

the

Exley

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THE UNIVERSITY OF
TEXAS AT DALLAS
UNDERGRADUATE
RESEARCH JOURNAL



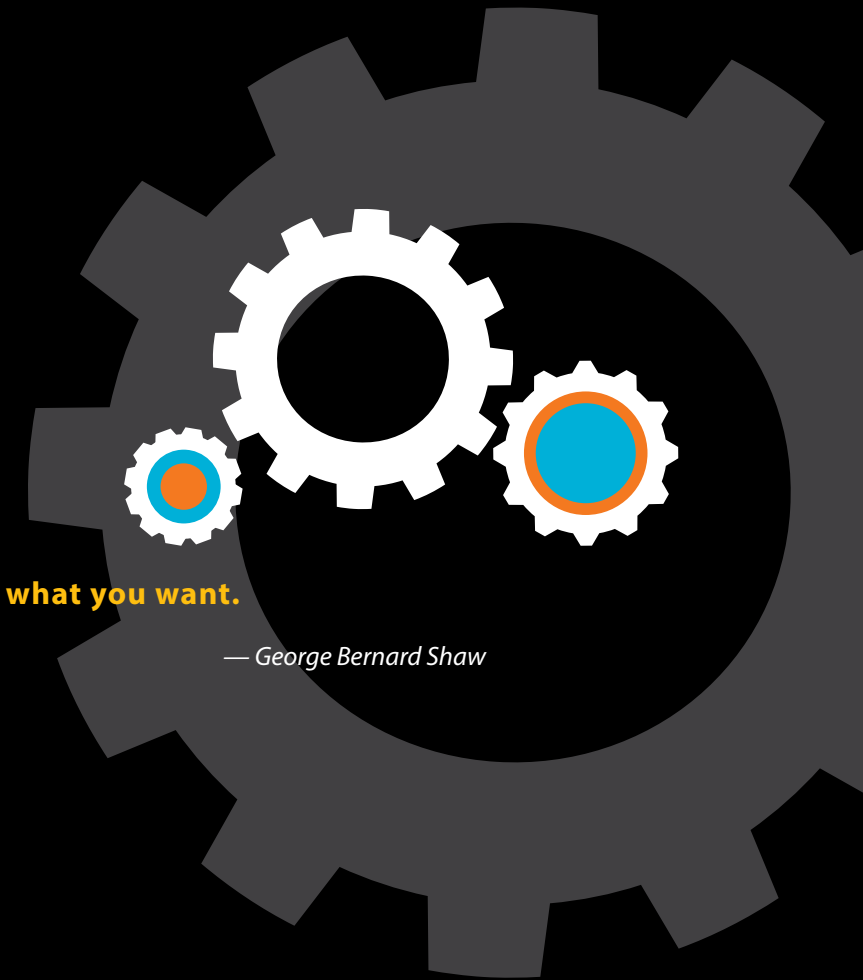
The Creative Mind at Work

Featuring

- What Shapes You? — by Jean-Jean Gwo
- Personal Space — by Holly Lynn
- Understanding the Molecular Basis of Pediatric Bone Cancer — by Anandini Sunil Rao

Imagination is the beginning of creation. You imagine what you desire, you will what you imagine and at last you create what you want.

— George Bernard Shaw





About The Exley




Sheila Amin Gutiérrez de Piñeres, PhD
Dean of Undergraduate Education

Dear Readers, The articles and creative works published in *The Exley* showcase the hard work and dedication of the student authors and their faculty mentors. I hope these works inspire other students to become engaged in research and share their creative work with our university community through *The Exley*.

UT Dallas values the undergraduate research experience and encourages its students, regardless of discipline, to speak out and participate in the creation of knowledge. UT Dallas undergraduate students are engaged in research activities with our nationally recognized faculty and post-doctoral fellows. *The Exley* was established to provide a platform for UT Dallas undergraduates to publish research articles and creative works.

The works published in *The Exley* reflect the valuable and enriching experiences UT Dallas provides students and the impact of faculty research on undergraduate education. *The Exley* is managed by the Office of Undergraduate Education and is produced in collaboration with staff, administration from each school, faculty, and students.

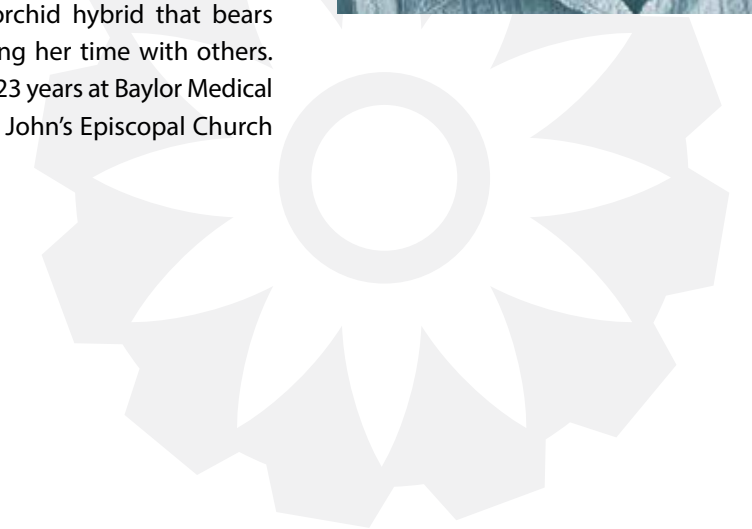
In closing, I would like to personally thank Ms. Elizabeth Exley Hodge, who dedicated nineteen years to UT Dallas as an employee. Her generous support helped found this journal. *The Exley* is named in her honor. The Office of Undergraduate Education recognizes her generosity and commitment to continued excellence in undergraduate research.

The Spring of 2011 found Ms. Elizabeth Exley Hodge making a generous donation to support the publication of UT Dallas' first interdisciplinary undergraduate research journal. Hodge's maiden name, Exley, represents the rich history of her family. Her brother, John, searched records in Manchester and Halifax, England in 1971, which revealed that the surname Exley was believed first to be Ecclesley, dating from 1245, meaning "Church Fields." The area where her great-great-grandfather was born now exists as Exley Hall in Yorkshire, England. Several in the current family have visited there. The journal was named *The Exley* to show the University's appreciation of Hodge's support.

The Exley Name

Elizabeth Exley Hodge Biography

Hodge was born in a small farming community in Worcester County, Maryland, in 1920. She is one of eleven children of Lola Marie Watson and John O. Exley, who had distinguished himself with a gold medals in rowing at the 1900 and 1904 Olympic Games. After high school, Hodge lived nine years in Philadelphia, where she worked for an insurance company. When World War II was declared, she volunteered in a program with the U.S. Air Corps, where she met the man she later married, Noble H. Hodge, from Fannin County, Texas. They were married in 1942. Following his military service in England, they moved in 1945 to Dallas, Texas, where Hodge still resides. In 1967, Hodge joined the administrative offices of the Southwest Center for Advanced Studies. When the center became UT Dallas in 1969, she transferred to the Department of Biology in the School of Natural Science and Mathematics, where she assisted faculty members preparing research grant applications. After a number of years in grants management in the school of Natural Sciences and Mathematics and later in the Office of Sponsored Projects, she retired in 1986. Hodge has been an avid gardener for many years. She has a personal arboretum and an orchid hybrid that bears her name. She enjoys cooking and sharing her time with others. Hodge has volunteered weekly for the last 23 years at Baylor Medical Center in Garland. She is a member of St. John's Episcopal Church near her home.



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About the creative contributors



Cara Curley is a sophomore arts and technology major from Portland, Oregon. As a proud Bryce Jordan Creative and Performing Arts Scholar, she aspires to become a production artist for games and film. Currently, she serves as an officer for the Student Game Developer Alliance and Animation Guild at UT Dallas, and has produced artwork for a variety of games and student animations. Her lighter works appear around the UT Dallas campus in the form of club posters and off-beat cartoons. She can most often be found huddled over a computer and drawing tablet, and she would greatly appreciate it if someone brought her some more caffeine.



Adbeel García Cardoso was born in Cuba, came to the States at the age of 7, and is now a literary studies major with a minor in creative writing at UT Dallas. He occasionally dabbles in writing as well as photography and drawing. A few of the writers who inspire him include Kafka, Cortázar, and McCarthy. He aspires to go to graduate school and to become a professor.



Jean-Jean Gwo is a junior pre-dental biology major from Plano, Texas. Art has been her passion ever since she was a young girl. In elementary school, instead of paying attention in class, she would fill all her textbooks with small drawings from her imagination. Painting and drawing have become forms of her self-expression. Once she starts drawing, she is completely absorbed into her own world of serenity. Currently, Jean-Jean plays tennis competitively for the UT Dallas women's team, researches at Baylor College of Dentistry, and volunteers in the community on a weekly basis. Upon graduation, she hopes to enter dental school and pursue her dream occupation that is a perfect blend of art and science.



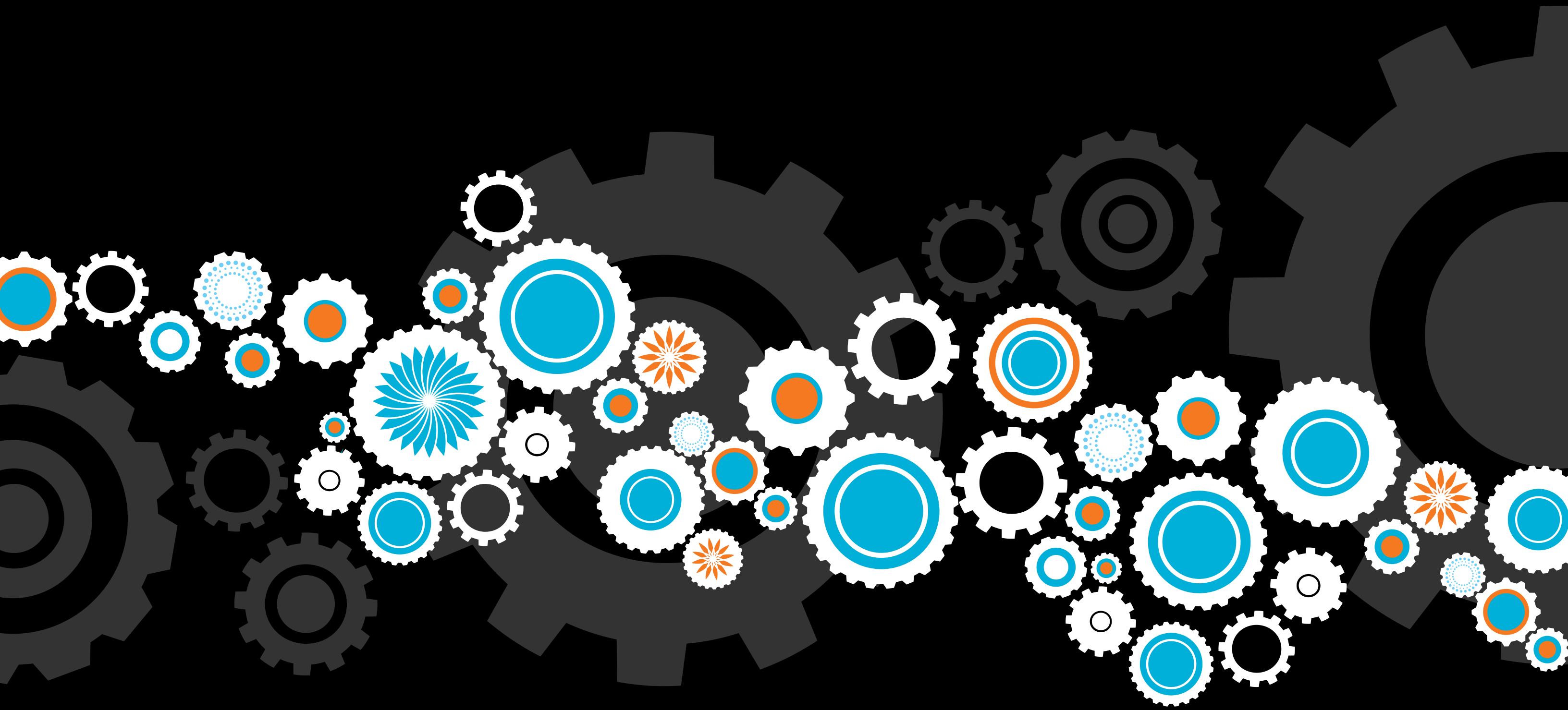
Kenneth Livingston is a sophomore electrical engineering major from Dallas, Texas. During high school, his interests revolved around music and technology. These interests inspired him to pursue a degree in electrical engineering, a field which connects the two subjects when applied to professional audio engineering. Kenneth constantly acquires knowledge to better prepare himself for interactions in the professional world. In addition to providing live entertainment at parties and weddings, he interned at Audio Electronics as a repair technician, handling a variety of equipment ranging from Jimmy Buffett's guitar amplifier to a mixing console used by Willie Nelson. He currently contributes to the Institute of Electrical and Electronics Engineers (IEEE) UT Dallas Student Chapter as the vice-chairman for the 2012-2013 academic year.
Honors: Jonsson School Academic Success Award (Fall 2012)



Samir Patel is a senior from Colleyville, Texas, majoring in biochemistry. He is also simultaneously pursuing a master's degree in business administration and master's of science in supply chain management from the UT Dallas Naveen Jindal School of Management. His hobbies include investing, gardening, and creative writing. His career goal is to become the chief executive officer of a Fortune 500 company.



Holly Lynn from Allen, Texas, is a senior obtaining a bachelors' in arts and performance with a concentration in photography. Born and raised in the North Dallas Fort Worth area, Lynn has indulged in the many opportunities the region has to offer the visual artist. She feels the need to capture her surroundings, in the hope that others will see the unique moments that make up our day-to-day lives, because she believes still images can make strong statements in this technology-savvy society. She has been photographing for over ten years, all because she picked up her father's film camera and could not put it down. She has gained many techniques along the way and has learned the skills required to satisfy clients as a freelancer, all while projecting thought-provoking ideas with personal projects in between work and school.



Creative



Fairytale

There are some traditional artists that consider digital artists ‘cheaters.’ There’s a false perception that the computer does all the work for you and miraculously creates artwork for the artist with a few clicks of the button. Being primarily a digital artist, I have to disagree. My computer isn’t just a medium to me; it becomes an extension of myself while I draw. My mouse journeys across the screen with my hand and thoughts, and I channel all of my emotions, all of my colors, all of my patterns onto the virtual canvas with ease.

The result of this feels like a transfer of consciousness. I become one with the machine and my imagination, and can use this wholeness to create endless of worlds and designs. Hours later, I snap out of my daze and observe what I’ve created, and more often than not I can translate an image I’ve seen in my mind’s eye into a digital format. This process has become a part of my daily routine; I can’t think of a day in the past five years where I haven’t had a Photoshop window open.

My love for digital drawing was spawned from an early love of cartoons and my yearning to replicate the professional quality of work I saw on the television screen. After years of disappointment (realizing that I couldn’t just copy other artists’ rendering styles), I began to find my own path, inspired by a variety of cartoonists and illustrators, and I began to pour my heart and soul into a world of my own design. The result of this is artworks like “Fairytale,” which have emerged from years of practice and joy.

— by Cara Curley



Wolfsong

This past summer, I had the opportunity to create a variety of conceptual illustrations for “Wolfsong,” a Game Lab production for Fall 2012. The game takes place in a dreamlike version of a spirit forest, and I drew inspiration from the forests near my home in Portland, Oregon. Being primarily a digital artist, I composed all of the concept illustrations in Photoshop, and constantly battled with creating a natural, ethereal feel to the pieces within a rigid technological application. Through a combination of unnatural shapes of the trees and glowing lines that permeate the image, dim and scattered light, and a wide range of color, I molded a mystical environment that is currently serving as a basis for the creation of a three-dimensional virtual landscape.

— by Cara Curley



I don't pretend to uncover truths, only possibilities. Fear is one of our most innate and overwhelming emotions, seen as an evolutionary advantage because of its ability to trigger the "flight" response. One day it occurred to me that maybe people live with a half-subconscious anxiety which rules the decisions they make throughout their lives; hence, most decisions are made with the purpose of "fleeing" a situation which would force one to confront that anxiety. To understand this underlying force is to understand yourself better, and to understand yourself is to know all you need to know. But intense fear also has the power to cripple, as it does in numerous phobias. Is it possible, then, to be able to understand this aforementioned anxiety without crippling yourself in the process? Or is the crippling process crucial to understanding? Is the end of the poem a triumph or a tragedy for the child? These questions may focus the reader on the various possibilities presented in the poem.

The poem is foremost centered around a chiasmic structure, which is evident not only in individual phrases such as, "Live undaunted if you must,/ But should you dare to live with fear," but also on a larger scale, like in the rhyme scheme of the non-italicized stanzas: ABBA. This structure is meant to emphasize the dual, cyclic nature of the poem. In the poem, opposing ideas are often juxtaposed and treated as equals, offering an ambiguity which is meant to be enriching. An iambic meter permeates the poem, but is occasionally interrupted. After all, the narrator claims to be interpreting the cicadas' sound, which is described as a "symphonic dissonance." Anyone who has heard cicadas knows what I'm talking about. The poem is that same, syncopating "white noise." In order to capture the song of the cicadas better, I use repetitive consonance of the sounds "r" "t" and "s." Also, I pay special attention to the long "e" sound as in "fear." Overall, the poem became naturally alliterative, as if taking a life of its own. These stylistic choices weave anxiety into the poem in the form of the insect's shrill vibrations.

Maybe it's just me, but those little creatures kind of creep me out. Anyway, I recommend reading the poem while listening to a chorus of cicadas.

— by Adbeel García Cardoso

*A syncopation of cicadas echoes
In symphonic dissonance
Through the trees,
Where a child
Scurries scared—
Here is what they seem to scream:*

Live undaunted if you must,
But should you dare to live with fear,
{This white noise in my ear}
And strain your eye upon the dust

Which rushes from the future, swarms
Your fields, devours cattle, makes rust
Your sword, then breeds your mate's mistrust,
Smothers dreams and many nightmares warms—

*The child crashes into a tree,
A horde descends,
Awoken from its peace,
And like medieval Buddhist priests
It seeks to crack the body like the soul with shrieks:*

And should you dare
To bear its unrelenting forms:
The chokes, the cheers, the breeze, the storms—
And in your room where winter air

Crawls in to lick your dirty face
{Something's burrowing inside my skull...
This brain will be as chewed as cud}
You pray and pray for this affair with sheer disgrace—

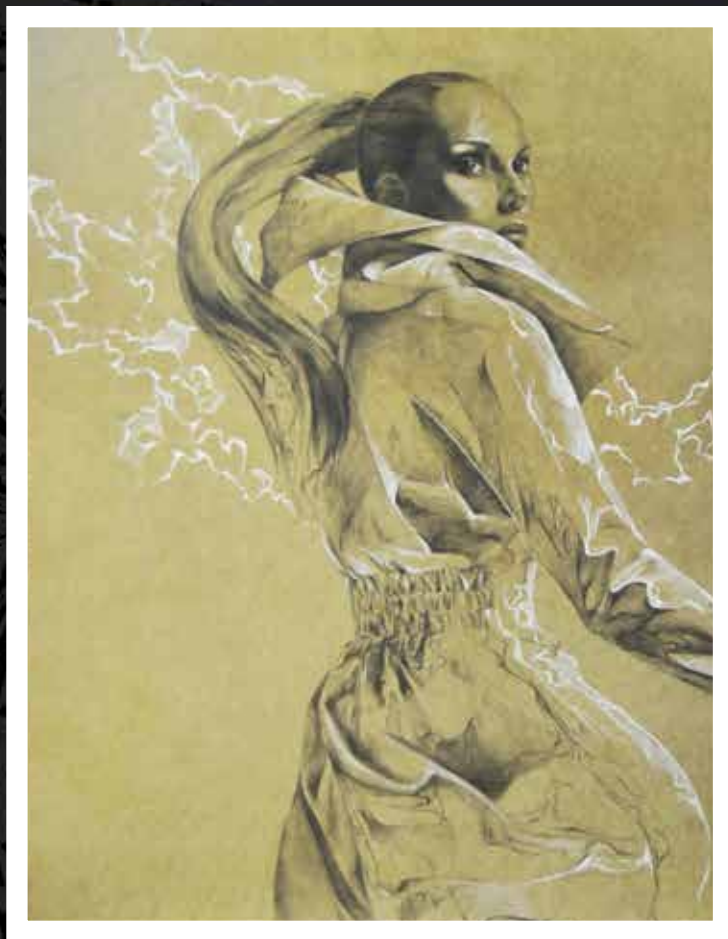
*In the morning the child
Awakes to a certain silent buzzing,
Whose source remains uncertainly internal.
Sure, the search party sees him
But can't comprehend the child's chatter.*

{And should I bear the whispers and the jeers,
Sickly fingers stabbing through physical frontiers,
Most notably these ears}
"What's the child up to now?" they squeal—

Should you dare all this, what then?
You'll eat your last fat hen
And render all those saints debased:
Sounds and Silence, Stagger and Chase.
Will it have been worth it, then?

*Some nights,
Feeling fully alone,
The child disappears
Into the vast emptiness of the forest
To climb some tree
And shake like a cicada.*





What Shapes You?

My artwork surrounds the idea of social standards and the influences they have on an individual. On these wood surfaces, I drew figures with abstract objects unraveling in their heads and bodies to symbolize the idea of fabricated lies and outer influences. The use of these abstract objects covering or infesting parts of the bodies symbolizes the outside influences that each and every individual needs to go through every day. The use of my media, graphite pencils and white charcoal, allows me to add fine details and precision to the figures and the line work. The wood gives the painting a slight texture that you can only see in person which makes each individual piece a lot more appealing and personal. Although I plan out the bases of what I want to draw, working from a crumbled paper still life has given me the excitement of not knowing exactly what the final product will turn out to be. All of the abstract shapes were drawn on separately, making the shapes and forms almost grow and extend continuously by themselves. That particular idea of uncertainty mirrors the concept of not having full control of your life and future. Unknowingly, so much of what we do and who we are is influenced by what is around us. The discovery of self is sometimes intimidating because it may be hidden by what you are expected to see.

— by Jean-Jean Gwo







DOMINO

There exists a symbiotic relationship between a man and his art. An image expresses a specific truth that is unique to each artist. My work not only reflects my passion for music, but has also driven me to gain notoriety in the vast and exciting world of live DJ'ing.


This image of the antique record player inspired in me a wave of exploration into providing entertainment. Art is often passive; however, music is always extremely active. Music is unique in that it can be admired for the quality of the work itself in addition to being used literally to move those who are experiencing it.

My story begins with an accident. Before college, I restricted my skill to a digital camera. As my interest in music became more pronounced in my work, I began opening up to music. I soon found myself setting up speakers at house parties, where I quickly earned the nickname DJ KEN. Fast forward two years, and I find myself providing entertainment for 600 young UT Dallas students, at a dance which resembles the atmosphere of a night club. Breaking the restrictions of my own narrow-mindedness allowed me to flourish in this competitive DJ atmosphere.

Music persists in our culture as a tool of expression and inspiration. I relish the fact that I can drop a beat and influence hundreds of people with just the click of a button. My job as a DJ extends beyond playing music at an event. During a set, I synchronize with the audience and create an atmosphere to perpetuate the mood that evening. Music comes in many different flavors, and it is a sign of great skill when one can select the perfect track from a vast inventory of albums. It is a powerful moment when a DJ is able to excite a group of people beyond the confines of the event's walls and garner support for their skill. Who knew this would occur with the simple shutter of my camera?

This image, in particular, embodies my interaction with music. The needle of the record player is used to bridge the gap between the physical music and an audience, much like a DJ connects an audience to his selection of music. The entire contraption, record player and speakers, has the power to persuade its listeners. Each component relies on another to provide a continuous stream of entertainment. The DJ would be nothing without his equipment, especially his library of music; just as a record player would be nothing without a record. And the DJ serves as the head of his (musical) setup, like a needle as the head of a record player. And how good is a record player without the mechanism to release the music?

— by **Kenneth Livingston**



BOTTLES

Ever since I was young, I have loved stories and the way they immerse you in someone else's world. Inevitably, learning about someone else's world teaches you more about your own. As soon as I was old enough to be able to, I started writing my own short stories and novels. Each one is fundamentally a message, or a thesis if you will, developed in narrative form through the events, and, more importantly, the emotions, that the characters experience.

Bottles was written in thirty minutes on a night when I was particularly frustrated; it was synthesized from a depressing news headline (or five), a personal issue one of my close friends was dealing with, and a general distaste for the "party" mentality worshiped by altogether too many college students. It's a departure from my normal stylistic preference (first person, past tense), but I wanted to change it up as an exercise.

— by **Samir Patel**

A fourteen year old boy sits in front of a computer.
He's a freshman in high school, a pretty good student – As and Bs, taking a couple APs. Good kid to boot – he spent the summer volunteering with his father's church, building houses for the homeless. In the evenings, when the summer sun abated to an almost bearable level, he cut his neighbors' lawns for movie money.
The only part of that that matters now is the reason he's here. His dad's occupation: pastor.
He glances at the bottle. Interesting label: ETHYLENE GLYCOL, 95% WT. Antifreeze. The same stuff they put in cars.
He's been keeping it under his bed since summer.
Tonight's the night.
He pours himself a glass.
It tastes sweet.
He logs onto Facebook for one last look at the people who used to mean something. His home screen is filled with the remnants of his schoolmates' token messages in honor of his recent birthday. A hundred and twenty three people wished him. Seventeen were thoughtful enough to include an emoticon, caps lock, or extra exclamation points.
It would only take one word – one fatal word – for all but three of them to defriend him. Not just on Facebook, but in real life too.
He navigates to the profile of a boy he knows. His best friend. He smiles sadly at the profile picture – it's the two of them, standing on a boat. They're holding a bigmouth buffalo they caught. It was forty eight pounds. Pretty close to the state record.
The boy sighs. There was a conversation he'd always wanted to have with his best friend.
But it's too late for that now.
He picks up the bottle and tips it to his mouth.

Three houses down, a nineteen year old guy stumbles around in a darkened room, laughing.
He's a freshman in college, a terrible student – rubber-stamped Cs only because he was on the high school football team. Douchebag to boot, the type that lets doors slam in little old ladies' faces.
He barely made it into the state college. The only reason he's here is his dad's occupation: United States Senator.
He glances at the bottle. Interesting label: GREY GOOSE. 80-proof vodka. The stuff everyone who's anyone gulps down like mother's milk every Friday night. And Tuesday night. And, really, every night.
He grins. He's on number nine – or is it ten? He can't remember.
He pours himself a glass.
It burns his throat going down, but it's so worth it. After all, partying's the point of life. That's what he learned in high school, anyway.
"More," chant his classmates. He's their hero – he parties the hardest.
He picks up the bottle and tips it to his mouth.

The boy's mother is the first to find him.
She's distraught, naturally. She calls her husband, who's quite annoyed as he stamps up the stairs.
Wife didn't even have the decency to let him finish the newspaper.
He sees his son, who's barely clinging to life. The pastor steps around a puddle of puke, furrowing his eyebrows distastefully.
He knows they should probably call the hospital, but he's not sure if it's worth it.
"It's okay," he says, consoling his wife. "Trust in the Lord. He has a plan for all of us. We just can't see it."
They leave the room to notify the authorities.
They never notice the Facebook message from their son's best friend. It was sent at two in the morning – several hours after their son finished the bottle.
The subject line: SOMETHING I REALLY NEED TO TELL YOU.
Hey, it starts. I've been thinking about this for a while, but I couldn't find the right moment to say it...

The guy wakes up, groaning. A thin layer of newspapers does nothing to make the damp concrete any more comfortable.

“Where – where am I, man?” he asks, slurring.

“County lockup,” replies the officer on the other side of the bars, not bothering to shoot the loser so much as a glance.

“Hey, man, I need my –” The guy swallows, trying but failing to rid his mouth of the dry sweetness. “Need my phone call, man. My dad’s –”

“Right here,” announces a commanding voice. The senator strides through the door. “I thought I told you to release him?”

The officer still doesn’t make eye contact. “He was out cold,” he says shortly, unlocking the cell.

The guy leaves, glad to be away from the other residents – they were quite seedy. The underbelly. Not the type he likes associating with.

“So what happened?” asks the senator, waiting as his chauffeur kindly opens the limo’s door. He steps inside, being extra careful not to crease his two thousand dollar Gucci suit.

“Not sure.” The guy groans again – his head hurts. He can’t remember much. The night was a blur of bra straps and broken teeth. “We were – we were doing shots of vodka.”

“How many?”

He thinks. “Twelve, at least.”

“Two away from my record.” The senator pats his son on the back. “Well done. Next time, just try not to get caught – looks bad when you run for office.”

“Mmm.” His son’s half listening, more interested in checking his cell phone.

His best friend had sent him a message twenty minutes ago.

hey, were r u bro? need 2 find new digs 2nite, his uncle came back early

The middle aged man steps over the puddle of puke in the middle of his living room. It was beyond repair. He hadn’t even bothered trying to clean it up.

Definitely the last time he would ever leave his keys with his in-laws while he was on a business trip.

He kicks aside a bottle emblazoned with the words GREY GOOSE and clicks on the TV, flicking through the channels. There aren’t many options on a Saturday morning.

“And our communist government,” shouts the balding anchor, “has mind-control techniques to –”

He groans. Changes the channel to another cable news network.

“And what’s wrong today,” says a man with a horribly unkempt beard, “is we’ve got all these corporations profiting –”

He changes the channel again, abandoning the cable networks in favor of the local news.

“The senator, currently seeking reelection, has no comment on the rumors – though a source inside his campaign claims the police are harassing his son in retaliation for his accusations about their use of pepper spray in recent months. And in other news, the son of a local pastor is in critical condition at Lakeview Hospital after an apparent suicide attempt.” A picture of the boy flashed across the screen. “So sad. Now let’s go to our correspondent in the field for more on the Kardashian breakup”

He powers off the television, disgusted.

It takes him a few seconds to remember – he knew that kid. Lived up the street. Good young man. Fourteen, maybe fifteen. He’d mowed the lawn in the summer a few times, ten bucks a go – done a pretty good job too, besides leaving a couple edges untrimmed.

Despite what the newscasters said, he knew what was wrong – and what wasn’t.

It wasn’t the corporations that provided the goods and services needed to keep the fragile economy going. It sure wasn’t the police keeping the peace by controlling violent rioters.

He knew it was wrong that the decent kid down the street was dead, just an afterthought on the morning news, and the college kids who’d trashed his house got to get away scot-free – their vodka-aided exploits to serve as modern day bards’ tales. He stands up, pushing the thoughts out of his mind. Winter’s coming, and he has a lot to do today. First of all, he needs to grab a bottle of antifreeze from the store – his car’s just about out.

Funny thing, that. He could’ve sworn he’d bought a full bottle sometime during the summer, when it was on sale. But when he’d checked the garage for it last week, it had mysteriously gone missing.

Luckily, antifreeze isn’t the most expensive thing they sell in bottles.

Dee, Age 74



Personal Space

The concept for *Personal Space* involves a certain curiosity. When entering into one's atmosphere, I am transferred into another world: the world that is created unlike any other through the arrangement of furniture, colors, objects and treasures. I portray my concept of personal space as a new idea, separated from the dictionary's term. To me, it's the space a person occupies and spends his or her time in. People of all ages create an environment that they control and be a part of; it's what we strive in our society: a place to fit in and be welcomed. This same place is built upon a person's character, it identifies who he or she is.

I captured several personal places throughout this project and enjoyed the uniqueness and quality each one had. I have been welcomed in by friends and family in the sharing of these places, and in return have captured who they really were, in their own environment. Each person's space is captured by black and white images, using natural light.

The people I chose for this project were people I came into contact with fairly frequently: co-workers, friends and relatives. In these photographs, I show their personal room/space they spend their time in the most. I chose to shoot black and white documentary, in order to capture the reality of each person and the creativeness he or she expressed.

Each image has more to look at than meets the eye, the details and emotions were pure, as the people shared their stories and allowed me to really know them. This project allows others to see into the worlds of their fellow mankind. My camera was just the tool to bring awareness to everyone's creative side.

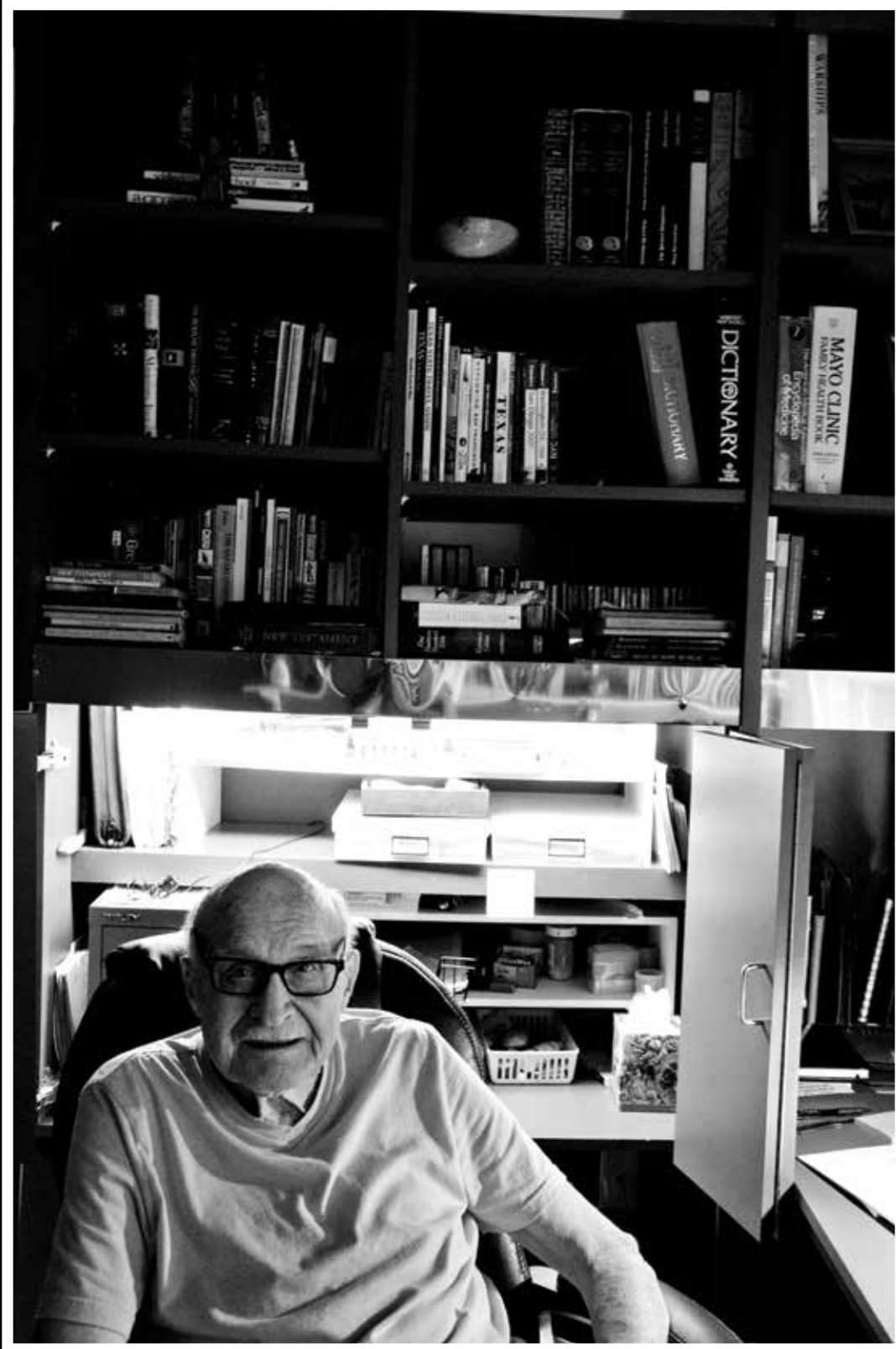
— by Holly Lynn



Andrew, Age 25



Dustin, Age 30



Ed, Age 88



Jayna, Age 16



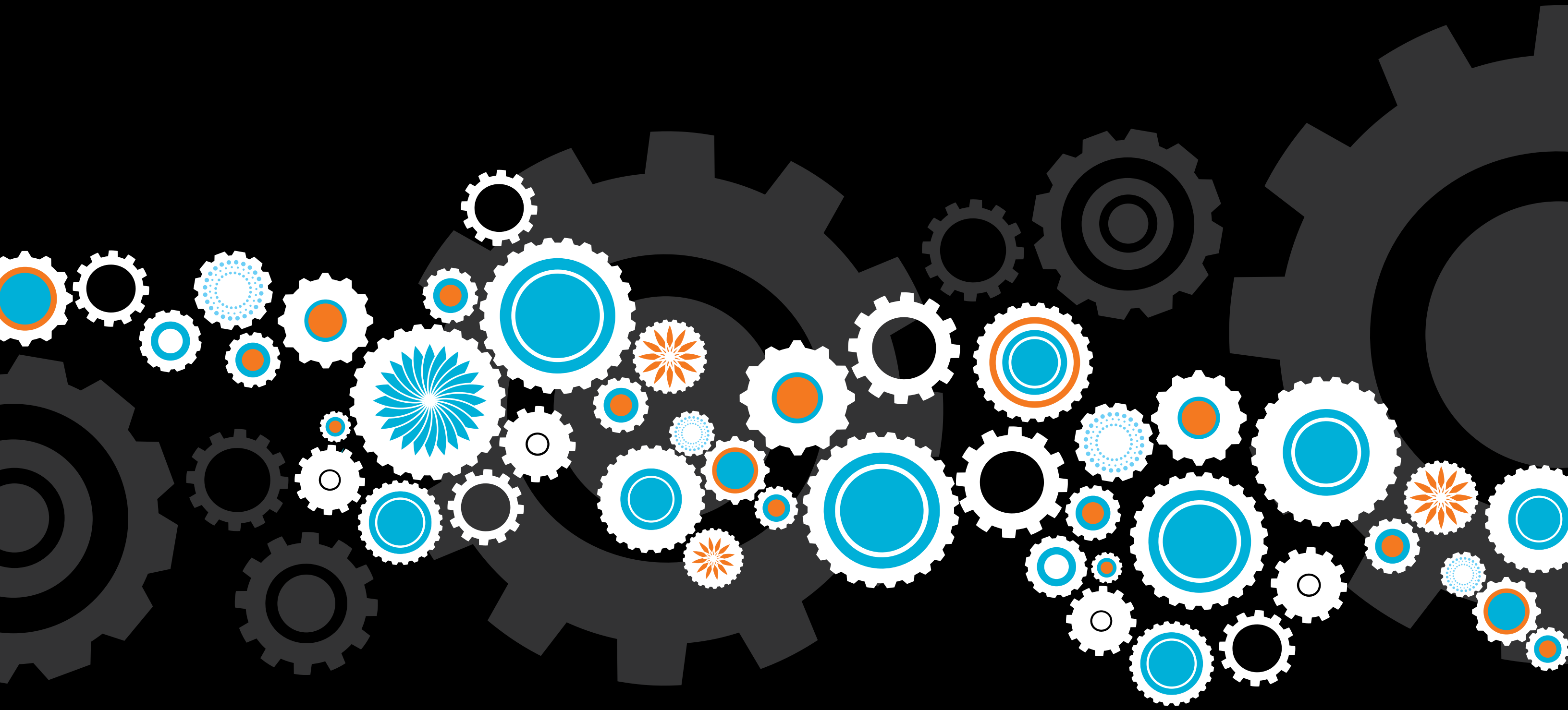
Jason, Age 22



Rainee, Age 2



Steph, Age 35



Research

About the **research** contributors



Jennifer LaPrade is a senior political science major who returned to college to pursue her academic dreams after working as a journalist for many years. Jennifer has always had a passion for law and the American legal system, but no legal system is ever perfect. Therefore, her research with the Innocence Project of Texas in Dallas, involving the wrongfully convicted prisoners the organization has helped set free, has been particularly fascinating. As an intern with the Innocence Project of Texas, she helps attorneys comb through trial transcripts and evidence to determine and prove the innocence of convicted prisoners who may be wrongfully imprisoned. Jennifer is a member of the UT Dallas Mock Trial team, the Mediation Program, the John Marshall Pre-Law Society, and the Student Media Operating Board. After graduating this spring, Jennifer plans to continue her education at UT Dallas by pursuing a master's degree in constitutional law, and she hopes to one day attend law school.



Mayu Takeda is a senior from Denver, Colorado. She is pursuing a degree in political science and a minor in psychology. During her sophomore year, Mayu began researching immigration policy and has spent the last year analyzing the implications of reauthorizing the V visa as a member of the UT Dallas Debate Team. While interning at the Center for American Progress as a Bill Archer Fellow in Washington, D.C., she published an argument for reinstating the V visa. She is currently collaborating with Dr. Joel Swerdlow, with whom she has co-authored a book on economic growth, *A Larger Pie*. Takeda is the founding president of the Comet Debate Society and the president of Pi Sigma Alpha, the political science honor society. In her spare time, she likes to explore various ethnic foods and watch *My So-Called Life* on Netflix.



Anandini Rao is a biology major from Coppell. She is currently a Green Fellow at the University of Texas at Southwestern Medical Center (UTSW). Anandini is on the pre-med track at UT Dallas, and her research interests range from cancer to cardiology. Outside of class, she is an editor for the Collegium V Honors Newsletter and loves to crochet baby booties, start and finish 1000 piece puzzles, and draw henna. Her research experiences include internships in the Clark Summer Research Program and the Summer Undergraduate Research Program at MD Anderson Cancer Center. Her work at MD Anderson, featured in *The Exley*, details an exciting breakthrough in understanding the role of a specific growth receptor in the malignancy of pediatric osteosarcoma (bone cancer). If pursued, her angle of investigation could lead to a targeted chemotherapeutic agent in the context of the treatment of osteosarcoma. In the future, Anandini hopes to attend medical school and make both patient care and research important aspects of her future career.

Honors: Collegium V Honors, Green Fellow at UTSW, Academic Excellence Scholarship, Dean's List (Fall 2011, Fall 2012), Clark Scholar, National HOSA Champion in Medical Terminology, State HOSA Champion in Medical Terminology, Biology Olympiad Semifinalist



Nimmy Mammoottil is a senior chemistry major, minoring in political science. She is currently working under Dr. Dennis W. Smith, Jr., on projects involving the characterization of biodegradable polymers for the purpose of creating meshes for prolapsed pelvic organs. Working with various fluoropolymers and rubber particles sparked Mammoottil's interest in analytical and polymer chemistry. Being able to apply the knowledge gained from undergraduate chemistry classes and the influence of professional researchers has allowed her to understand the fascinating world of chemistry better. Her gratitude goes to Dr. Smith, Ben Batchelor, and Shant Aghyarian.



JAMES LEE WOODARD

The Texas legal system is notorious for being tough on crime and giving little mercy to criminals. Unfortunately, that relentless pursuit of convictions sometimes puts innocent people behind bars. Once convicted, prisoners have a very difficult time proving their innocence. The Innocence Project of Texas reviews hundreds of cases each year in an attempt to help those wrongly incarcerated find freedom and exoneration. James Lee Woodard, one of 48 Texas inmates who have been exonerated since 1994, served 27 years behind bars for a crime he did not commit. Here is his story.

— by Jennifer LaPrade

It was an unusually warm sunny morning on New Year's Eve in 1980, as David Sanders and his wife Marguerita drove back to their south Dallas home after selling a load of junk iron to a local vendor. David was always irritated when he saw "No Dumping" signs surrounded by debris, trash and other obviously dumped goods.

"Look at that," he told his wife, disgusted, as he pointed to another such sign near a local river bottom littered with rubbish, junk and waste. Marguerita looked in the direction of the trash and suddenly saw something startling that caught her attention.

"Wait! I think I see a body!" she exclaimed.

David looked in the direction his wife indicated and also saw the shape of a body, but hoped it was just a discarded mannequin. David turned his truck around and proceeded toward the river bottoms on a rarely used, muddy path so they could get a closer look. This was no mannequin. Hidden in the weeds, just under some barbed wire, was the lifeless, brutalized body of a young African American woman—naked except for knee-high stockings around her ankles and shoes.

Shaken, David and Marguerita immediately went to a nearby business to call the police, and then returned to the scene. Three uniformed officers and two detectives from the Dallas Police Department showed up at the site and the investigation began.¹

Who was this young woman? What had happened to her?

Dallas officers took photos of the body from every angle, searched the entire area for more clues and investigated what appeared to be fresh tire marks leading straight to the body.

Nothing else was found at the scene to give investigators any other clues to help solve this gruesome crime.²

The body was taken to the medical examiner, who performed a full autopsy and found the victim had been violently raped vaginally and anally before she was strangled, which ultimately caused her vicious death. The doctor also found several lacerations indicating blunt trauma on the victim's face and neck as well as on her shoulders and other areas of her body. Based on dried blood and rigor mortis, the doctor estimated the time of death to be the afternoon or evening of December 29, 1980—two days before the body was found. The death was ruled a homicide.³

Identification

Later that same afternoon, local media released reports that an unidentified African American female body was discovered in the river bottoms of south Dallas. Oscar Edwards, a Dallas welder, heard the radio reports on his way home from work. He immediately feared the worst.⁴

Just two days earlier, Edwards was awakened around 3 a.m. by knocking at his door. He stumbled to the door and opened it, finding a familiar man asking to see Beverly Ann Jones, Edwards' stepdaughter who lived with him. Edwards told the man Beverly was not home and went back to sleep. Edwards identified this man as James Lee Woodard, Beverly's boyfriend of more than two years.⁵ Later that day, two neighbors at Edwards' apartment complex informed him they had both heard Beverly screaming, "Daddy help me! Please help me!" as she got into a car that same night around 3:30 a.m.⁶

"She was in the car with (Woodard) and he was speeding out of here as if he was crazy or something, and beat her up," one neighbor said. "She was screaming and calling you to come help her."⁷

The second neighbor confirmed the account and said she was sure the car she saw—a black and white Buick Electra 225—was the same one that she had seen on many other occasions and that it belonged to Beverly's boyfriend, James Woodard. She could clearly see Woodard as the driver of the vehicle from her apartment balcony as he sped away with the hysterical Beverly.⁸

Edwards had not seen his stepdaughter since that night. He called the police after hearing the news on the radio and told them of his fears that the body could be that of Beverly Ann Jones. Edwards' worst fears were confirmed when he met with police.⁹ That traumatized and lifeless body was all that was left of the stepdaughter he had loved and raised as his own.

With a positive identification of the body, the police investigation shifted into overdrive to bring to justice the person or persons responsible for this heinous crime.

Oscar told the police about the knock on his door at 3 a.m. by Woodard and gave police the names of the neighbors who said they saw Woodard take Beverly away, just minutes later that same night, as she was screaming. The next day, on January 1, 1981, investigators questioned those neighbors, who both told police exactly what they had seen from two separate apartments—James Woodard driving away from the apartment complex as Beverly screamed around 3:30 a.m. on December 29, 1980—the very day the medical examiner estimated Beverly's murder had occurred.¹⁰

Prime Suspect

Later on January 1, 1981, the police came to Woodard's parents' house looking for Woodard and had him follow them back to the station. Woodard was questioned for approximately four hours that night.

"I didn't believe he was telling me the truth," one of the officers said about that questioning. "He was unemotional. He didn't appear to be upset with the fact that she was dead—someone he told me he had been living with on and off and cared for, but he was very unemotional. Very cold."¹¹

Based on the eyewitness evidence of Oscar Edwards and the two neighbors, Woodard was arrested around 10 p.m. that same night for the murder of 21-year-old Beverly Ann Jones. His car was thoroughly searched, yet no evidence of blood or foul play was found.

Even though Woodard had been arrested for the murder of Beverly Ann Jones, he believed he would be cleared of this crime. After all, he had an alibi. In fact, he claimed he was sleeping in the bed of another woman on the night in question.

In the Jury's Hands

On May 18, 1981, the jury trial began to decide if James Lee Woodard was guilty of the murder of Beverly Ann Jones.

The prosecution's witnesses included the victim's mother, Arthur Lou Edwards, who testified that she "didn't like the kind of guy" Woodard was and said she saw regular scars and marks on Beverly's neck after she started dating Woodard, describing him as an abusive and no-good boyfriend.¹²

The next witness, Beverly's stepfather, Oscar Edwards, had similar incriminating things to say about Woodard. Edwards gave his critical testimony to jurors about the knock on his door by Woodard in the early morning hours of December 29—the day of his stepdaughter's death.

Then came the star witness testimony of one of the neighbors, who testified seeing Woodard driving away with a screaming Beverly on the morning of her murder.¹³

The prosecution painted James Lee Woodard as a volatile man who had a rocky relationship full of conflict and trouble with the murder victim. Two eyewitnesses saw the defendant in a violent confrontation with Beverly on the morning of her murder. Then her body was found. Murdered.

Alibi?

The defense of James Lee Woodard was built around one fact—there was no possible way he could have committed this crime because he had an alibi.

In his defense, a young woman testified that Woodard was with her all night during the evening in question. The woman's aunt also testified that she saw Woodard with her niece that night. James Woodard, 28 years old at the time, took the stand in his own defense, adamantly denying his involvement in this murder and confirming his alibi at the time of the murder. But would the jury believe him?

Verdict

The jury began its deliberations on May 21, 1981 at 4:15 p.m. Just 30 minutes later, the jury had reached a verdict: "We, the jury, find the defendant, James Lee Woodard, guilty of the offense of murder."¹⁴ Woodard was given a life sentence.¹⁵

New Evidence

Less than two months after the trial, James Lee Woodard and his attorney were in the courtroom fighting for a new trial. New evidence had emerged. As it turned out, Beverly Ann Jones was actually with three men on the night of Sunday, December 28, into the early morning hours of December 29—the day of her death. The defense was unaware of this evidence during the trial: the prosecution did have this information, but withheld it from the defense. Therefore, the defense wanted a new trial on the grounds that the State had failed to produce exculpatory evidence.

Not only was she with three other men that night, but one of those men—Theodore Blaylock—was a convicted violent rapist. The defense argued to the judge that this new evidence changed everything and that the prosecution deliberately hid it from the defense.¹⁶

However, the judge disagreed and denied the motion for a new trial.¹⁷

Woodard's appeal was also denied, and Woodard was out of options. He was now serving a life sentence in prison for the brutal murder of Beverly Ann Jones.

Pleas of Innocence

Even though James Lee Woodard was behind bars, he still claimed his innocence and wrote numerous letters to the State asking for help. In one of those letters, dated July 20, 1984, Woodard writes:

"There were two victims in my case, the murdered victim and myself. ...I've appealed to you in every way I can and I'm tired. You seem to be adamant in your decision not to investigate my case, but I won't give up until I get this thing out in the open, because it's wrong for me to be here. It's one thing to be in here for what you've done, but it's totally different to be here for something you haven't done. My communication is limited, but I won't allow that handicap to stop from writing everyone I can think of to bring this grave injustice to light. I'm a young man and I have a right to freedom and the pursuit of happiness just as everyone else."¹⁸

Woodard sent pleas for help for years, but nothing ever happened. He was even up for parole a whopping 12 times, but he was denied every time. Why? Because he would not admit guilt to his crime.¹⁹

The Tide Turns

In 2007, after Woodard had been in a Texas prison for over a quarter of a century, a Texas law student named Alexis Hoff, who had not even been born when Woodard was convicted, selected Woodard's file to review as part of her work with the Innocence Project of Texas.

On November 27, 2007, a post-conviction DNA test was approved for Woodard. There was sperm on the vaginal swab taken from Beverly Ann Jones after her death, and fortunately it was in a condition where it could be tested. On December 28, 2008—exactly 28 years from the date of the crime—the DNA test came back.

The DNA did not match. Therefore, because the evidence showed the person who raped Beverly also killed her, Woodard could not have murdered Beverly Ann Jones. Alexis Hoff and Innocence Project representative Jeff Blackburn visited Woodard in prison to give him the good news.

"The conclusion of the test was that there was not a match. It means that someone else raped Beverly Ann Jones," Hoff told Woodard. "It is my honor to be here today to tell you that after spending 27 years in jail for a crime that you did not commit you will walk out of this courthouse tomorrow, a free man."

"I'm speechless. That's about it. You'll have to give me a minute to gather myself, to sink this all in," Woodard said, with tears welling up in his eyes. "I mean, don't crack jokes now. ... Are you sure I get out tomorrow?" Woodard asked with disbelief.

"Yep," Blackburn replied.

The next day, James Lee Woodard appeared again in court. This time, it was a happy and joyous occasion.

District Judge Mark Stoltz then set Woodard free. "Unfortunately, Mr. Woodard, you're not getting justice today. You're just getting the end of injustice," he said.

James Lee Woodard went to prison when he was 28 years old. When he was finally exonerated, he was 55, having served 27 years in prison for a crime he did not commit.²⁰

Who Was the Actual Murderer?

Who really killed Beverly Ann Jones?

One of the men she was with the morning of her murder was convicted of aggravated rape committed just three weeks after Beverly's rape and murder. This man was killed in 1982 while attempting to rape another woman in a vehicle. She pulled out a gun and shot him as he was raping her.²¹

Another man Beverly was with that same night had also been convicted of rape. The whereabouts of the third man are unknown.

Since Woodard's exoneration, Beverly's stepfather, Oscar Edwards, has recanted his testimony. He said James Lee Woodard was not at his house knocking on his door at 3 a.m. that morning and he does not believe Woodard is Beverly's killer.²²

A Free Man

On September 30 2009, Texas Gov. Rick Perry pardoned James Lee Woodard for the murder of Beverly Ann Jones. Woodard received a compensation package of more than \$2 million for the 27 years he wrongfully spent behind bars.²³ Of the money he received, he made a \$100,000 donation to the Innocence Project of Texas.

Sadly, James Woodard lived as a free man only four years after his exoneration. In October 2012, Woodard died in Dallas, Texas, as the result of a seizure. He was 60 years old. Cory Session, policy director for the Innocence Project of Texas, said Woodard was "directly responsible for the eyewitness ID law that Texas now has that requires all police agencies to have an eyewitness ID procedure in place. He was directly responsible for health insurance that wrongful convicted persons now have." Woodard was also active in helping other Texas exonerees adjust to life outside after being wrongfully convicted and serving time in prison.

"It's a loss that we can't get back and we will definitely miss him," Session said. "The impact that he left will overshadow anything in his life."²⁴

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**Immigration as an Arrestable Offense:
Colorado's Senate Bill 90 and Racial
Profiling in the Context of Probable
Cause and Arrest**

— by Mayu Takeda



Introduction

On May 1, 2006, Colorado's then-Gov. Bill Owens signed Senate Bill 90 into law. Under the statute, anyone arrested for a criminal offense in the state of Colorado who a peace officer or county sheriff has probable cause to believe is unlawfully present in the United States must be reported to U.S. Immigration and Customs Enforcement (ICE) (with some exceptions for potential victims of domestic violence).

Although much public scrutiny and academic inquiry has been focused upon Arizona's S.B. 1070—a similar law that seeks to compensate for a perceived lack of action at the federal level—discussion of the Colorado law, despite being passed and implemented nearly four years before Arizona's, has been scant. Furthermore, much of the literature discussing racial profiling, even in the context of state immigration laws such as S.B. 1070, has largely focused on stop and search practices, although the question of arrest is central to state immigration laws.¹

This study therefore seeks to examine the effect of S.B. 90 on the practice of arresting offenders for traffic violations in Colorado. Under S.B. 90, the officer does not make an "Illegal Alien Inquiry" (IAQ) to ICE unless an arrest is made and there is probable cause to believe that the offender is an undocumented immigrant. Thus, it would appear that an increase in the number of in-custody arrests for traffic offenses post-S.B. 90 would indicate that peace officers are detaining individuals not for their crimes, but for their potential unauthorized status.

Because most peace officers do not have access to ICE databases at the time of a routine traffic stop, there is no way to know with certainty whether the driver is residing without authorization until he or she is reported to ICE through an IAQ.² Assuming there is an increase in arrests for minor traffic violations, this means that a particularly pronounced increase for minority groups (i.e. Latinos) indicates the use of racial profiling on the part of the peace officer.

Racial Profiling and Immigration-- Background and Literature

Racial profiling, defined as the act of "using race as a key factor in deciding whether to make a traffic stop" is not illegal.³ The constitutionality of profiling in the context of traffic stops and immigration has been addressed by the U.S. Supreme Court, and on each occasion, the Court has ruled that while ethnic appearance cannot be the sole factor for the police stopping someone, it may be one of several factors.⁴ However, the literature documenting the negative consequences of racial profiling is extensive. Scholars have long focused on the erosion of trust between the immigrant community and law enforcement through

racially-motivated traffic stops.⁵ Because these stops are by far the most common form of interaction between police and members of the public, the perception of racial profiling has an enormous potential to affect police-community relations.⁶ Members of a community that perceive racial profiling targeted toward them may become reluctant to report crimes or to help solve them, negatively affecting overall public safety.⁷ Thus, rather than enhancing the effectiveness of fighting crime, focusing on certain racial and ethnic groups means law enforcement is likely to be concentrating resources in a manner detrimental to preventing crimes that are more directly harming the community.

Until now, the extent of racial profiling pre- and post-S.B. 90 has not been statistically documented. Interestingly, a special report by the U.S. Department of Justice found that in 2005, white, black, and Hispanic drivers in the United States were stopped by police at similar rates (8.8 percent, 9.2 percent, and 8.6 percent, respectively);⁸ of the drivers who were stopped, 2.1 percent of the white drivers were arrested, compared to 4.5 percent of the black drivers and 3.1 percent of the Hispanic drivers.⁹

Method

The study will examine arrest records in Denver County over a 28-month period, divided into the 13 months prior to and the 14 months following the signing of S.B. 90. For our purposes, we will define "traffic violations" as misdemeanor traffic offenses, petty offenses, and traffic infractions as defined by Colorado Revised Statutes. Also included were arrests that resulted from traffic stops, such as arrests for the absence of documents like proof of insurance and driver's licenses, and the use and/or offer of false identification. The traffic violations included in the dataset involved neither the use of drugs or alcohol nor the death or injury of another person. Violations that fit the category of felony traffic violations were excluded as all felony traffic suspects are jailed as stipulated by the Denver Police Department policies.¹⁰ For purposes of these data, "arrest" was defined as in-custody arrests, and not instances where individuals were cited and released.

Denver County is the second most populous county in the state of Colorado, and it is relatively diverse. In 2010, 31.8 percent of Denver County was Hispanic, 10.3 percent black, and 52.6 percent white (non-Hispanic).¹¹ These percentages provide an important baseline from which to compare the proportion of arrestees who were of each ethnic and racial category. This study examined 110,406 arrest records from Denver County between April 2005 and June 2007. Of these, 11,792 arrests stemming from traffic violations were extracted and included in the sample. The data, provided by the Department

of Safety of the City and County and Denver, were arranged by race and ethnicity (Hispanic, black, and white), description of offense, length of stay in detention, age, and sex. Comparisons of arrest rates were made across race and ethnicity, and the proportions of arrests for traffic violations were determined based on the overall number of arrests.

The statistical significance of changes in arrest rates for traffic-related offenses in Denver County before and after passage of S.B. 90 were determined using the Z-test for difference of proportions, and the rates of arrest for traffic-related offenses were compared across race and ethnicities using the Wilcoxon signed-rank test.

In order to show that traffic-related arrests as a proportion of overall arrests increased after passage of S.B. 90, we must be able to reject the notion that the proportion of arrests before and after the passage of the law did not significantly differ. This means we must be able to reject the null hypothesis, which is denoted as follows:

$$H_0 : p_1 = p_2 \text{ or } H_0 : p_1 - p_2 = 0$$

where p_1 is the proportion of traffic-related arrests before passage and p_2 is the proportion of traffic-related arrests after passage. In instances where there is enough evidence to reject the null hypothesis, we adopt the alternative hypothesis, which in this case is that traffic-related arrests as a proportion of all arrests before the passage of the law was less than the proportion of traffic-related arrests after the law, and is symbolized by the following:

$$H_1 : p_1 < p_2 \text{ or } H_1 : p_1 - p_2 < 0$$

To proceed with this hypothesis test, we first estimate p_1 and p_2 by using the equations

$$\hat{p}_1 = \frac{r_1}{n_1} \quad \hat{p}_2 = \frac{r_2}{n_2}$$

where \hat{p}_1 is the estimate of p_1 and \hat{p}_2 the estimate of p_2 , r_1 and r_2 are the numbers of traffic-related arrests before and after passage, respectively, and n_1 and n_2 are the numbers of all arrests before and after passage of S.B. 90, respectively. We then estimate the overall probability of traffic-related arrests, \bar{p} at all points of time as well as the overall probability of non-traffic-related arrests, \bar{q} at all points of time by calculating the pooled best estimates:

$$\bar{p} = \frac{r_1 + r_2}{n_1 + n_2} \quad \bar{q} = 1 - \bar{p}$$

From these values we were able to determine the test statistic which follows the expression

$$Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\frac{\bar{p}\bar{q}}{n_1} + \frac{\bar{p}\bar{q}}{n_2}}}$$

to provide the corresponding p -value. Because the alpha level in our analysis is 0.05, which means that we are looking for a 95 percent certainty that the changes are significant, the p -value must be less than α of 0.05 to reject the null hypothesis and reach statistical significance. Comparisons were also made regarding the likelihood of an arrestee being of a particular racial or ethnic group (Hispanic, black, and white) before and after the passage of S.B. 90.

To see whether the differences in the number of traffic-related arrests across races and ethnicities were statistically significant, we used the Wilcoxon signed-rank test. This was done by taking the difference in the number of arrests between two ethnic groups for each month and ranking the differences. The sum of the ranks symbolized as W was then taken along with the standard deviation of the sampling distribution of W :

$$\sigma_w = \sqrt{\frac{N(N+1)(2N+1)}{6}}$$

where N is the total number of trials, or months during which observations were collected. Here we assume that the sample size of 27 is large enough to assume normality for the standardized form of the Wilcoxon signed-rank test statistic. Using both W and σ_w , the test statistic Z was determined using the following formula:

$$Z = \frac{(W - \mu_w) \pm 0.5}{\sigma_w}$$

where μ_w is the mean of the distribution W (and is in all cases equal to 0). The ethnic and racial groups compared within our sample were Hispanic, black, and white.

Results

Increase in Traffic-Related Arrests

Figure 1 presents the change over time in traffic-related arrests as a proportion of all arrests in Denver County. The increase in proportion is apparent: there is a gradual increase since April 2005, when roughly 8.6 percent of all arrests stemmed from traffic offenses until September 2006, three months after S.B. 90 was passed and two months after it was implemented (the law went into effect on July 1, 2006). In October 2006, the number suddenly jumps up 1.5 percentage points to almost 12 percent and stays relatively high for the next eight months. Statistical analysis using the Z-test for difference of proportions shows that the increase in the proportion of traffic-related arrests after the passage of S.B. 90 was statistically significant (p -value <0.0001 , $<.05$). This is as expected, given the increase demonstrated in Figure 1.

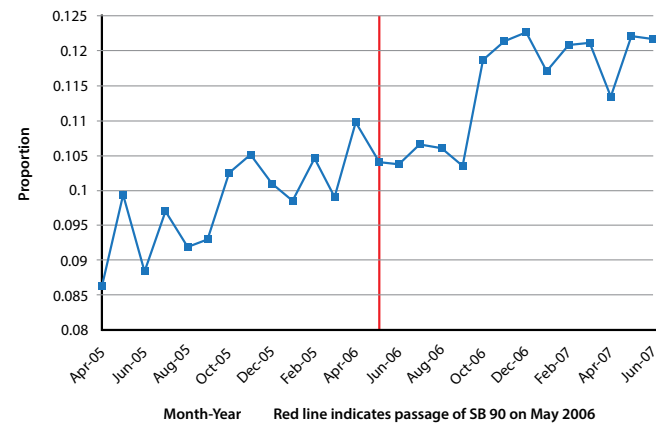


Figure 1. Proportion of traffic-related arrests to total arrests in Denver County

Changes in Proportion by Race and Ethnicity

Do increases in traffic-related arrests of Hispanics account for the jump in overall traffic-related arrests? To determine this, we compared the likelihood both before and after S.B. 90 was passed that an arrestee for a traffic violation was Hispanic. Figure 2 shows the change in proportions of arrests of Hispanics for traffic violations over time.

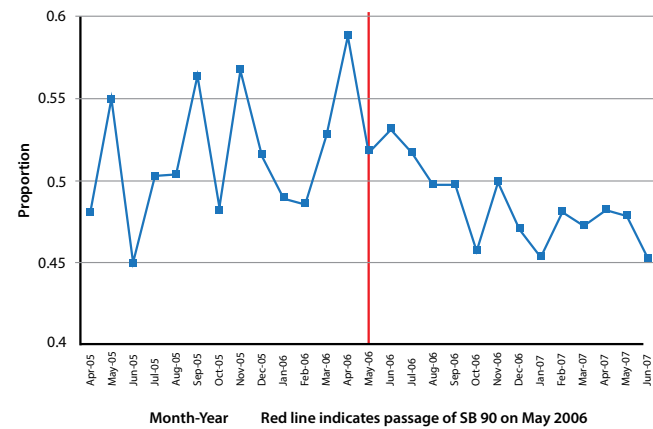


Figure 2. Hispanic proportion of traffic-related arrests

To our surprise, when determining the sample statistics of the probability that a traffic violation arrestee was Hispanic before the law passed (\hat{p}_1) and the probability that the arrestee was Hispanic after the law was passed (\hat{p}_2), \hat{p}_1 was greater than \hat{p}_2 .

This means that after S.B. 90 was signed into law, an arrestee was less likely to be Hispanic. This decrease in the proportion of Hispanic traffic-related arrestees was statistically significant (p -value=0.0002, $<.05$). The proportion of black traffic-related arrestees decreased as well, and this was also statistically significant (p -value=0.0467, $<.05$). On the other hand, the proportion of white traffic-related arrestees increased by a statistically significant amount (p -value <0.0001 , $<.05$).

Comparison of Proportions of Arrests across Race and Ethnicity

We then examined the differences between the races and ethnicities. Figure 3 shows the proportion of Hispanic arrestees, black arrestees, and white arrestees for traffic violations across time. It is evident that there is a clear and significant difference in proportions between Hispanic, black, and white arrestees.

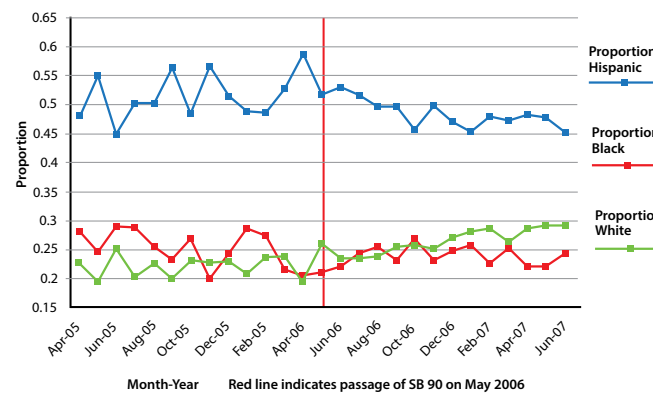


Figure 3. Proportion of traffic-related arrests by race and ethnicity in Denver County

Using the Wilcoxon signed-rank test, it was shown that the variation between proportions for Hispanic and black arrestees as well as Hispanic and white arrestees was statistically significant, although the difference between black and white arrestees was not found to be statistically significant. The sample size (N), the sum of the signed ranks (W), the standard deviation (σ_w), the Z-score (Z), and the p -value are shown in Table 1.

	Hispanic-Black	Hispanic-White	Black-White
α -level	0.05	0.05	0.05
N	27	27	27
W	378	3378	-17
σ_w	83.24662	83.24662	83.24662
Z	4.534719	4.534719	-0.19827
P -value	3E-06	3E-06	0.4214

Table 1. Comparison across ethnicity and race

Differences between Hispanic proportions and black and white proportions were statistically significant across time, meaning that when proportions of Hispanic arrests were compared to those of black and white arrests both before and after S.B. 90 passage, the differences were statistically significant at both periods.

Discussion and Conclusion

When Senate Bill 90 was passed in the Colorado state legislature, there was much concern over the potential friction it would cause between immigrant communities and agents of law enforcement through racial profiling. However, our results suggest a slightly more optimistic outcome. Although the proportion of arrests stemming from traffic violations has significantly increased since S.B. 90 was signed into law, the proportion of Hispanic arrests for traffic violations has fallen significantly, which in part has been offset by a significant increase in the proportion of white traffic-related arrests. This implies that Denver County may have been cognizant of the potential for targeted profiling of Hispanic drivers and consciously sought to lower the Hispanic share of traffic-related arrests. However, an alternative interpretation of the data is that the law's mandate to report any suspected undocumented immigrants to ICE widened the net for arrest to include more white drivers, a theory supported by the overall increase in the number and proportion of traffic-related arrests.

Furthermore, although the share of traffic related arrests for Hispanic drivers has substantially decreased, there remains a wide gap between the share of these drivers and that of black drivers and white drivers. That the difference in proportions between Hispanic and white traffic-related arrests continued to be statistically significant, with Hispanics bearing a significantly larger share of the arrests, indicates

that even the substantial increase in the proportion of white drivers arrested and the substantial decrease in the Hispanic share of traffic-related arrests could not compensate for the vast and disproportionate gap between the two. As discussed earlier, we must keep in mind that Denver County in 2010 was 31.8 percent Hispanic, 10.3 percent black, and 52.6 percent white. Given this demographic, it is appropriate to examine why Hispanics made up 49.9 percent of the arrests stemming from traffic violations, while black drivers also have a relatively large share of 24.3 percent, and white drivers held a low share of 24.6 percent. Hispanic drivers' proportion of traffic-related arrests may have fallen, but it is difficult to overcome the perception that racial profiling is being implemented in Denver County, despite the possible good intentions of peace officers to prevent it.

The very fact that the rates of in-custody arrest stemming from traffic violations increased significantly after the passage of S.B. 90 is also cause for concern. The law was not designed to increase the number of arrests; it was meant to increase the number of Illegal Alien Queries to ICE. It is possible that peace officers may have lowered their threshold for detaining civilians—particularly for offenders who commit traffic violations—in order to ensure that they are held in custody while the IAQ is completed.

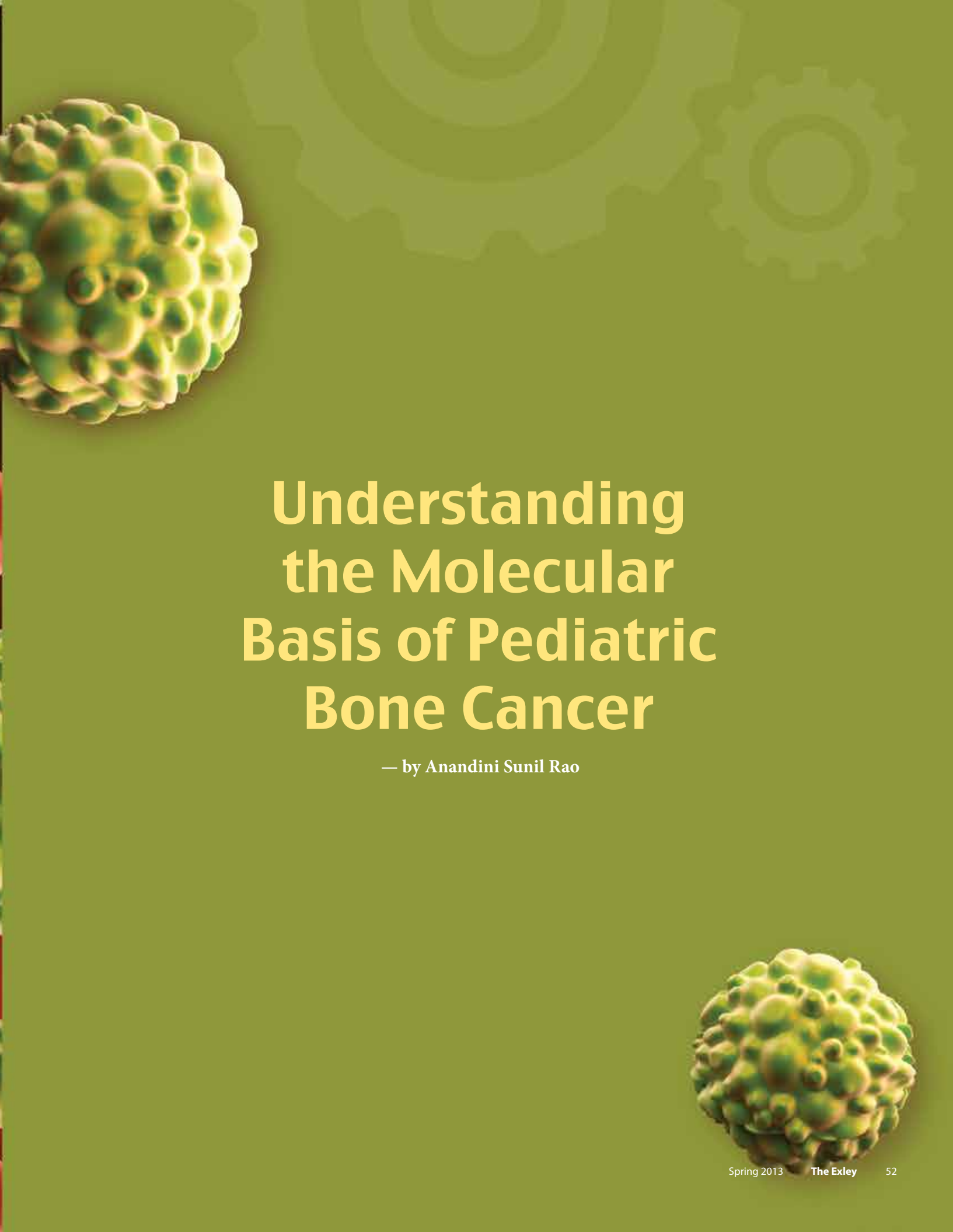
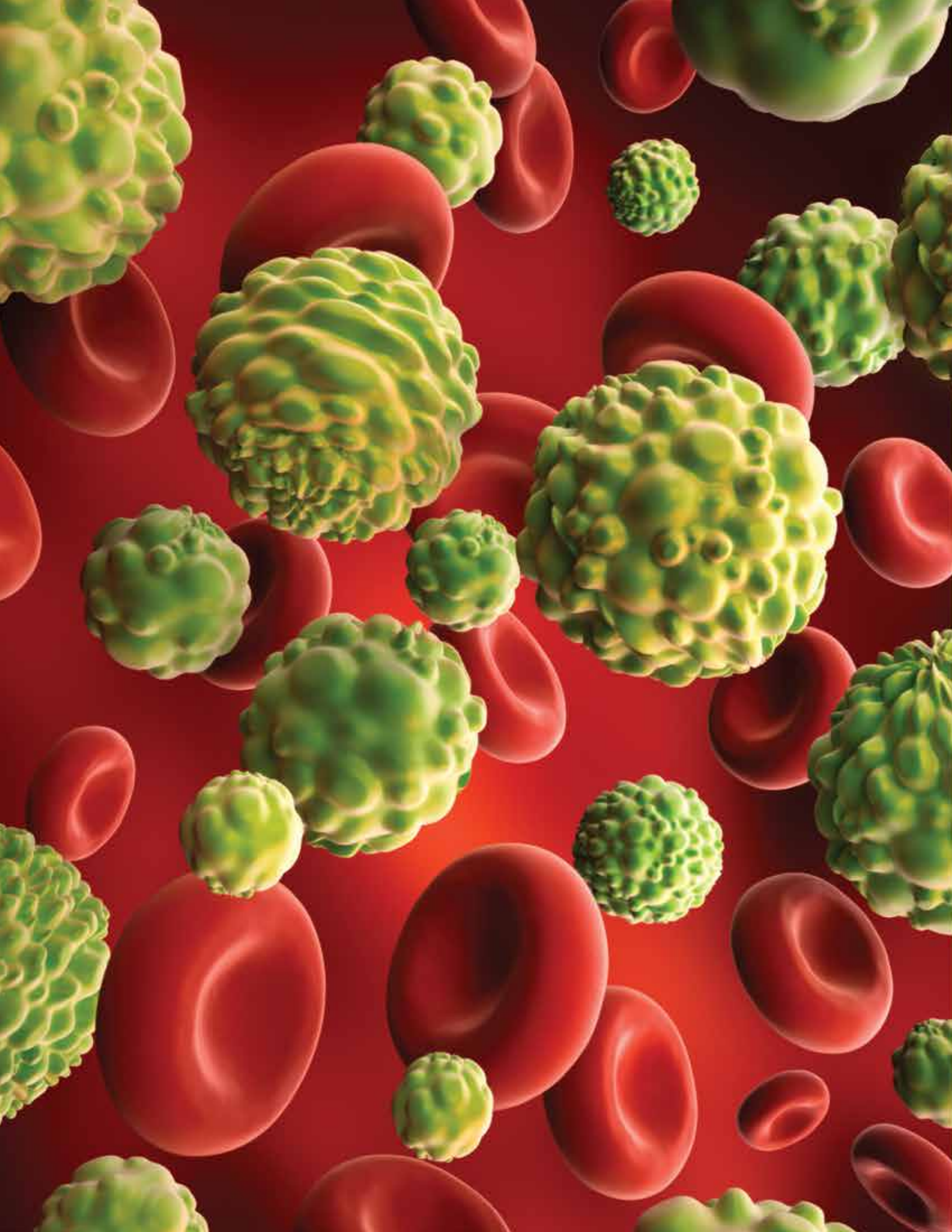
Future studies should expand to include longer timeframes and various counties across Colorado to capture a larger trend. Given the potential consequences of racial profiling on the community, greater effort should be expended to prevent the targeted enforcement of traffic violations in Denver County.

Acknowledgments

I would like to thank Dr. Anthony Champagne for his wonderful support and guidance in formulating and implementing this project. I would also like to thank Dr. Bhargab Chattopadhyay for his invaluable counsel on the statistical aspects of this project.

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Understanding the Molecular Basis of Pediatric Bone Cancer

— by Anandini Sunil Rao



A diagnosis of cancer can break the toughest adults, but imagine getting a diagnosis of cancer as a child. Just visualizing the pain that children feel is enough to inspire many pediatric oncologists to find a cure for cancer. It seems like a daunting prospect but the devoted doctors at MD Anderson work at it every single day. Pediatric osteosarcoma, or bone cancer is a tumor that can often be malignant if it becomes metastatic. In other words, if a new tumor forms at another site before treatment can fight the cancer into submission, the cancer is terminal. When metastatic to the lungs (the most common site), it can be resistant to chemotherapy and can be fatal. Osteosarcoma arises from osteoblasts (bone-forming cells) grown wild. It occurs most commonly during growth spurts – when production of osteoblasts and epidermal growth receptors increases. It is most commonly diagnosed during childhood or teenage years, when growth spurts are most common.¹

If we are to fight the cancer, we must target the processes that make it so malignant. This research came down to the pure biology of cancer – what makes some cells migrate, and what makes some cells stay in the primary tumor. The body's cells have a family of growth receptors called EGFR, or epidermal growth factor receptors. They are responsible for everything from angiogenesis (the formation of blood cells) to mitogenesis (cell division). There are four main types: EGFR1, HER2, HER3, and HER4. The answer lies, we found, in the different forms of an epidermal growth factor receptor called HER4. HER4 is a very interesting growth receptor that plays an important role in osteosarcoma.² Two of the four forms are cleavable; that is, they can be “cut” to create a fragment that can detach from the cell membrane and go into the nucleus to further influence protein expression and perhaps play a role in the patient's survival.³ We are able to identify these different forms at the mRNA level and through reverse transcription polymerase chain reaction (RT-PCR) to amplify targeted RNA so that we can measure how many copies of each HER4 form were expressed in the cell.

Introduction

We used four cell lines in the lab: OS-D, OS-O, HOS, and SAOS2 all of which are derived from human tumor samples. HER4 is widely expressed in different conditions of these four cell lines: serum starvation, spheroids, monolayer, and high density.

Like any protein, HER4 is made when its corresponding mRNA is expressed. Each of its isoforms is expressed on the mRNA level before they are expressed into the four isoforms of receptors. Isoforms include: JMA, JMB, JMC, and JMD.⁴ JMA and JMD are both cleavable isoforms while JMB and JMC are whole receptors. The mRNA sequence containing the exons that express the isoforms are between two

permanent exons 14 and 17 and contain two alternatively spliceable exons 15b (β) and 16 (α). JMA only has the α exon between X and Y exons. JMD contains both β and α exons between X and Y exons. JMB contains only the β exon and JMC contains neither α or β .⁵ The α exon codes the cut site for the Adam 17 (TACE) enzyme. TACE cuts in the juxtamembranous region of HER4.⁶ γ secretase, which makes the intracellular portion after TACE has cut, is not coded by a specific exon.

JMA and JMD have been previously shown to be expressed at much higher levels than JMB and JMC at the mRNA level in neuroblastoma cells.⁷ However, because the effect of monolayer vs sphere culture on the expression of the four isoforms is unknown, any results are theorized and unexpected. Spheroid culture is said to represent the actual live tumor. The exact functionality of the four isoforms is unknown and it is entirely possible that cleavable isoforms are expressed at higher levels in spheroid culture than in monolayer culture.

The research examined the effect of culture conditions, specifically anchorage dependent (monolayer) and anchorage independent (spheroid) on expression of different HER4 isoforms, testing the following hypotheses:

- I. Stressful conditions like spheroid culture express more cleavable isoforms (JMA and JMD) than monolayer culture.
- II. The protein expression level change from monolayer to spheroid may correspond with the amount of cleavable vs non cleavable isoforms

Materials and Methods

Cell Culture – Cells used included four osteosarcoma cell lines derived from human patients: CCH OS-D, CCH OS-O, HOS, SAOS. They were grown in DMEM culture medium containing PenStrep and 10% fetal bovine serum. Cells were split every day for HOS and OS-D and every other day for SAOS and OS-O. They were split into four 15cm plates: two were used for spheroid plating, one was used for monolayer mRNA and one was kept growing or frozen. Both spheroids and monolayer were collected on Day 2 as much as possible for RNA extraction.

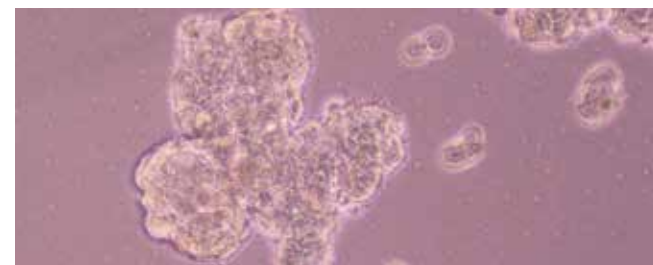


Figure 1. CCHD Spheres

RNA Extraction – Using a Qiagen RNeasy Mini kit, cells in spheroid culture were treated as cells in suspension and were pelleted first (usually frozen). Cells in monolayer culture were lysed on the plate and then transferred to a sterile Eppendorf tube. The kit provided all the buffers (RLT, RW1, and RPE) and collection tubes. After the mRNA had been collected on the membrane inside the collection tube, RNASE free water was used to elute the RNA. Immediately following this, the purity and concentration of the RNA was analyzed using a spectrophotometer in order to check for protein contamination.



Figure 2. SAS2 Monolayer

Quantitative Reverse Transcriptase Real Time Polymerase Chain Reaction (qRT-PCR) – We reverse transcribed the total RNA extracted to cDNA using materials from the Invitrogen SuperScript III First Strand Synthesis System for RT-PCR and Qiagen Omniscript RT.

Real Time PCR – Using a fluorescent SYBR green dye we quantified the fluorescence given off by the amount of dye that has hybridized with the expected product. I studied the four different isoforms: JMA, JMB, JMC, and JMD at the mRNA expression level.⁸ GAPDH is a housekeeper gene that acts as a control. We used the following primers:

- a. JMA forward primer:
 - a. CTGCACCCAAGGGTGTAAACG
- b. JMC forward primer:
 - a. CAAACTGCACCCAAGGAATC
- c. JMD forward primer:
 - a. CGGCCTGATGGATAGGTGTAAC
- d. GAPDH forward primer:
 - a. GCATCCTGGGCTACTGAG
- e. HER4 reverse primer:
 - a. GCAAATGTCAGACCCACAATG
- f. GAPDH reverse primer:
 - a. CCACCACCTGTTGCTGTAG

We used the same forward primers that had previously used in other experiments conducted by researchers in the lab but could never replicate JMB results.⁹ The HER4 reverse primer is common to all isoforms.

Name	Slope	Intercept
GAPDHG	-2.9839	36.283
JMA	-3.1696	40.243
JMC	-2.9401	35.885
JMD	-3.9498	41.269

GAPDH has its own specific forward and reverse primers. We used relative quantification to analyze the data by comparing the threshold cycles of each isoform to the threshold cycle of GAPDH and also performed absolute quantification to achieve a definite quantifiable copy number. Absolute quantification was performed using standard curves made from the positive control plasmids. Standard curves were created using different dilutions of each plasmid. We also used negative controls – where the wrong plasmid was used for the primers--using the JMB control plasmid for all primers: JMA, JMC, JMD, and GAPDH. This provided a negative threshold level.

Running CDNA Products from RTPCR on the gel – To confirm that the product was actually amplified, we searched for a single band at the corresponding molecular weight:

- i. JMA: 155 bp
- ii. JMB: 82 bp
- iii. JMC: 84 bp
- iv. JMD: 158 bp
- v. GAPDH: 161 bp

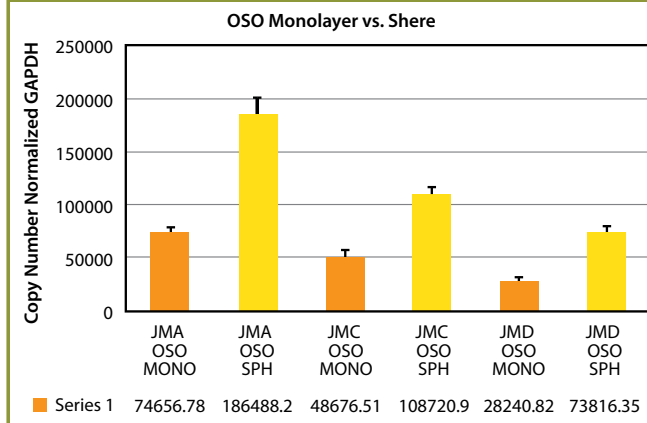
Results

Spheroids express more JMA isoform than monolayer culture across all cell lines.. However, JMA and JMD are still produced at much higher levels than JMB or JMC. JMB was not a reproducible isoform and when the corresponding samples were run on an agarose gel for which the thresholds were present, no products were found. Absolute quantification used a standard curve. The second standard curve was prepared with a master mix that was also used for the rest of the experiments. These experiments were performed to verify previous results using a different standard curve and different cDNA synthesis kit. The Superscript III First-Strand Synthesis System was used because it was reputed to provide conditions for greater specificity of products.

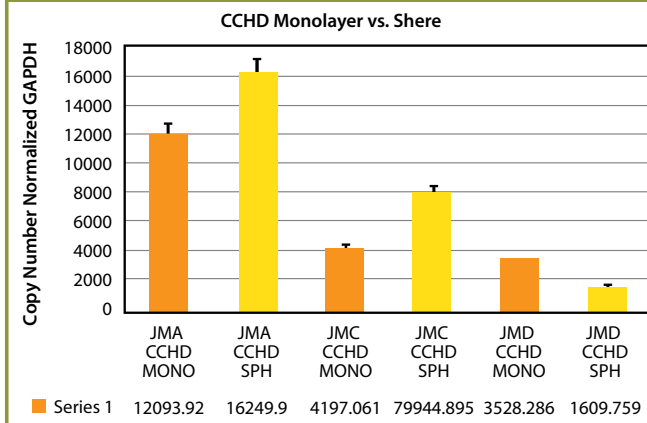
Cell Type Specific Analysis

OS-O and OS-D are primary osteosarcoma cell lines and exhibit the same trend of expression of isoforms: JMA, JMC, and JMD in a decreasing fashion. JMD decreases in spheroids in OS-D and SAOS2. JMD increases in spheroids in OS-O and HOS. HOS expresses higher levels of JMA and JMD than JMC. In non-metastatic osteosarcoma cells like SAOS, JMC is the highest expressed isoform.

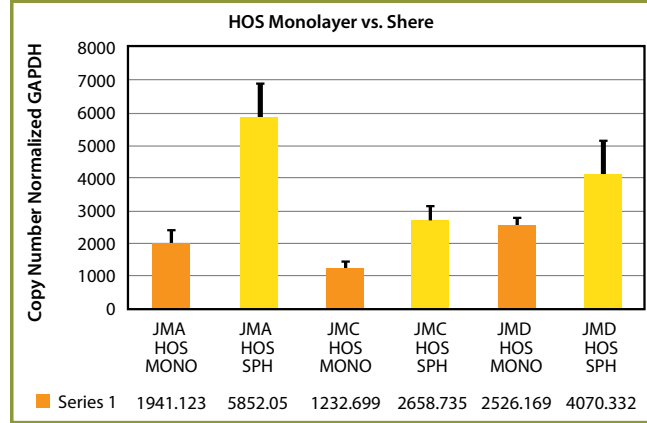
OSO Monolayer vs. Sphere — Invitrogen Kit



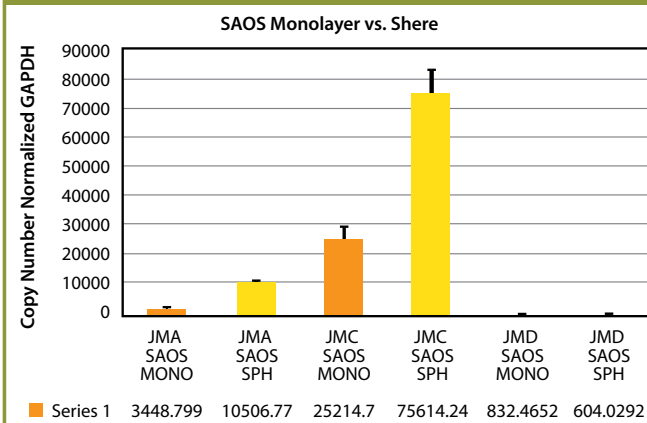
CCHD Monolayer vs. Sphere — Invitrogen Kit



HOS Monolayer vs. Sphere — Invitrogen Kit



SAOS Monolayer vs. Sphere — Invitrogen Kit



OSO-Invitrogen	Ratio - Mono:SPH
JMA OSO MONO: SPH	2.498
JMA OSO SPH	
JMC OSO MONO: SPH	2.23
JMC OSO SPH	
JMD OSO MONO: SPH	2.61
JMD OSO SPH	

HOS-Invitrogen	Ratio - Mono:SPH
JMA HOS MONO	3.015
JMA HOS SPH	
JMC OSO MONO	2.16
JMC HOS SPH	
JMD HOS MONO	1.61
JMD HOS SPH	

CCHD-Invitrogen	Ratio - Mono:SPH
JMA CCHD MONO	3.015
JMA CCHD SPH	
JMC CCHD MONO	2.16
JMC CCHD SPH	
JMD CCHD MONO	1.61
JMD CCHD SPH	

SAOS-Invitrogen	Ratio - Mono:SPH
JMA SAOS MONO	3.015
JMA SAOS SPH	
JMC SAOS MONO	2.16
JMC SAOS SPH	
JMD SAOS MONO	1.61
JMD SAOS SPH	

Discussion

HER4 is a complicated family member of the epidermal growth factor receptor. In neuroblastoma, it was previously shown that HER4 is upregulated in spheres. However HER4 upregulation was shown only through Western blotting. In terms of isoforms, it has been previously shown that across neuroblastoma and osteosarcoma cell lines in monolayer culture, JMA and JMD are produced at high levels compared to JMC. But there has never been a comparison between monolayer vs sphere culture conditions in different types of osteosarcoma cell lines.

When neuroblastoma cell lines are grown on poly-HEMA plates they form non adherent colonies of cells.¹⁰ The same thing occurs when we make osteosarcoma spheres by seeding 1x10⁶ cells per well of a six-well plate allowing them to settle and graphing them with a microscope.

The sphere model can show the inside of a ball like tumor before it has been invaded by blood vessels--a stage 1 tumor. It resembles solid tumors more than fluid tumors. The spherical, nonadherent condition allows more cell-to-cell contact, and this inherent characteristic may explain why HER4 is upregulated.

Conclusion

OS-O and OS-D were taken from initial biopsies of tumors of osteosarcoma patients that later turned metastatic. HOS was also a human osteosarcoma cell line that was metastatic. All three cell lines display high levels of the JMA and JMD isoforms. SAOS is considered a non metastatic cell line and expresses much lower levels of JMA and JMD. JMA and JMC increase in spheroids across all cell lines. JMD decreases in spheroids in OSD and SAOS. JMD increases in spheroids in OSO and HOS. These findings suggest another aspect of the role that HER4 isoforms JMA and JMD plays in osteosarcoma – as responsible for metastases. These results are intriguing and suggest that studying the functionality of the different isoforms should be the next step in elucidating the role of each HER4 isoform.

We used a fold ratio to quantify the change between monolayer and sphere culture. Although the analysis is incomplete because of the inability to replicate previous results as to JMB, the results are interesting: SAOS2 cells, which constitute the only non-invasive cell line used, expressed a huge jump from JMC monolayer to sphere. This may suggest a correlation between a non-soluble isoform and metastases.

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**Analysis of Rheological Studies
Using Instrumental Analysis of
Poly(L-Lactic) Acid and
Poly(D,L-Lactic) Acid
for Applications in
Biomedical Research**

— by Nimmy Mammootil



Introduction

Current socioeconomic drivers have necessitated the development of new materials that are both biorenewable and biodegradable for industrial and medicinal applications. Additionally, bioresorbable materials, which degrade within the body in a non-destructive manner, are of current interest to the medical device community.¹ Specifically, poly(lactic acid) (PLA), an aliphatic polyester² that is formed from ring opening polymerization of lactide subunits, has revolutionized the field of biomedical science.³ PLA-based devices have been transformative in surgery, sutures, controlled-drug release systems, and corrective meshes for pelvic organ prolapse.⁴ Due to its innovative uses and remarkable mechanical properties, PLA is currently being explored for many applications within the field of medicine. Therefore, a thorough study of the mechanical properties of PLA and its copolymers would prove useful and timely.

Many properties retained by PLA permit it to be cohesive within the body, such as its stable glass transition temperature and varying high molecular weights. However, lactide itself contains numerous conformations relating to its polarization. Poly(L-lactic acid) (PLLA) rotates counterclockwise in plane polarized light, meaning it has a levorotatory conformation. Poly (D,L-lactic acid) (PDLLA) has a racemic mixture of both levorotatory and dextrorotatory molecules. The importance of the conformations of these polymers lies in the subtle modifications it has to the vast properties that these polymers hold. Although the essential backbone of both polymers may be comparable, the properties that they both possess tend to disperse in numerous directions. Examining and comparing the properties of both polymers will contribute toward biomedical research an understanding of how PLA harmonizes with the ideal conditions within the body. Herein we propose to study the rheological properties of a series of PLA polymers and copolymers.

The objective of this study is to explore the properties of the different conformations of poly(lactic acid), particularly poly(L-lactic acid) and poly(D,L-lactic acid). These biodegradable polymers are derived from the same monomer, but have varying differences that build upon each other, beginning with the molecular weight. Properties such as the degradation temperature, glass transition temperature, melt temperature, and crystallinity temperature differ depending on the conformation of the polymer.

In this study, lactic acid was synthesized with ring opening polymerization (ROP) and tests such as differential scanning calorimetry, thermogravimetric analysis, Attenuated Total Reflectance-Fourier transform infrared spectroscopy, and gel permeation chromatography were conducted to ascertain the varying properties of the two isomers of the polymer.

Materials and Methods

Poly(L-Lactic) Acid and Poly (D,L-Lactic) Acid Synthesis⁵
Synthesis of the polymers was conducted using ring opening polymerization (ROP) of both L-lactide and D,L-lactide. Both conformations of lactide were initially recrystallized using ethyl acetate to rid them of impurities. The recrystallized lactide was placed in a round-bottomed flask with appropriate measurements of Tin(II)2-ethylhexanoate (Sn(Oct)2), the catalyst used to drive the polymerization reaction. The addition of anhydrous toluene aids with absorption of excess water present in the reaction and allows the monomers to gain better access to the catalyst. The round bottom was attached to a condenser and placed under nitrogen flow for 24 hours. The polymer was then dissolved in chloroform and precipitated in methanol after the allotted time for reaction was completed.

Gel Permeation Chromatography (GPC)

To obtain the molecular weight of each polymer, gel permeation chromatography under chloroform was conducted on a Shimadzu GPC model. Each polymer sample was weighed in concentrations of 4mg to 1ml of chloroform and filtered into vials. The filtered vials were then run using chloroform columns for 30 minutes each and the average molecular weight (Mn) and the polydispersity index (PDI), among other data, were recorded.

Differential Scanning Calorimetry (DSC)

Because glass transition temperature, melt temperature and crystallinity temperature are important factors that contribute to the palpable properties of a polymer, a Mettler-Toledo DSC1 Star System machine was used to record the temperatures that affected the stages of conversions within PLA. Less than 10mg of PLA was placed within a pan and run under the flow of nitrogen with three cycles of heating and cooling. The temperature was raised from 25°C to 220°C under an N2 flow rate of 10.00°K/min, and then lowered from 225°C to 25°C, with an N2 flow rate of -10.00°K/min, repeatedly. The replicated cycles were performed to purge previous thermal history within the polymer.

Thermogravimetric Analysis (TGA)

Weight dynamics and degradation processes of a polymer assist in discovering any impurities trapped within the polymer and the maximum temperature that can be handled before the polymer disintegrates. Approximately 5mg of PLA was added in a pan and was controlled by a method heating the polymer from 25°C to 270°C. An empty pan was placed as a blank to subtract any curves that did not belong to the polymer.

Attenuated Total Reflectance - Fourier Transform Infrared Spectroscopy (ATR-FTIR)

The primary molecules and bonds within a polymer account for the more prominent peaks. A qualitative analysis of PLA was conducted using a Shimadzu IR-Affinity-1 Attenuated Total Reflectance-Fourier transform infrared spectroscopy machine to determine the compounds that constitute the polymer in question. A blank run was initially conducted to eliminate background information picked up by the instrument. Afterward, enough PLA was placed under the scope to read the noticeable peaks within the polymer to determine whether the molecular structure shown by the graph correlated with the polymer that we intended to synthesize.

Results and Discussion

Molecular Weight⁶

Molecular Weight of Polymers in Question Using Gel Permeation Chromatography					
Polymer	Mn (Da)	Mw (Da)	Mz (Da)	Mw/Mn	Mz/Mw
PLLA	56842	113886	177784	2.00	1.56
PDLLA	57013	124684	213913	2.19	1.72

Table 1. Molecular weights of analyzed polymers in daltons. The comparison of the average molecular weight (Mn) and the polydispersity index (Mw/Mn) attests to the properties of each polymer.

The determination of a polymer's property begins with its molecular weight. Particularly for PLA, the molecular weight can be manipulated using the catalyst, SnOct2, which doubles as an initiator. With the appropriate monomer-to-catalyst ratio, a specific molecular weight can be reached. Even if the same ratio were used for both categories of polymers that are being analyzed within this study, the molecular weights and its polydispersity index have the possibility of being dissimilar along with the probability of each polymer being related. A range of molecular weights was attained by altering the reaction conditions. Changes pertaining to the average molecular weight (Mn) affect the mechanical properties of the system.

Although the weights listed in Table 1 may seem like meaningless numbers, the polydispersity index (PDI) of the polymer is what gives each chain its significance.⁷ The polydispersity index is defined according to how distributed the molecules are within a synthetic polymer chain (Mw/Mn). A polymer chain with a PDI between 0 and 1 is more linear in shape than a polymer chain with a higher PDI. There are multiple molecules involved within synthetic polymers, so the polydispersity index in these cases tends to be on the higher end of the scale. The closer the PDI is to 1.00, the more linear and uniform the chain tends to be. As seen in the data, although the differences are subtle, PLLA has a PDI closer to 1.00 than does PDLLA. This can also be perceived by the physical shapes each polymer takes. PDLLA, being more brittle and assuming a more crystal-like structure, can be effortlessly broken apart, while PLLA, being more flexible, aggregates to remain harder to dismantle. This is reflected in the PDI of each polymer as PLLA's molecular weights are closer together than PDLLA's. Neither polymer is linear in shape but both have stable, high average molecular weights.

Infrared Spectroscopy Peaks⁸

Conducting infrared spectroscopy on a molecule reinforces the molecular structure of the compound. Figures 1 and 2 highlight peaks within the PLLA and PDLLA polymer chain, respectively. The absorbed peak at ~1750 could attribute to the CO2 present in the air. Smaller peaks at ~3000 possibly will attain the C=O bond within the open chain of the polymer. Anything below 1600 is known as the fingerprint region, where the peaks are questioned, but peaks ~1200 can be attributed to any ether linkages within the polymer. In Figure 1 featuring peaks within PLLA, smaller peaks between ~1600 to ~1700 could highlight the conjugation of the CO2 double bonds. These subtle peaks can possibly display the minor differences in conformations within the isomers of PLA.

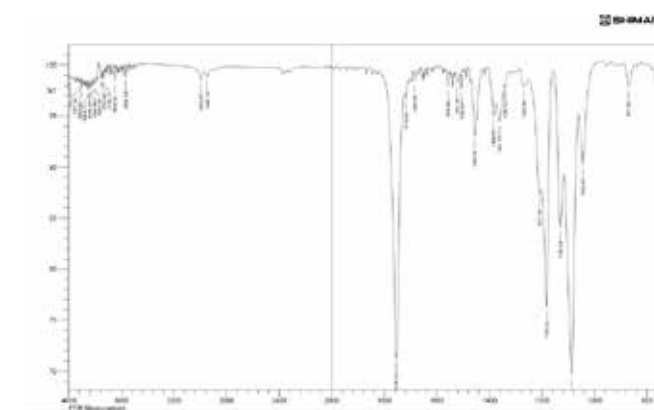
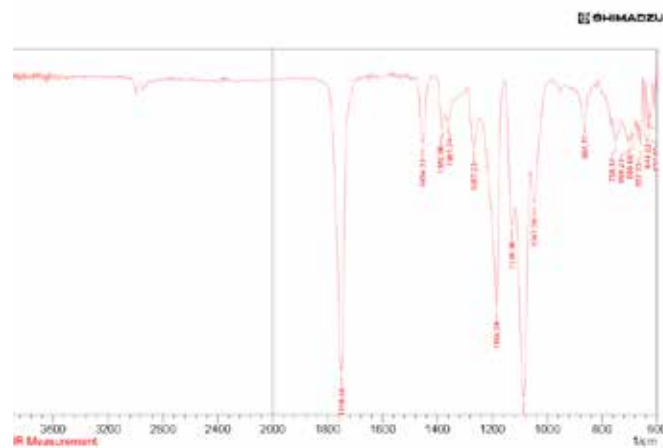


Figure 1. Significant peaks within PLLA conducted by FTIR



Thermogravimetric Analysis (TGA)
Figure 2. Significant peaks within PDLLA conducted by FTIR

Thermogravimetric Analysis (TGA)

TGA is a rheological assessment that can be conducted to obtain fluctuations in weight as the polymer degrades, providing a tremendous amount of knowledge regarding the properties of the polymer, especially if it is a copolymer. TGA is an excellent source to gain information on the point at which the polymer decomposes or whether the polymer contains any residual solvents or contaminants. All three properties can be examined by any depressions within a TGA graph; due to the heat gradually being raised and annotating any changes in relation to temperature.

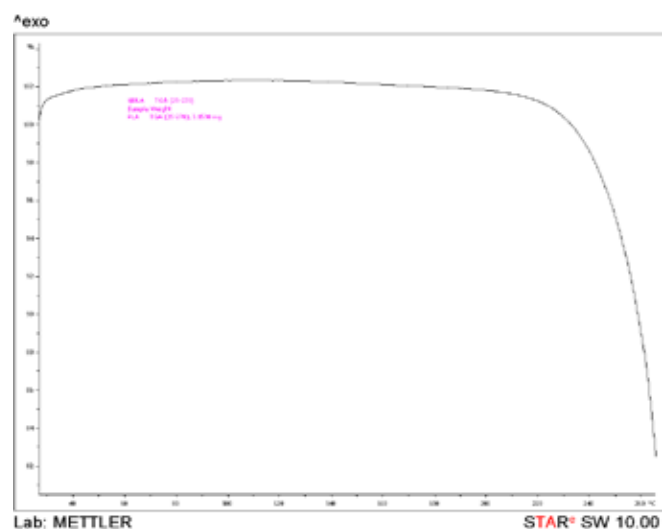


Figure 3. TGA graph of PLLA showing degradation

Figure 3 shows the degradation of PLLA at ~230°C and the progressively endothermic graph develops smoothly. Figure 4 shows the degradation of PDLLA to be at 30°C lower at ~200°C. Even though PDLLA degrades at a lower temperature, the degradation temperature is far above that of the human body, so notions of immediate

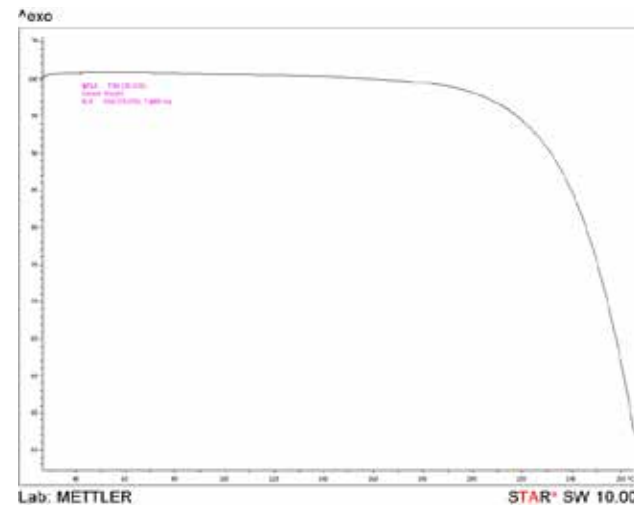


Figure 4. TGA graph of PDLLA showing degradation

repercussions due to temperature can be eliminated, although the long-term effects of degradation temperatures can be questioned. Both graphs are essentially even and any inconsistencies could be ascribed to residual chloroform used to precipitate the PLA.

Glass Transition Temperature, Melt Temperature, and Crystallinity Temperature⁹

At an initial glance, it is obvious that in Figure 6, there is an absence of the two peaks that can be seen in Figure 5. The first endothermic depression is the glass transition temperature (T_g), which is the position where a polymer is in between a solid and liquid state.

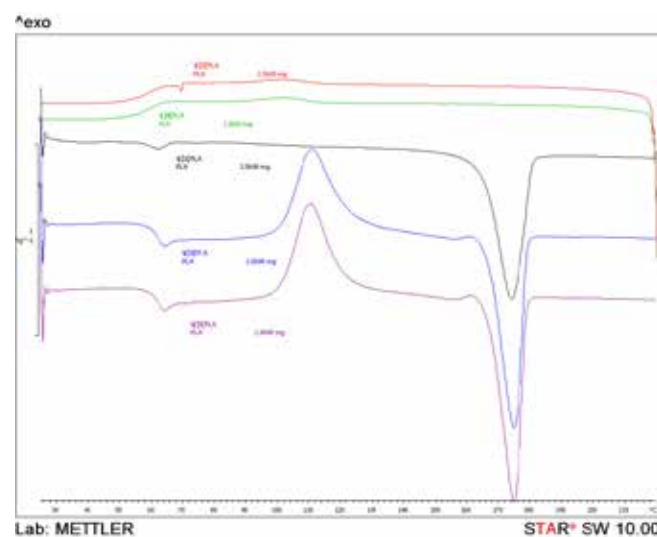


Figure 5. DSC graph of PLLA containing T_g, T_m and T_c

The exothermic protuberance is the crystallinity temperature (T_c), where the polymer is in a solid state, and the final endothermic depression is the melt temperature (T_m) of a

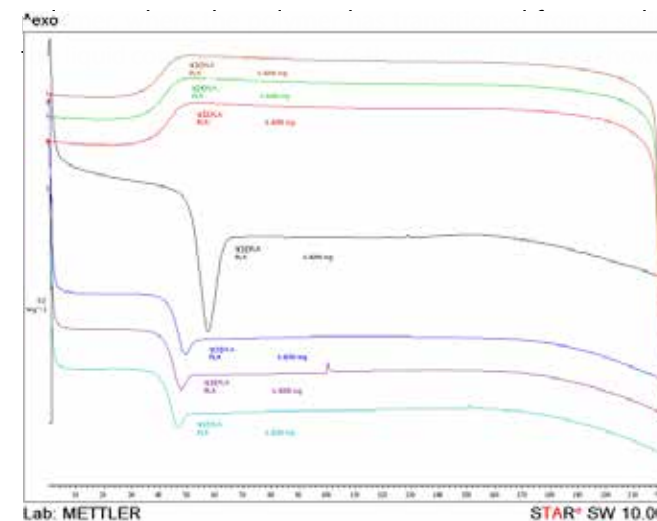


Figure 6. DSC graph of PDLLA containing T_g, but expressing the absence of T_c, and T_m

with the T_g at ~60°C, a T_c at ~115°C and a T_m at ~170°C. Both the T_c and T_m peaks are absent within Figure 6, the DSC graph for PDLLA, probably due to the brittleness and rigidity of PDLLA, but an apparent T_g can be found at ~45°C.

Future Studies

The possibility of creating thin sheets or films using either a Carver press or solution casting will prove to be useful for this study. The film can be used to perform dynamic mechanical analysis (DMA) experiments to further input information on PLA's list of properties by adding Young's Modulus data, and stress and strain curves. The degradation rate and process can also be considered for an extension to this report by creating copolymers with compounds such as perfluoropolyether (PFPE) to conduct FNMR.10 Alternatives within the synthesis process could very well aid in varying the properties within PLA. Due to catalyst and initiators being key participants within the formation of the polymer, substituting the polymer with various end groups and determining several ratios of catalyst to polymer will attest to the stability of the polymer. All of these opportunities constitute to modify properties that will be vital to the advance of biomedical research as well as the biorenewable polymer industry.

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A decorative graphic in the bottom-left corner consisting of several overlapping, swirling lines in a light gray color, resembling stylized grass or calligraphic flourishes.

Science **does not know its debt to imagination.**

— *Ralph Waldo Emerson*

A graphic on the right side of the page featuring a large, dark gray gear with three smaller white gears inside it. The two smaller gears have blue centers with orange rings. The text is positioned in the center of the large gear.

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