occasionally		49	48%
3	Frequently		27	26%
	Total		103	100%

Sound Design:

#	Answer		Response	%
1	Not At All		22	42%
2	Occasionally		19	37%
3	Frequently		11	21%
	Total		52	100%

Music Only:

#	Answer		Response	%
1	Not At All		17	24%
2	Occasionally		34	49%
3	Frequently		19	27%
	Total		70	100%

Sound Design Only:

#	Answer		Response	%
1	Not At All		12	63%
2	Occasionally		4	21%
3	Frequently		3	16%
	Total		19	100%

Both:

#	Answer		Response	%
1	Not At All		10	30%
2	Occasionally		15	45%
3	Frequently		8	24%
	Total		33	100%

Question 28. Do you agree with this statement: Learning to analyze that structure affected my other academic tasks.

Full: (83 responses)

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		22	27%
3	Agree		46	55%
4	Strongly Agree		15	18%

Music: (74 responses)

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		21	28%
3	Agree		42	57%
4	Strongly Agree		12	16%

Sound Design: (29 responses)

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		10	36%
3	Agree		12	43%
4	Strongly Agree		7	25%

Music Only: (54 responses)

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		12	23%
3	Agree		34	64%
4	Strongly Agree		8	15%

Sound Design Only: (8 responses)

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		1	13%
3	Agree		4	50%
4	Strongly Agree		3	37%

Both: (21 responses)

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		9	43%
3	Agree		8	38%
4	Strongly Agree		4	19%

Question 29. If so, please describe how it affected your other academic tasks.
Note: All responses were strategy codes (STC)

Full: (57 responses)

Categories	number	%
patterns	15	0.26
analysis/critical thinking	14	0.25
structure	11	0.19
details	5	0.09
learning	3	0.05
other	9	0.16
total	57	1.00

Subjects	number	%
Mathematics	10	0.36
Literature	7	0.25
Natural sciences	8	0.29
Writing	3	0.11
total	28	1.00

Music Students: ((49 responses)

Categories	number	%
patterns	13	0.25
analysis/critical thinking	13	0.25
structure	10	0.19
details	5	0.10
learning	2	0.04
other	9	0.17
total	52	1.00

Subjects	number	%
Mathematics	8	0.31
Literature	7	0.27
Natural sciences	8	0.31
Writing	3	0.12
total	26	1.00

Sound Design Students: (19 students)

Categories	number	%
patterns	6	0.32
analysis/critical thinking	4	0.21
structure	4	0.21
details	1	0.05
learning	2	0.11
other	2	0.11
total	19	1.00

Subjects	number	%
Mathematics	5	0.83
Literature	1	0.17
Natural sciences	0	0.00
Writing	0	0.00
total	6	1.00

Music Only: (36 responses)

Categories	number	%
patterns	9	0.23
analysis/critical thinkng	10	0.26
structure	8	0.21
details	4	0.10
learning	1	0.03
other	7	0.18
total	39	1.00

Subjects	number	%
Mathematics	5	0.23
Literature	6	0.27

Natural sciences	8	0.36
Writing	3	0.14
total	22	1.00

Sound Design Only: (6 responses)

Categories	number	%
patterns	2	0.29
analysis/critical thinkng	1	0.14
structure	2	0.29
details	0	0.00
learning	1	0.14
other	1	0.14
total	7	1.00

Subjects	number	%
Mathematics	2	1.00
Literature	0	0.00
Natural sciences	0	0.00
Writing	0	0.00
total	2	1.00

Both: (13 responses)

Categories	number	%
patterns	4	0.33
analysis/critical thinkng	3	0.25
structure	2	0.17
details	1	0.08
learning	1	0.08
other	1	0.08
total	12	1.00

Subjects	number	%
Mathematics	3	0.75
Literature	1	0.25
Natural sciences	0	0.00
Writing	0	0.00
total	4	1.00

Question 30. "Rubato" is the concept of changing slightly the tempo of a piece, referring to expressive and rhythmic freedom by a slight speeding up and then slowing down of the tempo of a piece at the discretion of the soloist. Have you ever used rubato in a musical piece?

Full:

#	Answer		Response	%
1	Yes		92	75%
2	No		30	25%
	Total		122	100%

Music:

#	Answer		Response	%
1	Yes		83	83%
2	No		17	17%
	Total		100	100%

Sound Design:

#	Answer		Response	%
1	Yes		31	63%
2	No		18	37%
	Total		49	100%

Music Only:

#	Answer		Response	%
1	Yes		59	86%
2	No		10	14%
	Total		69	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		7	39%
2	No		11	61%
	Total		18	100%

Both:

#	Answer		Response	%
1	Yes		24	77%
2	No		7	23%
	Total		31	100%

Question 31. If so, please describe that experience.

Many of the responses to this question did not address rubato, or did not describe an experience and were not included.

Full: (80 responses)

	number	%	code
natural	5	0.08	SC
expression	12	0.20	STC
emotion	22	0.37	AC
technique	9	0.15	AC
individual creativity	8	0.14	AC
add or hold interest	3	0.05	STC

	59	1.00	

code	%
Situation codes	0.08
Activity codes	0.66
Strategy codes	0.25
	1.00

Music: (75 responses_

	number	%	code
natural	5	0.09	SC
expression	12	0.22	STC
emotion	21	0.38	AC
technique	9	0.16	AC
individual creativity	7	0.13	AC
add or hold interest	1	0.02	STC
	55	1.00	

code	%
Situation codes	0.09
Activity codes	0.67
Strategy codes	0.24
	1.00

Sound Design: (28 responses)

	number	%	code
natural	2	0.12	SC
expression	3	0.18	STC
emotion	6	0.35	AC
technique	2	0.12	AC
individual creativity	2	0.12	AC
add or hold interest	2	0.12	STC
	17	1.00	

code	%
Situation codes	0.12
Activity codes	0.59
Strategy codes	0.29
	1.00

Music Only: (52 responses)

	number	%	code
natural	3	0.07	SC
expression	10	0.23	STC
emotion	16	0.37	AC
technique	7	0.16	AC
individual creativity	6	0.14	AC
add or hold interest	1	0.02	STC

	43	1.00	

code	%
Situation codes	0.07
Activity codes	0.67
Strategy codes	0.26
	1.00

Sound Design Only: (5 responses)

	number	%	code
natural	0	0.00	SC
expression	1	0.20	STC
emotion	1	0.20	AC
technique	0	0.00	AC
individual creativity	1	0.20	AC
add or hold interest	2	0.40	STC
	5	1.00	

code	%
Situation codes	0
Activity codes	0.40
Strategy codes	0.60
	1.00

Both: (23 responses)

	number	%	code
natural	2	0.17	SC
expression	2	0.17	STC
emotion	5	0.42	AC
technique	2	0.17	AC
individual creativity	1	0.08	AC
add or hold interest	0	0.00	STC
	12	1.00	

code	%
Situation codes	0.17
Activity codes	0.67
Strategy codes	0.17
	1.00

Question 32. The study of music theory can be similar to that of studying mathematics or a language. Have you ever studied music theory?

Full:

#	Answer		Response	%
1	Yes		81	67%
2	No		40	33%
	Total		121	100%

Music:

#	Answer		Response	%
1	Yes		69	70%
2	No		30	30%
	Total		99	100%

Sound Design:

#	Answer		Response	%
1	Yes		34	68%
2	No		16	32%
	Total		50	100%

Music Only:

#	Answer		Response	%
1	Yes		45	67%
2	No		22	33%
	Total		67	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		10	56%
2	No		8	44%
	Total		18	100%

Both:

#	Answer		Response	%
1	Yes		24	75%
2	No		8	25%
	Total		32	100%

Question 33. Do you agree with this statement: Studying music theory enhanced my academic skills in other courses?

Full:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		31	38%
3	Agree		28	35%
4	Strongly Agree		22	27%
	Total		81	100%

Music:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		28	41%
3	Agree		24	35%
4	Strongly Agree		17	25%
	Total		69	100%

Sound Design:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		11	32%
3	Agree		11	32%
4	Strongly Agree		12	35%
	Total		34	100%

Music Only:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		19	42%
3	Agree		17	38%
4	Strongly Agree		9	20%
	Total		45	100%

Sound Design Only:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		2	20%
3	Agree		4	40%
4	Strongly Agree		4	40%
	Total		10	100%

Both:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		9	38%
3	Agree		7	29%
4	Strongly Agree		8	33%
	Total		24	100%

Question 34. If so, describe how studying music theory has affected your other academic skills.

Other respondents mentioned performance, sound, discipline, and symbolism; other subjects mentioned were chemistry, programming, philosophy and reading.

Full: (45 responses)

SKILLS	resp	%	codes
critical analysis	8	0.19	STC
patterns	9	0.21	STC
form	2	0.05	STC
learning	12	0.29	SC
writing skills	3	0.07	STC
other	8	0.19	n/a
total	42	1.00	

SUBJECTS	number	%
mathematics	12	0.46
language	4	0.15
writing	4	0.15
physics	4	0.15
history	2	0.08
total	26	1.00

CODES	%
STC	0.52
SC	0.29
other	0.19
	1.00

Music: (38 responses)

SKILLS	resp	%	codes
critical analysis	8	0.21	STC
patterns	8	0.21	STC
form	2	0.05	STC

learning	10	0.26	SC
writing skills	3	0.08	STC
other	8	0.21	n/a
total	39	1.00	

other: symbolism, details, sound, translation, performance, perception, creating

SUBJECTS	number	%
mathematics	9	0.43
language	4	0.19
writing	4	0.19
physics	3	0.14
history	1	0.05
total	21	1.00

CODES	%
STC	0.54
SC	0.26
other	0.20
	1.00

Sound Design: (21 responses)

SKILLS	resp	%	codes
critical analysis	2	0.11	STC
patterns	6	0.32	STC
form	1	0.05	STC
learning	6	0.32	SC
writing skills	0	0.00	STC
other	4	0.21	n/a
total	19	1.00	

other: translation, focus, discipline, creating

SUBJECTS	number	%
mathematics	7	0.54
language	2	0.15
writing	1	0.08
physics	2	0.15
history	1	0.08
total	13	1.00

CODES	%
STC	0.47
SC	0.32

other	0.21
	1.00

Music Only: (24 responses)

SKILLS	resp	%	codes
critical analysis	6	0.25	STC
patterns	3	0.13	STC
form	1	0.04	STC
learning	5	0.21	SC
writing skills	2	0.08	STC
other	7	0.29	n/a
total	24	1.00	

other: sound, performance, perception, creating, thinking, details, symbolism

SUBJECTS	number	%
mathematics	7	0.47
language	2	0.13
writing	3	0.20
physics	2	0.13
history	1	0.07
total	15	1.00

CODES	%
STC	0.50
SC	0.21
other	0.29
	1.00

Sound Design Only: (7 responses)

SKILLS	resp	%	codes
critical analysis	0	0.00	STC
patterns	1	0.17	STC
form	0	0.00	STC
learning	3	0.50	SC
writing skills	0	0.00	STC
other	2	0.33	n/a
total	6	1.00	

other: focus, discipline

SUBJECTS	number	%
mathematics	3	0.60
language	0	0.00
writing	0	0.00
physics	1	0.20
history	1	0.20
total	5	1.00

CODES	%
STC	0.17
SC	0.50
other	0.33
	1.00

Both: (14 responses)

critical analysis	2	0.15	STC
patterns	5	0.38	STC
form	1	0.08	STC
learning	3	0.23	SC
writing skills	0	0.00	STC
other	2	0.15	n/a
total	13	1.00	

other: translation creating

SUBJECTS	number	%
mathematics	4	0.58
language	1	0.14
writing	1	0.14
physics	1	0.14
history	0	0.00
total	7	1.00

CODES	%
STC	0.62
SC	0.23
other	0.15
	1.00

Question 35. Studying music or sound design requires a lot of practice and discipline. Do you agree with this statement: Studying music or sound design has enhanced my discipline and time management skills in other subjects.

Full:

#	Answer		Response	%
1	Strongly Disagree		2	2%
2	Disagree		24	20%
3	Agree		53	45%
4	Strongly Agree		39	33%
	Total		118	100%

Music:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		20	20%
3	Agree		44	44%
4	Strongly Agree		35	35%
	Total		99	100%

Sound Design:

#	Answer		Response	%
1	Strongly Disagree		1	2%
2	Disagree		11	23%
3	Agree		17	36%
4	Strongly Agree		18	38%
	Total		47	100%

Music Only:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		12	18%
3	Agree		34	51%
4	Strongly Agree		21	31%
	Total		67	100%

Sound Design Only:

#	Answer		Response	%
1	Strongly Disagree		1	7%
2	Disagree		3	20%
3	Agree		7	47%
4	Strongly Agree		4	27%
	Total		15	100%

Both:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		8	25%
3	Agree		10	31%
4	Strongly Agree		14	44%
	Total		32	100%

Question 36. If so, please describe an experience where study in music or sound design has affected your other academic skills as regards discipline and time management.

Answers varied here, but the great majority referred to planning, scheduling, setting time aside, etc. (29), others mentioned the dedication it takes (3), heightened focus (5), awareness of what you were doing (3), learning to be more efficient (3), increased motivation (8), finding balance between activities (3), learning a complex subject (2), prioritizing tasks (2), learning to expend great effort (5), understanding delayed gratification (2) and learning patience (3). Single responses were recognizing deficiencies, managing expectations, the value of repetition and compartmentalizing tasks. Some responses did not describe an experience.

Full: (83 responses)

	resp	%	code
planning	32	0.44	STC
dedication	3	0.04	SC
focus	6	0.08	STC
awareness	3	0.04	SC
efficiency	3	0.04	STC
motivation	8	0.11	SC
balance	3	0.04	SC
complex	2	0.03	SC
prioritizing	3	0.04	STC
effort	5	0.07	SC
delayed gratification	2	0.03	SC
patience	3	0.04	SC
	73	1.00	

STC (strategy codes)		0.60

SC (situation codes)		0.40
		1.00

Music: (74 responses)

	resp	%	code
planning	29	0.43	STC
dedication	3	0.04	SC
focus	6	0.09	STC
awareness	3	0.04	SC
efficiency	3	0.04	STC
motivation	7	0.10	SC
balance	3	0.04	SC
complex	2	0.03	SC
prioritizing	3	0.04	STC
effort	4	0.06	SC
delayed gratification	2	0.03	SC
patience	3	0.04	SC
	68	1.00	

STC (strategy codes)	0.60	
SC (situation codes)	0.40	
	1.00	

Sound Design: (31 students)

	resp	%	code
planning	12	0.50	STC
dedication	0	0.00	SC
focus	1	0.04	STC
awareness	0	0.00	SC
efficiency	0	0.00	STC
motivation	3	0.13	SC
balance	2	0.08	SC
complex	1	0.04	SC
prioritizing	2	0.08	STC
effort	3	0.13	SC
delayed gratification	0	0.00	SC
patience	0	0.00	SC
	24	1.00	

STC (Strategy codes)	0.63	
SC (Situation codes)	0.38	
	1.00	

Music Only: (52 students)

	resp	%	code
planning	20	0.40	STC
dedication	3	0.06	SC
focus	6	0.12	STC

awareness	3	0.06	SC
efficiency	3	0.06	STC
motivation	5	0.10	SC
balance	2	0.04	SC
complex	0	0.00	SC
prioritizing	1	0.02	STC
effort	2	0.04	SC
delayed gratification	2	0.04	SC
patience	3	0.06	SC
	50	1.00	
STC (Strategy codes)	0.60		
SC (Situation codes)	0.40		
	1.00		

Sound Design Only: (9 students)

	resp	%	code
planning	3	0.60	STC
dedication	0	0.00	SC
focus	0	0.00	STC
awareness	0	0.00	SC
efficiency	0	0.00	STC
motivation	1	0.20	SC
balance	0	0.00	SC
complex	0	0.00	SC
prioritizing	0	0.00	STC
effort	1	0.20	SC
delayed gratification	0	0.00	SC
patience	0	0.00	SC
	5	1.00	

STC (Strategy codes)	0.60	
SC (Situation codes)	0.40	
	1.00	

Both: (22 students)

	resp	%	code
planning	9	0.47	STC
dedication	0	0.00	SC
focus	1	0.05	STC
awareness	0	0.00	SC
efficiency	0	0.00	STC
motivation	2	0.11	SC
balance	2	0.11	SC
complex	1	0.05	SC
prioritizing	2	0.11	STC
effort	2	0.11	SC

delayed gratification	0	0.00	SC
patience	0	0.00	SC
	19	1.00	

STC (Strategy codes)	0.63	
SC (Situation codes)	0.37	
	1.00	

Question 37. Do you agree with this statement: Studying music or doing sound design requires one to maintain attention while listening to a stream of aural information.

Full:

#	Answer		Response	%
1	Strongly Disagree		1	1%
2	Disagree		6	5%
3	Agree		54	46%
4	Strongly Agree		57	48%
	Total		118	100%

Music:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		4	4%
3	Agree		46	46%
4	Strongly Agree		49	49%
	Total		99	100%

Sound Design:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		4	9%
3	Agree		18	38%
4	Strongly Agree		25	53%
	Total		47	100%

Music Only:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		2	3%
3	Agree		35	52%
4	Strongly Agree		30	45%
	Total		67	100%

Sound Design Only:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		2	13%
3	Agree		7	47%
4	Strongly Agree		6	40%
	Total		15	100%

Both:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		2	6%
3	Agree		11	34%
4	Strongly Agree		19	59%
	Total		32	100%

Note: Question 38 was eliminated in final editing.

Question 39. If you agree, has the need to maintain attention through listening to a stream of aural information affected your academic skills?

Full:

#	Answer		Response	%
1	Yes		80	73%
2	No		30	27%
	Total		110	100%

Music:

#	Answer		Response	%
1	Yes		70	74%
2	No		24	26%
	Total		94	100%

Sound Design:

#	Answer		Response	%
1	Yes		29	69%
2	No		13	31%
	Total		42	100%

Music Only:

#	Answer		Response	%
1	Yes		49	75%
2	No		16	25%
	Total		65	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		8	62%
2	No		5	38%
	Total		13	100%

Both:

#	Answer		Response	%
1	Yes		21	72%
2	No		8	28%
	Total		29	100%

Question 40. If so, please describe that experience.

Major responses here tended to emphasize an increase in critical listening skills (23), enhanced ability to multitask (13), increased focus and concentration (20), picking out details (5), and enhancing auditory memory (7). Activities most mentioned were listening to lectures (16) and studying (7).

Full: (74 responses)

Category	resp	%	strategy
listening	26	0.35	STC
multitasking	14	0.19	STC
focus	22	0.30	SC
details	5	0.07	SC
memory	7	0.09	SC
total	74	1.00	
STC (Strategy codes)	0.54		
SC (Situation codes)	0.46		
	1.00		

activity	resp	%
lectures	18	0.72
studying	7	0.28

total	25	1.00

Music: (69 responses)

Category	resp	%	codes
listening	24	0.35	STC
multitasking	13	0.19	STC
focus	21	0.30	SC
details	4	0.06	SC
memory	7	0.10	SC
total	69	1.00	
STC (Strategy codes)	0.54		
SC (Situation codes)	0.46		
	1.00		

activity	resp	%
lectures	17	0.68
studying	7	0.28
total	24	0.96

Sound Design: (28 responses)

Category	resp	%	codes
listening	9	0.32	STC
multitasking	5	0.18	STC
focus	9	0.32	SC
details	4	0.14	SC
memory	1	0.04	SC
total	28	1.00	
STC (Strategy codes)	0.50		
SC (Situation codes)	0.50		
	1.00		

activity	resp	%
lectures	5	0.20
studying	2	0.08
total	7	0.28

Music Only: (49 responses)

Category	resp	%	codes
listening	18	0.37	STC
multitasking	9	0.18	STC
focus	14	0.29	SC
details	2	0.04	SC
memory	6	0.12	SC
total	49	1.00	

STC (Strategy codes)	0.55
SC (Situation codes)	0.45
	1.00

activity	resp	%
lectures	13	0.87
studying	2	0.13
total	15	1.00

Sound Design Only: (5 responses)

category	resp	%	codes
listening	2	0.40	STC
multitasking	1	0.20	STC
focus	1	0.20	SC
details	1	0.20	SC
memory	0	0.00	SC
total	5	1.00	
STC (Strategy codes)	0.60		
SC (Situation codes)	0.40		
	1.00		

activity	resp	%
lectures	1	1.00
studying	0	0.00
total	1	1.00

Both: (22 responses)

Category	resp	%	strategy
listening	7	0.32	STC
multitasking	4	0.18	STC
focus	8	0.36	SC
details	2	0.09	SC
memory	1	0.05	SC
total	22	1.00	
STC (Strategy codes)	0.50		
SC (Situation codes)	0.50		
	1.00		

activity	resp	%
lectures	4	0.16
studying	2	0.08
total	6	0.24

Question 41. Studying music or sound design requires the breaking up of auditory information into smaller "segments". Have you experienced this "segmenting" when you studied music or sound design?

Full:

#	Answer		Response	%
1	Yes		101	87%
2	No		15	13%
	Total		116	100%

Music:

#	Answer		Response	%
1	Yes		86	88%
2	No		12	12%
	Total		98	100%

Sound Design:

#	Answer		Response	%
1	Yes		43	96%
2	No		2	4%
	Total		45	100%

Music Only:

#	Answer		Response	%
1	Yes		56	84%
2	No		11	16%
	Total		67	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		13	93%
2	No		1	7%
	Total		14	100%

Both:

#	Answer		Response	%
1	Yes		30	97%
2	No		1	3%
	Total		31	100%

Question 42. If so, please describe that experience.

Full: (89 responses)

CATEGORY	number	%
horizontal	41	0.59
vertical	29	0.41
	70	1.00

ACTIVITY	number	%	code

learning	32	0.41	AC
analyzing	26	0.33	STC
memorizing	2	0.03	STC
listening	13	0.16	AC
other	6	0.08	
	79	1.00	

AC (Activity codes)	0.57	
STC (Strategy codes)	0.35	
Other	0.08	
	1.00	

Music: (78 responses)

horizontal	38	0.58
vertical	27	0.42
	65	1.00

ACTIVITY	number	%	code
learning	30	0.41	AC
analyzing	23	0.31	STC
memorizing	2	0.03	STC
listening	13	0.18	AC
other	6	0.08	
	74	1.00	

AC (Activity codes)	0.58	
STC (Strategy codes)	0.34	
Other	0.08	
	1.00	

Sound Design: (41 responses)

horizontal	17	0.55
vertical	14	0.45
	31	1.00

ACTIVITY	number	%	code
learning	12	0.34	AC
analyzing	14	0.40	STC
memorizing	1	0.03	STC
listening	5	0.14	AC
other	3	0.09	
	35	1.00	

AC (Activity codes)	0.49	
STC (Strategy codes)	0.43	
Other	0.09	

	1.00	

Music Only: (48 responses)

horizontal	26	0.63
vertical	15	0.37
	41	1.00

ACTIVITY	number	%	code
learning	22	0.46	AC
analyzing	12	0.25	STC
memorizing	1	0.02	STC
listening	8	0.17	AC
other	5	0.10	
	48	1.00	

AC (Activity codes)	0.63	
STC (Strategy codes)	0.27	
Other	0.10	
	0.98	

Sound Design Only: (11 responses)

horizontal	3	0.60
vertical	2	0.40
	5	1.00

ACTIVITY	number	%	code
learning	2	0.33	AC
analyzing	3	0.50	STC
memorizing	0	0.00	STC
listening	0	0.00	AC
other	1	0.17	
	6	1.00	

AC (Activity codes)	0.33	
STC (Strategy codes)	0.50	
Other	0.17	
	1.00	

Both: (30 responses)

horizontal	14	0.56
vertical	11	0.44
	25	1.00

ACTIVITY	number	%	code
learning	10	0.34	AC
analyzing	11	0.38	STC
memorizing	1	0.03	STC

listening	5	0.17	AC
other	2	0.07	
	29	1.00	

AC (Activity codes)	0.52	
STC (Strategy codes)	0.41	
Other	0.07	
	1.00	

Question 43. Have you graduated from UTD with an undergraduate degree?

Full:

#	Answer		Response	%
1	Yes		23	20%
2	No		94	80%
	Total		117	100%

Music:

#	Answer		Response	%
1	Yes		22	22%
2	No		77	78%
	Total		99	100%

Sound Design:

#	Answer		Response	%
1	Yes		8	17%
2	No		38	83%
	Total		46	100%

Music Only:

#	Answer		Response	%
1	Yes		14	21%
2	No		53	79%
	Total		67	100%

Sound Design Only:

#	Answer		Response	%
1	Yes		0	0%
2	No		14	100%
	Total		14	100%

Both:

#	Answer		Response	%
1	Yes		8	25%
2	No		24	75%
	Total		32	100%

Question 44: What degree did you earn and when?

Full (22 responses):

Art and Performance	1	A&H
Neuroscience	4	BBS
Accounting	1	SOM
Arts and Technology	3	ATEC
Interdisciplinary Studies	1	IS
Business Administration	1	SOM
Biology	1	NSM
Computer Science	1	EECS
Physics	2	NSM
Biochemistry	1	NSM
Child Learning & Development	2	EPPS
Global Business	1	SOM
Literary Studies	1	A&H
Psychology	1	EPPS
Unspecified	2	
	23	

Note: One double major in psychology/child development

Music: This information was identical to the full sample. Therefore, all alumni had taken a music course.

Sound Design: (8 responses)

Arts and Technology	3	ATEC
Physics	2	NSM
Child Learning & Development	2	EPPS
Global Business	1	SOM
Unspecified	1	

Music Only:

Art and Performance	1	A&H
Neuroscience	4	BBS
Accounting	1	SOM
Interdisciplinary Studies	1	IS
Business Administration	1	SOM
Biology	1	NSM
Computer Science	1	EECS
Biochemistry	1	NSM
Literary Studies	1	A&H
Psychology	1	EPPS
Unspecified	1	

Sound Design Only: There were no alumni in the sample that had taken only sound design courses.

Both: This result is identical to the sound design sample above, since all alumni had taken music courses as well as sound design courses.

Of the 22 alumni that responded, all had taken a music course and, in addition, 8 had taken a sound design course. 14 had taken only music classes.

Questions 45-47 pertained to alumni. There is no "Sound Design Only" cohort and the "Music student" cohort is identical to the full sample. The "Sound Design" and "Both" Cohorts are identical.

Question 45. What are you doing now (graduate school, medical or dental school, working, seeking work, etc.)?

Full/music:

SUMMARY		
working	7	0.33
seeking work	3	0.14
graduate/medical school	7	0.33
research asistant	1	0.05
taking a break	1	0.05
applying to med/grad school	2	0.10
	21	1.00

Music only:

working	2	0.14
seeking work	2	0.14
graduate/medical school	7	0.50
research asistant	1	0.07
taking a break	0	0.00
applying to med/grad school	2	0.14
	14	1.00

Sound Design/Both:

working	5	0.71
seeking work	1	0.14
graduate/medical school	0	0.00
research asistant	0	0.00
taking a break	1	0.14
applying to med/grad school	0	0.00
	7	1.00

Question 46. Do you agree with this statement: Study in music or sound design helped me with my post-graduation activities (school, work, etc.).

There were 54 students who answered this question, but many had not graduated. In order to isolate just those students who had actually graduate, we applied a filter to isolate just alumni. As before, all students had taken a music class and some had also taken a sound design class.

Full/music:

#	Answer		Response	%
1	Strongly Disagree		1	4%
2	Disagree		2	9%
3	Agree		13	57%
4	Strongly Agree		7	30%
	Total		23	100%

Music only:

#	Answer		Response	%
1	Strongly Disagree		1	8%
2	Disagree		1	8%
3	Agree		9	69%
4	Strongly Agree		2	15%
	Total		13	100%

Sound design/Both:

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		1	11%
3	Agree		4	44%
4	Strongly Agree		4	44%
	Total		9	100%

Question 47: If so, describe how it helped you.

There were 54 students who answered this question, but many had not graduated. In order to isolate just those students who had actually graduate, we applied a filter to isolate just alumni. As before, all students had taken a music class and some had also taken a sound design class.

Full/music:

enjoyment	2	0.07	AC
time management	4	0.15	STC
listening	1	0.04	AC
well-rounded	2	0.07	SC
stress relief	6	0.22	STC
resume	2	0.07	SC
critical thinking	3	0.11	AC
social connections	1	0.04	SC
current work	2	0.07	SC
other	4	0.15	
	27	1.00	

Code summary			
AC (Activity codes)	0.22		
STC (Strategy codes)	0.37		
SC (Situation codes)	0.26		
other	0.15		
	1.00		

Music only:

enjoyment	2	0.14	AC
time management	1	0.07	STC
listening	1	0.07	AC
well-rounded	0	0.00	SC
stress relief	4	0.29	STC
resume	2	0.14	SC
critical thinking	2	0.14	AC

social connections	1	0.07	SC
current work	1	0.07	SC
other	0	0.00	n/a
	14	1.00	
Code summary			
AC (Activity codes)	0.36		
STC (Strategy codes)	0.36		
SC (Situation codes)	0.29		
	1.00		

Sound design/Both:

enjoyment	2	0.22	AC
time management	1	0.11	STC
listening	1	0.11	AC
well-rounded	1	0.11	SC
stress relief	1	0.11	STC
resume	0	0.00	SC
critical thinking	1	0.11	AC
social connections	0	0.00	SC
current work	2	0.22	SC
total	9	0.99	n/a
Code summary			
AC (Activity codes)	0.44		
STC (Strategy codes)	0.22		
SC (Situation codes)	0.33		
	0.99		

Question 48. Finally, please describe any other musical or sound design experience you have had that you feel has affected your ability in other coursework.

Most respondents felt the survey had covered all the material, so they responded with N/A or something similar. Keywords and phrases for those that responded are listed; answers were so varied they were not categorized.

Full: (35 responses

I make music, mix, and master tracks everyday,
joy, relieving stress.
sharpen my senses and discern quality work.
programming.
creation.
networking skills

analyzing music made it easier for me to analyze the emotional content of literature
Practicing make you realize the work you have to put in to achieve greatness.
focus more when I move on to other work.
keeps me grounded.
The process of how to learn music is integral to being able to work on my school workflow I write my programs.
f the "right" music to help me either concentrate or de-stress.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
cooperation. Working, especially in a small ensemble, is very similar to coursework done in a group project setting.
gotten used to performing onstage
The people in music change who you are
creativity needed to solve problems
obsessively producing digital music, devoting many hours listening to music affecting my work studies by not letting me focus
It's all in the past responses.
negative affect. I can't concentrate on my other academic classes
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me succeed in coursework
I like to analyze each voice, instrument, or section of audio
helped my self-esteem and self-regulation, interact with the most diverse groups of people, using a large team of students from various backgrounds and skillset
have helped me develop a photographic memory
I cannot think of any at this time.
It's really hard for me to say
I don't think I have anything to add here.
confidence that i use to reach my goals
music programs, singing, writing, producing
time management, rhythm and patterns
better understanding of my own work, patterns and tiechniques in other subjects
progress my skills and a fundamental education

Music: (31 responses)

I make music, mix, and master tracks everyday,
joy, relieving stress.
sharpen my senses and discern quality work.
programming.
creation.
networking skills
analyzing music made it easier for me to analyze the emotional content of literature
Practicing make you realize the work you have to put in to achieve greatness.

focus more when I move on to other work.
keeps me grounded.
The process of how to learn music is integral to being able to work on my school workflow
I write my programs.
The "right" music to help me either concentrate or de-stress.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
cooperation. Working, especially in a small ensemble, is very similar to coursework
done in a group project setting.
gotten used to performing onstage
The people in music change who you are
creativity needed to solve problems
obsessively producing digital music, devoting many hours listening to music affecting
my work studies by not letting me focus
negative affect. I can't concentrate on my other academic classes
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me
succeed in coursework
I like to analyze each voice, instrument, or section of audio
helped my self-esteem and self-regulation, interact with the most diverse groups of people, u
using a large team of students from various backgrounds and skillset
have helped me develop a photographic memory
confidence that i use to reach my goals
music programs, singing, writing, producing
time management, rhythm and patterns
better understanding of my own work, patterns and techniques in other subjects
progress my skills and a fundamental education

Sound Design: (12 responses)

I make music, mix, and master tracks everyday,
sharpen my senses and discern quality work.
creation.
analyzing music made it easier for me to analyze the emotional content of literature
The process of how to learn music is integral to being able to work on my school workhow I write my programs.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
done in a group project setting.
negative affect. I can't concentrate on my other academic classes
using a large team of students from various backgrounds and skillset
have helped me develop a photographic memory
time management, rhythm and patterns
better understanding of my own work, patterns and tiechniques in other subjects
progress my skills and a fundamental education

Music Only: (17 responses)

joy, relieving stress.
programming.
networking skills
Practicing make you realize the work you have to put in to achieve greatness.
focus more when I move on to other work.
keeps me grounded.
the "right" music to help me either concentrate or de-stress.
cooperation. Working, especially in a small ensemble, is very similar to coursework
done in a group project setting.
gotten used to performing onstage
The people in music change who you are
creativity needed to solve problems
obsessively producing digital music, devoting many hours listening to music affecting
my work studies by not letting me focus
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me
succeed in coursework
I like to analyze each voice, instrument, or section of audio
helped my self-esteem and self-regulation, interact with the most diverse groups of people,
using a large team of students from various backgrounds and skillset
confidence that i use to reach my goals
music programs, singing, writing, producing

Sound Design Only: (3 responses)

analyzing music made it easier for me to analyze the emotional content of
literature
time management, rhythm and patterns
better understanding of my own work, patterns and techniques in other subjects

Both: (11 responses)

I make music, mix, and master tracks everyday,
sharpen my senses and discern quality work.
creation.
The process of how to learn music is integral to being able to work on my school work, how I write my programs.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
done in a group project setting.
negative affect. I can't concentrate on my other academic classes
sing a large team of students from various backgrounds and skillset
have helped me develop a photographic memory
progress my skills and a fundamental education

APPENDIX F

RESULTS, COHORT COMPARISON: STEM VERSUS NON-STEM MAJORS

The University of Texas at Dallas consists of eight Schools, four of which have STEM-related majors, and four which do not:

Stem Major Schools:	Arts, Technology and Emerging Communications (ATEC) Behavioral and Brain Science (BBS) Natural Science and Mathematics (NS&M) Electrical Engineering and Computer Science (EECS)
Non-stem Major Schools:	Arts and Humanities (A&H) Management (SOM) Economics, Political and Policy Science (EPPS_ Interdisciplinary Studies (IS)

By using Qualtrics filters and the "contain" feature, it was possible to create reports that identified all those students within a certain major, and to aggregate them into STEM and non-STEM fields. The resulting reports allowed a comparison of answers to the survey questions. Note: there were four students who listed "undeclared" as a major; they are not included in these samples. There was also one double major in both STEM (speech pathology) and non-STEM (Art and Performance). 100% of both the STEM sample and the non-STEM sample read the consent form and proceeded with the survey.

Questions 2- 4 were to establish identifier codes.

Question 5: Are you a currently registered student at UT Dallas or have been in the past ten years? (Students who were not registered were sent to the end of the survey)

All respondents were registered students or had been in the past 10 years.

Question 6: What is your gender?

STEM

#	Answer		Response	%
1	Male		55	48%
2	Female		59	52%
	Total		114	100%

NON-STEM

#	Answer		Response	%
1	Male		12	36%
2	Female		21	64%
	Total		33	100%

Question 7: What is your ethnicity?

STEM

#	Answer		Response	%
1	White/Caucasian		50	44%
2	Asian		37	32%
3	Hispanic		11	10%
4	African/American		4	4%
5	Native American		1	1%
6	Native Hawaiian		0	0%
7	Two or more races		10	9%
8	Don't Know/Prefer Not to Answer		1	1%
	Total		114	100%

NON-STEM

#	Answer		Response	%
1	White/Caucasian		18	55%
2	Asian		7	21%
3	Hispanic		5	15%
4	African/American		1	3%
5	Native American		0	0%
6	Native Hawaiian		0	0%
7	Two or more races		2	6%
8	Don't Know/Prefer Not to Answer		0	0%
	Total		33	100%

Question 8. Have you been enrolled in a music or sound design course in the last 10 years?

STEM

#	Answer		Response	%
1	Yes		114	100%
2	No		0	0%
	Total		114	100%

NON-STEM

#	Answer		Response	%
1	Yes		33	100%
2	No		0	0%
	Total		33	100%

Question 9: What is/was your major?

STEM

Arts, Technology & Emerging Communication (ATEC)	**45**	**39.47%**
Arts & Technology	36	
EMAC	9	
Behavioral and Brain Science (BBS)	**23**	**14.94%**
Child Learning and Development	4	
Communication disorders	1	
Psychology	6	
Speech-language Pathology and Audiology	4	
Neuroscience	8	
Electrical Engineering & Computer Science (EECS)	**12**	**10.53%**

Computer Engineering	1	
Computer Science	6	
EE	3	
Software Engineering	2	
Natural Science & Mathematics (NS&M)	**34**	**22.08%**
Actuarial Science	1	
Biochemistry	9	
Biology	14	
Chemistry	3	
Math	3	
Phsyics	4	
TOTAL (including double majors)	**114**	**87.01%**

NON-STEM

Arts and Humanities (A&H)	**17**	**48.57%**
Art & Performance	12	
Literary	5	
Economic, Political and Policy Science (EPPS)	**4**	**11.43%**
International Political Economy	1	
Political Science	3	
Interdisciplinary Studies (IS)	**1**	**2.86%**
Interdisciplinary Studies	1	
School of Management (SOM)	**13**	**37.14%**
Accounting	2	
Business Administration	4	
Finance\Economics	1	
Global Business	1	
Information System	2	
Marketing	3	
TOTAL (including double majors)	**35**	**100.00%**

Question 10: Are you/Were you a music minor?

STEM

#	Answer		Response	%
1	Yes		28	25%
2	No		86	75%
	Total		114	100%

NON-STEM

#	Answer		Response	%
1	Yes		12	36%
2	No		21	64%
	Total		33	100%

Question 11. Have you played an instrument or sang in a formal musical experience (classes, private study, ensemble) besides your UTD course?

STEM

#	Answer		Response	%
1	Yes		95	83%
2	No		19	17%
	Total		114	100%

NON-STEM

#	Answer		Response	%
1	Yes		28	85%
2	No		5	15%
	Total		33	100%

Question 12. If yes, for how long and in what capacity? Please include any ensembles (choir, orchestra, band) that you have played in.

STEM

	choir	voice	band	piano	orchestra
total trs	154	77	173	116	178
responses	27	12	31	18	34
average	5.70	6.42	5.58	6.44	5.24
range	1 to 14	1 to 15	1 to 10	1 to 14	1 to 22

	No. of instruments		%
	1	53	0.64
	2	25	0.30
	3	4	0.05
	4	1	0.01
	responses	83	1.00

NON-STEM

	choir	voice	band	piano	orchestra
total trs	113	19	28	32	53
responses	15	5	4	4	8
average	7.53	3.80	7.00	8	6.63
range	1 to 20	1 to 8	1 to 10	1 to 14	1 to 16

	No. of instruments		%
	1	11	0.50
	2	9	0.41
	3	2	0.09
	4	0	0.00
	responses	22	1.00

Question 13 Have you participated in music or sound design in an informal capacity (in a band, composing, arranging, recording, etc.)?

STEM

#	Answer		Response	%
1	Yes		57	52%
2	No		52	48%
	Total		109	100%

NON-STEM

#	Answer		Response	%
1	Yes		19	58%
2	No		14	42%
	Total		33	100%

Question 14. If so, how long and in what capacity?

STEM

	responses	%
composition	40	0.45
arranging	5	0.06
digital music	4	0.05
recording	6	0.07
sound/audio engineer	13	0.15
band	6	0.07
a cappella group	3	0.03
private study	4	0.05
podcasting	2	0.02
no response	5	0.06
	88	1.00

Average years (29 responses) 4.00
Range 1 - 14 years

NON-STEM

	responses	%
composition	4	0.25
arranging	2	0.13
digital music	0	0.00
recording	3	0.19
sound/audio engineer	2	0.13
band	3	0.19
a cappella group	2	0.13
private study	0	0.00
podcasting	0	0.00
no response	0	0.00
	16	1.00

Average years (8 responses) 2.00
Range 1 - 5 years

Question 15. What music courses have you taken at UTD, either now or in the last ten years? Please indicate the name of the course and the MUSI number, if you can recall it, and when you were enrolled. If you were not enrolled in a MUSI course, please respond "none".

STEM

COURSES BY GENRE			
Music History and Appreciation		25	0.12
Instrumental Ensemble		43	0.20
Vocal and choral		81	0.38
Piano		13	0.06
Guitar		10	0.05
Music Theory		24	0.11
Ind Study		6	0.03
Creating Music		2	0.01
Digital Music		12	0.06
		216	1.00

NON-STEM

COURSES BY GENRE			
Music History and Appreciation		14	0.12
Instrumental Ensemble		7	0.06
Vocal and choral		81	0.68
Piano		1	0.01
Guitar		1	0.01
Music Theory		9	0.08
Ind Study		5	0.04
Creating Music		0	0.00
Digital Music		2	0.02
		120	1.00

NOTES MUSI1306 satisfies the state core curriculum requirement and is required for the music minor
MUSI 2328 and 3322 are required for the music minor
Students may repeat performance courses up to three times

Question 16. What sound design courses have you taken at UTD, either now or in the last ten years? Please indicate the name of the course and the ATEC number, if you can recall it, and when you were enrolled. If you were not enrolled in a sound design course, please respond "none".

STEM

2385	INTRO TO SOUND DESIGN		33	0.53
3310	AUDIO TECHNOLOGIES		8	0.13
3312	AUDIO PRODUCTION LAB		1	0.02
3354	SOUND DESIGN FOR GAMES		4	0.06
4375	SPECIAL TOPICS IN SOUND DESIGN		16	0.26
			62	1.00

Note: 51 students said "none"

NON-STEM

2385	INTRO TO SOUND DESIGN		0	0.00
3310	AUDIO TECHNOLOGIES		0	0.00
3312	AUDIO PRODUCTION LAB		0	0.00
3354	SOUND DESIGN FOR GAMES		0	0.00
4375	SPECIAL TOPICS IN SOUND DESIGN		0	0.00
			0	0.00
	Note: 25 students said "none"			

This result was quite a surprise. Among students who were not majoring in STEM, <u>not a single respondent had taken a sound design course</u>. This is a strong indication that sound design is either not know or not an elective activity for those outside ATEC/EMAC and the other STEM schools.

Question 17. Have you studied music before you attended UT Dallas?

STEM

#	Answer		Response	%
1	Yes		79	80%
2	No		20	20%
	Total		99	100%

NON-STEM

#	Answer		Response	%
1	Yes		24	89%
2	No		3	11%
	Total		27	100%

Question 18. If yes, for how long and in what capacity?

STEM

	choir	voice	band	piano	orchestra
total yrs	86	37	78	114	89
responses	14	8	14	13	12
average	6.14	4.63	5.57	8.77	7.42
range	1 to 12	1 to 13	1 to 9	2 to 16	3 to 13

NON-STEM

	choir	voice	band	piano	orchestra
total yrs	39	23	13	59	16
responses	7	7	2	8	3
average	5.57	3.29	6.50	7.38	5.33
range	2 to 13	1 to 5	6 to 7	2 to 13	1 to 8

Question 19. Have you studied sound design before you attended UT Dallas?

STEM

#	Answer		Response	%
1	Yes		15	15%
2	No		82	85%
	Total		97	100%

NON-STEM

#	Answer		Response	%
1	Yes		1	4%
2	No		25	96%
	Total		26	100%

Question 20. If yes, for how long and in what capacity?

STEM

These responses were the same as the full sample, except for the one response. Two answered none or very little; other responses were from 1 to 4 years of study, others did not list time or specifics. One had 20 years of professional experience.

NON-STEM

Only one student answered this question, and the response was “One year in high school”.

Question 21. Do you agree with this statement: Participating in music or sound design courses has affected my academic abilities in other courses.

STEM (97 responses)

#	Answer		Response	%
1	Strongly Disagree		4	4%
2	Disagree		17	18%
3	Agree		45	46%
4	Strongly Agree		33	34%

NON-STEM (25 responses)

#	Answer		Response	%
1	Strongly Disagree		4	16%
2	Disagree		2	8%
3	Agree		10	40%
4	Strongly Agree		9	36%

Question 22: Describe one experience that has affected your skills in other classes.

STEM

Categories	responses	percentage	code
Concentration, focus	12	0.14	STC
Memorization	3	0.04	AC
Relieve stress	14	0.17	STC
Time management	3	0.04	STC
Public speaking, communication	1	0.01	AC
New perspectives	7	0.08	SC
Knowledge	11	0.13	SC
Mathematics skills	8	0.10	AC
Interrelationship of parts, connections	4	0.05	SC
Discipline	6	0.07	STC
Critical thinking skills	8	0.10	AC
Expressivity	3	0.04	PC
Other	3	0.04	*
	83	1.00	

STC (Strategy codes)	0.42	
AC (Activity codes)	0.24	
SC (Situation codes)	0.27	
PC (Process codes)	0.03	

other	0.04	
	1.00	

NON-STEM

Categories	responses	percentage	code
Concentration, focus	3	0.15	STC
Memorization	0	0.00	AC
Relieve stress	3	0.15	STC
Time management	1	0.05	STC
Public speaking, communication	4	0.20	AC
New perspectives	1	0.05	SC
Knowledge	2	0.10	SC
Mathematics skills	2	0.10	AC
Interrelationship of parts, connections	0	0.00	SC
Discipline	1	0.05	STC
Critical thinking skills	1	0.05	AC
Expressivity	0	0.00	PC
Other	2	0.10	*
	20	1.00	

STC (Strategy codes)	0.40	
AC (Activity codes)	0.35	
SC (Situation codes)	0.15	
PC (Process codes)	0.03	
other	0.04	
	0.97	

Question 23. Some musicians relate experiencing "flow" when they study or perform music. One indication of "flow" is the sense that you "lost track of time" during the experience. Have you ever experienced "flow" when doing music or sound design?

STEM

#	Answer		Response	%
1	Never		4	4%
2	Rarely		5	5%
3	Sometimes		28	30%
4	Most of the Time		38	41%
5	Always		18	19%
	Total		93	100%

NON-STEM

#	Answer		Response	%
1	Never		1	4%
2	Rarely		2	8%
3	Sometimes		13	50%
4	Most of the Time		6	23%
5	Always		4	15%
	Total		26	100%

Question 24. If so, please describe the feeling you had during that experience.

STEM

Categories	responses	percentage	code
Serenity	4	0.04	SC
Natural	4	0.04	SC
Free and easy	6	0.07	SC
Fun	4	0.04	SC
Perception of time	42	0.47	SC
Immersion	2	0.02	SC
Embodiment	2	0.02	AC
Joy	5	0.06	SC
Confidence	1	0.01	SC
Focus	4	0.04	STC
Feeling the emotion	8	0.09	SC
Other	7	0.08	*
	89	1.00	

STC (strategy codes)	0.04		
AC (activity codes)	0.02		
SC (situation codes)	0.85		
PC (process codes)	0.00		
other	0.08		
	0.99		

NON-STEM

Categories	responses	percentage	code
Serenity	1	0.04	SC
Natural	1	0.04	SC
Free and easy	0	0.00	SC
Fun	0	0.00	SC
Perception of time	13	0.50	SC
Immersion	1	0.04	SC
Embodiment	2	0.08	AC
Joy	2	0.08	SC
Confidence	1	0.04	SC

Focus	3	0.12	STC
Feeling the emotion	0	0.00	SC
Other	2	0.08	*
	26	1.00	

STC (strategy codes)	0.12		
AC (activity codes)	0.08		
SC (situation codes)	0.73		
PC (process codes)	0.00		
other	0.08		
	1.00		

Question 25. Have you also experience flow in a non-musical activity?

STEM

#	Answer		Response	%
1	Yes		76	82%
2	No		17	18%
	Total		93	100%

NON-STEM

#	Answer		Response	%
1	Yes		20	83%
2	No		4	17%
	Total		24	100%

Question 26. If so, please describe that experience.

STEM

Sports/exercise	16	0.21
Artistic/creative	13	0.17
Entertainment (video games, friends)	7	0.09
Reading for pleasure	10	0.13
Studying/learning	7	0.09
Writing	8	0.11
Programming	4	0.05
Science/math	5	0.07
Presentation	2	0.03
Other	4	0.05
	76	1.00

NON-STEM

Sports/exercise	4	0.19
Artistic/creative	7	0.33
Entertainment (video games, friends)	4	0.19
Reading for pleasure	2	0.10
Studying/learning	1	0.05

Writing	2	0.10
Programming	0	0.00
Science/math	1	0.05
Presentation	0	0.00
Other	0	0.00
	21	1.00

Question 27. Many music students study the "form" of a musical work (such as ABA, rondo form, sonata form, etc.) when they study pieces of music. Have you ever analyzed the form of a piece of music?

STEM

#	Answer		Response	%
1	Not At All		33	36%
2	Occasionally		37	40%
3	Frequently		22	24%
	Total		92	100%

NON-STEM

#	Answer		Response	%
1	Not At All		3	13%
2	Occasionally		14	58%
3	Frequently		7	29%
	Total		24	100%

Question 28. Do you agree with this statement: Learning to analyze that structure affected my other academic tasks.

STEM (59 responses)

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		15	26%
3	Agree		30	52%
4	Strongly Agree		14	24%

NON-STEM (21 responses)

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		7	35%
3	Agree		13	65%
4	Strongly Agree		1	5%

Question 29. If so, please describe how it affected your other academic tasks.

STEM

Categories	number	%	code
patterns	9	0.21	STC
analysis/critical thinkng	8	0.19	STC
structure	10	0.23	STC
details	4	0.09	STC
learning	3	0.07	STC
other	9	0.21	
total	43	1.00	

All responses were strategy codes

Subjects	number	%
Mathematics	9	0.38
Literature	5	0.21
Natural sciences	8	0.33
Writing	2	0.08
total	24	1.00

NON-STEM

Categories		number	%	code
patterns		5	0.38	STC
analysis/critical thinkng		6	0.46	STC
structure		1	0.08	STC
details		1	0.08	STC
learning		0	0.00	STC
other		0	0.00	
total		13	1.00	

Subjects	number	%
Mathematics	0	0.00
Literature	2	0.67
Natural sciences	0	0.00
Writing	1	0.33
total	3	1.00

Question 30. "Rubato" is the concept of changing slightly the tempo of a piece, referring to expressive and rhythmic freedom by a slight speeding up and then slowing down of the tempo of a piece at the discretion of the soloist. Have you ever used rubato in a musical piece?

STEM

#	Answer		Response	%
1	Yes		68	76%
2	No		22	24%
	Total		90	100%

NON-STEM

#	Answer		Response	%
1	Yes		19	86%
2	No		3	14%
	Total		22	100%

Question 31. If so, please describe that experience.

STEM

	number	%	code
natural	3	0.07	SC
expression	10	0.23	STC
emotion	15	0.34	AC
technique	7	0.16	AC
individual creativity	6	0.14	AC
add or hold interest	3	0.07	STC
	44	1.00	

code	%
STC (strategy codes)	0.30
AC (activity codes)	0.64
SC (situation codes)	0.07
	1.00

NON-STEM

	number	%	code
natural	2	0.14	SC
expression	1	0.07	STC
emotion	7	0.50	AC
technique	2	0.14	AC
individual creativity	2	0.14	AC
add or hold interest	0	0.00	STC
	14	1.00	

code	%
STC (strategy codes)	0.07
AC (activity codes)	0.80
SC (situation codes)	0.14
	1.00

Question 32. The study of music theory can be similar to that of studying mathematics or a language. Have you ever studied music theory?

STEM

#	Answer		Response	%
1	Yes		60	67%
2	No		30	33%
	Total		90	100%

NON-STEM

#	Answer		Response	%
1	Yes		16	73%
2	No		6	27%
	Total		22	100%

Question 33. Do you agree with this statement: Studying music theory enhanced my academic skills in other courses?

STEM

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		22	37%
3	Agree		21	35%
4	Strongly Agree		17	28%
	Total		60	100%

NON-STEM

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		7	44%
3	Agree		5	31%
4	Strongly Agree		4	25%
	Total		16	100%

Question 34. If so, describe how studying music theory has affected your other academic skills.

STEM

SKILLS	resp	%	codes
critical analysis	6	0.19	STC
patterns	7	0.22	STC
form	0	0.00	STC

learning	10	0.31	SC
writing skills	3	0.09	STC
other	6	0.19	n/a
total	32	1.00	

SUBJECTS	number	%
mathematics	11	0.52
language	2	0.10
writing	3	0.14
physics	3	0.16
history	2	0.10
total	21	1.00

CODES	%
STC (strategy codes)	0.50
SC (situation codes)	0.31
other	0.19
	1.00

NON-STEM

SKILLS	resp	%	codes
critical analysis	2	0.22	STC
patterns	2	0.22	STC
form	2	0.22	STC
learning	2	0.22	SC
writing skills	0	0.00	STC
other	1	0.11	n/a
total	9	1.00	

SUBJECTS	number	%
mathematics	1	0.20
language	2	0.30
writing	1	0.20
physics	1	0.20
history	0	0.00
total	5	1.00

CODES	%
STC (strategy codes)	0.67
SC (situation codes)	0.22
other	0.11
	1.00

Question 35. Studying music or sound design requires a lot of practice and discipline. Do you agree with this statement: Studying music or sound design has enhanced my discipline and time management skills in other subjects.

STEM

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		18	21%
3	Agree		39	45%
4	Strongly Agree		30	34%
	Total		87	100%

NON-STEM

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		4	18%
3	Agree		10	45%
4	Strongly Agree		8	36%
	Total		22	100%

Question 36. If so, please describe an experience where study in music or sound design has affected your other academic skills as regards discipline and time management.

STEM

	resp	%	code
planning	27	0.51	STC
dedication	2	0.04	SC
focus	2	0.04	STC
awareness	1	0.02	SC
efficiency	2	0.04	STC
motivation	5	0.09	SC
balance	2	0.04	SC
complex	2	0.04	SC
prioritizing	3	0.06	STC
effort	3	0.06	SC
delayed gratification	2	0.04	SC
patience	2	0.04	SC
	53	1.00	

STC (strategy codes)	0.64	
SC (situation codes)	0.36	

	1.00	

NON-STEM

	resp	%	code
planning	5	0.26	STC
dedication	1	0.05	SC
focus	4	0.21	STC
awareness	2	0.11	SC
efficiency	1	0.05	STC
motivation	3	0.16	SC
balance	1	0.05	SC
complex	0	0.00	SC
prioritizing	0	0.00	STC
effort	1	0.05	SC
delayed gratification	0	0.00	SC
patience	1	0.05	SC
	19	1.00	

STC (strategy codes)	0.53	
SC (situation codes)	0.47	
	1.00	

Question 37. Do you agree with this statement: Studying music or doing sound design requires one to maintain attention while listening to a stream of aural information.

STEM

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		4	5%
3	Agree		40	46%
4	Strongly Agree		43	49%
	Total		87	100%

NON-STEM

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		1	5%
3	Agree		9	41%
4	Strongly Agree		12	55%
	Total		22	100%

Note: Question 38 was eliminated in final editing

Question 39. If you agree, has the need to maintain attention through listening to a stream of aural information affected your academic skills?

STEM

#	Answer		Response	%
1	Yes		59	71%
2	No		24	29%
	Total		83	100%

NON-STEM

#	Answer		Response	%
1	Yes		17	85%
2	No		3	15%
	Total		20	100%

Question 40. If so, please describe that experience.

STEM

category	resp	%	strategy
listening	21	0.35	STC
multitasking	11	0.18	STC
focus	17	0.28	SC
details	4	0.07	SC
memory	5	0.08	SC
learning	2	0.03	SC
communication	0	0.00	SC
total	60	0.97	

codes	
STC (strategy codes)	0.53
SC (situation codes)	0.47
	1.00

activity	resp	%
lectures	13	0.68
studying	6	0.32
total	19	1.00

NON-STEM

category	resp	%	strategy
listening	5	0.26	STC
multitasking	3	0.16	STC
focus	5	0.26	SC
details	1	0.05	SC
memory	2	0.11	SC
learning	2	0.11	SC
communication	1	0.05	SC

total	19	1.00

codes	
STC (strategy codes)	0.42
SC (situation codes)	0.58
	1.00

activity	resp	%
lectures	5	0.83
studying	1	0.17
total	6	1.00

Question 41. Studying music or sound design requires the breaking up of auditory information into smaller "segments". Have you experienced this "segmenting" when you studied music or sound design?

STEM

#	Answer		Response	%
1	Yes		76	88%
2	No		10	12%
	Total		86	100%

NON-STEM

#	Answer		Response	%
1	Yes		19	86%
2	No		3	14%
	Total		22	100%

Question 42. If so, please describe that experience.

STEM

category	*resp*	*%*
horizontal	33	0.60
vertical	22	0.40
	55	1.00

strategy

ACTIVITY	number	%	code
learning	25	0.42	AC
analyzing	20	0.34	STC
memorizing	1	0.02	STC
listening	10	0.17	AC
other	3	0.05	
	59	1.00	

AC (activity codes)	0.59	

STC (strategy codes)	0.36	
other	0.05	
	1.00	

NON-STEM

category	*resp*	*%*	*strategy*
horizontal	6	0.50	
vertical	6	0.50	
	12	1.00	

ACTIVITY	number	%	code
learning	6	0.35	AC
analyzing	4	0.24	STC
memorizing	1	0.06	STC
listening	3	0.18	AC
other	3	0.18	
	17	1.00	

AC (activity codes)	0.29	
STC (strategy codes)	0.53	
other	0.18	

Question 43. Have you graduated from UTD with an undergraduate degree?

STEM

#	Answer		Response	%
1	Yes		15	17%
2	No		72	83%
	Total		87	100%

NON-STEM

#	Answer		Response	%
1	Yes		7	32%
2	No		15	68%
	Total		22	100%

Question 44: What degree did you earn and when?

STEM

by degree		school
Neuroscience	4	BBS
Arts and Technology	3	ATEC
Biology	1	NSM
Computer Science	1	EECS
Physics	2	NSM
Biochemistry	1	NSM
Child Learning & Develop.	1	EPPS

Psychology/Child Dev	1	EPPS
Unspecified	1	
	15	
by school		
Arts and Technology	3	
Behavioral and Brain Science	4	
Econ., Political & Policy Science	2	
Electrical Eng. & Computer Science	1	
Natural Science & Mathematics	4	
	14	

NON-STEM

by degree		school
Art and Performance	1	A&H
Accounting	1	SOM
Interdisciplinary Studies	1	IS
Business Administration	1	SOM
Global Business	1	SOM
Literary Studies	1	A&H
Art and Performance	1	A&H
Unspecified	1	
	8	
by school		
Arts and Humanities	3	
Interdisciplinary Studies	1	
Management	3	
	7	

Question 45. What are you doing now (graduate school, medical or dental school, working, seeking work, etc.)?

STEM

	CATEGORY	
graduate school	graduate school	
research assistant	research assistant	
graduate school at UTD	graduate school	
Taking a break	break	
medical school	medical school	
Graduate school	Graduate school	
applying to graduate and medical school,	apply to grad/med school	
seeking work	seeking work	
seeking work and seeking medical school	apply to med school	
Physician Assistant school	PA school	
Working	working	

Medical student	medical school	
seeking work	seeking work	
working	working	
working	working	
SUMMARY		
working	3	0.20
seeking work	2	0.13
graduate/medical school	6	0.40
research assistant	1	0.07
taking a break	1	0.07
applying to med/grad school	2	0.13
	15	1.00

NON-STEM

	CATEGORY	TYPE
full time writer.	working	writer
Working	working	
Seeking work	seeking work	
Working as a Staff Accountant for a small company	working	staff accountant
graduate school	graduate school	
Working as a QA Tester Intern at id Software.	working	game company
SUMMARY		
working	4	0.67
seeking work	1	0.17
graduate/medical school	1	0.17
research assistant	0	0.00
taking a break	0	0.00
applying to med/grad school	0	0.00
	6	1.00

Question 46. Do you agree with this statement: Study in music or sound design helped me with my post-graduation activities (school, work, etc.).

STEM

#	Answer		Response	%
1	Strongly Disagree		4	5%
2	Disagree		23	28%
3	Agree		39	48%
4	Strongly Agree		15	19%
	Total		81	100%

NON-STEM

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		5	26%
3	Agree		12	63%
4	Strongly Agree		2	11%
	Total		19	100%

Question 47: If so, describe how it helped you.

STEM

	CATEGORY	%	code
enjoyment	5	0.12	AC
time management	5	0.12	STC
listening	2	0.05	AC
well-rounded	4	0.09	SC
stress relief	6	0.14	STC
resume	3	0.07	SC
critical thinking	2	0.05	AC
social connections	4	0.09	SC
current work	4	0.09	SC
other	8	0.19	
	43	1.00	

Code summary			
AC (activity codes)	0.21		
STC (strategy codes)	0.26		
SC (situation codes)	0.35		
other	0.19		
	1.00		

NON-STEM

	CATEGORY	%	code
enjoyment	1	0.13	AC
time management	3	0.38	STC
listening	0	0.00	AC
well-rounded	0	0.00	SC
stress relief	3	0.38	STC
resume	0	0.00	SC
critical thinking	1	0.13	AC
social connections	0	0.00	SC
current work	0	0.00	SC
other	0	0.00	
	8	1.00	

Code summary			
AC (activity codes)	0.25		
STC (strategy codes)	0.75		
SC (situation codes)	0.00		
other	0.00		
	1.00		

Question 48. Finally, please describe any other musical or sound design experience you have had that you feel has affected your ability in other coursework.

STEM

I make music, mix, and master tracks everyday,
joy, relieving stress.
sharpen my senses and discern quality work.
programming.
creation.
analyzing music made it easier for me to analyze the emotional content of literature
Practicing make you realize the work you have to put in to achieve greatness.
focus more when I move on to other work.
keeps me grounded.
The process of how to learn music is integral to being able to work on my school work how I write my programs.
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
gotten used to performing onstage
The people in music change who you are
creativity needed to solve problems
obsessively producing digital music, devoting many hours listening to music affecting my work studies by not letting me focus
It's all in the past responses.
negative affect. I can't concentrate on my other academic classes
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me succeed in coursework
I like to analyze each voice, instrument, or section of audio
have helped me develop a photographic memory
I don't think I have anything to add here.
confidence that i use to reach my goals
time management, rhythm and patterns
better understanding of my own work, patterns and tiechniques in other subjects
progress my skills and a fundamental education

NON-STEM

networking skills
f the "right" music to help me either concentrate or de-stress.
cooperation. Working, especially in a small ensemble, is very similar to coursework done in a group project setting.
helped my self-esteem and self-regulation, interact with the most diverse groups of people, using a large team of students from various backgrounds and skillset
music programs, singing, writing, producing

APPENDIX G

RESULTS, COHORT COMPARISON:

ATEC/EMAC STUDENTS VERSUS STEM STUDENTS

The University of Texas at Dallas consists of eight Schools, four of which have STEM-related majors:

Stem Major Schools: Arts, Technology and Emerging Communications (ATEC)
Behavioral and Brain Science (BBS)
Natural Science and Mathematics (NS&M)
Electrical Engineering and Computer Science (EECS)

By using Qualtrics filters and the "contain" feature, it was possible to create reports that identified all those students in the School of Arts and Technology and those STEM majors outside ATEC/EMAC and in BBS, NS&M and EECS (denoted STEM no ATEC/EMAC). The resulting reports allowed a comparison of answers to the survey questions. For both ATEC/EMAC and STEM no ATEC /EMAC, 100% of respondents answered Yes on the consent form.

Questions 2- 4 were to establish identifier codes.

Question 5: Are you a currently registered student at UT Dallas or have been in the past ten years? (Students who were not registered were sent to the end of the survey.) All respondents answered "yes".

Question 6: What is your gender?

ATEC/EMAC

#	Answer		Response	%
1	Male		24	53%
2	Female		21	47%
	Total		45	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Male		30	44%
2	Female		38	56%
	Total		68	100%

Question 7: What is your ethnicity?

ATEC/EMAC

#	Answer		Response	%
1	White/Caucasian		24	53%
2	Asian		9	20%
3	Hispanic		7	16%
4	African/American		2	4%
5	Native American		0	0%
6	Native Hawaiian		0	0%
7	Two or more races		3	7%
8	Don't Know/Prefer Not to Answer		0	0%
	Total		45	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	White/Caucasian		26	38%
2	Asian		28	41%
3	Hispanic		4	6%
4	African/American		2	3%
5	Native American		1	1%
6	Native Hawaiian		0	0%
7	Two or more races		6	9%
8	Don't Know/Prefer Not to Answer		1	1%
	Total		68	100%

Question 8. Have you been enrolled in a music or sound design course in the last 10 years?

All respondents answered “yes”.

Question 9: What is/was your major?

ATEC/EMAC

Arts, Technology & Emerging Communication (ATEC)		
Arts & Technology	36	
EMAC	9	
TOTAL	**45**	

STEM NO ATEC/EMAC

Behavioral and Brain Science (BBS)	**23**	
Child Learning and Development	4	
Communication disorders	1	
Psychology	6	
Speech-language Pathology and Audiology	4	
Neuroscience	8	
Electrical Engineering & Computer Science (EECS)	**12**	
Computer Engineering	1	
Computer Science	6	
EE	3	
Software Engineering	2	
Natural Science & Mathematics (NS&M)	**34**	
Actuarial Science	1	
Biochemistry	9	
Biology	14	
Chemistry	3	
Math	3	
Phsyics	4	
TOTAL	**69**	

Question 10: Are you/Were you a music minor?

ATEC/EMAC

#	Answer		Response	%
1	Yes		8	18%
2	No		37	82%
	Total		45	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		20	29%
2	No		48	71%
	Total		68	100%

Question 11. Have you played an instrument or sang in a formal musical experience (classes, private study, ensemble) besides your UTD course?

ATEC/EMAC

#	Answer		Response	%
1	Yes		34	76%
2	No		11	24%
	Total		45	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		61	90%
2	No		7	10%
	Total		68	100%

Question 12. If yes, for how long and in what capacity? Please include any ensembles (choir, orchestra, band) that you have played in.

ATEC/EMAC

	choir	voice	band	piano	orchestra
total trs	43	5	66	26	44
responses	8	1	13	5	11
average	5.38	5.00	5.08	5.20	4.00
range	1 to 14	5	1 to 8	1 to 13	1 to 8

	number of instruments		%
	1	19	0.73
	2	6	0.23
	3	1	0.04
	4	0	0.00
	responses	26	1.00

STEM NO ATEC/EMAC

	choir	voice	band	piano	orchestra
total trs	107	72	104	76	134
responses	18	11	17	12	23
average	5.94	6.55	6.12	6.33	5.83
range	1 to 12	1 to 15	1 to 20	1 to 14	1 to 22

	number of instruments		%
	1	33	0.61
	2	19	0.35
	3	1	0.02
	4	1	0.02
	responses	54	1.00

Question 13 Have you participated in music or sound design in an informal capacity (in a band, composing, arranging, recording, etc.)?

ATEC/EMAC

#	Answer		Response	%
1	Yes		26	59%
2	No		18	41%
	Total		44	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		31	48%
2	No		34	52%
	Total		65	100%

Question 14. If so, how long and in what capacity?

ATEC/EMAC

	responses
composition	5
arranging	0
digital music	3
recording	4
sound/audio engineer	6
band	2
a cappella group	1
private study	0
podcasting	1
no response	3
	25

Average years (25 responses) 1.64

Range 1 - 7 years

STEM NO ATEC/EMAC

	responses
composition	6
arranging	4
digital music	1
recording	2
sound/audio engineer	2
band	4
a cappella group	2
private study	3
podcasting	0
no response	2
	26

Average years (26 responses) 2.88

Range 1 - 14 years

Question 15. What music courses have you taken at UTD, either now or in the last ten years? Please indicate the name of the course and the MUSI number, if you can recall it, and when you were enrolled. If you were not enrolled in a MUSI course, please respond "none".

	COURSES TAKEN - MUSI	ATEC		STEM		
		EMAC		no ATEC		
CRS NO	TITLE		%		%	category
1306	UNDERSTANDING MUISC	4	0.09	14	0.08	HIST
2113	PEP BAND	2	0.04	5	0.03	INSTR
2127	COMMUNITY CHORALE	1	0.02	2	0.01	VOC
2315	GUITAR I	4	0.09	5	0.03	GUITAR
2317	PIANO 1	0	0.00	7	0.04	PIANO
2319	DIGITAL MUSIC	6	0.13	6	0.04	DIGITAL
2322	MUSIC IN WESTERN CIV	0	0.00	0	0.00	HIST
2324	VOCAL INSTRUCTION I	4	0.09	13	0.08	VOC
2328	MUSIC THEORY I	7	0.15	12	0.07	THEORY
3312/4312	ADV MUSIC ENSEMBLE	0	0.00	2	0.01	INSTR
3316/4316	GUITAR ENSEMBLE	0	0.00	1	0.01	GUITAR
3318/4318	STRING ENSEMBLE	4	0.09	9	0.05	INSTR
3320/4320	WIND ENSEMBLE	3	0.07	10	0.06	INSTR
3322	MUSIC IN HIST CONTEXT	1	0.02	1	0.01	HIST
3324/3325	JAZZ HISTORY	0	0.00	5	0.03	HIST
3328	MUSIC THEORY II	1	0.02	4	0.02	THEORY
3381	INSTRUMENTAL ENSEMBLE	1	0.02	1	0.01	INSTR
3382	BEST OF BROADWAY	1	0.02	5	0.03	VOC
3382	VOCAL INSTRUCTION II	2	0.04	4	0.02	VOC
3385/4385	CHAMBER SINGERS	0	0.00	30	0.18	VOC
3386/4386	JAZZ ENSEMBLE	3	0.07	1	0.01	INSTR
3388	PIANO II	0	0.00	6	0.04	PIANO
4345	MUSIC PERF III	0	0.00	9	0.05	VOC
4347	VOCAL ENSEMBLE III	0	0.00	10	0.06	VOC
4348	CREATING MUSIC	0	0.00	2	0.01	CREATE
2V71	INDEPENDENT STUDY	0	0.00	1	0.01	IS
4V71	INDEPENDENT STUDY	2	0.04	3	0.02	IS
4346	INSTRUMENT ENSEMBLE III	0	0.00	2	0.01	INSTR
		46	1.00	170	1.00	

COURSES BY GENRE						
Music History and Appreciation			0.11		0.12	
Instrumental Ensemble			0.28		0.18	
Vocal and choral			0.17		0.43	
Piano			0.00		0.08	

Guitar			0.09		0.04	
Music Theory			0.17		0.09	
Ind Study			0.04		0.02	
Creating Music			0.00		0.01	
Digital Music			0.13		0.04	
			1.00		1.00	

NOTES: MUSI1306 satisfies the state core curriculum requirement, and is required for the music minor. MUSI 2328 and 3322 are required for the music minor. Students may repeat performance courses up to three times

Question 16. What sound design courses have you taken at UTD, either now or in the last ten years? Please indicate the name of the course and the ATEC number, if you can recall it, and when you were enrolled. If you were not enrolled in a sound design course, please respond "none".

		ATEC		STEM	
		EMAC	%	NO ATEC	%
2385	INTRO TO SOUND DESIGN	29	0.50	4	1.00
3310	AUDIO TECHNOLOGIES	8	0.14	0	0.00
3312	AUDIO PRODUCTION LAB	1	0.02	0	0.00
3354	SOUND DESIGN FOR GAMES	4	0.07	0	0.00
4375	SPECIAL TOPICS IN SOUND DESIGN	16	0.28	0	0.00
		58	1.00	4	1.00
	Note: 51 students said "none"				

Question 17. Have you studied music before you attended UT Dallas?

ATEC/EMAC

#	Answer		Response	%
1	Yes		30	73%
2	No		11	27%
	Total		41	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		48	83%
2	No		10	17%
	Total		58	100%

Question 18. If yes, for how long and in what capacity?

ATEC/EMAC

	choir	voice	band	piano	orchestra
total yrs	32	2	26	15	52
responses	4	1	5	4	7

average	8.00	2.00	5.20	3.75	7.43
range	1 to 12	2	3 to 7	2 to 13	3 to 13

STEM NO ATEC/EMAC

	choir	voice	band	piano	orchestra
total yrs	54	35	55	72	54
responses	10	7	10	9	7
average	5.40	5.00	5.50	8.00	7.71
range	1 to 12	1 to 13	1 to 9	2 to 16	3 to 13

Question 19. Have you studied sound design before you attended UT Dallas?

ATEC/EMAC

#	Answer		Response	%
1	Yes		9	23%
2	No		31	78%
	Total		40	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		5	9%
2	No		52	91%
	Total		57	100%

Question 20. If yes, for how long and in what capacity?

ATEC/EMAC

There were only eight responses to this question. Answers varied from “very little”, to one year in high school and personal experience. All responded they had done it independently.

STEM NO ATEC/EMAC

There were only three responses to this question. One have four years of experience, another had two years of informal study.

Question 21. Do you agree with this statement: Participating in music or sound design courses has affected my academic abilities in other courses.

ATEC/EMAC (40 responses)

#	Answer		Response	%
1	Strongly Disagree		4	10%
2	Disagree		8	20%
3	Agree		17	43%
4	Strongly Agree		11	28%

STEM NO ATEC/EMAC (59 responses)

#	Answer		Response	%
1	Strongly Disagree		1	2%
2	Disagree		9	16%
3	Agree		28	49%
4	Strongly Agree		21	37%

Question 22: Describe one experience that has affected your skills in other classes.

ATEC/EMAC

Categories	responses	percentage	code
Concentration, focus	3	0.14	STC
Memorization	0	0.00	AC
Relieve stress	1	0.05	STC
Time management	1	0.05	STC
Public speaking, communication	1	0.05	AC
New perspectives	2	0.09	SC
Knowledge	7	0.32	SC
Mathematics skills	0	0.00	AC
Interrelationship of parts, connections	1	0.05	SC
Discipline	1	0.05	STC
Critical thinking skills	2	0.09	AC
Expressivity	1	0.05	PC
Other	2	0.09	*
	22	1.00	

STC (strategy codes)	0.27		
AC (activity codes)	0.14		
SC (situation codes)	0.45		
PC (process codes)	0.05		
other	0.09		
	1.00		

STEM NO ATEC/EMAC

Categories	responses	percentage	code
Concentration, focus	9	0.15	STC
Memorization	4	0.07	AC
Relieve stress	12	0.20	STC
Time management	2	0.03	STC
Public speaking, communication	2	0.03	AC
New perspectives	5	0.08	SC
Knowledge	4	0.07	SC
Mathematics skills	7	0.12	AC
Interrelationship of parts, connections	5	0.08	SC
Discipline	3	0.05	STC
Critical thinking skills	3	0.05	AC
Expressivity	1	0.02	PC
Other	3	0.05	*
	60	1.00	

STC (strategy codes)	0.43		
AC (activity codes)	0.27		
SC (situation codes)	0.23		
PC (process codes)	0.03		
other	0.04		
	1.00		

Question 23. Some musicians relate experiencing "flow" when they study or perform music. One indication of "flow" is the sense that you "lost track of time" during the experience. Have you ever experienced "flow" when doing music or sound design?

ATEC/EMAC

#	Answer		Response	%
1	Never		2	5%
2	Rarely		2	5%
3	Sometimes		8	22%
4	Most of the Time		18	49%
5	Always		7	19%
	Total		37	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Never		2	4%
2	Rarely		3	5%
3	Sometimes		21	38%
4	Most of the Time		20	36%
5	Always		10	18%
	Total		56	100%

Question 24. If so, please describe the feeling you had during that experience.

ATEC/EMAC

Cateogries	responses	percentage	code
Serenity	1	0.03	SC
Natural	3	0.10	SC
Free and easy	1	0.03	SC
Fun	0	0.00	SC
Perception of time	20	0.67	SC
Immersion	1	0.03	SC
Embodiment	0	0.00	AC
Joy	2	0.07	SC
Confidence	0	0.00	SC
Focus	0	0.00	STC
Feeling the emotion	1	0.03	SC
Other	1	0.03	*
	30	1.00	

STC (strategy codes)	0.00		
AC (activity codes)	0.00		
SC (situation codes)	0.97		
PC (process codes)	0.00		
other	0.03		
	1.00		

STEM NO ATEC/EMAC

Categories	responses	percentage	code
Serenity	3	0.05	SC
Natural	1	0.02	SC
Free and easy	5	0.08	SC
Fun	4	0.07	SC
Perception of time	22	0.37	SC
Immersion	1	0.02	SC

Embodiment	2	0.03	AC
Joy	3	0.05	SC
Confidence	1	0.02	SC
Focus	4	0.07	STC
Feeling the emotion	7	0.12	SC
Other	6	0.10	*
	59	1.00	

STC (strategy codes)	0.07		
AC (activity codes)	0.03		
SC (situation codes)	0.80		
PC (process codes)	0.00		
other	0.10		
	1.00		

Question 25. Have you also experience flow in a non-musical activity?

ATEC/EMAC

#	Answer		Response	%
1	Yes		31	84%
2	No		6	16%
	Total		37	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		45	80%
2	No		11	20%
	Total		56	100%

Question 26. If so, please describe that experience.

ATEC/EMAC

Sports/exercise	4	0.29
Artistic/creative	7	0.50
Entertainment (video games, friends)	1	0.07
Reading for pleasure	1	0.07
Studying/learning	0	0.00
Writing	1	0.07
Programming	0	0.00
Science/math	0	0.00
Presentation	0	0.00
Other	0	0.00
	14	1.00

STEM NO ATEC/EMAC

Sports/exercise	10	0.20
Artistic/creative	4	0.08
Entertainment (video games, friends)	4	0.08
Reading for pleasure	7	0.14
Studying/learning	5	0.10
Writing	7	0.14
Programming	4	0.08
Science/math	5	0.10
Presentation	2	0.04
Other	1	0.02
	49	1.00

Question 27. Many music students study the "form" of a musical work (such as ABA, rondo form, sonata form, etc.) when they study pieces of music. Have you ever analyzed the form of a piece of music?

ATEC/EMAC

#	Answer		Response	%
1	Not At All		16	43%
2	Occasionally		16	43%
3	Frequently		5	14%
	Total		37	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Not At All		18	32%
2	Occasionally		21	38%
3	Frequently		17	30%
	Total		56	100%

Question 28. Do you agree with this statement: Learning to analyze that structure affected my other academic tasks.

ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		7	33%
3	Agree		10	48%
4	Strongly Agree		5	24%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		8	22%
3	Agree		21	57%
4	Strongly Agree		8	22%

Question 29. If so, please describe how it affected your other academic tasks.

ATEC/EMAC

Categories	number	%	code
patterns	4	0.25	STC
analysis/critical thinking	2	0.13	STC
structure	6	0.38	STC
details	2	0.13	STC
learning	1	0.06	STC
other	1	0.06	
total	16	1.00	

All responses were strategy codes

Subjects	number	%
Mathematics	4	0.80
Literature	1	0.20
Natural sciences	0	0.00
Writing	0	0.00
total	5	1.00

STEM NO ATEC/EMAC

Categories	number	%	code
patterns	5	0.19	STC
analysis/critical thinking	6	0.22	STC
structure	4	0.15	STC
details	2	0.07	STC
learning	2	0.07	STC
other	8	0.30	
total	27	1.00	

Subjects	number	%
Mathematics	5	0.26
Literature	4	0.21
Natural sciences	8	0.42

Writing	2	0.11
total	19	1.00

All responses were strategy codes.

Question 30. "Rubato" is the concept of changing slightly the tempo of a piece, referring to expressive and rhythmic freedom by a slight speeding up and then slowing down of the tempo of a piece at the discretion of the soloist. Have you ever used rubato in a musical piece?

ATEC/EMAC

#	Answer		Response	%
1	Yes		21	58%
2	No		15	42%
	Total		36	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		47	85%
2	No		8	15%
	Total		55	100%

Question 31. If so, please describe that experience.

ATEC/EMAC

	number	%	code
natural	1	0.09	SC
expression	2	0.18	STC
emotion	5	0.45	AC
technique	0	0.00	AC
individual creativity	2	0.18	AC
add or hold interest	1	0.09	STC
	11	1.00	

code	%
SC (Situation codes)	0.09
AC (Activity codes)	0.64
STC (Strategy codes)	0.27
	1.00

STEM NO ATEC/EMAC

	number	%	code
natural	2	0.06	SC
expression	8	0.24	STC
emotion	11	0.33	AC
technique	6	0.18	AC
individual creativity	4	0.12	AC

add or hold interest	2	0.06	STC
	33	1.00	

code	%
SC (Situation codes)	0.06
AC (Activity codes)	0.64
STC (Strategy codes)	0.30
	1.00

Question 32. The study of music theory can be similar to that of studying mathematics or a language. Have you ever studied music theory?

ATEC/EMAC

#	Answer		Response	%
1	Yes		25	69%
2	No		11	31%
	Total		36	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		35	65%
2	No		19	35%
	Total		54	100%

Question 33. Do you agree with this statement: Studying music theory enhanced my academic skills in other courses?

ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		11	44%
3	Agree		6	24%
4	Strongly Agree		8	32%
	Total		25	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		12	34%
3	Agree		15	43%
4	Strongly Agree		8	23%
	Total		35	100%

Question 34. If so, describe how studying music theory has affected your other academic skills.

ATEC/EMAC

SKILLS	resp	%	codes
critical analysis	1	0.09	STC
patterns	3	0.27	STC
form	0	0.00	STC
learning	3	0.27	SC
writing skills	0	0.00	STC
other	4	0.36	n/a
total	11	1.00	

SUBJECTS	number	%
mathematics	5	0.71
language	1	0.14
writing	0	0.00
physics	0	0.00
history	1	0.14
total	7	1.00

CODES	%
STC (Strategy codes)	0.36
SC (Situation code)	0.27
other	0.36
	1.00

STEM NO ATEC/EMAC

SKILLS	resp	%	codes
critical analysis	5	0.20	STC
patterns	4	0.16	STC
form	0	0.00	STC
learning	7	0.28	SC
writing skills	3	0.12	STC
other	6	0.24	n/a
total	25	1.00	

SUBJECTS	number	%
mathematics	6	0.44
language	1	0.16
writing	3	0.16
physics	3	0.16
history	1	0.08
total	14	1.00

CODES	%
STC (Strategy codes)	0.48
SC (Situation code)	0.31
other	0.19
	0.98

Question 35. Studying music or sound design requires a lot of practice and discipline. Do you agree with this statement: Studying music or sound design has enhanced my discipline and time management skills in other subjects.

ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		10	30%
3	Agree		11	33%
4	Strongly Agree		12	36%
	Total		33	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		8	15%
3	Agree		29	54%
4	Strongly Agree		17	31%
	Total		54	100%

Question 36. If so, please describe an experience where study in music or sound design has affected your other academic skills as regards discipline and time management.

ATEC/EMAC

	resp	%	code
planning	10	0.59	STC
dedication	0	0.00	SC

focus	1	0.06	STC
awareness	1	0.06	SC
efficiency	1	0.06	STC
motivation	1	0.06	SC
balance	0	0.00	SC
complex	1	0.06	SC
prioritizing	1	0.06	STC
effort	0	0.00	SC
delayed gratification	0	0.00	SC
patience	1	0.06	SC
	17	1.00	

STC (strategy codes)	0.76	
SC (situation codes)	0.24	
	1.00	

STEM NO ATEC/EMAC

	resp	%	code
planning	17	0.49	STC
dedication	2	0.06	SC
focus	1	0.03	STC
awareness	0	0.00	SC
efficiency	1	0.03	STC
motivation	3	0.09	SC
balance	2	0.06	SC
complex	1	0.03	SC
prioritizing	2	0.06	STC
effort	3	0.09	SC
delayed gratification	2	0.06	SC
patience	1	0.03	SC
	35	1.00	

STC (strategy codes)	0.60	
SC (situation codes)	0.40	
	1.00	

Question 37. Do you agree with this statement: Studying music or doing sound design requires one to maintain attention while listening to a stream of aural information.

ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		3	9%
3	Agree		12	36%
4	Strongly Agree		18	55%
	Total		33	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		0	0%
2	Disagree		1	2%
3	Agree		29	54%
4	Strongly Agree		24	44%
	Total		54	100%

Note: Question 38 was eliminated in final editing.

Question 39. If you agree, has the need to maintain attention through listening to a stream of aural information affected your academic skills?

ATEC/EMAC

#	Answer		Response	%
1	Yes		21	70%
2	No		9	30%
	Total		30	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		38	72%
2	No		15	28%
	Total		53	100%

Question 40. If so, please describe that experience.

ATEC/EMAC

category	resp	%	*codes*
listening	6	0.25	STC
multitasking	4	0.17	STC
focus	9	0.38	SC
details	3	0.13	SC
memory	1	0.04	SC

learning	1	0.04	SC
communication	0	0.00	SC
total	24	1.00	

codes	
STC	0.42
SC	0.58
	1.00

activity	resp	%
lectures	4	0.67
studying	2	0.33
total	6	1.00

STEM NO ATEC/EMAC

category	resp	%	*codes*
listening	14	0.38	STC
multitasking	7	0.19	STC
focus	8	0.22	SC
details	2	0.05	SC
memory	4	0.11	SC
learning	2	0.05	SC
communication	0	0.00	SC
total	37	1.00	

codes	
STC	0.57
SC	0.43
	1.00

activity	resp	%
lectures	9	0.69
studying	4	0.31
total	13	1.00

Question 41. Studying music or sound design requires the breaking up of auditory information into smaller "segments". Have you experienced this "segmenting" when you studied music or sound design?

ATEC/EMAC

#	Answer		Response	%
1	Yes		31	97%
2	No		1	3%
	Total		32	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		45	83%
2	No		9	17%
	Total		54	100%

Question 42. If so, please describe that experience.

ATEC/EMAC

CATEGORY	number	%
horizontal	12	0.55
vertical	10	0.45
	22	1.00

ACTIVITY	number	%	code
learning	9	0.41	AC
analyzing	10	0.45	STC
memorizing	0	0.00	STC
listening	3	0.14	AC
other	0	0.00	
	22	1.00	

AC (activity codes)	0.55	
STC (strategy codes)	0.45	
other	0.00	
	1.00	

STEM NO ATEC/EMAC

CATEGORY	number	%
horizontal	21	0.64
vertical	12	0.36
	33	1.00

ACTIVITY	number	%	code
learning	16	0.44	AC
analyzing	9	0.25	STC
memorizing	1	0.03	STC
listening	7	0.19	AC
other	3	0.08	
	36	1.00	

AC (activity codes)	0.64	
STC (strategy codes)	0.28	
other	0.08	
	1.00	

Question 43. Have you graduated from UTD with an undergraduate degree?

ATEC/EMAC

#	Answer		Response	%
1	Yes		3	9%
2	No		30	91%
	Total		33	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Yes		12	22%
2	No		42	78%
	Total		54	100%

Question 44: What degree did you earn and when?

ATEC/EMAC

Bachelor of Arts in Arts and Technology 2014 Fall
ATEC, 2015
ATEC, 2015

STEM NO ATEC/EMAC

BS December 2014
B.S. Neuroscience 2011
Bs biology
Bachelors in Computer Science Fall 2014
Neuroscience, Spring 2014
Physics Degree, 2012
BS in Physics, spring of 2013
Bachelor of Science in Biochemistry in 2012
B.S Neuroscience
Child Learning and Development 2012
BS neuroscience with economics minor
2 degrees one in Psychology and one in Child Development

Question 45. What are you doing now (graduate school, medical or dental school, working, seeking work, etc.)?

ATEC/EMAC

Taking a break
Working, traveling, exploring personal hobbies
Working

STEM NO ATEC/EMAC

graduate school and working on a startup
I am a research assistant in cognitive neuroscience, having finished my masters degree in August, and not starting my PhD until this coming fall.
medical school
Graduate school
applying to graduate and medical school, seeking work
Freelancing, seeking work
seeking work and seeking medical school
Physician Assistant school
Working
Medical student
seeking work

Question 46. Do you agree with this statement: Study in music or sound design helped me with my post-graduation activities (school, work, etc.).

ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		2	7%
2	Disagree		10	33%
3	Agree		11	37%
4	Strongly Agree		7	23%
	Total		30	100%

STEM NO ATEC/EMAC

#	Answer		Response	%
1	Strongly Disagree		2	4%
2	Disagree		13	25%
3	Agree		29	57%
4	Strongly Agree		7	14%
	Total		51	100%

Question 47: If so, describe how it helped you.

ATEC/EMAC

	CATEGORY	%	code
enjoyment	2	0.13	AC
time management	3	0.19	STC
listening	2	0.13	AC
well-rounded	1	0.06	SC

stress relief	1	0.06	STC
resume	0	0.00	SC
critical thinking	2	0.13	AC
social connections	0	0.00	SC
current work	2	0.13	SC
other	3	0.19	
	16	1.00	

Code summary			
AC (activity codes)	0.38		
STC (strategy codes)	0.25		
SC (situation codes)	0.19		
other	0.19		
	1.00		

STEM NO ATEC/EMAC

	CATEGORY	%	code
enjoyment	3	0.11	AC
time management	2	0.07	STC
listening	1	0.04	AC
well-rounded	3	0.11	SC
stress relief	5	0.18	STC
resume	3	0.11	SC
critical thinking	0	0.00	AC
social connections	4	0.14	SC
current work	2	0.07	SC
other	5	0.18	
	28	1.00	

Code summary			
AC (activity codes)	0.14		
STC (strategy codes)	0.25		
SC (situation codes)	0.43		
other	0.19		
	1.00		

Question 48. Finally, please describe any other musical or sound design experience you have had that you feel has affected your ability in other coursework.

The great majority felt the survey had covered all the topics. Listed are the few responses received.

ATEC/EMAC

I make music, mix, and master tracks everyday,
sharpen my senses and discern quality work.
programming.

analyzing music made it easier for me to analyze the emotional content of literature
I don't feel that studying music has affected my academics one way or the other.
persistence and patience. Stress relief and mindfulness
obsessively producing digital music, devoting many hours listening to music affecting my work studies by not letting me focus
I like to analyze each voice, instrument, or section of audio
time management, rhythm and patterns
progress my skills and a fundamental education

STEM NO ATEC/EMAC

joy, relieving stress.
creation.
Practicing make you realize the work you have to put in to achieve greatness.
focus more when I move on to other work.
keeps me grounded.
The process of how to learn music is integral to being able to work on my school work how I write my programs.
gotten used to performing onstage
The people in music change who you are
creativity needed to solve problems
It's all in the past responses.
negative affect. I can't concentrate on my other academic classes
the vigor required to succeed inspired me to cultivate and maintain a drive that lets me succeed in coursework
have helped me develop a photographic memory
I don't think I have anything to add here.
confidence that i use to reach my goals
better understanding of my own work, patterns and techniques in other subjects

APPENDIX H

NATIONAL ENDOWMENT FOR THE ARTS RESEARCH LAB GRANT PROPOSAL

This grant was submitted to the National Endowment for the Arts on July 12, 2016. Notification of awards is still pending.

UT Dallas
National Endowment for the Arts Research Labs
Reference: CFSA No. 45.024, NEAPS1602

Principal Investigators: Roger Malina and Kathryn Evans

Title:
Building Bridges to Success: Developing new evidence to guide arts integration in STEM to STEAM

a) Your organization's **mission** and how it relates to this program

The newly established School of Art, Technology and Emerging Communication (ATEC) at UT Dallas is under the leadership of its first Dean Anne Balsamo, PhD. The school carries out research and education that span the Arts, Design and Humanities with STEM disciplines. The School offers BA, MA, MFA and PhD degrees in Art and Technology and in Emerging Media and Communications.

Dr. Roger Malina established the ArtSciLab in 2014 to conduct research in three broad areas that require collaboration between artists, scientists, engineers and humanists:

a) Multimodal representation of complex data sets, drawing on the interactive arts and development of novel approaches to sonification and performance of data.
b) Experimental Publishing: developing new publishing and presenting methodologies for the art-science technology community through a partnership with Leonardo/International Society for the Arts, Sciences and Technology, MIT and MIT Press; specifically the new ARTECA art science technology aggregator platform as infrastructure development, which also serves as a platform for cultural analytics studies.
c) STEM to STEAM research. Developing new forms of evidence for the benefits of integration of arts and design into STEM research and teaching. Development of STEAM undergraduate and graduate level curricula. Study of transdisciplinary collaboration methodologies and training.

The ArtSciLab has a collaboration mission to serve as an enabling node with faculty in various schools at UT Dallas including ATEC, Arts and Humanities, Brain and Behavioral Science, Natural Science and Mathematics, Engineering and Computer Science and the School of Management. The collaborations involve undergraduate research as well as Masters and PhD diploma theses from these multiple schools at UT Dallas.

The collaboration strategy also involves professional associations. Dr Malina is a member of the SEAD network steering group, and chaired the NSF funded study on enabling new forms of collaboration, and the Executive Editor of the Leonardo Publications which involves collaborations with SIGGRAPH, ISEA, College Art Association, IEEE. This proposal is within the STEM to STEAM mission of ArtScilab, but draws extensively also on other activities of the lab for collaboration methodologies.

b) Your organization's **experience** in commissioning and conducting research in the behavioral or social sciences

Robert and Michele Root-Bernstein of Michigan State University have conducted numerous studies of the relationship between arts and sciences over several decades. One type of study focused the investigation of how scientists and artists perform creative thinking involving both historical and interview methods, resulting in the book Sparks of Genius, which provides a set of "thinking tools" that underpin the conceptual basis of this proposal. The Root-Bernsteins have also carried out psychological studies of the role of arts, music and other recreational activities in the development of the careers of 40 scientists over a period of 30 years; historically-based comparisons of arts participation by 510 Nobel Prize winners in the sciences with control populations such as 4400 members of Sigma Xi (The Research Organization) and census data for the general U.S. population; interview surveys of several hundred mid-career scientists and engineers with regard to their attitudes to, and level of participation in, and the economic impact of the arts in their careers; and most recently, a meta-study of "gold standard" pedagogical research into methods for integrating arts with STEM subjects in K-20 classrooms (see Root-Bernstein bio). These studies have involved a wide range of methods and techniques requiring the design of statistically powerful studies; design and implementation of various types of literature reviews, surveys and interview instruments; human use approval; recruitment of study participants; data acquisition and analysis; and publication and data dissemination by means of professional talks and public media.

Dr. Guadagno's research interests and experience pertain to digital communication, gender roles, and social influence. For example, one of her primary lines of research examines whether the communication media used for a persuasion attempt affects the outcome. Overall, her research has found that the answer depends on whether the persuader physically present or salient to be effective. Thus, when social influence occurs as a result of internal psychological change, communication mode does not typically affect the outcome of an influence appeal (Guadagno, in press). However, if an influence practitioner needs to be physically present during a persuasion attempt, the results of Dr. Guadagno's research indicates that the communication modality can strongly affect the outcome, not necessarily in ways conducive to the influence practitioner's goals. Dr. Guadagno's work has over 2600 citations (b index==28) and has published in a wide variety of journals such as: *Perspectives on Psychological Science; Psychological Inquiry; Personality and Social Psychology Bulletin; Social Influence; Basic and Applied Social Psychology; Journal of Applied Social Psychology; Prevention Science; Sex Roles; Self & Identity; Media Psychology; Evolution and Human Behavior; Evolutionary Psychology; Personal Relationships; Group Dynamics; Aggressive Behavior; CyberPsychology, Behavior, & Social Networking; Psychology of Popular Media Culture;* and *Computers in Human Behavior.* In addition, her work has been covered in the press by: *CBS News, The New York Times, The Atlantic Monthly, The New Yorker, The Associated Press, ESPN, The New Scientist, MSNBC*, and *Alabama Public Radio*. Dr. Guadagno is an expert blogger for *Psychology Today*, is on the editorial board for *Basic and Applied Social Psychology and CyberPsychology, Behavior, & Social Networking*, and serves as the Editor of the *International Journal of Interactive Communication Systems and Technologies*. She runs the Online Social Influence Laboratory (OSIL) which features numerous options for data collections with human research participants. She has thus far graduated six PhD students, four master's students and myriad undergraduate students from her lab. Currently, Dr. Guadagno mentors two PhD students, one MFA student, tow undergraduates honor's students, and five undergraduate research assistants. Her research has been supported by the National Science Foundation (NSF), The University of Alabama, UT Dallas, Belmont University, and the National Institutes for Mental Health. She has a new book is coming out in 2017 that is entitled: Why We Click: The Psychology of Social Media.

Roger Malina chaired the NSF funded study *Steps to an Ecology of Networked Knowledge and Innovation: Enabling New Forms of Collaboration among Sciences, Engineering, Arts, and Design* (http://www.mitpressjournals.org/page/NSF_SEAD) which reviewed the emerging opportunities and obstacles for the STEM to STEAM movement. As part of this study he has been working with Robert Root-Bernstein and the SEAD steering group to mobilize literature review and advocate new evidence bases studies. He has been supervising the PhD dissertation of Kathryn Evans that is described in this proposal and motivated this next work. That phenomenological study surveyed and interviewed the population of UT Dallas non-arts majors, including STEM students, who had enrolled in music or sound design classes. With Kathryn Evans, they have developed the CDASH resource reviewing the history of international approaches on interdisciplinarity. In a current DARPA

funded study, he is co-PI on work to develop user testing for new visualization tools that use data sonification as a technology of attention. He leads the UT Dallas ArtSciLab and its collaboration with experimental psychologist Rosanna Guadagno and Robert Root-Bernstein, who are key personnel on this proposal.

Eun Ah Lee has been working on the NSF funded study *Engineering Ethics as an Expert-Guided and Socially Situated Activity* conducted at the Center for Values in Medicine, Science, and Technology at UT Dallas, which explored multi-layered ethics understanding of engineering students through cognitive ethnography. This study showed that students' explicit and implicit understanding of engineering ethics may not be the same and, in some cases, they can be quite different (Lee et al, 2015). The result implied that implicit understanding may have been closely related to cultural and social contexts of engineering students, thus this type of understanding could be improved by educational effort to include social and cultural contexts such as STEM to STEAM approach. Eventually STEM to STEAM may help enrich ethics and values in STEM education.

c) Proposed project activities

i. Relevant theories and previous research

The STEM to STEAM movement has encouraged the integration of the arts into STEM education and research at all levels. Yet, there is insufficient solid evidence-based research to support the claim that education in the arts enhances academic skills in other subjects. A recent review of studies by Robert Root-Bernstein *A Review of Studies Demonstrating the Effectiveness of Integrating Arts, Music, Performing, Crafts and Design into Science, Technology, Engineering, mathematics and Medical Education* called for more specificity and well-defined pedagogical connections for trans-disciplinary transfer. This study addresses that lack and proposes to create a two-phase research project that tackles that issue.

We will address No. 2, *The Arts, Creativity, Cognition, and Learning* and the following two required research questions in our proposal:

What is the relationship between one or more forms of arts participation and other forms of creativity?

What are the cognitive processes of arts-based creativity, and how do they affect learning-related outcomes?

ii. Overview of our proposed research

The vast majority of STEAM experimental studies suffer from one or more major flaws. Most are carried out with zero or inadequate controls so that it is not possible to determine whether the integration of arts into the STEM curriculum is responsible for learning outcomes. One very common outcome that is often reported is that students enjoyed or were excited by the addition of arts to their STEM classes, but such reports are very rarely associated with improved learning measures. One major problem is that arts are usually added to STEM curricula with without explicit "bridges" to link teacher training, curriculum and learning outcomes. In consequence, teachers do not know how to integrate content in meaningful ways and students do not understand the purpose of the art training, much as they may enjoy it. (Root-Bernstein, Pathak, and Root-Bernstein, 2016) Additionally, most STEAM projects separate forms of creativity in STEM and in the arts and design. Neither assumption is correct, resulting in baseless expectations and misleading study results. And finally, "creativity" outcomes in STEAM studies usually involve some form of divergent thinking testing, which decades of research have proven to be unrelated to STEM creativity. (Mansfield and Busse, 1981) A century long series of initiatives to engage students in interdisciplinary studies has had marginal success. Programs that promote collaborations between traditional disciplines often have limited staying power. (Feller 2002, 2006) Few institutions have implemented systemic reforms for lowering institutional barriers to programs that promote research that involves both the sciences and the arts (National Academy of Sciences 2004).

Creativity can have domain-specific aspects. Evidence has been accumulated to support the importance of domain-specific knowledge on creativity (Csikszentmihalyi, 1996; Gardner, 1993; Weisberg, 1993). This indicated that

creativity in arts and creativity in STEM might not be measured by the same standards. Therefore measuring "creativity" outcomes in STEAM studies within the frame of general creativity may be insufficient to bring a reliable result. Kind and Kind (2007) argued that each school subject should emphasize creativity within an agenda reflecting the characteristics of each subject. This indicates that, if we consider creativity or any other concept of learning in arts and STEM, we need to consider it in relation to the characteristics of each. This understanding also suggests a cognitive approach in STEAM studies. Cognitive approach aims to understand the cognitive processes underlying reasoning, rather than just identifying particular intellectual skills (Sternberg & Lubart, 1999). Therefore, when we try to identify thinking skills or traits that bridge different characteristics to facilitate learning in STEAM studies, we also need to understand how these skills link those characteristics in STEAM areas.

A recent study by Kathryn Evans at UT Dallas, a member of the ATEC Art-Sci lab, entitled *Does studying music enhance higher order learning skills in undergraduate non-music majors?"* used an in-depth phenomenological methodology to study 175 students who took music and sound design classes at UT Dallas, who were majoring in other fields, with over 70% in the STEM areas. It revealed that students felt there was a strong connection between specific types of learning in music and sound design and skills in their other courses. (Evans, 2016) Many of these connections overlap significantly with a list of "bridges" that STEM professionals describe as linking arts with scientists in their careers, and which the Root-Bernstein et al. have documented to improve STEM learning outcomes in a recent review of "gold standard", well-controlled studies of effective STEAM curricula. (Root-Bernstein, Pathak and Root-Bernstein, 2016a). This proposal is the first study in a larger to develop new evidence to guide arts integration in STEM to STEAM.

Root-Bernstein lists the following thinking tools in his bridge for integration of the arts into STEM fields: Observing, Imaging, Abstracting, Patterning, Analogizing, Modeling and Dimensional Thinking, Empathizing and Playacting, Body Thinking, and Transforming and Synthesizing. (Root-Bernstein, Pathak, and Root-Bernstein, 2016) The following six thinking tools are closely linked to the connections revealed in Evans' study.

Observing relates to a portion of the Evans' survey where students were asked if the need to maintain attention to aural information had affected their skills in other courses. Over 75% felt that it had and went on to relate specific examples in listening, multitasking, focus, attention to details, memorization and rigorous attention to lectures.

Imaging relates to a portion of the Evans' survey where students were asked about "segmenting" information. Surprisingly, many answered about both the horizontal and vertical direction of segmentation of either polyphonic or simultaneous streams, rather than just the temporal horizontal one, an indication that music and sound design enhance the ability to analyze in two dimensions.

Abstracting and *Patterning* relate to a portion of the Evans' survey about music theory, which requires students to analyze a musical piece, using concrete methods of inquiry. Students reported enhanced skills in critical thinking, pattern recognition, and general learning, in mathematics, languages, writing and physics. Root-Bernstein et al. (2016) discusses the "salient qualities of the objects that form the pattern", which can be specified as the musical notes as the objects and the phrase as the pattern. Music theory requires the abstraction from smaller units (notes, then themes or motifs) to the larger structure of the work.

Embodiment and Playacting, and *Body Thinking* Two of our team members who teach dance and drama improvisation reported that their experiences with students demonstrate an enhanced ability in this area. In addition, many music students report the experience of "becoming one with instrument". Playing a musical instrument requires a type of dexterity applied to a complex technology, for example, the musical instrument, that can easily translate to other practices involving complex apparatuses, such as surgery.

iii. Methodology for the planned research

This study will look at these principles by using accepted tests in cognition, creativity and learning, based on the data from the Evans' survey and Root-Bernstein's work in evidence-based research, and the expertise of Rosanna Guadagno, a joint faculty member in ATEC and the School of Behavioral and Brain Sciences (Psychology). We will

focus on five thinking skills which are overlapped with six bridges identified both in Root-Bernstein's work and in Evans's survey; observing, imaging, abstracting, patterning, and embodiment. We will collect various test items addressing these thinking skills, and use them as the basis of our test. In developing a test to measure these thinking skills, we will first develop the evidence statements and/or the performing expectation for each skill. These statements will be the baseline for each test item. Hu and Adey (2002) and a few other studies constructed test items to measure processing skills such as imagination and thinking based on the scientific structure creativity model (Hu & Adey, 2002; Lin et al, 2003). We will review and modify their developing procedure to develop the test items to measure the six bridging skills.

The measures of creative thinking that we will utilize are directly related to the five basic categories of arts-science interactions that we have identified above as effective "bridges" between the disciplines: **observing, imaging, abstracting, patterning,** and **embodiment**. More specifically, we will draw our tools for measurement from well-controlled, "gold standard" pedagogical studies that have previously demonstrated effective improvements in STEM education outcomes following arts integration. (Root-Bernstein, Pathak and Root-Bernstein, 2016a) Drawing from previous literature, we will adapt measures relevant to our proposed research.

To measure **observing**, we will follow Kirklin, et al (2007) and Naghshine, et al. (2008). Students in intervention and control groups will be required to describe sets of course-appropriate materials. Those students taking a "bridged" course will be tested pre- and post-intervention. The observed materials will be randomized to prevent clustering of answers. Our hypothesis is that artistically trained students will have better observation skills than those without and that "bridged" coursework will improve observational skills over baseline.
To measure **imaging**, we will follow Aleman, et al., (2000), who have demonstrated that music training improves the ability of students to recognize themes from songs as well as a variety of everyday sounds. We will also follow Sorby (1999) in using the Differential Aptitude Test: Space Relations (DAT:SR) (Bennett et al., 1973), since it has proven to be the most effective measure of engineering design ability. Although our students will not be getting visual imaging training directly, visual imaging skill is very highly associated with success in all STEM subjects (Sorby, 1999; Root-Bernstein, et al., 2016), so we hypothesize that any type of arts training will improve visualization ability compared with lack of arts training, and that "bridged" coursework will improve visualization ability over baseline.

To measure **abstracting**, we will adapt Scheiter, et al. (2009), which is based on visual abstracting, to our musical and performance needs. Following Scheiter, et al., students will be presented either with multiple observations of musical, dance or theater performances that display one or more common themes or principles, or students will be presented first with an abstract set of themes or principles that are then exemplified by musical, dance or theater performances. Students in the various control and intervention groups will then be tested (multiple choice and written description) on whether they can apply their learning to novel examples. Again, we hypothesize that arts-trained students will be more adept at abstracting than non-trained students, and that "bridged" coursework will improve abstracting skills over baseline.

To measure **patterning**, we will follow Wee and Sanderson (2008) in testing student ability to learn and recognize sets of similar auditory or movement patterns made up from permutations of basic elements. Part of the patterning training will be explicit using techniques such as "Isochords" (Bergstrom, et al., 2007), which employs graphing techniques to visualize musical patterns and one or more of the dance notations, such as Eshkol-Wachman or Benesh Movement Notation. Since all arts require the learning, practice and recognition of patterns, we hypothesize that arts-trained students will perform better on patterning tests than students without arts training. And since patterning depends on observational, imaging and abstracting skills that will be taught independently in the bridged courses, we expect that such training will produce a significant improvement in patterning as well.

We have not been able to find any well-established measures for **embodiment** skills such as kinesthetic ability, proprioceptive ability or playacting (empathizing) ability, related to STEM subjects (Root-Bernstein, et al., 2016), so we will spend the first year of the grant inventing and testing possible measures to be applied in the second Phase of the project.

We will run ANOVA tests to determine whether there are interactions among the various skills and interventions. We hypothesize that better observational skills will improve imaging and abstracting ability and that improved abstracting ability will correlate with improved patterning. Embodiment skills depend on observational, imaging, abstracting and patterning skills, so that further correlations with embodiment ability are expected.
Finally, we will also collect data on overall student classroom performance, including grades in core subject courses (math, physics, chemistry, etc.) and overall grade point averages. Our hypothesis is that arts-trained students will have better creative skill abilities and core course grades and GPAs than non-arts trained students and that "bridged" coursework may improve overall creative thinking ability and STEM performance by teaching students explicitly to transfer their creative skill use from their bridged courses to the rest of their learning.
The research will be carried out in two phases. The first phase will be performed during the first year of the grant; the second phase will be influenced by the results of the first phase, and be carried out in the second year of the grant.

Phase I students will be drawn from the STEM population of students at UT Dallas. These students will be divided into two groups: those that have some experience, either through organized classes or private lessons in music, drama or dance; and those that have no experience in those fields (control group). Students will take an initial on-line survey to determine demographics, their major and their experience in the arts. Our sample will be comprised of 75 students with extensive arts experience and 75 students without any arts experience will be asked to take tests designed to examine their skills in the observing, abstracting, patterning, and embodiment, and the results from the two samples will be analyzed. Students will be compensated for their participation in the study according to UT Dallas policy on payment of research subjects (https://policy.utdallas.edu/utdbp3036). Our hypothesis is that extensive arts experiences will provide STEM students with improved learning and creative thinking skills compared with STEM students lacking arts experience.

Phase II will offer workshop in the UT Dallas Freshmen course *Exploration of the Arts* (ARTS1301) as an arts intervention to see if the workshops enhance student outcomes. This course fulfills the state requirement, but students in the arts may take a discipline-dependent course instead. As a result, the majority of the students in this course are not arts majors, and, given the nature of the enrollment at UT Dallas, which has a heavy emphasis in science and technology, the majority of the students are in STEM fields. Workshops will be given to 75 volunteer students in the course in three areas, music, dance and drama, and within the framework of the bridges drawn from Phase I of the study. Each workshop will contain 25 students. Seventy-five students in the same course who do not participate in workshops will be used as the control group. Students in both groups will be given a pre- and post-test to see if the intervention enhances student skills. Workshops have been included in the course in the past, and in particular, with Evans as the instructor of record for the course.

These workshops will be designed specifically to integrate best-practice teaching lessons from "gold standard" STEAM studies that have been proven to improve STEM learning outcomes by means of arts integration. These best practice lessons will be drawn from the Root-Bernstein, Pathak and Root-Bernstein (2016) review of "gold standard" STEAM studies. The purpose of designing these workshops will be to devise specific curricular "bridges" incorporating observing, abstracting, imaging, patterning and embodiment skills that have been demonstrated to be effective in other STEM-to-STEAM curricula, and also to determine whether the use of such arts "bridges" is more effective as a means of improving educational outcomes than merely having arts experience. Our hypothesis is that STEAM courses in which explicit arts-sciences bridges are utilized will be more effective at teaching trans-disciplinary learning strategies and creative thinking skills than will arts experiences that do not include such explicit "bridges". The results of these tests will permit us to examine the importance of explicit "bridges" versus arts content, and allow for a carefully controlled study with verifiable outcomes.

One example of such a workshop is *Thinking Tools and the Multi-Disciplinary Imagination: Exploring Abstraction in Dance and Creative Writing*, which was designed and implemented by Michel Root-Bernstein, in accordance with the Kennedy Center Guidelines for Arts Integration: "Arts integration is an approach to teaching in which students construct and demonstrate understanding through an art form and other subject areas and meet evolving objectives in both." This workshop focused on the nurture of a core set of cognitive tools: observing, abstracting, pattern forming and transforming. These tools for imaginative thinking are at the heart of successful learning and

doing across the arts, sciences and humanities and are aligned with the bridges mentioned above. More details about this workshop can be found in Attachment 5: Root-Bernstein Thinking Tools Workshop.

These results will be of paramount importance to stakeholders in the STEM to STEAM movement, which include a very large proportion of State Boards of Education in the US; teachers who wish to integrate the arts into their STEM teaching; and it will have pedagogical implications for those who teach in the arts at the college level and how it affects the STEM students in their courses. Additionally, the National Academies of Science, Engineering and Medicine are beginning studies on the educational impacts of integration of the arts, humanities, and STEM in education. At present, the Root-Bernstein et al. have identified only about 75 "gold standard" STEAM studies covering every possible science-art combination across the entire K-20 and professional school educational system, which effectively means that there are only a handful of best-practice models available for any set of arts-and-sciences teachers at any grade level. One major gap is whether music education has any significant impact on STEM learning at the college level, which our study will address. A second major gap is whether it is sufficient merely to integrate arts into STEM education to provide good learning outcomes, or whether integration must provide explicit content and skill-promoting "bridges" to obtain the best pedagogical results. By addressing these gaps, our research will have a major impact on how STEAM can be most effective. Publications will spread the word that the arts can have an evidence-based impact on STEM subjects and students

iv) Research team and Institutional Review Board approval

We have formed a team of faculty from the UT Dallas School of Arts, Technology and Emerging Communication, The UT Dallas School of Arts and Humanities, the UT Dallas School of Behavioral and Brain Sciences, and Michigan State University with expertise in the needed areas. Key personnel are listed first. All key personnel have completed the NIH Human Participant Protections Education for Research Teams. Certificates are included in Attachment 5.

Roger Malina, Project Director

Distinguished Professor of Art and Technology and Professor of Physics, UT Dallas School of Arts and Technology; PhD Astronomy, UC Berkeley. Director ArtSci lab, Editor-in-chief Leonardo publications.

Expertise: Data science and software development, STEM to STEAM education, artist residences and art-science collaborations.

Robert Root-Bernstein, Consultant

Professor of Physiology, Michigan State University. PhD, History of Science, Princeton University.

Expertise: Creativity research, co-author "Sparks of Genius", evidence-based research on arts and skills transfer, human subjects research

Kathryn Evans, Project Manager

Senior Lecturer, UT Dallas School of Arts and Humanities; Doctoral candidate School of Arts and Technology; MA Music and MA Mathematics, University of California, San Diego. Doctoral dissertation: "Does studying music enhance the academic skills of undergraduate non-music majors?", expected completion Fall 2016.

Expertise: STEM to STEAM education, cross-disciplinary curriculum, music and skill transfer, music pedagogy.

Rosanna E. Guadagno, Research Design and Data Analysis

University of Texas at Dallas, Associate Professor, Emerging Media and Communication;
Associate Professor, Psychology PhD, Social Psychology (quantitative methodology minor)
Arizona State University

Expertise: Social Psychology; STEM dropout among women; the Science of Learning; Quantitative Research Methods; Social Media

Eun Ah Lee, Project Design
PhD. Science Education, Seoul National University in Korea; MA Emerging Media and Communications, UT Dallas School of Arts and Technology.
Expertise: Science education, the cognitive science of learning and STEAM ethics, testing and assessment.

Additional personnel:
Frank Dufour, Project design
Professor, UT Dallas School of Arts and Technology. PhD, University of Paris 8, France
Expertise: Perception of sound and music from a phenomenological perspective, sound design

Kathy Lingo, Workshop design
Senior Lecturer, UT Dallas School of Arts and Humanities. MFA, UTD DallasSchool of Arts and Technology.
Expertise: Theatre, improvisation and embodiment

Michele Root-Bernstein, Workshop design
Adjunct Assistant Professor, Michigan State University, Department of Theatre. PhD, History, Princeton University. Kennedy Center "teaching artist."
Expertise: Creative play across the lifespan; tools for thinking imaginatively (co-author of ”Sparks of Genius”); trans-disciplinary learning.

The University of Texas at Dallas has an Institutional Research Board (IRB) and a well-defined approval process for research involving human subjects. For more information and specific processes, see https://research.utdallas.edu/orc/irb.

d) Schedule

This project will take place in two phases as outlined below.

Phase I: Testing of STEM students in music, dance and drama classes at UT Dallas to see if their involvement has heightened their abilities in pattern recognition, critical thinking, perception of form and structure, etc.

March-May, 2017: Initial design work.

May-August 2017: Creation of on-line survey and testing (should include demographics, experience, etc. and recognized testing vehicles for above).

August – May 2018: Testing. Solicitation through marketing, email, social media, etc. of STEM students at UT Dallas. The experimental group will be comprised of students with previous arts courses in music, dance or drama. Control group participants will be recruited from pre-test participants that have no previous experience in the arts and/or from students in the UT Dallas psychology subject pool. To increase statistical power and control for any pre-exiting differences between groups based on our quasi-experimental independent variable (i.e., previous arts experience), we will used a matched design such that participants in each group will be matched by domain-relevant demographic information such as SES, ethnicity, gender, and age. Data analysis. Manuscript preparation for dissemination of results. Workshop design according to results.

Phase II: Design and implementation of workshops in ARTS1301 course, with workshops taught by Evans, Lingo and M. Root-Bernstein.

May – August 2018: Workshop design.

August – December 2019: Workshops will be offered during the Fall 2018 term with students from ARTS1301. A second round of workshop can be offered in early Spring 2019 if deemed necessary. ARTS1301 is offered every Fall and Spring.

January – February, 2019: Analysis and first results for reporting to the NEA after conclusion of the project on February 28, 2019. Publication and presentation of results will follow in top-tier journals and at conferences.

d) Dissemination

The results of this study will be made available to other researchers and the public at large. All data will be anonymized and made available post-publication from a secure serve at UT Dallas and made available to other researchers in the art-science education area through Leonardo Magazine (Roger Malina, Founder and Chief Editor), the SEAD (Science, Education, Art and Design) website; and the CDASH (Curriculum Development in the Arts, Sciences and Humanities), maintained by Kathryn Evans. This will include an anonymized version of both raw- and meta-data form of the study. Appropriate protection of anonymity will be assured through the IRB process and features embedded in the Qualtrics platforms. This data sharing plan is independent of the members of the research team and will be maintained, and hosted on UT Dallas stable servers.

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Root-Bernstein RS, Pathak A, Root-Bernstein MM. (2016a). PART 1. A Review of Studies Demonstrating the Effectiveness of Integrating Arts, Music, Performing, Crafts and Design into Science, Technology, Engineering, Mathematics and Medical Education, Part 1: Summary of Evidence that Integration Is Professionally Useful and Effective. Submitted to LEONARDO; available in draft at http://sead.viz.tamu.edu

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Biographical Summaries for UT Dallas NEA Research Labs Grant

Roger Malina, Program Director

Roger F. Malina is an art-science researcher, astronomer and editor. He is a Distinguished Professor of Arts and Technology and Professor of Physics at the University of Texas, Dallas where he heads the ArtSciLab; The ArtScilab seeks to develop art-science collaborations that lead both to scientific discoveries and intense contemporary art works. The Lab also runs initiatives in Experimental Publishing with MIT press which seek to develop new forms of scholarly publishing and public engagement. He is a former Directeur de Recherche of the CNRS in France and former Director of the Observatoire Astronomique de Marseille Provence at Aix-Marseille University. His scientific specialty is in space instrumentation and big data problems; he was the Principal Investigator for the NASA Extreme Ultraviolet Explorer Satellite at the University of California, Berkeley. He also has been involved for 25 years with the founding of the Leonardo organization whose mission is to promote and make visible work that explores the interaction of the arts and sciences and the arts and new technologies; he serves as the Executive Editor of the Leonardo publications at MIT Press. More recently he helped set up the Mediterranean Institute for Advanced Studies (IMERA).He is an elected member of the International Academy of Astronautics.
URLS:
http://malina.diatrope.com
http://www.utdallas.edu/ah/atec/
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ORCID No: orcid.org/0000-0003-3399-3865

Education: 1979-PhD, University of California, Berkeley, Astronomy. 1968. BSc. Massachusetts Institute of Technology. Physics.

Employment and Teaching Experience: Present: Distinguished Professor of Art and Technology and Professor of Physics, University of Texas at Dallas. Present:Executive Editor, Leonardo Publications , MIT Press and Leonardo/International Society for the Arts, Sciences and Technology. President. Association Leonardo. Paris.

Past. Director of the Observatoire Astronomique de Marseille Provence.1995- 2004 Director, Laboratoire d'Astrophysique de Marseille/CNRS/Univ Marseille-Provence.1991 – 1999 Executive Director, Center for Extreme Ultraviolet Astrophysics, U.C. Berkeley.

Recent Grants: 2016 DARPA Co-PI with Gagan Wig, Data Stethoscope for the Brain Connectome. $270,000. 2014 UT System PI STARS grant, $500,000. 2014 Co-PI NEA Grant INSTRUMENT: One Antarctic Night, $25.000.

Rosanna E. Guadagno

Dr. Rosanna Guadagno received her Ph.D. in Social Psychology (with a quantitative methodology minor) from Arizona State University and completed her postdoctoral research fellowship at the Research Center for Virtual Environments and Behavior in the Department of Psychology at the University of California at Santa Barbara. After serving on the Psychology faculty at the University of Alabama, she spent two years as a Program Director at the National Science Foundation serving three programs: Social Psychology; the Science of Learning Centers; and Secure and Trustworthy Cyberspace (SaTC). Following her rotation at NSF, Dr. Guadagno joined UT Dallas in 2014.

Dr. Guadagno's research interests pertain to digital communication, gender roles, and social influence. This is an interest that emerged in her early days as an undergraduate at Santa Clara University, grew during graduate

school, and has continued to define her career for 20 years. Dr. Guadagno takes a person by situation approach to research and in my work, exam various individual (e.g., personality, gender) and contextual moderators (face-to-face vs. online) that can affect the success of an interpersonal interaction. For example, one of her primary lines of research examines whether the communication media used for a persuasion attempt affects the outcome. Overall, her research has found that the answer depends on whether the persuader physically present or salient to be effective. Thus, when social influence occurs as a result of internal psychological change, communication mode does not typically affect the outcome of an influence appeal (Guadagno, in press). However, if an influence practitioner needs to be physically present during a persuasion attempt, the results of Dr. Guadagno's research indicates that the communication modality can strongly affect the outcome, not necessarily in ways conducive to the influence practitioner's goals (Guadagno & Cialdini, 2002; 2007).

Dr. Guadagno's work has been published in a wide variety of journals such as: *Perspectives on Psychological Science; Psychological Inquiry; Personality and Social Psychology Bulletin; Social Influence; Basic and Applied Social Psychology; Journal of Applied Social Psychology; Prevention Science; Sex Roles; Self & Identity; Media Psychology; Evolution and Human Behavior; Evolutionary Psychology; Personal Relationships; Group Dynamics; Aggressive Behavior; CyberPsychology, Behavior, & Social Networking; Psychology of Popular Media Culture;* and *Computers in Human Behavior.* In addition, her work has been covered in the press by: CBS News, The New York Times, The Atlantic Monthly, The New Yorker, The Associated Press, ESPN, The New Scientist, MSNBC, and Alabama Public Radio.

Dr. Guadagno is an expert blogger for *Psychology Today*, am on the editorial board for *Basic and Applied Social Psychology* and *CyberPsychology, Behavior, & Social Networking*, and serve as the Editor of the *International Journal of Interactive Communication Systems and Technologies*. Her research has been supported by the National Science Foundation (NSF), The University of Alabama, Belmont University, and the National Institutes for Mental Health. She has a new book is coming out in 2017 that is entitled: *Why We Click: The Psychology of Social Media*.

Most relevant to the proposed research is Dr. Guadagno's NSF-funded work on women and STEM drop out. Thus far, this research has yielded the following presentations and publications:

Barth, J. M., Guadagno, R. E., Eno, C. A., Rice, L., Minney, J. A., & Alabama STEM Education Research Team. (2015). Untangling Life Goals and Occupational Stereotypes in Men's and Women's Career Interest. *Sex Roles*, *73*(11-12), 502-518.

Barth, J. M., Kim, H., Eno, C. A., Guadagno, R. E., & Alabama STEM Education Research Team. (2015). Choosing a career: For children and young adults ability matters more than gender stereotypes. *Manuscript in preparation, University of Alabama, Tuscaloosa*.

Barth, J. M., Todd, B., McCallum, D. M., Goldston, M., Guadagno, R. E., Roskos, B., & Burkhalter, C. (2011, January). Effects of engaging classroom strategies and teacher support on student outcomes over school transitions. In *Proceedings of the American Society for Engineering Education*.

Barth, J., Todd, B., Goldston, D., Guadagno, R., & STEM Education Research Team. (2010). An Integrated Approach to Choosing Technical Careers: Gender Differences in Life Goals for College Students. In *American Society for Engineering Education*. American Society for Engineering Education.

Eno, C. A., Guadagno, R. E., Barth, J. M., & STEM Education Research Team. (2010). The Role of ability and gender stereotypes on occupation interest. In *Paper presented as part of a symposium entitled "An Individual Difference Approach to Understanding Interest in STEM Careers"(Chair: Rosanna E. Guadagno) at the annual meeting of the Midwestern Psychological Association, Chicago, IL*.

Rice, L., Barth, J. M., Guadagno, R. E., Smith, G. P., & McCallum, D. M. (2013). The role of social support in students' perceived abilities and attitudes toward math and science. *Journal of youth and adolescence*, *42*(7), 1028-1040.

In the last 10 years, Dr. Guadagno has mentored 9 undergraduate honors students through successful honors research projects, including one computer-based honors student. These theses have resulted in: one peer reviewed publication, two manuscripts under review, two manuscripts in preparation, three award winning poster presentations, five additional conference presentations, and two computer programs for use in Dr. Guadagno's lab. In addition to these honor's students, Dr. Guadagno has worked with hundreds of undergraduate research assistants over the course of her career (starting in 1993), many of whom have gone on to obtaining advanced degrees. With

respect to graduate students, Dr. Guadagno has successfully mentored four M.A. students and six Ph.D. students. The results of their collaborations are reflected in the vast majority of Dr. Guadagno's publications. Many of these students, like Dr. Guadagno herself (she is Hispanic), came from either ethnically minority and/or an economically disadvantaged background.

As indicated above, during her graduate training, Dr. Guadagno minored in quantitative methodology, taking a total of eight courses from world-renowned experts such as Drs. Leona Aiken, Steve West, and David MacKinnon. This expertise is reflected in both her research and her teaching. Throughout her teaching career, a substantial proportion of her courses pertain to training in statistics and research methods. Her expertise with quantitative methodology is reflected in her research as well.

Finally, Dr. Guadagno has considerable expertise in working with human research participants. Not only has she been doing so for over 20 years, she has also served on the University of Alabama's IRB and her rotation at the National Science Foundation also involved considerable training in the ethical treatment of human research participants.

Robert S. Root-Bernstein

A. Professional Preparation

Princeton University, Biochemistry, A.B., 1975Princeton University, History of Science, Ph. D., 1980
Salk Institute for Biological Studies, Theories in Biology, Postdoctoral Fellow, 1981-1984.
Visiting Assoc Professor, College of Fine- Arts and Honors College, UCLA, LA, CA, 1987
Research Associate, Neurobiochemistry, V. A. Hospital, Brentwood, CA, 1985-1986
Asst Prof, Natural Sciences and Physiology, Michigan State University, EL, MI , 1987-1989
Associate Professor, Physiology, Michigan State University, East Lansing, MI, 1989-1995
Full Professor, Physiology, Michigan State University, East Lansing, MI, 1995-present

B. Selected Honors

MacArthur Prize Fellow, 1981-1986
Donald R. Benson Lecturer on Science, Literature and the Arts, Iowa State University Center for Excellence in the Arts and Humanities, Iowa State University, Ames, Iowa, 11 April 2006.
E. Paul Torrance Lecturer in Creativity, Torrance Center for Creativity, University of Georgia, Athens, GA, 4 March 2010.
E. Paul Torrance Lecturer in Creativity (with Michele Root-Bernstein), National Association for Gifted Children, New Orleans, LO, 5 Nov 2011.

C. Roles and Responsibilities: Project Co-Director: study design, implementation, analysis and publication.

D. Percent Time To Be Devoted to Project: 5%

E. Involved with Human Subjects Research or Data: Yes

F. Publications

(i) Peer Reviewed:

Root-Bernstein R, LaMore R, Lawton J, Root-Bernstein MM, et al. 2013. Arts, crafts and STEM innovation: A network approach to understanding the creative knowledge economy. In Michael Rush (Ed.), *Creative Communities: Art Works in Economic Development* (Washington D. C.: National Endowment for the Arts and The Brookings Institution), pp. 97-117.

Lamore R, Root-Bernstein RS, Lawton J, Schweitzer J, Root-Bernstein MM, Roraback E, Peruski A, Van Dyke M, Fernandez L. 2013. Arts and Crafts: Critical to Economic Innovation. Economic Development Quarterly, 27 (3): 221-229.

Root-Bernstein RS, Allen L, Beach L, et al. 2008. Arts Foster Success: Comparison of Nobel Prizewinners, Royal Society, National Academy, and Sigma Xi Members. J Psychol Sci Tech 1(2):51-63.

Root-Bernstein, R. S. Sensual chemistry. Aesthetics as a motivation for research. Hyle: The Journal of the Philosophy of Chemistry 9, 35-53, 2003.

Root-Bernstein, M. M. and Root-Bernstein, R. S. "Martha Graham and the Polymathic Imagination: A Case of Multiple Intelligences or Universal Tools for Thinking?" J Dance Education 3, 16-27, 2003.

Root-Bernstein, R. S. "Aesthetic cognition," Journal of the Philosophy of Science, 16, no. 1, 61-77, 2002.

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Root-Bernstein, R. S., Bernstein, M. and Garnier, H. W. 1995. "Correlations between Avocations, Scientific Style, and Professional Impact of Thirty-Eight Scientists of the Eiduson Study," Creativity Research Journal 8: 115-137.

Root-Bernstein, R. S. "Harmony and Beauty in Biomedical Research," Journal of Molecular and Cellular Cardiology 19 (1987), 1-9.

(ii) Non-Peer Reviewed:

Root-Bernstein RS, Root-Bernstein MM. "The Necessity of Arts and Crafts for Science Education," Educational Leadership 70 (5): 16-21, 2013. http://www.ascd.org/publications/educational-leadership/feb13/vol70/num05/The-Art-and-Craft-of-Science.aspx; http://m.ascd.org/EL/Article/a19b4a699786c310VgnVCM100000250210acRCRD

Root-Bernstein RS, Root-Bernstein MM. *Sparks of Genius* (Houghton Mifflin, 1999Book of the Year in Korea in 2008.

Root-Bernstein, R. S. "The Arts' Unsung Role in Supporting Science," Chronicle of Higher Education, 43: 15 (11 July 1997); reprinted in The Education Digest, 63(4): Dec 1997, 32-35.

Root-Bernstein, R. S. "Hobbled Arts Limit Our Future," Los Angeles Times, Op-Ed page B7, 2 September 1997.

Root-Bernstein, R. S. The Sciences and Arts Share a Common Creative Aesthetic, in Alfred I. Tauber, ed. *The Elusive Synthesis: Aesthetics and Science* (Boston: Kluwer, 1996) pp. 49-82.

Root-Bernstein RS. *Discovering* (Harvard University Press, 1989). Nominee for the Los Angeles Times Book Award, 1990.

(iii) Under Review:

Root-Bernstein RS, Pathak A, Root-Bernstein MM. PART 1. A Review of Studies Demonstrating the Effectiveness of Integrating Arts, Music, Performing, Crafts and Design into Science, Technology, Engineering, Mathematics and Medical Education, Part 1: Summary of Evidence that Integration Is Professionally Useful and Effective. Submitted to LEONARDO; available in draft at http://sead.viz.tamu.edu

Root-Bernstein RS, Pathak A, Root-Bernstein MM. PART II. Review of Studies Demonstrating the Effectiveness of Integrating Arts, Music, Performing, Crafts and Design into Science, Technology, Engineering, Mathematics and Medical Education, Part 2: Statistically-Validated and Controlled Pedagogical Studies of the Root-Bernsteins' "Tools for Thinking". Submitted to LEONARDO; available in draft at http://sead.viz.tamu.edu

Root-Bernstein RS, Pathak A, Root-Bernstein MM. PART III. Review of Studies Demonstrating the Effectiveness of Integrating Arts, Music, Performing, Crafts and Design into Science, Technology, Engineering, Mathematics and Medical Education, Part 3: Statistically-Validated and Controlled Pedagogical Studies of Eleven ACD-Integration Strategies Utilized by STEMM Professionals and General Conclusions. Submitted to LEONARDO; available in draft at http://sead.viz.tamu.edu

G. Synergistic Activities

Editor of a section of the journal LEONARDO on ArtScience (2005- present).

Author of several dozen popular science articles in magazines such as Discover, Atlantic Monthly, American Scientist, The Scientist, etc. E.g., Root-Bernstein, R. "Darwin's Rib", [Teaching Evolution to Creationists] Discover 38-41, September 1995.

H. Research Skills

Scientist (physiology, biochemistry and immunology). Doctorate in History (historical methods of data collection and analysis). Statistical methods (both scientific and social-science related). Survey and interview methods.

1987:Elected Member, International Academy of Astronautics.1993: Social Science Award, International Academy of Astronautics. 1993: NASA Public Service Award. NASA EUVE Group Achievement Award. 1996: Corresponding Member of Académie Européenne des Sciences, des Arts et des Lettres. 2016: Honorary Doctorate of Fine Arts, Universitat Politècnica de València

Print Publications

Over 260 refereed publications. Google Scholar: 8964 citations (June 24 2016), h-index 45, i-10 index 115. Books: *Extreme Ultraviolet Astronomy*, ed. R. F. Malina and S. Bowyer, New York: Pergamon Press, 1991.*Astrophysics in the Extreme Ultraviolet*, ed. S. Bowyer and R.F. Malina. Kluwer Academic Publishers, the Nederlands, 1996. Recent publications : *Une Archeologie des Media, Exhibition*, Seconde Nature 2016/3/28 Journal Leonardo. *DataRemix: Designing the Datamade;* Ruth West, Roger Malina, John Lewis, Scot Gresham-Lancaster, Alejandro Borsani, Brian Merlo, Lifan Wang 2015/9/23, Journal, Leonardo. *Steps to an Ecology of Networked Knowledge and Innovation: Enabling New Forms of Collaboration among Sciences, Engineering, Arts, and Design*; C..LaFayette Roger F. Malina, C. Strohecker.2015. MIT PRESS

Kathryn C. Evans

Kathryn Evans holds degrees in mathematics and music from the University of California, San Diego and has been involved in the art-science movement and higher education for over 40 years. She is currently a senior lecturer in music at the University of Texas at Dallas since 1994, and teacher choral and vocal music, and music history with an emphasis on inter-disciiplinary coursework and teaching music to non-music majors. Her course "Music in Modern Culture" focuses on the connections between music and other fields, especially those in the STEM (Science, Technology, Engineering and Mathematics) areas and encourages students, through special projects and presentations, to make connections between music and their primary field of study.

Ms. Evans joined the Art-Sci Lab under Roger Malina as a part of her doctoral work in art-science curriculum and research. In 2012, she initiated the CDASH project (Curriculum Development in the Arts, Sciences and Humanities) to catalog and examine cross-disciplinary curriculum at the college level. The site http://www.utdallas.edu/atec/cdash/ now holds over 150 courses as well as other resources for those involved in the Art-Science area. Her doctoral dissertation project "Does Does musical study enhance academic skills in undergraduate non-music majors?" has been completed and she will publish and defend her dissertation in the Fall of 2016.

Ms. Evans served the School of Arts and Humanities as the Associate Dean for the Arts from 2005-2010 and was awarded the School of Arts and Humanities Distinguished Service Award in 2010 for her contributions to the program. Evan's current interests include enhancing the cultural environment at the University for students, faculty, staff and the community at large; the creation of an arts curriculum that uses technology to enhance the marketability of students with arts degrees; and evidence-based research that demonstrates the academic impact of arts courses for STEM majors.

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EDUCATION:
Doctoral candidate, University of Texas at Dallas, Arts and Technology.
Dissertation advisor: Dr. Roger Malina, Distinguished Professor of Arts and Technology.
Expected completion, September 2016. ABD (All But Disseration).
Dissertation: Does musical study enhance academic skills in undergraduate non-music majors?
Coursework completed, May, 2013, including courses in Sound Design; Animation Production; Special Topics in Art, Science and the Humanities; Research Methods; History of Arts Education; Translation in the Digital Age; Educational Games.

Special Project: CDASH (Curriculum Development in Arts, Sciences and Humanities), 2012 – present, with Roger Malina, Distinguished Professor of Arts and Technology, website http://www.utdallas.edu/atec/cdash/

M.A., Music, University of California, San Diego, 1978. Thesis: "An acoustical study of vocal technique."
M.A., Mathematics, University of California, San Diego, 1976
B.A., Mathematics, University of California, San Diego, 1974

EMPLOYMENT AND TEACHING EXPERIENCE:

Senior Lecturer in Music, The University of Texas at Dallas, School of Arts and Humanities, 1994 - present. Director of the UT Dallas Chamber Singers and the Musical Theatre Workshop. Courses taught: UT Dallas Chamber Singers, UT Dallas Community Chorale, Vocal Instruction I, II and III, Musical Theatre Workshop, Exploration of the Arts, Music History (both lower and upper level), History of Song, Music Appreciation. New course for Fall 2013: Music in Modern Culture, emphasizing 21st art-science-technology connections. New course for Spring 2017: Opera Workshop.

Associate Dean for the Arts, UT Dallas, School of Arts and Humanities, 1999 - 2010. Responsible for all Art and Performance curricular needs (materials, space, budget, scheduling of spaces); oversaw all Art and Performance events (music, theater, dance, visual arts, creative writing), including all publicity, promotion, scheduling, budgets, technical needs, contracts and consulting agreements, and all contact with faculty and professional artists and performers; assisted faculty in production of events; maintaineed and oversaw all Art and Performance spaces (Visual Arts Building, University Theater, Jonsson Performance Hall, Jonsson Rehearsal Hall, new AH1 music building and AH2 arts building) and equipment located in those spaces and in classrooms and offices, including supervising ongoing renovation projects; oversaw all lectures and invitational events; oversaw rental of performance spaces and acted as liaison to community arts groups; scheduled Art and Performance curriculum and assisted the other Associate Deans in scheduling and curriculum of other areasin History and Literature; acted as Petty Cash Custodian for the School of Arts and Humanities; acted as liaison for the Communications Officer and the Advancement Officer for the School of Arts and Humanities for all arts and performance matters; worked with Arts and Humanities Graphics Designer on all related projects; liaison to other event producers and coordinators, including Student Life, the Holocaust Center, the Confucius Institute, the US-Mexico Center and the Office of the President. Assisted the Dean with other matters pertaining to the Art and Performance division, including fund-raising, student and faculty recruitment and community outreach. Oversaw six full time staff members (Administrative Assistant, Events Management Assistant, A&P Office Secretary, Technical Director, Assistant Technical Director and Staff Accompanist), one half-time faculty appointment (Visual Arts Assistant/Curator), various Teaching Assistants and Student Employees. Administered the Bryce Jordan Scholarship fund. Oversaw Arts and Humanities website, design and content. Reported directly to the Dean of the School of Arts and Humanities.

Member, ArtSci Laboratory, Arts and Technology, UT Dallas, 2012 - present.

Executive Director and Founder, Texas Annual Guitar Competition and Festival, 2001 - 2012. Three-day event with concerts,lectures and professional level competition, with over $7500 in prizes awarded. Judges from U.S., Mexico, Czech Republic, Germany and Austria. Addition of Youth Competition in 2011.

Director, UT Dallas Chamber Singers, 1994 - present. Minimum of four concerts per year, including fully staged musical theatre revues, classical and jazz concerts and annual Holiday Sing.

Director, Dallas Pro Musica, 2006 – 2012, professional vocal quintet dedicated to the recreation of Medieval, Renaissance and Early Baroque vocal music.

Content expert for the Digital Calculus Coach, summer 2010, Art and Technology program at The University of Texas at Dallas.

Liaison to the Eisemann Center for annual residency program, 2007 – present, funded by Mid Atlantic Arts Alliance Grant. Two special performances with the UT Dallas Chamber Singers (King's Singers in 2010 and Swingle Singers in 2013).

University Level Curricular Advisor, DCCCD Humanities 1315 - Fine Arts Appreciation Course Redesign, Fall 2007 – 2009.

Director, UT Dallas Community Chorus, 1996-1999.

Private teacher (vocal technique and performance), 1976 - present.

Assistant Dean and Senior Lecturer, 1998 - 1999, UT Dallas, School of Arts and Humanities,.

Arts Coordinator and Senior Lecturer, 1995 - 1998, UT Dallas, School of Arts and Humanities.

Director, Bach Society Chamber Orchestra and Chorus, Bach Society of La Jolla, 1992-1994.

Artistic Director, The Orpheus Ensemble, a vocal-instrumental ensemble specializing in the works of J. S. Bach and his contemporaries, 1987-1994.

Instructor, UCSD Extension, "Sing Along with Bach: A Reading Chorus," University of California, San Diego, 1992-1994.

Instructor, Mount Vernon College, Washington, DC, 1982-1983.

Instructor, Menlo College, Menlo Park, California, 1979-1980.

Instructor, University of San Diego, San Diego, California, 1978-1979.

Instructor, University of California, San Diego, 1978-1979.

Teaching assistant, University of California, San Diego, 1974-1978.

PUBLICATIONS

"Breaking Down the Silos: Curriculum Development in the Arts, Sciences and Humanities", with Roger Malina (UT Dallas), White paper for SEAD (Network for Science, Engineering, Art and Design), November 2012. Peer reviewed. http://seadnetwork.wordpress.com/white-paper-abstracts/final-white-papers/ Forthcoming in Leonardo Electronic Almanac, 2015.

"Playing Audrey II: creating a digital actor through game technology", with Monica Evans, Proceeding in SIGGRAPH '13, ACM SIGGRAPH 2013 Studio Talks, Article No. 1, ACM New York, NY. 2013

Compact Disk, *Voz y Guitarra*, with guitarist Enric Madriguera, featuring previously unrecorded works of composers John Duarte and Ernesto Cordero, 2003.

CONFERENCES AND PRESENTATIONS

Panel organizer and presenter, Society for Literature, Science and the Arts (SLSA), October 9, 2014. Panel: Cross-Disciplinary Fluidity: Art-Science-Humanities Curricula at the University Level. Presentation: Case Studies and Best Practices in Art-Science-Humanities Curriculum.

College Art Association (CAA), "The Art/Science Curriculum in the Classroom and in the Cloud", February 14, 2014 for LEAF (Leonardo Education and Art Forum).

XVIII ISA World Congress of Sociology, 13-19 June, 2014, Yokohama, Japan. Presentation of "Breaking Down the Silos: Curriculum Development in the Arts, Sciences and Humanities" at Fostering Transdiciplinarity, Amonst the Social and Natural Sciences, Engineering, Arts and Design. Supported in part by the National Science Foundation.

SEAD, NEA and Smithsonian Institution workshop in Washington, D.C. May 16, 2013. Presentation of "Breaking Down the Silos: Curriculum Development in the Arts, Sciences and Humanities".

ISEA 2013 International Symposium on Electronic Art, invited participant, Cloud Curriculum Workshop, Sydney, Australia, June 15, 2013.

SIGGRAPH 2013 (Special Interest Group on GRAPHics and Interactive Techniques), presenting "Playing Audrey II: Directing a Digital Actor with Game Technology", with Monica Evans, Anaheim, CA, July, 2013.

COMMUNITY SERVICE
Member, Chancellor's Council for the University of Texas System, 2013- present.
Member, Member, Executive Board, Repertory Theatre Company, 2004 – 2010 , 2015-present.
President, Dallas Chamber Music, 2012 - 2013.
UTD Liaison, Executive Board, Dallas Chamber Music Society, 2007 – 2013.
Vice President, Creative Arts Alliance, 2006 – 2010.
Member, Advisory Board, Indian Classical Music Circle, Dallas, 2006 -2012.
Faculty Associate, Center for U. S. Mexico Studies, 2003 – 2010.
Chairperson of the Board, Richardson Council of the Arts, 2002 - 2004
President, Richardson Council of the Arts, 2000 – 2002.
Board member, Texas Alliance for Education in the Arts, 1999 - 2003.

SELECTED CONCERTS AS DIRECTOR, CONDUCTOR AND PERFORMER

Best of Broadway I – VIII, 2007 to 2015, featuring students from vocal and choral classes at UT Dallas, presenting fully stage and costumed excerpts from Broadway shows.

Full staged musical theatre productions: *A Little Night Music* (2015), *Songs for a New World (*2014), *Red, Hot and Cole* (2013), *The 25th Annual Putnam County Spelling Bee* (2012), *I Love You, You're Perfect Now Change* (2011) and *Side Show the Musical* (2010), highest attendace record for any dramatic production at UTD (six sold out performances). Included the first ever use of a game engine to drive a fully controllable animated character, Audrey II in *Little Shop of Horrors* in 2012.

Concerts with the UT Dallas Chamber Singers have included "composer concerts" dedicated to the works of Stravinsky, Mozart, Satie, Arlen, Rodgers, Gershwin, and homages to the music of Frank Sinatra, the King's Singers and the Beatles.

As a solo recitalist: Concerts have included European tours to Spain, Austria, Switzerland, Czech Republic, Mexico, Ecuador and others. Numerous concerts in the US and abroad featuring the music of Spanish and Latin American composers.

Eun Ah Lee

Ph.D. in science education, Seoul National University in Korea

M.S. in applied cognitive science

M.A. in emerging media and communication, University of Texas at Dallas, Arts, Technology and Emerging Communication

M.A. in science education

B.S. in earth science

Eun Ah Lee is a science educator who has been working for secondary and higher education for more than 12 years. Her previous works include Earth Systems Education focusing on developing interdisciplinary curriculum, environmental education focusing on measuring k-12 students' understanding of environmental literacy, and STEAM education focusing on implementing interdisciplinary learning into school systems. In her research works, she has used both quantitative and qualitative methods to study students' understanding, attitudes, and skills. With her background knowledge and experience, she will contribute to construct survey questionnaire and to develop test items to measure students' core knowledge, cross-cutting concepts and skills. She will also contribute to develop general study design, and to devise relevant methodologies. She is currently working on the NSF funded Engineering Ethics Education project at UT Dallas.

Selected Publications

Lee, E. A., Grohman, M. G., Gans, N., Tacca, M., and Brown. M. J. (2016). A Role of Implicit Understanding of Engineering Ethics in Student Teams' Discussion (submitted).

Lee, E. A., Grohman, M. G., Gans, N., Tacca, M., and Brown, M. J. (2015). Exploring Implicit Understanding of Engineering Ethics in Student Teams. Proceedings of ASEE Annual Conference & Exposition. Seattle, WA. https://peer.asee.org/exploring-implicit-understanding-of-engineering-ethics-in-student-teams

Park, H.J., Kim, Y., Noh, S., Jeong, J.-S., Lee, E. A., Yu, E., Lee, D., Park, J., & Baek, Y. S. (2012). Developmental study of science education content standards. Journal of The Korean Association for Science Education, 32, 729-750.

Lee, E. A. & B.-G. Park. (2008). A preliminary study on high school students' understanding of the distinction between scientific theories and scientific laws. Journal of the Korean Earth Science Society, 29(1), 91-97.

Lee, E. A. & Fortner, R. W. (2007). Mystery lines. Science Activities. 43(4), 22-26.

Chu, H.-E., Lee, E. A., Ko, H. R., Shin, D. H., Lee, M. N., Min B. M., & Kang , K. H. (2007). Korean year 3 children's environmental literacy: A prerequisite for a Korean environmental education curriculum. International Journal of Science Education. 29(6), 731-746

Lee, E. A. & Seo, H.-A. (2006). Understanding of creativity by Korean elementary teachers in gifted education. Creativity Research Journal, 18(2), 237-242.

Lee, E. A. & Fortner, Rosanne W. (2006). Development of the K-12 science literacy education program focused on the earth system and environment. The Journal of Korean Earth Science Society, 27(7), 723-729.

Lee, E. A. (2005). A modified H-R diagram activity to introduce the nature of science. The Journal of Korean Earth Science Society, 26(4), 329-335.

Seo, H.-A., Lee, E. A., & Kim, K.-H. (2005). Korean science teachers' understanding of creativity in gifted education. The Journal of Secondary Gifted Education, 16(2/3), 98-105.

Shin, D.-H., Chu, H.-E., Lee, E. A., Ko, H.-R., Lee, M. N., Kang, K. H. , Min, B. M., & Park, J. H. (2005). An assessment of Korean students' environmental literacy. The Journal of Korean Earth Science Society, 26(4), 358-364.

Lee, E. A., Shin, D.-H., Chu, H.-E., & Ko, H.-R. (2004). The study of high school students' environmental literacy. The Journal of Korean Earth Science Society, 25(3), 185-193.

Lee, E. A., & Choe, S.-U. (2003). Development of the test instrument to assess students' progress in understanding nature of science. The Journal of the Korean Earth Science Society, 24, 93-99.

Lee, E. A. & Choi, S. H. (2003). Scientifically gifted students' conceptions of nature of science. The Journal of the Korean Earth Science Society, 24, 100-107.

Lee, E. A., & Choi, S. H. (2002). Pre-service teachers' conceptions of the nature of science. The Journal of the Korean Earth Science Society, 23, 140-146.

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Association of American Colleges & Universities . "Liberal Education for the Twenty-First Century: Science, Technology, and Society at Stanford University." Association of American Colleges & Universities. 2014. Accessed November 01, 2015. https://www.aacu.org/campus-model/liberal-education-twenty-first-century-science-technology-and-society-stanford.

Barry, Andrew. "Interdisciplinarity and Society: A Critical Comparative Study: Full Research Report". *ESRC End of Award Report, RES-151-25-0042-A.* Swindon: ESRC. (2007)

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Campbell, Mark Robin, and Linda K. Thompson. "A Critical Analysis of Qualitative Research on Learning to Teach Music in Preservice Music Teacher Education." In *The Oxford Handbook of Qualitative Research in American Music Education*, edited by Colleen M. Conway. Oxford: Oxford University Press, 2014.
doi: 10.1093/oxfordhb/9780199844272.013.024

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Conoscenti, Lauren M., and Bennette Zimmer. "Best Practices in Survey Research Using Qualtrics." Tufts Office of Institutional Research and Evaluation. Accessed August 15, 2016. http://provost.tufts.edu/institutionalresearch/files/Survey-Best-Practices-Webinar.pdf.

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Zemsky, Robert. *Checklist for Change: Making American Higher Education a Sustainable Enterprise*. New Brunswick: Rutgers University Press, 2013.

BIOGRAPHICAL SKETCH

A singer, conductor, director, producer and academic researcher of many diverse talents, Ms. Evans has performed and directed music composed from 1200 to contemporary times using a variety of settings and styles. An accomplished recitalist and chamber musician, Ms. Evans has completed tours of music for voice and guitar with fellow faculty member Dr. Enric Madriguera in Austria, Switzerland, the Czech Republic, Mexico, Spain and Latin America. She co-produced and performed in a series of "composer concerts" with Robert X. Rodriguez, featuring the music of Mozart, Monteverdi, Brahms and Satie. She was the Executive Director of the Annual Texas Guitar competition, and celebrated their 10th anniversary with a series of concerts and competitions for both youth and adults in 2011. She released her CD, *Voz y Guitarra*, with guitarist Enric Madriguera, featuring previously unrecorded works of composers John Duarte and Ernesto Cordero, in 2003, and completed a concert tour to Ecuador in 2007, including appearances on national radio and television programs. She appeared as The Abbess in *The Sound of Music* with Repertory Company Theatre. In 2006, Ms. Evans created the Dallas Pro Musica, a vocal quintet dedicated to the re-creation of vocal music of the Medieval, Renaissance and Early Baroque periods, with occasional forays into the 21st century. Her musical creation *The Music of Isaac Albeniz* was performed in Dallas and Honolulu, Hawaii in 2011. Ms. Evans is currently the head of the Vocal and Choral division of the School of Arts and Humanities at The University of Texas at Dallas, where she directs the UT Dallas Chamber Singers, teaches Vocal Instruction II and II, Musical Theatre Workshop, Opera Theatre Workshop and a variety of music history courses, as well as general arts education courses.

Ms. Evans was the Associate Dean of the School of Arts and Humanities at The University of Texas at Dallas from 1999 to 2010, where she ran the Art and Performance division. She was appointed Associate Dean for the Arts in 1999 after serving as Assistant Dean and Arts Coordinator for the School from 1995 – 1999. As Associate Dean for the Arts, Ms. Evans was responsible for the fine arts program, including all curricular needs (budget, materials, space and scheduling), facilities, and an extensive and comprehensive arts season in classical music, jazz, guitar, art exhibitions, theatre and dance productions, lectures and student festivals. She supervised all publicity, promotion, scheduling, budgets, technical needs, contracts and consulting agreements for the series and all contact with faculty and professional artists and performers. She oversaw three performance venues: Performance Hall (and supervised a complete renovation in 2004-05), the Visual Arts Building (with two galleries and five classrooms) and the University Theatre (and supervised the renovation of the lobby in 2006, and created a new art gallery in that space) and exhibitions in the Green Center. She oversaw rental of performance spaces and acted as liaison to the community arts groups; scheduled all arts curriculum and assisted the other Associate Deans in other curriculum; acted as Petty Cash Custodian for the School of Arts and Humanities; oversaw all press and publicity for the School of Arts and Humanities; and acted as liaison to other event producers and coordinators, including Student Life, the Holocaust Center, the Confucius Institute, the US-Mexico Center and the Office of the President. She assisted the Dean with other matters pertaining to the Art and Performance division, including fund-raising, student and faculty recruitment and community outreach and oversaw the content of the Arts and Humanities website. Additionally, she administered the Bryce Jordan Scholarship fund, awarding over $20,000 annually in recognition

awards and scholarships for students in the fine arts. In 2009, Ms. Evans supervised the addition of two buildings for music rehearsal space and arts studios, and the re-designed Arts and Humanities website.

Premiere performances in 2010 - 2015 include directing the UT Dallas Chamber Singers at the Eisemann Center in two residency programs, with the Kings Singers (2010) and the Swingle Singers (2013); and directing the most successful theatrical production in the history of UT Dallas: *Side Show the Musical*, with over 50 students in the cast, orchestra and crew; a production team of 12, with 1800 in attendance at six sold-out performances. Programs included Baroque Duets and The American Songbook (as performer) and productions of the musicals *I Love You, You're Perfect, Now Change* (2011), *The 25th Annual Putnam County Spelling Bee* (2012), *Red, Hot and Cole* (2013), *Songs for a New World* (2014) and *Stephen Sondheim's A Little Night Music* (2015). Ms. Evans directs the *Annual Best of Broadway* show every November, and *Creepy and Kooky* included the first ever use of a game engine to drive a fully controllable animated character, Audrey II in *Little Shop of Horrors*, was performed to four sold-out houses. Ms. Evans presented this animation, along with her co-author, Monica Evans, at SIGGRAPH in July of 2013. She has presented her research at conferences in Sydney, Australia; Yokohama, Japan; at the College Art Association (USA) and the SLSA (Society for Literature, Science and the Arts), and presented before a joint meeting of the NEA and NSF for SEAD (Science, Engineering, Arts and Design).

Ms. Evans was awarded the School of Arts and Humanities Distinguished Service Award in 2010 for her 15 years of service as Associate Dean for the Arts. Ms. Evans' current interests include enhancing the cultural environment at the University for students, faculty, staff and the community at large; the creation of an arts curriculum that uses technology to enhance the marketability of students with arts degrees; and evidence-based research that demonstrates the academic impact of arts courses for STEM majors. She is a member of the STEM (Science, Technology, Engineering and Mathematics) to STEAM (the addition of the Arts) working group at UT Dallas, under the direction of Professor Roger Malina. Ms. Evans holds M. A. degrees in Mathematics and Music from the University of California, San Diego. Her doctoral dissertation research project "Does studying music and sound design enhance academic skills in undergraduate non-music majors" is on going. She expects to complete her Ph.D. in the Fall of 2016.

Curriculum Vitae

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EDUCATION

Doctoral candidate, University of Texas at Dallas, Arts and Technology.
Expected completion, Decedmber 2016. ABD (All But Disseration).
Dissertation: *Does musical study enhance academic skills in undergraduate non-music majors?*

Proposal accepted, January 2016 Dissertation advisor: Dr. Roger Malina, Distinguished Professor of Arts and Technology.
Coursework completed, May, 2013, including courses in Sound Design; Animation Production; Special Topics in Art, Science and the Humanities; Research Methods; History of Arts Education; Translation in the Digital Age; Educational Games.

Special Project: CDASH (Curriculum Development in Arts, Sciences and Humanities), 2012 – present, with Roger Malina, Distinguished Professor of Arts and Technology, website http://www.utdallas.edu/atec/cdash/

M.A., Music, University of California, San Diego, 1978
Thesis: "An acoustical study of vocal technique."
M.A., Mathematics, University of California, San Diego, 1976
B.A., Mathematics, University of California, San Diego, 1974

PROFESSIONAL POSITIONS

Senior Lecturer in Music, The University of Texas at Dallas, School of Arts and Humanities, 1994 - present. Director of the UT Dallas Chamber Singers and the Musical Theatre Workshop. Courses taught: UT Dallas Chamber Singers, UT Dallas Community Chorale, Vocal Instruction I, II and III, Musical Theatre Workshop, Exploration of the Arts, Music History (both lower and upper level), History of Song, Music Appreciation. New course for Fall 2013: Music in Modern Culture, emphasizing 21st art-science-technology connections. New course for Spring 2017: Opera Workshop.

Associate Dean for the Arts, UT Dallas, School of Arts and Humanities, 1999 - 2010.
Responsible for all Art and Performance curricular needs (materials, space, budget, scheduling of spaces); oversaw all Art and Performance events (music, theater, dance, visual arts, creative writing), including all publicity, promotion, scheduling, budgets, technical needs, contracts and consulting agreements, and all contact with faculty and professional artists and performers; assisted faculty in production of events; maintaineed and oversaw all Art and Performance spaces (Visual Arts Building, University Theater, Jonsson Performance Hall, Jonsson Rehearsal Hall, new AH1 music building and AH2 arts building) and equipment located in those spaces and in classrooms and offices, including supervising ongoing renovation projects; oversaw all lectures and invitational events; oversaw

rental of performance spaces and acted as liaison to community arts groups; scheduled Art and Performance curriculum and assisted the other Associate Deans in scheduling and curriculum of other areasin History and Literature; acted as Petty Cash Custodian for the School of Arts and Humanities; acted as liaison for the Communications Officer and the Advancement Officer for the School of Arts and Humanities for all arts and performance matters; worked with Arts and Humanities Graphics Designer on all related projects; liaison to other event producers and coordinators, including Student Life, the Holocaust Center, the Confucius Institute, the US-Mexico Center and the Office of the President. Assisted the Dean with other matters pertaining to the Art and Performance division, including fund-raising, student and faculty recruitment and community outreach. Oversaw six full time staff members (Administrative Assistant, Events Management Assistant, A&P Office Secretary, Technical Director, Assistant Technical Director and Staff Accompanist), one half-time faculty appointment (Visual Arts Assistant/Curator), various Teaching Assistants and Student Employees. Administered the Bryce Jordan Scholarship fund. Oversaw Arts and Humanities website, design and content. Reported directly to the Dean of the School of Arts and Humanities.

Member, ArtSci Laboratory, Arts and Technology, UT Dallas, 2012-present.

Executive Director and Founder, Texas Annual Guitar Competition and Festival, 2001 - 2012
Three-day event with concerts,lectures and professional level competition, with over $7500 in prizes awarded. Judges from U.S., Mexico, Czech Republic, Germany and Austria. Addition of Youth Competition in 2011.

Director, UT Dallas Chamber Singers, 1994 - present. Minimum of four concerts per year, including fully staged musical theatre revues, classical and jazz concerts and annual Holiday Sing.

Director, Dallas Pro Musica, 2006 – 2012, professional vocal quintet dedicated to the recreation of Medieval, Renaissance and Early Baroque vocal music.

Content expert for the Digital Calculus Coach, summer 2010, Art and Technology program at The University of Texas at Dallas.

Liaison to the Eisemann Center for annual residency program, 2007 – present, funded by Mid Atlantic Arts Alliance Grant. Two special performances with the UT Dallas Chamber Singers (King's Singers in 2010 and Swingle Singers in 2013).

University Level Curricular Advisor, DCCCD Humanities 1315 - Fine Arts Appreciation Course Redesign, Fall 2007 – 2009.

Director, UT Dallas Community Chorus, 1996-1999.

Private teacher (vocal technique and performance), 1976 - present.

Assistant Dean and Senior Lecturer, 1998-1999, UT Dallas, School of Arts and Humanities,.

Arts Coordinator and Senior Lecturer, 1995 – 1998, UT Dallas, School of Arts and Humanities.

Director, Bach Society Chamber Orchestra and Chorus, Bach Society of La Jolla, 1992-1994.

Artistic Director, The Orpheus Ensemble, a vocal-instrumental ensemble specializing in the works of J. S. Bach and his contemporaries, 1987-1994.

Instructor, UCSD Extension, "Sing Along with Bach: A Reading Chorus," University of California, San Diego, 1992-1994.

Instructor, Mount Vernon College, Washington, DC, 1982-1983.

Instructor, Menlo College, Menlo Park, California, 1979-1980.

Instructor, University of San Diego, San Diego, California, 1978-1979.

Instructor, University of California, San Diego, 1978-1979.

Teaching assistant, University of California, San Diego, 1974-1978.

PUBLICATIONS

"Breaking Down the Silos: Curriculum Development in the Arts, Sciences and Humanities", with Roger Malina (UT Dallas), White paper for SEAD (Network for Science, Engineering, Art and Design), November 2012. Peer reviewed. http://seadnetwork.wordpress.com/white-paper-abstracts/final-white-papers/ Leonardo Electronic Almanac, 2015.

CONFERENCES AND PRESENTATIONS

Panel organizer and presenter, Society for Literature, Science and the Arts (SLSA), October 9, 2014. Panel: Cross-Disciplinary Fluidity: Art-Science-Humanities Curricula at the University Level. Presentation: Case Studies and Best Practices in Art-Science-Humanities Curriculum.

College Art Association (CAA), "The Art/Science Curriculum in the Classroom and in the Cloud", February 14, 2014 for LEAF (Leonardo Education and Art Forum).

XVIII ISA World Congress of Sociology, 13-19 June, 2014, Yokohama, Japan. Presentation of "Breaking Down the Silos: Curriculum Development in the Arts, Sciences and Humanities" at Fostering Transdiciplinarity, Amonst the Social and Natural Sciences, Engineering, Arts and Design. Supported in part by the National Science Foundation.

SEAD, NEA and Smithsonian Institution workshop in Washington, D.C. May 16, 2013. Presentation of "Breaking Down the Silos: Curriculum Development in the Arts, Sciences and Humanities".

ISEA 2013 International Symposium on Electronic Art, invited participant, Cloud Curriculum Workshop, Sydney, Australia, June 15, 2013.

SIGGRAPH 2013 (Special Interest Group on GRAPHics and Interactive Techniques), presenting "Playing Audrey II: Directing a Digital Actor with Game Technology", with Monica Evans, Anaheim, CA, July, 2013.

COMMUNITY SERVICE

Member, Chancellor's Council for the University of Texas System, 2013- present.

Member, Member, Executive Board, Repertory Theatre Company, 2004 – 2010 , 2015-present.

President, Dallas Chamber Music, 2012 - 2013.

UTD Liaison, Executive Board, Dallas Chamber Music Society, 2007 – 2013.

Vice President, Creative Arts Alliance, 2006 – 2010.

Member, Advisory Board, Indian Classical Music Circle, Dallas, 2006 -2012.

Faculty Associate, Center for U. S. Mexico Studies, 2003 – 2010.

Chairperson of the Board, Richardson Council of the Arts, 2002 - 2004

President, Richardson Council of the Arts, 2000 – 2002.

Board member, Texas Alliance for Education in the Arts, 1999 - 2003.

Biographical sketch

A singer, conductor, director and producer of many diverse talents, Ms. Evans has performed and directed music composed from 1200 to contemporary times using a variety of settings and styles. An accomplished recitalist and chamber musician, Ms. Evans recently completed tours of music for voice and guitar with fellow faculty member Dr. Enric Madriguera in Austria, Switzerland, the Czech Republic, Mexico, Spain and Latin America. She co-produced and performed in a series of "composer concerts" with Robert X. Rodriguez, featuring the music of Mozart, Monteverdi, Brahms and Satie. She is the Executive Director of the Annual Texas Guitar competition, and celebrated their 10th anniversary with a series of concerts and competitions for both youth and adults in 2011. She released her CD, *Voz y Guitarra*, with guitarist Enric Madriguera, featuring previously unrecorded works of composers John Duarte and Ernesto Cordero, in 2003, and recently completed a concert tour to Ecuador in 2007, including appearances on national radio and television programs. She appeared as The Abbess in *The Sound of Music* with Repertory Company Theatre. In 2006, Ms. Evans created the *Dallas Pro Musica*, a vocal quintet dedicated to the re-creation of vocal music of the Medieval, Renaissance and Early Baroque periods, with occasional forays into the 21st century. Her most recent musical creation *The Music of Isaac Albeniz* was performed in Dallas and Honolulu, Hawaii in 2011. Ms. Evans is currently the head of the Vocal and Choral division of the School of Arts and Humanities at The University of Texas at Dallas, where she directs the UT Dallas Chamber Singers, teaches vocal instruction, musical theatre workshop and a variety of music history courses, as well as general arts education courses. Ms. Evans was the Associate Dean of the School of Arts and Humanities at The University of Texas at Dallas from 1999 to 2010, where she ran the Art and Performance division. She was appointed Associate Dean for the Arts in 1999 after serving as Assistant Dean and Arts Coordinator for the School from 1995 – 1999. As Associate Dean for the Arts, Ms. Evans was responsible for the fine arts program, including all curricular needs (budget, materials, space and scheduling), facilities, and an extensive and comprehensive arts season in classical music, jazz, guitar, art exhibitions, theatre and dance productions, lectures and student festivals. She supervised all publicity, promotion, scheduling, budgets, technical needs, contracts and consulting agreements for the series and all contact with faculty and professional artists and performers. She oversaw three performance venues: Performance Hall (and supervised a complete renovation in 2004-05), the Visual Arts Building (with two galleries and five classrooms) and the University Theatre (and supervised the renovation of the lobby in 2006, and created a new art gallery in that space) and exhibitions in the Green Center. She oversaw rental of performance spaces and acted as liaison to the community arts groups; scheduled all arts curriculum and assisted the other Associate Deans in other curriculum; acted as Petty Cash Custodian for the School of Arts and Humanities; oversaw all press and publicity for the School of Arts and Humanities; and acted as liaison to other event producers and coordinators, including Student Life, the Holocaust Center, the Confucius Institute, the US-Mexico Center and the Office of the President. She assisted the Dean with other matters pertaining to the Art and Performance division, including fund-raising, student and faculty recruitment and community outreach and oversaw the content of the Arts and Humanities website. Additionally, she administered the Bryce Jordan Scholarship fund, awarding over $20,000 annually in recognition awards and scholarships for students in the fine arts. In 2009, Ms. Evans supervised the addition of two buildings for music rehearsal space and arts studios, and the re-designed Arts and Humanities website. Premiere performances in 2010 -2013 include directing the *King's Singers* and UT Dallas Chamber Singers at the Eisemann Center in two resdiency residency programs, with the Kings Singers (2010) and the Swingle Singers (2013); and directing the most successful theatrical production in the history of UT Dallas: *Side Show the Musical*, with over 50 students in the cast, orchestra and crew; a production team of 12, with 1800 in attendance at six sold-out performances. Programs in 2012 and 2013 included *Baroque Duets* and *The American Songbook* (as performer) and productions of the musicals *I Love You, You're Perfect, Now Change* (2011), *The 25th Annual Putnam County Spelling Bee* (2012) and *Red, Hot and Cole* (2013). Ms. Evans directs the Annual *Best of Broadway* show every November, and *Creepy and Kooky* included the first ever use of a game engine to drive a fully controllable animated character, Audrey II in *Little Shop of Horrors*, was peformed to four sold-out houses. Ms. Evans will be presenting this animation, along with her co-author, Monica Evans, at SIGGRAPH in July of 2013. Evan's current interests include a compilation of classical music for voice and guitar; enhancing the cultural environment at the University for students, faculty, staff and the community at large; and creation of an arts curriculum that uses technology to enhance the marketability of students with arts degrees. Ms. Evans holds M. A. degrees in Mathematics and Music from the University of California, San Diego. She is currently pursuing a Ph.D. in Art and Technology, with an emphasis on arts education in the 21st century. Her current project "Bridging the Silos" Curriculum Development in the Arts, Sciences and Humanities" will be presented at the SEAD/NEA workship in Washington, D.C. and she has been invited to

participate in a panel disucssion at ISEA 2013 in Sydney, Australia in June of 2013. Ms. Evans was awarded the School of Arts and Humanities *Distinguished Service Award* in 2010 for her 15 years of service as Associate Dean for the Arts. Her doctoral dissertation research project "Does studying music enhance academic skills in undergarduate non-music majors" is on going. She expects to complete her Ph.D. in the spring of 2016.

Before coming to Dallas in September of 1994, she was the Director of the *Bach Society Chamber Orchestra and Chorus* from 1992 to 1994 for the Bach Society of la Jolla. She also served as the Artistic and Musical Director of the *Orpheus Ensemble*, a chamber ensemble based in La Jolla, California, dedicated to performance of the works of J.S. Bach in historical and unique settings. She is the 1991 recipient of the Brandenburg Award, for contribution to the community of the works of J.S. Bach. Ms. Evans was also a well known performer in the Washington, D.C. area where she was a member of the Opera Theatre of Washington and performed such roles as Gilda in *Rigoletto*, Gretel in *Hansel and Gretel*, Micaela in *Carmen* and Norina in *Don Pasquale*. Ms. Evans sang the title role in the U.S. premiere of *Betly* by Donizetti and the Washington premiere of *The Nymph and the Farmer* by Tcherepnin, and has specialized in the performance of contemporary opera roles. In 1982, Ms. Evans completed an 8-week series of performances with the Opera Theatre of Washington at Wolf Trap Farm Park, in Wolf Trap, Virginia. Ms. Evans founded and directed the *Washington Pro Musica*, a vocal ensemble specializing in authentic re-creation of vocal music and styles of the medieval, renaissance and early baroque periods, from 1981 to 1983. From 1975 to 1980, she was musical director of the Early Music Ensemble of San Diego, and directed European concert tours of Switzerland, Germany, France and Italy during 1975, 1977 and 1979. Ms. Evans held faculty positions at Mount Vernon College in Washington, D.C., at the University of San Diego, the University of California, San Diego, and at Menlo College, in Palo Alto, California before coming to The University of Texas at Dallas.

"Kathryn Evans has a very flexible voice and she use(s) it accurately and with considerable imagination....splendid acting..."

The Washington Post

MUSICAL EXPERIENCE

Solo recitalist, conductor and voice teacher, 1976 to present, including European Tours to Spain, Austria, Switzerland, Czech Republic, Mexico, Ecuador and others; tour to Mexico, September, 2002; CD release *Voz y Guitarra*, October, 2003. Tour to Ecuador, December, 2007.

Director, UT Dallas Chamber Singers, 1994 to present.

Director, UT Dallas Musical Theatre Workshop and main stage performances, 2007 to present.

Director, Dallas Pro Musica, 2006 – 2012.

CD producer, "Horses (Kuajt)", music by Gjon Kapedani, text in Albanian by Gjeke Marinaj, English version by Fred Turner. Hoyt Neal, tenor and Michael McVay, pianist, summer 2010.

Director, UT Dallas Community Chorus, 1996-1999.

Soloist and Visiting Conductor, Preston Hollow United Methodist Church, 1997-2002.

Soloist, La Jolla Congregational Church, La Jolla, California, 1985-1994.

Soloist, Temple Solel, Encinitas, California, 1989-1994.

Concert Coordinator, Bach Society of La Jolla, La Jolla, California, 1988.

Performing member, Pacific Chamber Opera, San Diego, California, 1986.

Leading soprano, Opera Theatre of Washington, Washington, DC, 1981-1982.

Director, Washington Pro Musica, a Washington-based vocal ensemble specializing in early music, Washington, DC, 1981-1983.

Invited performer, Alexandria Recital Series, Alexandria, Virginia, 1983.

Soloist, Temple Rodef-Shalom, McLean, Virginia, 1982-1983.

Invited performer, Pleshakov-Kaneko Institute of Music, Palo Alto, California, performing original compositions, Spring, 1980.

Director, Early Music Ensemble of San Diego, 1975-1980, performances in California and in Europe in 1975, 1977 and 1979.

Invited performer, American Society of University Composers Conference, University of California, San Diego, California, March, 1979.

Soloist, La Jolla Civic University and Chorus, La Jolla, California, 1979. Solos included German Requiem of Brahms, Come Ye Sons of Art of Purcell, and Awake, Awake my Lyre of Blow.

Soloist, University of San Diego, performing original works by faculty members, San Diego, California, 1978-79.

Soloist, Sacred Heart Catholic Church, Coronado, California, 1979.

Participant in Basically Baroque Seminar, La Jolla, California, summer, 1978.

CD RELEASE

Voz y Guitarra, released in the United States, October 2003 and in Europe, April, 2004. Previously unrecorded music for voice and guitar of John Duarte and Ernesto Cordero. Recorded, produced and edited at the University of Texas at Dallas, Richardson, TX.

CD PRODUCER

Produced CD of "Horses (Kuajit)" for Gjeke Marinaj commemorative website, composed by Gjon Capedani with Albanian text by Gjeke Marinaj, September 2010. English translation by Fred Turner. Recorded by Hoyt Neal, tenor and Michael McVay, pianist. Received rave reviews and recognition in numerous Albanian newspapers, radio and television.

HONORS AND AWARDS

Chancellor's Council for the University of Texas system, selected for contributions to UT Dallas, 2012-present.

Distinguished Service Award, The University of Texas at Dallas School of Arts and Humanities, 2010.

Brandenburg Award, La Jolla Bach Society, for contribution to the community of the works of J.S. Bach, 1991.

Regional Quarterfinalist, Metropolitan Opera Auditions, Southern California Division, 1979.

3rd place, National Association of Teachers of Singing, Singer of the Future Award, Los Angeles, California, November, 1977.

3rd place, La Jolla Youth Talent Auditions, La Jolla, California, 1978.

2nd place, La Jolla Youth Talent Auditions, La Jolla, California, 1977.

RECENT PERFORMANCES (through May, 2013):

As Soloist and with Dallas Pro Musica:

Baroque Duets, with Mary Medrick, mezzo-soprano and Michael McVay, piano, UT Dallas Faculty at Five series, Richardson, TX, September, 25, 2013.

Earthly Delights and Music of the Spheres, soprano soloist, with the UT Dallas Community Chorale, Richardson, TX, May 12, 2013.

The Great American Songbook, with Michael McVay, piano, Faculty at Five series, UT Dallas, Richardson, TX, January 25, 2013.

Ode for St. Cecilia's Day by G. F. Handel, soprano soloist, with the UT Dallas Chamber Singers and Community Chorale, Mary Medrick, conductor, University of Texas at Dallas, May 12, 2012.

Organ Plus Faculty Recital, featuring music of J. S. Bach, with Jamila Javadova, organ and Lisa Bost, flute, Christ United Methodist church, Plano, TX, April 17, 2012.

The Great American Songbook, with Michael McVay, pianist, for Faculty @ 5, University of Texas at Dallas, Richardson, TX, January 25, 2012.

Dallas Pro Musica: The Meaning of Life with works by Gesualdo, Monteverdi, Morley, Gibbons, Landini, Byrd and more, University of Texas at Dallas, Richardson, TX, September 9, 2011.

Afro-American Fragments by William Averitt, soprano soloist, with the UT Dallas Community Chorale, Hoyt Neal, director, Richardson, TX, May 7, 2011.

Songs of Isaac Albeniz, with Michael McVay, pianist, International Conference on the Arts and Humanities, Honolulu, Hawaii, January 10, 2010.

Music of Isaac Albeniz, with Michael McVay, pianist, Enric Madriguera and Eddie Healy, guitars, Faculty at Five concert series, UT Dallas, Richardson, TX, October 13, 2010.

Music in the Era of Charles V, with Enric Madriguera and Sabine Madriguera, guitar, for the Meadows Museum at Southern Methodist University, Dallas, TX, July 1, 2010.

Songs of Spain, with Enric Madriguera, guitar, for the *Dia de La Guitarra*, Eastfield College, Mesquite, TX, June 5, 2010.

Chandos Anthem No. 5 by G. F. Handel, for the *UT Dallas Choral Concert*, with the UT Dallas Chamber Singers and the UT Dallas Community Chorale, Richardson, TX, May 8, 2010.

Romancero Gitano, for the *40th Anniversary Concert of The University of Texas at Dallas,* with th*e Dallas Pro Musica,* Richardson, TX, January 29, 2010.

Lord Nelson Mass, for the *All Haydn Choral Concert*, with the UT Dallas Chambers Singers and the UT Dallas Community Chorale, Richardson, TX, May 9, 2009.

Music of the Spanish World, with Enric Madriguera, guitarist, International Guitar Festival in Morelia, Mexico, April 14, 2009.

Eddie Healy and Friends, invited soloist, UT Dallas Faculty at Five series, February 25

Dallas Pro Musica: Birds, Beasts and Bug, UT Dallas, Richardson, TX, January 21, 2009

Kathryn Evans and Friends, with Enric Madriguera, guitar, Winston Stone, clarinet and Michael McVay, piano, UT Dallas, Richardson, TX, November 19, 2008.

Dallas Pro Musica: The Italian Way , Lord of Life Lutheran Church, Plano, TX, May 31, 2008.

The Messiah, with the UT Dallas Chamber Singers and the UT Dallas Community Chorale, UT Dallas, Richardson, TX, May 3, 2008.

Dallas Pro Musica: The Italian Way and Basically British, UT Dallas, Richardson, TX, January 19, 2008.

Music of the Spanish World, with Enric Madriguera, guitarist, International Guitar Festival in Cuenca, Ecuador, with concerts at the Abraham Lincoln Center and FIGCEE (Festival Internacional de Guitarra Clásica Cuenca), December 6-8, 2007, including national radio and TV appearances.

Music of the Spanish World, with Enric Madriguera, guitarist, Eastfield College, Dallas, TX, October 31, 2007.

Lieder Recital, featuring Kathryn Evans, soprano and Michael McVay, piano, in conjunction with the German Club, UT Dallas, Richardson, TX, September 19, 2007

Music of the Spanish World, with Enric Madriguera, guitarist, Latino Cultural Center, Dallas, TX, April 26, 2007.

Music of the Spanish World, with Enric Madriguera, guitarist, Richland College, Dallas, TX, February 20, 2007.

Music of the Spanish World, with Enric Madriguera, guitarist, UT Dallas, Richardson, TX, January 18, 2007.

The Italian Way, Dallas Pro Musica vocal quintet (UT Dallas faculty members and guests artists), UT Dallas,

Richardson, TX, November 1, 2006.

A Mozart Celebration, with the UT Dallas Chamber Singers and UT Dallas Chorale, directed by Hoyt Neal, UT Dallas, Richardson, TX, April 23, 2006.

Diva: Ladies of the Stage and Screen, UT Dallas , Richardson, TX, April 19, 2006.

The Sound of Music (Mother Abbess), Repertory Company Theatre, Richardson, TX, December 8 - 17, 2005.

Twentienth Century Greats, music for guitar and chamber ensemble, with Enric Madriguera, guitar, UT-Dallas, November 11, 2005.

From Monteverdi to Verdi, with Hoyt Neal, tenor, solos and duets from opera and musical theatre, UT-Dallas, September 14, 2005.

Faure's Requiem, soloist with the UT Dallas Chamber Singers and UT Dallas Chorale, Hoyt Neal, director, UT-Dallas, April 24, 2005.

The Prayers of Dallas, actress, play by Frederick Turner, Biblical Arts Center of Dallas, Dallas, TX, November 17-18, 2004.

Homage to Lorca, with Enric Madriguera, guitar, International Guitar Festival, Fundación Díaz Caneja, Palencia, Spain, November 12, 2004.

Homage to Lorca, soloist and conductor, with Enric Madriguera, guitar and the UT Dallas Chamber Singers, with special guest narrator Luis Martin, music of Lorca and Castelnuovo-tedesco, UT Dallas, November 6, 2004.

Basically Baroque Chamber Ensemble, performer and director, UT Dallas, featuring "The Wedding Cantata" of J. S. Bach and "Domine dominus" of Andre Campra, September 10, 2004.

*UT-Brownsville Guitar Ensemble Festival, Guest Artist, "*Voz y Guitarra" with Enric Madriguera, Guitar, Brownsville, TX, March 26, 2004.

*Texas Association of Music Schools Guest Artist, "*Voz y Guitarra" with Enric Madriguera, Guitar, Austin, TX, March 25, 2004.

Choral Concert, Soloist with the UT Dallas Concert Chorale, Kim Childs, director, in "Herr Jesu Christ", J.S. Bach and "The Blake Songs", R. Vaughan Williams, UT-Dallas, April 30, 2004.

John Duarte Concert, with Enric Madriguera and Vladislav Blaha, guitarists, UT Dallas 3rd Annual Guitar Competition, March 19, 2004.

Basically Baroque Chamber Ensemble, performer and director, February 21, 2004, Lord of Life Lutheran Church, Plano, TX.

Voz y Guitarra, with Enric Madriguera, guitar, and Connie Garrido, recorder, UT Dallas, October 10, 2003, in conjunction with release of CD, Voz y Guitarra.

Music of Spain, noon concert series, with Enric Madriguera, guitar, and Connie Garrido, recorder, Eastfield College, October 1, 2003.

Music of Ernesto Cordero, lecture/concert with the composer, with Enric Madriguera, guitar, UT Dallas, April 11, 2003.

Basically Baroque, music of G. F. Handel and J.S. Bach, for voice and chamber ensemble, UT Dallas, January 24, 2003.

Third Annual UT D Renaissance Festival, performing *The Mystic's Vision*, solo work for voice and dancer, featuring UTD Chamber Singers, UTD and UTD Dancers, UT-Dallas, October 18 & 19, 2002.

Madriguera & Evans, music for voice and guitar, invited performer, Richland College Concert Series, October 1, 2002.

Madriguera & Evans, music for voice and guitar, invited performer, Third Annual Academic International Festival, Guanajuato, Mexico, September, 2002.

Madriguera & Evans, music for voice and guitar, invited performer, XI International Guitar Festival. Brno, Czech Republic, August, 2002.

Vivaldi's Gloria, (performer and conductor) UTD Chamber Singers, Spring Arts Festival, UT-Dallas, May 5, 2002.

Duo Dallas, music for voice and guitar, invited performer, Lausanne Guitar Festival, Switzerland, April 2002.

Madriguera & Evans, music for voice and guitar, invited performer and juror, International Guitar Festival, Rust, Austria, March 2002.

Music of John Duarte, concert and lecture featuring the composer, with Enric Madriguera, guitar, October 12, 2001.

American Extravaganza, with the UTD Chamber Singers, Kim Childs, director and the UTD Chorale, April 6, 2001.

From Britain to America, faculty recital with Jeff Lankov, pianist and Kim Childs, tenor, UT-Dallas, February 2, 2001.

Monkey See, Monkey Do, with Voices of Change, Robert X. Rodriguez, conductor, UT-Dallas, November, 2000.

Musica Latina, with guitarist Enric Madriguera, at Eastfield College (September),Cedar Valley Community College (September) and UT-Dallas (October), 2000.

An Evening of Satie, with Musica Nova, and the UTD Dance Ensemble, Robert X. Rodriguez, director, featuring "Socrate", UT-Dallas, March 24, 2000.

Chants D'Amour, faculty recital with Jeff Lankov, pianist, featuring the greatest love songs of the 20th Century, UT-Dallas, February 4, 2000.

Medieval to Modern, soloist for "Mass" by Igor Stravinsky, and "A Singer's Complaint", Malcolm Singer, UT-Dallas, November, 1999.

All-Brahms Concert, soloist, with the UT-Dallas Choruses, Robert X. Rodriguez, director. featuring "Liebeslieder Waltzes", UT-Dallas, April, 1999.

Monteverdi, Mozart and Stravinsky, faculty recital with Kim Childs, tenor, featuring "The Rake's Progress", by Stravinsky, UT-Dallas, February, 1999.

Tango-Fandango, excerpts from "The Pentecost Cantata" by J. S. Bach, and "Suor Isabella", chamber opera by Robert X. Rodriguez, with Musica Nova and the UTD Dance Ensemble, UT-Dallas, November, 1998.

Bach-Britten Concert, featuring "Wachet Auf" by J. S. Bach and "Rejoice in the Lamb" by Benjamin Britten, with the UT-Dallas Chamber Singers, UT-Dallas Community Chorus and the Preston Hollow United Methodist Church Choir, UT-Dallas, October, 1998.

Bach Cantata Concert, featuring the "Coffee Cantata", and Cantata #4 "Christ Lag in Todesbanden", with the UT-Dallas Chamber Singers, UT-Dallas Community Chorus and the Preston Hollow United Methodist Church Choir, UT-Dallas, April, 1998.

Latin American Music Festival, classical and jazz selections, with guitarist Enric Madriguera and pianists Jeff Lankov and Kelly Durbin, UT-Dallas, March, 1998.

A Celebration of Monteverdi, "O Viva Fiamma" and "Zefiro Torna", duets by Monteverdi, with the UT-Dallas Chamber Singers, UT-Dallas Community Chorus and the UTD Chamber Music Ensemble, UT-Dallas, November, 1997.

Seven Centuries of Vocal Music, lecture/recital tracing the development of vocal music from Gregorian chant in the 12th century through the Renaissance, Baroque, Classical and Romantic periods to the 20th century, University of Texas at Dallas, March, 1997.

Musica Nova, directed by Robert X. Rodriguez, performing "Wir eilen mit schwachen doch emsigen schritten", J. S. Bach, December, 1996.

A Celebration of Mozart, as performer: "Bella mia fiamma", concert aria by Mozart; as director: "Ave Verum Corpus" for orchestra and chorus; & and as choral director and performer: "Credo Mass in C", UT-Dallas Community Chorus and the UT-Dallas Chamber Singers, November, 1996.

The Sounds of Class, outdoor concert with the Richardson Symphony Orchestra, Anshel Brusilow, director, performing songs of George Gershwin, UT-Dallas, September, 1996.

Classical Jazz, a concert of classical and jazz vocal music from the 20th century, with Jeff Lankov, classical pianist, Kelly Durbin, jazz pianist and Karl Lampman, saxophone, University of Texas at Dallas, Dallas, TX, March, 1996.

Ibero/American Music from the 16th to the 20th Century, with Enric Madriguera, guitar, Eastfield College Festival of 20th Century Music, Mesquite, TX, February , 1996.

Dido and Aeneas, producer, choral director and soprano, UT-Dallas Chamber Music Ensemble and Chamber Singers, performing the role of Belinda and directing the chorus, University of Texas at Dallas, Dallas, TX, December, 1995.

Shorelines by Jan Swafford, invited performer, TCU New Music Ensemble, Texas Christian University, Fort Worth, TX, April, 1995.

Musica de Espana, renaissance, baroque and contemporary music from Spain and the colonies, with Enric Madriguera, guitar and Mary Duren, piano, University of Texas at Dallas, Dallas, TX, April, 1995.

As Director (through May 2013):

Annual Choral Concert, with the UT Dallas Chamber Singers, music of Bach and arrangements by the Swingle Singers, UT Dallas, Richardson, TX, May 11, 2013.

Red, Hot and Cole: The Life and Music of Cole Porter, fully staged musical for the University of Texas at Dallas, UT Dallas, Richardson, TX, March 23 - 25, 3013

In Concert with the Swingle Singers, with the UT Dallas Chamber Singers, Annual Residency program with the Eisemann Center, Richardson, TX, Febuary 22, 2013..

36th Annual Holiday Sing "Basically Baroque" with the UT Dallas Chamber Singers and the UT Dallas Wind Ensemble, Richardson, TX, December 15, 2012.

Best of Broadway V: Creepy and Kooky, fully staged and costumed selections from Broadway shows, with the UT Dallas Chamber Singers and Musical Theatre Workshop, UT Dallas, Richardson, TX, November 7-10, 2012. Included special Audrey II animation project.

Earthly Delights and Music of the Spheres, with the UT Dallas Chamber Singers and Community Chorale, Richardson, TX, May 12, 2012.

The 25th Annual Putnam County Spelling Bee, fully staged musical for The University of Texas at Dallas, Richardson, TX, April 12 – 21 (six performances), 2012.

Music of the Spheres, multi-media performance with works and images about the universe, with the UT Dallas Chamber Singers and students from Vocal Instruction II, March 23 – 24, 2012

35th Annual Holiday Sing "The Most Wonderful Time of the Year" with the UT Dallas Chamber Singers and the UT Dallas Wind Ensemble, Richardson, TX, December 10, 2011.

Best of Broadway IV, fully staged and costumed selections from Broadway shows, with the UT Dallas Chamber Singers and Musical Theatre Workshop, UT Dallas, Richardson, TX, Novemer 10 – 12, 2011.

The Old Organist, for the American Guild of Organists, as theatrical director, Richardson TX, May 9, 2011

Music of Purcell, featuring choruses from Dido and Aeneas, and full work Come Ye Sons of Art, Richardson, TX, May 7, 2011.

I Love You, You're Perfect, Now Change, fully staged musical at the University of Texas at Dallas, Apr 28 - 30, 2011.

A Tribute to Frank Sinatra: with the UT Dallas Chamber Singers and students from Vocal Instruction II, Ricardshon, TX, Mar 24 – 26, 2011.

34th Annual Holiday Sing "Winter Wonderland" with the UT Dallas Chamber Singers and the UT Dallas Wind Ensemble, Richardson, TX, December 11, 2010.

Best of Broadway III, fully staged and costumed selections from Broadway shows, with the UT Dallas Chamber Singers and Musical Theatre Workshop, UT Dallas, Richardson, TX, November 10, 11 & 12, 2010.

Faure's Requiem and Pavane, for the UT Dallas Choral Concert and the Dallas Chamber Orchestra, director, with the UT Dallas Chamber Singers, Richardson, TX, May 8, 2010.

Side Show the Musical, with over 50 students in the cast, orchestra and crew. First fully stage musical with orchestra at The University of Texas at Dallas. April 8 – 17, 2010 (six performances).

Shakespeare in Song, with the UT Dallas Chamber Singers, Richardson, TX, March 26 & 27, 2010 (three performances).

The King's Singers with the UT Dallas Chamber Singers, performing music of Eric Whitacre and Bob Chillcott, for the 6th annual Eisemann Center Residency program, Richardson, TX, February 19, 2010.

33rd Annual Holiday Sing "The Stories of Christmas" with the UT Dallas Chamber Singers and the UT Dallas Wind Ensemble, Richardson, TX, December 12, 2009.

Best of Broadway II, fully staged and costumed selections from Broadway shows, with the UT Dallas Chamber Singers and Musical Theatre Workshop, UT Dallas, Richardson, TX, November 6 & 7, 2009.

Haydn Te Deum and Part Songs, for the *All Haydn Choral Concert*, director, with the UT Dallas Chambers Singers Richardson, TX, May 9, 2009.

When in '64: A Tribute to the Beatles, UT Dallas Chamber Singers, Richardson, TX, March 27 & 28, 2009 (three sold out performances).

32nd Annual Holiday Sing "An International Christmas", with the UT Dallas Chamber Singers and the UT Dallas Wind Ensemble, UT Dallas, Richardson, TX, December 18, 2008.

Best of Broadway: MobScenes, fully staged and costumed selections from Broadway shows, with the UT Dallas Chamber Singers and Musical Theatre Workshop, UT Dallas, Richardson, TX, October 31 and November 1, 2008.

Laudate Jehovam Omnes Gentes by *G. F. Telemann*, with the UT Dallas Chamber Singers, UT Dallas, Richardson, TX, May 3, 2008.

A Tribute to Harold Arlen, with the UT Dallas Chamber Singers and UT Dallas Jazz Band, UT Dallas, Richardson, TX, February 29 & March 1, 2008.

31st Annual Holiday Sing, "Feliz Navidad: Christmas in the Spanish World", with the Symphonic Brass Quintet, the UT Dallas Chamber Singers, and the UT Dallas Community Chorus, UT Dallas,

Richardson, TX, December 1, 2007.

Something Wicked This Way Comes, with the UT Dallas Chamber Singers and students from Intermediate Voice, UT Dallas, Richardson, TX, October 26 & 27, 2007.

The British Invasion, with the UT Dallas Chamber Singers and UT Dallas Chorale, UT Dallas, Richardson, TX, April 21, 2007).

A Tribute to the Manhattan Transfer, Jazz Concert with UT Dallas Chamber Singers and UT Dallas Jazz Band, UT Dallas, Richardson, TX, March 16 & 17, 2007.

*30th Annual Holiday Sing, "Wassail! Christmas in Merry Olde England", w*ith the Symphonic Brass Quintet, the UT Dallas Chamber Singers, and the UT Dallas Community Chorus, UT Dallas, Richardson, TX, December 2, 2006.

Shakespeare in Song, with the UT Dallas Chamber Singers and students from Intermediate Voice, UT Dallas, Richardson, TX, October 20 & 21, 2006.

A Celebration of Mozart, with the UT Dallas Chamber Singers and UT Dallas Chorale, UT Dallas , Richardson, TX, April 23, 2006.

A Tribute to Duke Ellington, Jazz Concert with UT Dallas Chamber Singers and UT Dallas Jazz Band, UT Dalals, Richardson, TX, February 26, 2006.

29th Annual Holiday Sing, "Home for the Holidays", with the Symphonic Brass Quintet, the UT-Dallas Chamber Singers, and the UT-Dallas Community Chorus, UT-Dallas, December 4, 2005.

Home for the Holidays, the UT-Dallas Chamber Singers, Winter Arts Festival, UT-Dallas, November 19, 2005.

La Vie Boheme, excerpts from "La Boheme" and "Rent", musical director, UTD Chamber Singers and students from Intermediate Voice, UT-Dallas, October 21 and 22.

Trois Chanson de Charles Orleans, by Claude Debussy, as a part of the All-French Choral Concert, with the UTD Chamber Singers and UTD Chorale, Hoyt Neal, director, UT-Dallas, April 24, 2005.

Jazz, Sweet Jazz, Jazz Concert with UTD Chamber Singers, special performance for "Governor for a Day Celebration", Senator Florence Shapiro, Texas State Capital, Austin, TX, April 10, 2005.

Jazz, Sweet Jazz, Jazz Concert with UTD Chamber Singers and UTD Jazz Band, UT-Dallas, February 26, 2005

28th Annual Holiday Sing, "A Child's Christmas", with the Symphonic Brass Quintet, the UT-Dallas Chamber Singers, and the UT-Dallas Community Chorus, UT-Dallas, December 5, 2004.

A Child's Christmas, the UT-Dallas Chamber Singers, Winter Arts Festival, UT-Dallas, November 19, 2004.

Music, Myths and Mysticism, featuring "Orfeo" of Monteverdi and "Ahkenaten" of Philip Glass, UT-Dallas Chamber Singers, October 15, 2004.

Gershwin, Rodgers and Porter, Jazz Concert with UTD Chamber Singers and UTD Jazz Band, UT-Dallas, February 27, 2004.

27th Annual Holiday Sing, with the Symphonic Brass Quintet, the UT-Dallas Chamber Singers, and the UT-Dallas Community Chorus, UT-Dallas, two performances, December 7, 2003.

Christmas from around the World, UTD Chamber Singers, Winter Arts Festival, UT-Dallas, November 21, 2003 .

Grave Performances Halloween Concert, UTD Chamber Singers, UTD Group and Intermediate Voice students, UT-Dallas, October 31, 2003.

All Mozart Concert, (performer and conductor) UTD Chamber Singers, Spring Arts Festival, UT-Dallas, April 27, 2003.

A Tribute to the Manhanntan Transfer, (conductor) with the UTD Chamber Singers and the UTD Jazz Ensemble, UT-Dallas, March 21, 2003.

26th Annual Holiday Sing, with the Symphonic Brass Quintet, the UT-Dallas Chamber Singers, and the UT-Dallas Community Chorus, UT-Dallas, two performances, December 8, 2002.

A Medieval to Modern Christmas, UTD Chamber Singers, Winter Arts Festival, UT-Dallas, November 22, 2002.

Third Annual UTD Renaissance Festival, (performer and conductor) featuring UTD Chamber Singers, UTD and UTD Dancers, UT-Dallas, October 18 & 19, 2002.

European Masterworks collection responses, performances with voice, dance and theater students, in conjunction with the Dallas Museum of Art, special exhibitions, , at the DMA Dallas, TX, April 6, 2002.

Swing Thing, (conductor) with the UTD Chamber Singers, the UTD Jazz Ensemble and the UTD Dance Ensemble, UT-Dallas, March 23, 2002.

25th Annual Holiday Sing, with the Symphonic Brass Quintet, the UT-Dallas Chamber Singers, and the UT-Dallas Community Chorus, UT-Dallas, two performances, December 9, 2001.

Christmas Songs, UTD Chamber Singers, Winter Arts Festival, UT-Dallas, December 7, 2001.

Second Annual UTD Renaissance Fair, featuring UTD Chamber Singers, UTD Guitar Ensemble, UTD Dancers, with booths by UTD student organizations, local guest artists and musician, UT-Dallas, October 19 & 20, 2001.

American Songs, UTD Chamber Singers, Spring Arts Festival, UT-Dallas, May 4, 2001.

Swing Thing, with the UTD Chamber Singers, the UTD Jazz Ensemble and the UTD Dance Ensemble, UT-Dallas, March 17, 2001.

24th Annual Holiday Sing, "A Renaissance Christmas" with the Symphonic Brass Quintet, the UT-Dallas Chamber Singers, and the UT-Dallas Community Chorus, UT-Dallas, December, 2000.

Winter Arts Festival, "A Renaissance Christmas", featuring the UTD Chamber Singers, December, 2000.

First Annual UTD Renaissance Fair, featuring UTD Chamber Singers, UTD Guitar Ensemble, UTD Dancers, with booths by UTD student organizations, local guest artists and musician, UT-Dallas, November, 2000.

American Music: Birds, Beasts and Bugs, UTD Chamber Singers, Spring Arts Festival, UT-Dallas, May, 2000.

Swing Thing, with the UTD Chamber Singers, the UTD Jazz Ensemble and the UTD Dance Ensemble, UT-Dallas, April 8, 2000.

23rd Annual Holiday Sing, with the Symphonic Brass Quintet, the UT-Dallas Chamber Singers, and the UT-Dallas Community Chorus, UT-Dallas, December, 1999.

A Victorian Christmas for the Winter Arts Festival, the UT-Dallas Chamber Singers, UT-Dallas, December, 1999.

Swing Music for Chorus, Spring Arts Festival, the UT-Dallas Chamber Singers performing jazz selections, UT-Dallas, May, 1999.

22nd Annual Holiday Sing, with the Dallas Brass Quintet, the UT-Dallas Chamber Singers, and the UT-Dallas Community Chorus, UT-Dallas, December, 1998.

A Very British Christmas, for the Winter Arts Festival, the UT-Dallas Chamber singers, UT-Dallas, December, 1998.

Jazzin' It Up, Spring Arts Festival, the UT-Dallas Chamber Singers performing jazz selections, UT-Dallas, May, 1998.

Bach Cantata Concert, featuring the "Coffee Cantata", and Cantata #4 "Christ Lag in Todesbanden", with the UT-Dallas Chamber Singers, UT-Dallas Community Chorus and the Preston Hollow United Methodist Church Choir, UT-Dallas, April, 1998.

21st Annual Messiah/Carol Sing, with the Dallas Brass Quintet and the UTD Chamber Singers, with audience participation, UT-Dallas, December, 1997.

Winter Arts Festival, UTD Chamber Singers, performing jazz selections, Christmas Music and music by Monteverdi, UT-Dallas, December, 1997.

A Celebration of Monteverdi, "Exultent Coeli" for orchestra and chorus; Concert Suite from "Orfeo", UT-Dallas Community Chorus and the UT-Dallas Chamber Singers, UT-Dallas, November, 1997.

The Sounds of Class, outdoor concert with the Richardson Symphony Orchestra, Anshel Brusilow, director, conducting the UT-Dallas Chamber Singers, UT-Dallas, September, 1997.

Motets, Madrigals and Rounds, music from the Middle Ages and the Renaissance, UT- Dallas Chamber Singers and UT-Dallas Community Chorus, for the Spring Arts Festival, April, 1997.

An Oxford Christmas, music of the Renaissance and 20th Century, for the Winter Arts Festival, UTD Chamber Singers; pre-concert performance, 20th Annual Messiah Sing, and various other on- and off-campus performances of Christmas Music, December, 1996.

A Celebration of Mozart, as performer: "Bella mia fiamma", concert aria by Mozart; as director: "Ave Verum Corpus" for orchestra and chorus; & and as choral director and performer: "Credo Mass in C", UT-Dallas Community Chorus and the UT-Dallas Chamber Singers, November, 1996.

Of Birds, Beasts and Bugs, music by Morley, Lasso, Vautor, Banchieri, Janequin, Stroope, Haydn and Wilberg, UTD Chamber Singers, Spring Arts Festival, April, 1996.

Christmas Carols from Around the World, UT-Dallas Chamber Singers, for the Winter Arts Festival, UTD Chamber Singers; pre-concert performance, 20th Annual Messiah Sing, and various other on- and off-campus performances of Christmas Music, December, 1995.

Dido and Aeneas, UT-Dallas Chamber Music Ensemble and Chamber Singers, performing the role of Belinda and directing the chorus, University of Texas at Dallas, Dallas, TX, December, 1995.

America Sings, Choral Music of the United States, UT-Dallas Chamber Singers, for the Spring Arts Festival, April, 1995.

Nowell Sing We, A Medieval Christmas, UT-Dallas Chamber Singers, for the Winter Arts Festival, and for the 18th Annual Messiah Sing, December 1994.

With the Bach Society Chamber Orchestra & the Orpheus Ensemble:

Director, Bach Society Chamber Orchestra and Chorus, Wachet Auf!, Annual Sing Along Concert, La Jolla, California, May , 1994.

Concert Coordinator, The Organ and its Use by Bach, a lecture/concert for the Annual Birthday Concert of the Bach Society of La Jolla, La Jolla, California, March, 1994.

Afternoon Delight, a concert of Baroque duets with guest artist Elisabeth Marti, for the Bach Society of La Jolla, La Jolla, California, February, 1994.

Director, Bach Society Chamber Orchestra and Chorus, A Mighty Fortress is our God (Cantata #80), La Jolla, California, October, 1993.

Director, Bach Society Chamber Orchestra and Chorus, Sing Along with Bach, a Cantata Concert, La Jolla, California, May , 1993.

Dance and the Music of J.S. Bach, for the Annual Birthday Concert of the Bach Society of La Jolla, La Jolla, California, March, 1993.

Christmas Carols from around the World, a special performance for the patients and staff of Scripps Memorial Hospitals, Encinitas and La Jolla, California, December, 1992.

Rebellious Bach, a concert commemorating the imprisonment of J.S. Bach, for the Bach Society of La Jolla, California, November, 1992.

Coffee Cantata, J.S. Bach, sponsored by local coffee houses, Cafe Cinema, San Diego, California, November, 1992.

Pipes and Reeds II, presented at Mission San Luis Rey, Oceanside, California, September, 1992 and at the MUSE series, La Jolla, California, September 1992.

Concert for the Annual Meeting of the Bach Society of La Jolla, La Jolla, California, March, 1992.

Palomar Concert Hour, duet concert with guest artist soprano Elisabeth Marti, San Marcos, California, February, 1992.

Annual Concert for the Bach Society of La Jolla, music of J.S. Bach and his contemporaries, La Jolla, California, November, 1991.

Holiday Bookreading Concert, poetry readings and music, sponsored by local bookstores, REI Concerts, San Diego, California, December, 1991 and 1990.

Coffee Cantata, J. S. Bach, sponsored by local coffee houses, Sushi Performance Gallery, San Diego, California, November, 1991, 1990 and 1989.

MUSE series concert, an evening of Baroque Cantatas, La Jolla, California, July, 1991.

Brandenburg Award Winner's Recital, Congregational Church of La Jolla, La Jolla, California, May, 1991.

Wachet Auf, J.S. Bach, (Sing-Along version), Congregational Church of La Jolla, La Jolla, California, May, 1991.

Concert/lecture on J.S. Bach and his music, A Birthday Bash for J.S. Bach, Congregational Church of La Jolla, La Jolla, California, March, 1991.

Holiday Bookreading Concert, poetry readings and music, sponsored by local bookstores, REl Concerts, San Diego, California, December, 1990.

Coffee Cantata, J.S. Bach, sponsored by local coffee houses, Sushi Performance Gallery, San Diego, California, November, 1990.

Concerts in Historical Settings, Mission San Luis Rey, Oceanside, California, April, 1990.

Annual Concert for the Bach Society of La Jolla, music of J.S. Bach and his contemporaries, La Jolla, California, November, 1989.

100th Anniversary Concert, Congregational Church of La Jolla, La Jolla, California, November, 1989.

Benefit Concert for the Lifesavers Foundation, Joshua Kaplan Fund, Solana Beach, California, June, 1989.

Concerts in Historical Settings, Mission San Luis Rey, Oceanside, California, April, 1989.

Annual Concert for the Bach Society of La Jolla, La Jolla, California, November, 1988.

Concert for the Bach Society of La Jolla, La Jolla, California, April, 1988.

All Bach Concert for the Bach Society of La Jolla, La Jolla, California, October, 1987.

Other Performances:

A Valentine's Tea and Concert, music of Gershwin, Berlin and Cole Porter, a benefit for the music fund of the Congregational Church of La Jolla, February, 1994 and 1993.

Director, Bach Society Singers with the San Diego Double Reed Ensemble, for A Wake for J.S. Bach, La Jolla, California, July, 1992.

Concert coordinator and soprano soloist, Sing Along Performance of J.S. Bach's Magnificat, La Jolla, California, May, 1992.
Duet Concert, romantic and baroque vocal music, Chula Vista Public Library, Chula Vista, California, November, 1989.
Die Schoene Mullerin, Franz Schubert, Del Mar, California, private reception, June 1987.
Guest performer, Sammis Conservatory of Music, Del Mar, California, March, 1987.
Fredericka Manor recital for Pacific Chamber Opera Out-reach program, a program of women's music, Chula Vista, California, February, 1987.
Casa de Manana recital for Pacific Chamber Opera Out-reach program, art songs of the romantic period, La Jolla, California, August, 1986.
Lecture recital, Words and Music Bookstore, lieder by Schumann and canciones by DeFalla, San Diego, California, June, 1986.
Concert, Atheneum Music and Art Library, art-songs and lieder, La Jolla, California, January, 1986 .
Cantata #51, J.S. Bach, La Jolla Congregational Church, La Jolla, California, December, 1986.
Concert of Spanish and German music, La Jolla Congregational Church, La Jolla, California, November, 1985.
Concert, Scripps Cottage Concert Series, San Diego State University, San Diego, California, November, 1984.

Opera and Musical Theatre Roles:

Mother Abbess, *The Sound of Music*, Repertory Company Theatre, Richardson, TX, December, 2005.
Socrates, *Socrat (Satie*), March, 2000.
Anne Truelove, *The Rake's Progress*, February, 1999.
Suor Isabella, Chamber Opera by Robert X. Rodriguez, November, 1998.
Belinda, *Dido and Aeneas*, UT-Dallas, December, 1995.
Anne Page, *Merry Wives of Windsor*, Pacific Chamber Opera, La Jolla, California, July, 1986
Norina, *Don Pasquale*, Opera Theatre of Washington, Washington, DC, May, 1982
"Mom," *The U.S. Express* (an original show), Opera Theatre of Washington, Wolf Trap Farm Park, Virginia, Summer, 1982 (8-week run)
Laetitia, *The Old Maid and the Thief*, Opera Theatre of Washington, Washington, DC, March, 1982 and September, 1981 at the National Press Club
Gilda, *Rigoletto*, Opera Theatre of Washington, Washington, DC, March, 1982 and September, 1981 at the National Press Club (scenes)
Papagena, *The Magic Flute*, Opera Theatre of Washington, Washington, DC, March, 1982 (scenes)
Mrs. Ford, *The Merry Wives of Windsor*, Opera Theatre of Washington, Washington, DC, March, 1982 (scenes)
Gretel, *Hansel and Gretel*, Opera Theatre of Washington, Washington, DC, December, 1981 (scenes)
Nymph, *The Nymph and the Farmer* (Tcherepnin), Opera Theatre of Washington, Washington, DC, December, 1982 (Washington Premiere)
Micaela, *Carmen*, Opera Theatre of Washington, Washington, DC, September, 1981, at the National Press Club (scenes)
L'Enfant, *L'Enfant et les Sortileges*, La Jolla Civic Orchestra and Chorus, La Jolla, California, March, 1979
Susannah, *Le Nozze di Figaro*, Pacific Lyric Theatre, San Diego, California, August, 1978
Fiordiligi, *Cosi Fan Tutte*, Young Artists Experimental Opera Theatre, La Jolla, California, April, 1978
Soprano, *The Four Note Opera* (Johnson), Young Artists Opera Theatre, La Jolla, California, April, 1977 (West Coast Premiere)
Betly, *Betly* (Donizetti), Young Artists Opera Theatre, La Jolla, California, April, 1977 (U.S. Premiere)
Therese, *Hochzeitsbraten* (Schubert), University of California, La Jolla, California, November, 1976
Celie, *Signor Deluso* (Pasatieri), Young Artists Opera Theatre, La Jolla, California, March and May, 1976
Nora, *Riders to the Sea* (Vaughan-Williams), Young Artists Opera Theatre, La Jolla, California, March, 1976
First Lady, *The Magic Flute*, Young Artists Opera Theatre, La Jolla, California, November, 1975