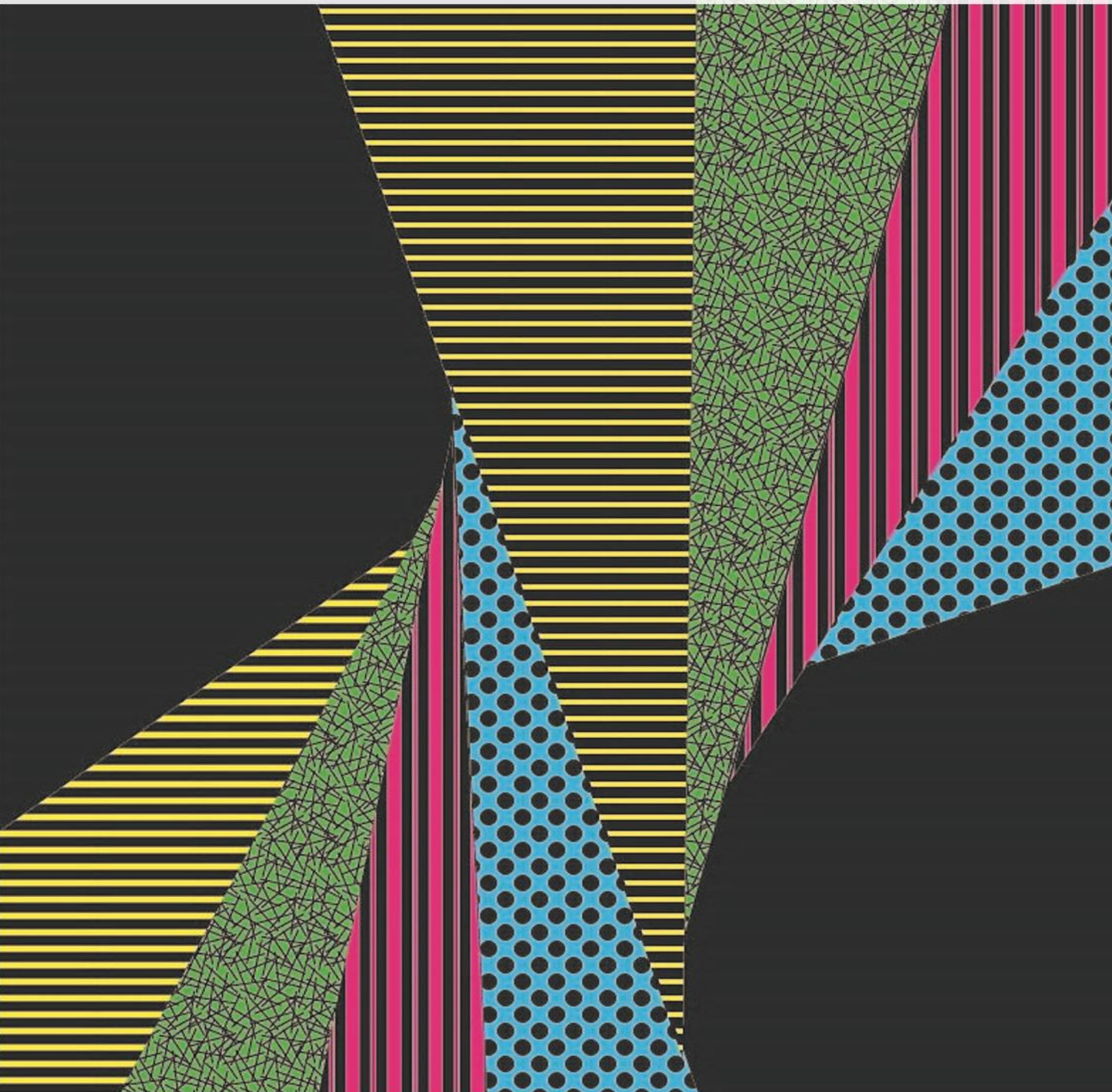


# CITATIONS

Journal of Undergraduate Research

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# CITATIONS

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*Editors*

Christi Hu, PhD

Associate Professor of Psychology

Laine A. Scott, PhD

Professor of English

*Cover Art:* Twisted Sista - Aubrey Bonds

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# Beyond the Book: An Initiative in Literacy

Michael Bleimeyer, Elissa Chandler, Noah Clipper, Elizabeth Compton, Bailey Crawford, Riley Densmore, Katelyn Dino, Coral Douglas, Grace Neal, Akeem Peterson, Jair Portillo, and Maura Webb

*Faculty Mentor: W. Jeff Lukken, JD*  
Wilkinson Family Servant Scholars Program

## Foreword

The Wilkinson Family Servant Scholars Program prepares the next generation of servant-leaders by linking the college's brightest students with community leaders and mentors so that they can study local needs—and decide how to best meet them. While living as part of a community, each student is engaged in active learning and service through individual internships at local agencies. The Servant Scholars' senior year involves a collaborative capstone project addressing a need that the group identifies from their junior-year service. The capstone project culminates in a Servant Scholars Colloquium presented to the campus and community near the end of the program's second year. The report below is evidence of their work during the 2019-2020 academic year.

## Abstract

Around the world, countries are investing in the reality that a good education system leads to increased economic activity and social values. As a foundational base for the education system, literacy skills are incredibly important for youths to develop, as being literate is the first step to gain more knowledge independently. For many years, Troup County, Georgia has worked in various ways to improve the literacy of adults and children. As an organization of service-minded college students, we decided to use our Servant Scholar senior project to support the Troup County School System (TCSS). Our main literacy initiative, named the Beyond the Book Initiative, worked in cooperation with the TCSS, community organizations, and the local government to provide literary resources for the citizens of Troup County. We improved the landscape of Troup County by implementing literary tools on sidewalks, helping parents teach their children about colors, numbers, and shapes in an engaging and interactive way. We entered classrooms in key schools with the lowest childhood literacy rates and served as resources to the students to read and engage with their curiosity and will to learn. We created literacy programs within the public library that engaged young children of the community and improved upon their will to learn and need to interact with education. We also put books in the hands of educators, students, and adults who wanted to help children with no books in their homes. Instead of handing out books to everyone for free, we sold books at extremely discounted rates of 5 cents per book. We followed the principles explained by Robert Lupton (2012) in his book, *Toxic Charity*, that those in need must be allowed the ownership and dignity that comes with assuming responsibility for their own development. We partnered with preexisting literacy programs, helping with smaller projects such as dictionary distribution and little free libraries. Finally, we finished the Beyond the Book project during the COVID-19 epidemic, sponsoring an online reading program. These measures impacted Troup County on a micro and macro level, encouraging a proactive approach towards fostering literacy in the LaGrange and Troup County area.

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## Introduction

With the motto of "Create Dangerously," the Wilkinson Family Servant Scholars Program believes that the LaGrange community could benefit from combining forces with LaGrange College to promote service through servant leadership. Using the philosophy of servant leadership,

developed by Robert Greenleaf in his book *The Servant as Leader*, encourages Scholars to function while valuing assisting individuals more than the power associated with leading.

In order to "create dangerously," each Cohort finds a passion and a need within the community of LaGrange and builds relationships to facilitate change. As the Cohort of 2020,

we were able to find a need and passion for working with the next generation. As we sat down to discuss the community’s needs, we brought in community leaders to express their concerns, what they believed would benefit the community the most, and methods to foster development. After listening to a few key speakers and hearing the low statistics for reading on grade level at the elementary school level, our Cohort of 2020 decided upon childhood literacy as our target.

One initiative that had already taken off within LaGrange was Groundwork, a campaign built to fight low literacy rates within Troup County. The community did this by bringing public awareness to the strikingly low percentages of children who could read on grade level. According to the Georgia Milestones Assessment Test, only 35% of Troup County third grade students are on grade level in English Language Arts (Georgia Department of Education, 2019). After hearing of the need, we researched why students in Troup County were struggling to read on grade level and the socioeconomics behind that statistic.

One of the leading books on literacy, *Meaningful Differences in the Everyday Experience of Young American Children*, cites that there is a 30-million-word deficit between children of poverty and those of affluence (Hart & Risley, 1995). This implies that children in poverty are specifically at an educational disadvantage, having been raised while hearing fewer words, into the millions, as opposed to children raised in a higher socio-economic class. Local non-profit leader Sherri Brown reported this about children in poverty in Troup County:

There are 33% of children in Troup County that live at or below the federal poverty level. There are a lot more that live in what we would consider low income homes that aren’t making it. This affects how a child may come to school or why a parent can’t make the parent-teacher conference. (The LaGrange Daily News, 2018)

According to Groundwork, 11% of elementary students in Troup County missed at least 15 days of school last year (Bearden & Tilley, 2019). Missing class also interferes with children who are already disadvantaged. We determined that in order to target a poverty-stricken area, assisting them towards reading on grade level, we had to reach them on their own terms. As a cohort, we decided on multiple initiatives to focus on throughout the year. One project was a mobile bookstore, selling books for five cents in areas and neighborhoods where we believed children would most benefit from the store.

According to research, teacher quality is the most important school-related factor influencing student achievement (Rice, 2003). Based on this, we also decided to enter into the school system to assist teachers with their students, helping to read with one-on-one attention. Because the Troup County school system was too large to tackle every elementary school, we decided to focus on the two elementary

Table 1

Georgia Milestones 2018-2019 Statewide Scores: Grade 3 English Language Arts Assessment

School Name	English Language Arts						
	# Tested	% BL	% DL	% PL	% DGL	% DL & Above	% PL & Above
West Point Elementary School	48	27.1	37.5	31.3	4.2	72.9	35.4
Long Cane Elementary School	67	32.8	26.9	32.8	7.5	67.2	40.3
Hollis Hand Elementary School	104	18.3	26.9	36.5	18.3	81.7	54.8
Franklin Forest Elementary	110	40.0	26.4	25.5	8.2	60.0	33.6
Hogansville Elementary School	65	44.6	27.7	23.1	4.6	55.4	27.7
Ethel W. Kight Elementary School	100	42.0	35.0	22.0	1.0	58.0	23.0
Clearview Elementary School	107	60.7	24.3	12.1	2.8	39.3	15.0
Hillcrest Elementary School	56	7.1	21.4	39.3	32.1	92.9	71.4
Rosemont Elementary School	72	15.3	29.2	31.9	23.6	84.7	55.6
Berta Weathersbee Elementary School	40	70.0	25.0	5.0	0.0	30.0	5.0

Note. BL = Beginning Learner, DL = Developing Learner, PL = Proficient Learner, DGL = Distinguished Learner.

Adapted from “Spring 2019 Georgia Milestones End-of-Grade Assessment - Grade 3 - School Level - July 26, 2019” by The Georgia Department of Education, 2019.

schools with the lowest reading levels, targeting the third-grade level. A detailed list of the elementary school literacy rates can be found in Table 1.

The third grade is a critical point in a child’s educational process, as children learn to read until the third grade, whereas afterward, the system prioritizes reading to learn (Feister, 2010). Without knowing how to read properly at grade level efficiency, children will falter during the remainder of their education. According to the Annie E. Casey Foundation, children who cannot read on grade level by the third grade are four times more likely to drop out of high school than proficient readers are (Feister, 2010).

In moving forward with our initiative, we chose to assist Ethel Kight Elementary School and Berta Weathersbee Elementary School. According to the 2019 Georgia Milestones Test scores: English Language Arts, these two schools had the lowest percent of 3rd graders who could read on grade level in Troup County (Georgia Department of Education, 2019). Berta Weathersbee had 5% of 3rd graders reading on grade level, and Ethel Kight had 23% (Georgia Department of Education, 2019). These staggering statistics were the driving force behind our initiative and passion for influencing the next generation, as we felt a strong desire to enhance their learning through education, literacy, in order to impact their overall future in the Troup County school system.

### Review of the Literature

Childhood literacy is a priority to Troup County. Education is a societal backbone that translates to several economic and social schemes (Al-Shuaibi, 2014). It is

important to teach children to read and write early because by the end of first grade, children begin to experiment with letters and the alphabet, demonstrating phonemic awareness, recognizing phonics and sounds, and spelling words by sound and sight (Gentry, 1997).

*The Reading Strategies Book* by Jennifer Serravallo helps individuals find methods to teach students how to read. Each strategy is supported by research and contains added suggestions for adaptation dependent on each reader. As the Cohort of 2020, we were faced with finding methods to encourage literacy with a diverse population of students, often simultaneously. Our weekly readings at the LaGrange Memorial Library relate to Serravallo's book, as Serravallo gives much insight on how to excel in that circumstance. According to Serravallo, "Engage your mind by asking questions as you read. In fiction, you might ask, 'What comes next? Why did the character do that?' In nonfiction, you might ask questions about the topic. Read on to answer your questions." (Serravallo, 2015, p. 59). These strategies have become a great asset for us while reading to children, supplying methods to keep the children engaged during readings. Serravallo's book is organized by goals. These goals are engagement, print work, fluency, and comprehension. From comprehension, the goals break down into learning the narrative of each story, along with main ideas, vocabulary, and themes. Each goal also contributes to specific reading strategies.

Concerning this connection, Diane McGuinness's book *Growing a Reader from Birth* explores each part of a child's development, as early as a baby's prenatal period, or six to nine months of gestation, and as mature as five years old. McGuinness states that understanding language is critical in the progression of literacy. *Growing a Reader from Birth* provides effective learning methods and conceptualizes a child's developmental stages. McGuinness explains the neurological background of a child's development, something that we lacked an educational background in. We did preemptively understand that some children process language differently than the majority do; therefore, we realized the need to focus on children who lacked vocabulary development, based upon the quantity of the words they heard in everyday life.

The guidelines in the previous book were similar to those presented in *Early Literacy Storytimes @ Your Library* by Pamela Martin-Díaz and Saroj Ghoting. The library's role in helping children learn key literacy skills cannot be overstated. This book is a guide on partnering with local libraries, teaching the importance of teaching, and paving the way for informative lesson plans. The book is divided into three parts: Learning It, Doing It, and Keeping It Going. The first part, Learning It, establishes the goal of the book and explains the research behind early-learning literacy. The second part, Doing It, consists of sample story times for all different age groups. The third part, Keeping It Going, embarks

on the process of assessing story times for effectiveness and details other steps to promoting early literacy activities in local libraries. The following passage explains more:

"The early literacy perspective asserts that reading readiness starts at birth, when the parent or caregiver begins talking with the baby. Adherents now believe that experiences throughout the early years affect the development of literacy. Failing to give children literacy experiences until they are school age can severely limit the reading and writing levels they ultimately attain." (Ghoting and Martin-Díaz, 2005, pg. 6)

As the Cohort of 2020, we encouraged parents to read to their children, as that plays a critical role of inestimable importance in laying the foundation for learning to read. Parents should informally teach preschool children about reading and writing by reading aloud to them, discussing stories and events, encouraging them to learn letters and words, and teaching them about the world around them. These practices help prepare children for success in reading.

In the works of *Scribble Scrabble*, Daniel Meier describes moments of literacy teaching that reveal important intersections among development, literacy, and diversity (Meier, 2000). Meier offers methods to unite developmentally appropriate and culturally responsive literacy practices. The book presents detailed portraits of children learning to make sense of literacy during their childhood years. Included are conversations with children, parents, and teachers about how they view literacy. The conversations highlight the important role that these beliefs and values play in literacy learning (Meier, 2000).

The first section of the book provides background on the teacher's role as developing appropriate and culturally responsive literacy practices. *Scribble Scrabble* especially gave us potent information on how to create strategic educational plans for Ethel Kight and Berta Weathersbee. Since we were not certified as teachers, we were able to reference plans from the book. The second section describes how to teach children, connecting development and diversity in their literacy learning with artwork, writing, and other creative measures. The last section describes and discusses the widening circles of literacy teaching and learning. This includes ways to strengthen existing school literacy practices by including family voices and perspectives within their children's education. The book ended with reflections on the continuing search for common ground between developmentally appropriate practice and culturally responsive teaching.

Similar to the previous book, Susan B. Neuman's, Carol Copple's, and Sue Bredekamp's book *Learning to Read and Write* illustrates the importance of learning to read and write in adolescence. It consists of three sections, the first being "The Position." This section specifies background research



performed during the book and different methods proven to increase reading in young children. A key component of this section is that a child's development with reading and writing must be estimated and built upon, noting that no teaching method or approach will be the same for all individuals (pg. 8-10). The second section is "Readers and Writers in the Making," and it speaks upon the power and pleasure of literacy, the environment a child is in, the importance of language development, building knowledge and comprehension, knowledge of print, phonological awareness, and letters and words. One technique expressed in this section is instituting a mailbox within the home or classroom for a child to interact with (pg.44). Writing letters to other people and communicating with them in this way increases a child's pleasure for reading and writing, as well as encourages them to keep doing so. The third section, named "Ensuring Children's Reading and Writing Success," takes a look at what the reader could personally do to promote literacy. This section notes that readers should perform assessments to monitor a child's literacy learning, periodically changing assessment measures (pg. 104).

In the next book, Robert Flesch details how he was inspired to write *Why Johnny Can't Read* while tutoring a middle school child named Johnny. In this, Flesch explains that the best way to teach a child how to read is through teaching phonics, since learning the sounds of letter combinations allows children to sound out unfamiliar words. Though this is an older resource, we appreciated the book's approach to phonics. A similar approach to phonics is also supported in *The Next Step Forward in Word Study and Phonics*, a book published in 2019 by Jan Richardson and Michèle Dufresne.

### **Beyond the Book Initiative**

#### **Our Daily Bread Soup Kitchen**

Our Daily Bread is not one of the initiatives started by the Cohort of 2020; however, it is an important part of the Servant Scholar learning experience. The first Servant Scholar Cohort noticed an important need within the LaGrange, a need met by every cohort has carried on since its start. The project, called Our Daily Bread, began in February of 2013, when the original Scholars noticed that LaGrange had accessible soup kitchens for every weekday, except for Fridays. This inspired them to open their own soup kitchen, running on Fridays from 11a.m. to 1p.m. Our Daily Bread is operated out of the LaGrange's Broad Street Church of Christ, which is located at 408 Broad St, LaGrange, GA 30240. As current Scholars, we used the church's kitchen and supply the food, plates, and drinks for the soup kitchen. To maintain the kitchen, we shopped at local discount food markets and Walmart, as well as collected food donations from the local community and LaGrange College. Our Daily Bread is unique from other food-based missions because after Scholars finish cooking the meal, they eat with the people they're serving. This allows for ample

fellowship, helping us, as Scholars, to build community and foster relationships.

During COVID-19, Our Daily Bread was able to adapt to its climate. Due to social distancing policies, we made packages for guests to safely retrieve. Each package, having multiple sandwiches, was set individually on a clean table so that the guests could easily collect their food and follow safe COVID-19 protocol.

Before COVID-19 was present in the Troup County community, we started instituting the help of the visitors in setting up and cleaning after eating. We also implemented book giveaways during the Beyond the Book project, to combine our 2019-2020 project with the longstanding successes of Our Daily Bread. The Our Daily Bread project has been the longest-running project in the Wilkinson Family Servant Scholar Program's history and has continued to leave a lasting impact on the city of LaGrange. Our Daily Bread was not one of the specific ideas created by this Servant Scholar class but is and will be continued by all Servant Scholars who pass through the program.

#### **Library Reading Program**

In attempts to cater to the Hillside community's literacy rates, we began a reading program at the LaGrange Memorial Library. This allowed us to gather data, foster literacy growth, and form meaningful relationships. We also knew that the LaGrange Memorial Library was constantly populated with many children who fit their target audience. To begin formulating the reading program, we visited similar programs that the Library already offered. We used these pre-existing programs to help develop their ideas and decide what we wanted to do during our program. Kate Chambers, the Youth Services Coordinator at LaGrange Memorial Library, was very helpful while we were in their initial phases of this project. We met with her at the library, talked with her about what times might be best for their program, and collaborated on providing craft supplies to use during their program. She was a vital piece of the puzzle, and her support helped us turn our program into a success.

When the library reading program began, there were fewer children in attendance than we had predicted. After a few weeks of determining the programming, we decided to change the time of the readings, moving it later by thirty minutes. This vastly improved the number of children in attendance, as it allowed for students to arrive at the library without having to rush.

The library reading program eventually began at 3:30 p.m. on Mondays, usually lasting an hour. The program was split into two parts: reading and crafts. The readings consisted of three different books that were relevant to current events and topics, such as seasonal books or positive topics. The crafts also mimicked the same topic that the books covered.

As the Cohort of 2020, we used many resources to guide the structure of the library reading program, one of which

was *Early Literacy Storytimes @ Your Library: Partnering with Caregivers for Success*. We used many methods listed in this book to help plan programs. The following paragraph informed us on specific learning styles to cater to:

The traditional storytime already touches a few learning styles. The musical learner enjoys the songs and finger plays, the linguistic learner is thriving with the word sounds in picture books, the kinesthetic learner is on the edge of his rug waiting for the movement song or activity, and the spatial learner has her crayons sharpened in anticipation of the craft activity. The naturalist learner thrives on the many stories that include animals and the outdoors. (Ghoting and Martin-Díaz, 2004, pg. 42)

Using this knowledge, we involved examples of each type of learning in many of our programs. Nine out of the 18 programs included naturalist stories, all of the programs included crafts suitable for both kinesthetic and spatial learners, and each book reading included stimulating questions aimed at linguistic learners. However, due to the quieter nature of the library, we sang fewer songs than other similar learning programs used.

In terms of attendance data, we had two different average attendance rates. Overall, we saw 88 children in 18 weeks of library programming. Before switching to the 3:30 p.m. time slot, we had 7 weeks of programming with a total of 12 students in attendance, leading to an average of fewer than 2 students per program. After changing to the 3:30 p.m. time slot, we had 76 students attend the remaining 11 programs, yielding an average of almost 7 students per program. We are aware that the increase in attendance was also related to better advertising and program consistency, but the time change was

influential enough to demand two separate estimates, as grouping all library sessions in the same estimate would yield a total estimate of fewer than 5 students per program, which seemed unrepresentative of the program. A detailed attendance chart can be found in Table 2.

As Scholars, we had many fond experiences while conducting the library reading program. The children were enthusiastic about learning and often came ready to socialize. One of the Scholars had a remarkable experience with a 3rd-grade student, registering her for a library card and helping her check out her first library book. The 3rd-grade student teared up by experiencing this newfound freedom and spent the rest of her time at the library picking books with us. Another positive moment came during a simple craft activity, where one student wrote a detailed thank-you card for us, thanking us for teaching him how to read. Afterwards, the student avidly attended each library reading program for the rest of the semester.

### Elementary School Readings

When we began our research on literacy in Troup County, we began to realize that the numbers were staggeringly low for students who could read on a 3rd-grade level. The 2019 Georgia Milestones Test scores: English Language Arts recorded that Ethel Kight Elementary and Berta Weathersbee Elementary had the lowest percentiles, with Berta Weathersbee at 5% and Ethel Kight at 23% (Georgia Department of Education, 2019). We had also previously learned that children learn to read up until the third grade, and after the third grade, they are reading to learn (Feister, 2010). Between both this acquired knowledge and statistical evidence, our initiative to read to these students was created.

We began this program by contacting the counselors and principals of both Berta Weathersbee and Ethel Kight Elementary Schools. These interactions were mostly made through email, with a few in-person meetings, but included the communication of our desire to assist the schools during the day, interacting in a positive manner with the students. Each school replied with excitement, and we began to plan times that would work best to go to each school.

As Scholars, we faced a large setback during the planning of this phase. Securing background checks took over two months of our time. With 12 Senior Scholars, securing this opportunity required immense planning, allowing the group to figure out the best time to attend each school. For Berta, we would attend the same class every Monday mid-morning, while attending Ethel Kight on Tuesday, Wednesday, and Thursday afternoons to help with their ACE programs. Ethel Kight also agreed for Scholars, who could not attend in the afternoon, to individually assist classrooms during a time that worked for them in the school day.

During the planning process, we deliberated on the best approach for assisting at both schools. By the end of planning, we reached an agreement, where we would interact

Table 2

*Attendance at the LaGrange Memorial Library Reading Program*

Date	# of Scholars	# of Students	Returning Students	Topic
Sept. 19	6	5	-	Weather
Sept. 23	5	1	-	Trees
Sept. 30	5	2	-	The Ocean
Oct. 7	4	1	-	Space
Oct. 14	4	0	-	Dinosaurs
Oct. 21	7	3	-	Dr. Seuss
Oct. 28	7	8	2	Halloween
Nov. 18	7	10	5	Thanksgiving
Dec. 2	5	5	1	Imaginary Friends
Dec. 9	4	7	2	Family
Dec. 16	2	6	5	Snow
Jan. 6	2	6	2	Sharing and Giving
Jan. 13	4	6	2	Community Helpers
Feb. 3	7	8	5	Groundhog/Winter
Feb. 10	2	7	3	Valentine's
Feb. 24	5	4	1	Presidents
Mar. 2	3	5	1	Safari Animals
Mar. 9	2	4	3	Pets
<b>Total attendees:</b>		<b>88</b>		

with the students through conversation, designated reading times, and playing games to help with the students' understanding of literary elements. Through these interactions, it was our hope not only to spark interest and hope for these generations but also to strengthen their literacy background for the future.

Each Scholar subsequently participated with the schools on an individual basis. Many attended Ethel Kight's ACE program, playing literacy games with students. Ethel Kight students specifically loved playing literacy bingo: a matching game with sight words. Cumulatively, we spent a substantial amount of time within Ethel Kight and Berta, influencing the children by example: learning with them by playing, rather than directly teaching.

### Bookmarks

For the next portion of our literacy initiative, we needed to install a sustainable aspect of our project. In doing this, we reflected on a class during our first year in the program when the president of United Way of West Georgia visited to discuss potential service opportunities where the community could benefit from our impact. Patty Youngblood presented the idea of interactive reading trails. Interactive sidewalks, formally known as Born Learning Trails, are created to stimulate areas of a child's brain to associate movements with colors, words, and numbers. Born Learning Trails are strategically placed with the most adolescent foot traffic in mind (United Way, 2020). The designs are painted on the sidewalks and used by children accompanied by their parents or guardians. Signs are placed at Born Learning Trails that have instructions for games and activities children and families can do together. These ideas led us to adopt a similar program.

Being mindful of the set budget, we created our own version of Born Learning Trails, referring to ours as "Bookmarks." Bookmarks became the sustainable piece of the literary puzzle and was funded through a grant from the Junior Service League of LaGrange. Members of the 2020 Cohort met with members of United Way, the City of LaGrange, and several communities within Troup County for support and approval of Bookmarks. The placement of Bookmarks was a thoughtful decision, as we finally settled on placements by Berta Weathersbee, the Calumet Village, and the Park at Shuford Fields. As of 2018, Berta Weathersbee had the highest percentage of students reading below grade level. Calumet Village housed families and individuals living at or below the poverty level, and the Park at Shuford Fields served as an area for children of all socioeconomic backgrounds have access to.

The first Bookmark was painted March 7th on the playground of the George Harris Baseball Complex, a spot with lots of weekend foot traffic. We met several children and excited adults who were looking forward to the completion of the project throughout Troup County. Due to complications with COVID-19, the remaining three Bookmarks were unable to be completed. Pictures taken during the creation of the

Figure 1. Bookmark Installation



George Harris Baseball Complex Bookmark can be found in Figures 1 and 2.

### The Panther Bookstore

During the Fall Semester of 2018-2019, we were encouraged to participate in a group project for our Junior year. This group project was to be beneficial to the Cohort, helping us to learn to work together with a common goal before conducting our Senior project. We decided, as a cohort, on a project called the Panther Toy Store.

In previous years, the Panther Toy Store has been traditionally hosted by LaGrange College Spiritual Life. It had not been active in several years, but because it had already been done before, it was an easy principle for us to follow. The concept behind the Toy Store was this: that we would collect

**Figure 2. Bookmark Installation**



new toys and host an event to sell them at extremely discounted rates. Rather than simply giving away toys during this holiday season, we sold them for pennies.

“It is important that giving be truly free. It must never degenerate into charity, in the pejorative sense. Almsgiving is Mammon’s perversion of giving. It affirms the superiority of the giver, who thus gains a point on the recipient, binds him, demands gratitude, humiliates him and reduces him to a lower state than he had before.” (Lupton, 2012)

Using this model was beneficial to those participating in the event because the guests were able to keep their dignity; parents still felt as though they were buying their children Christmas presents, instead of receiving handouts.

The event was invitation-only, as each of us reached out to counselors at multiple Troup County elementary schools. Each school counselor would then look for families who they believed would benefit from the Panther Toy Store, due to families lacking resources or funds. Each counselor responded to us by recommending five families for the toy store. After receiving the names, we sent formal invitations to those families through the counselors.

At the same time, we were also looking for sponsors and donors. These donors would help supply the toys that we would sell. First Presbyterian Church of LaGrange and the various sororities of LaGrange College were the primary donors for this event.

On the day of the event, we had several different rooms set up: one room was for shopping, one room for gift wrapping, and another room for playing with the families’ children. Some of us Scholars were assigned to play with the children while the parents were Christmas shopping, while other Scholars worked at the actual toy store. We received a significant

amount of donations and had over 30 families come to the event. Noting these results, we believed that our Panther Toy Store was very successful.

For our Senior year, we continued to follow this model. Rather than selling toys, though, we sold books. As a Cohort, we renamed this new project the Panther Book Store. We then worked over the summer months, collecting books. We were asking for children’s books from family, friends, and acquaintances. Collectively, we gathered 2,752 books.

Books were then sold at \$0.05 each, thus easily allowing families and individuals to buy 20 books for \$1. During the book sales, if a family did not have the means to purchase a book, we would find ways for them to earn books. We decided that the bookstores should include games. These games -- sometimes cornhole, bean bag toss, or frisbee -- allowed the winners to earn tickets. Tickets would then be redeemed for books. Individuals were allowed to play the game as much as possible so that they could earn tickets and purchase books. We used these efforts to actively empower families by allowing them to work to earn their tickets. “Little affirms human dignity more than honest work. One of the surest ways to destroy self-worth is subsidizing the idleness of able-bodied people. Work is a gift, a calling, a human responsibility” (Lupton, 2012). Books were sold at this price so that individuals purchasing the books kept their dignity.

Our goal was to host a Panther Bookstore, in various locations, every month, totaling 9 bookstores during the duration of the project. We partnered with various communities to host bookstores at multiple locations, such as the LaGrange Housing Authority, Mona Lane, Callaway Auditorium, Griggs Center, and in the Calumet community. Over the course of the Beyond the Book Initiative, we sold 1,128 books. In addition to this, we had a total of 127 visitors,

Table 3

*Panther Bookstore Data*

Date	Location	Student Visitors	Adult Visitors	Books sold
Sept. 28	Callaway Auditorium	0	3	30
Oct. 26	Griggs Center	3	10	250
Nov. 16	Housing Authority	30	35	495
Dec. 16	Mona Lane	15	4	75
Jan. 18	Griggs Center	1	2	29
Jan. 25	ARK Refugee Center	3	6	165
Feb. 21	Our Daily Bread	-	10	50
Feb. 28	Our Daily Bread	-	6	34
<b>Totals:</b>		<b>52</b>	<b>76</b>	<b>1,128</b>

families, individuals, and children, at our Panther Bookstore events. A more detailed report can be found in Table 3.

Throughout the sales, we were able to foster many relationships with the guests. We were able to see children either earn their books through winning games or pick out and purchase books with their own money. This was an encouraging experience for us, as we were able to personally interact with and encourage every student who attended the Panther Bookstore.

### The Jungle Bus

During our research on literacy in Troup County, we found other preexisting initiatives that aimed to boost literacy rates. As a cohort, we decided to unite with Literacy Volunteers of Troup County, the Jungle Bus, Get Troup Reading, and Troup County Certified Literate Community Program (CLCP). Through our work, we experienced one-on-one interactions with community members, learning more about the needs of Troup County.

When we initially decided to develop our project surrounding literacy rates, we developed a plan to partner with the Jungle Bus. Serving as a mobile library, the Jungle Bus delivers free books to students in Troup County. The Jungle Bus is an initiative that stems from the original work of Debbie Burdette and her aim to improve literacy as Mamma Jamma: The Story Telling Mamma. Ms. Burdette chose to continue her work with Lagrange’s Certified Literate Community Program and left the management of the Jungle Bus to Nicole Kennedy, Troup County Parent and Family Engagement Coordinator, and Gail Gordon, United Way West Georgia’s Success by Six’s coordinator. Both ladies have taken on personas who are known to be descendants of Mamma Jamma. Kennedy takes on the role of Jungle Jamma, and Gordon portrays a character named Reading Ranger. These personas keep children engaged, supporting the Jungle Bus’s theme and encouraging students to believe that reading can be fun.

Through Kennedy’s and Gordon’s leadership, the themed automobile has delivered over 3,000 books to children in Troup County (Troup County School System, 2019). We were able to hand-deliver books to children through this initiative, partnering with the Jungle Bus for the city’s annual

Chili Cook-Off. The cook-off was located in LaGrange’s downtown square, and through this centralized location, we made connections with many community members. We attended many other local events that the Jungle Bus participated in, including Law Enforcement’s National Night Out, the Community Trunk or Treat, and Family Day for the City. This helped the project fulfill the Wilkinson Family Servant Scholar Program’s overall mission, as it helped bridge the gap between the college campus and the LaGrange community.

The Jungle Bus is known across Troup County for being a fun and adventurous outlet for children to use and gain a positive experience in literacy. Our Beyond the Book goal targeted improving literacy in Troup County, from birth to third grade, but after learning about opportunities such as the Jungle Bus, we soon learned that other ages needed assistance as well. This did not sway us from our original goal but rather allowed us to expand appropriately. When third graders are unable to read on grade level, it complicates further education into fourth and fifth grade. To help those who have passed the third grade, the Jungle Bus invites all ages to participate, hoping to spark a passion for reading even in older students. This allows for reading at all levels to improve.

### Little Free Libraries

Get Troup Reading, a local initiative descending from the Get Georgia Reading program, was developed by Chamber of Commerce members with the intent to focus solely on the Troup County School System. Get Georgia Reading was an initiative started statewide, due to two-thirds of Georgia’s third graders not reading on grade level (Get Georgia Reading, 2016). We made a partnership with this program after being introduced to Kathy Tilley. As a member of the Chamber of Commerce and Get Troup Reading, Tilley understands the importance of early literacy learning initiatives. Tilley asked us to construct Little Free Libraries and strategically place them around LaGrange. The Cohort unanimously agreed to take the project on, constructing wooden structures that resembled large birdhouses. The Little Free Libraries boasted sliding transparent doors, as the books were kept inside the structures. They were made so that children could take books or leave books with no exchange rate. The libraries were meant to be installed in the Calumet community, among others. Due to the unexpected effects of COVID-19, we were unable to install the structures at the end of the semester, as previously planned.

### Success by 6

Success by 6, a United Way of West Georgia reading readiness program, focuses on children aged 3-5. In the 2019-2020 school year, the program ran every Tuesday morning, located on the bottom floor of the Bank of America building in downtown LaGrange. Operated by Gail Gordon, the Success by 6 Coordinator, the curriculum included art, language, and phonics. The sessions were free and in a centralized location,

allowing parents of all socioeconomic classes to attend with their children. We volunteered at this initiative, assisting in any way needed. We prepped the activities and helped assist children when parents were unable to. Success by 6 continuously sponsors varieties of school readiness activities aimed at providing developmentally appropriate activities and experiences for children aged 3-5. Because Success by 6's mission and age demographic matched our initiative, we decided to include this program in our Beyond the Book Initiative.

### **Certified Literate Community Program**

We also partnered with the Certified Literate Community Program (CLCP). The CLCP promotes community-wide literacy by enhancing the quality of literacy in accordance with the guidelines set by the State of Georgia. CLCP annually gives dictionaries to local third-grade classrooms. We helped the organization achieve its mission by placing stickers on over 1,000 dictionaries, as well as attending program meetings. Because of our dedication and aid, the CLCP recognized our Cohort with an award at their annual Literary Bee, an event hosted to thank all organizations that invest and support the CLCP. The award is given annually to an organization that exemplifies hard work towards improving literacy rates in Troup County. We then attended the Literary Bee and were recognized for our focus on literacy in the community within the past year.

### **Effects of COVID-19**

COVID-19 was a time of panic caused by a virus that led to a worldwide pandemic. Due to COVID-19, all colleges in the United States of America were forced to close, as well as move all remaining students out of campus dorms. This affected the student body of LaGrange College, as well as the Wilkinson Family Servant Scholars' Class of 2020 Senior Project. We had been working diligently on our Beyond the Book Initiative since the second semester of our Junior year. We had certain projects divided into different semesters, with some specific to the spring, including Bookmarks and work at local schools. COVID-19 put a halt to the Spring Semester, leading to an abrupt completion of the Beyond the Book Initiative.

However, we were not discouraged by this. Instead, we began working remotely to continue the improvement of literacy. As the world fled online, we followed suit, hoping to reach local students through the internet. Each of us chose two children's books, filming ourselves reading it for the internet. Then, a few of us edited the videos and uploaded them to the Senior Cohort's YouTube page. Finally, we released them in a timely manner to the Beyond the Book Facebook page. This page was created for children who were no longer able to attend school in person. We thought that some children may not have books in their homes and could be struggling to read on their own. We also considered parents who might have been

working from home, having to teach their children with time constraints.

We also continued to work on our colloquium. Though it would not be held on campus, as it had been for other cohorts, we saw the importance of continuing to educate others on our project's mission and our efforts. COVID-19 affected members of many cultures and backgrounds, forcing many to learn new skills and take new paths. With this in mind, we decided to make a virtual colloquium that embodied the Beyond the Book project and exemplified the standards of the Wilkinson Family Servant Scholar Program.

### **Conclusion**

As the Wilkinson Family Servant Scholars Cohort of 2020, we conducted work within the field of literacy with our 2019-2020 Senior project: Beyond the Book. In doing so, we completed over 1,200 hours of community service, working with multiple organizations in LaGrange, GA and Troup County. Through our efforts, we were able to disseminate 1,128 books to the community, fostering relationships with those who attended our Panther Bookstores. We also completed 18 programs at the LaGrange Memorial Library, having had a total of 88 students in attendance. We were also able to assist two local schools, helping students, encouraging them in their studies, reading to them, and playing learning games at Berta Weathersbee and Ethel Kight. We were able to participate alongside others in the literacy field of LaGrange, including giving out books with the Jungle Bus, assisting the CLCP, helping with the Success by 6 program, and building Little Free Libraries with the Get Troup Reading program. Finally, we were able to install a Bookmark at the George Harris Baseball Complex, seeing the impact that it had on local children even as they were painting it.

When first beginning as Wilkinson Family Servant Scholars, we heard a classic story about starfish. The program's director, Professor Jeff Lukken, noted the importance of little events with the following illustration:

"Sometimes, we get caught up in saving the world, when really, we are saving the world by helping one person at a time. This young girl is walking on the beach early in the morning, and she sees an older guy bending down and throwing something into the ocean. As she gets closer, she sees that he's throwing back starfish. She approached him, and she asked, 'What are you doing?' and the man said, 'Well, the sun's coming up, and there are thousands of these starfish that are all going to dry up if they don't get back into the ocean.' The girl said, 'Yeah, but there are thousands -- millions of them. You'll never make a difference.' As the man continued throwing each starfish back into the water, he replied with hesitation, 'It makes a difference for this one... and it makes a difference for this one... and it makes a difference for

this one...’ Any act of kindness can make a difference in someone’s world.” (J. Lukken, personal communication, April 20, 2020)

Many of the actions taken by our Cohort of 2020 may seem small in comparison to national projects. However, our Beyond the Book Initiative was a collection of many full-fledged programs that reached many individuals. These were all personal actions that were either sustainable or personal, in a meaningful way. Through Beyond the Book, we were able to distribute books to hundreds of students, via the Panther Bookstore and the Jungle Bus. Those books are now in the children’s hands, and that is sustainable in itself.

With projects like these, it is often hard to conclude with concrete findings or evidence, especially as there are no accurate literacy rates for the 2019-2020 year, due to the effects of COVID-19. However, we are extremely aware that we impacted individual lives, knowing that we inspired students by turning reading into an adventure. We also know that we impacted local students, having distributed 1,138 books into the community, and having had hundreds of personal conversations with local students. More than that, each effort has converted into a memory for each student involved in these programs -- memories that will continue to inspire them for much longer than the Beyond the Book initiative. In the same way, as Beyond the Book comes to a close, we will never forget our involvement with the LaGrange community, knowing that every book distributed, every student taught, and every child motivated helped us to toss another starfish back into the sea.

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# Financial Analysis of Intel Corporation

Michael Bleimeyer

*Faculty Mentor: Cindi Bearden, BS, Mac, CPA*  
Business and Nonprofit Studies, Accountancy

## Abstract

Intel Corporation is a semiconductor manufacturing business that is currently transforming into a data-centric business. Intel was founded in 1968 in California and went public in 1971. Intel's largest competitor is Advanced Micro Devices, which also manufactures semiconductors. Intel's revenue has been growing and reached \$71.9 billion in fiscal 2019. Intel's revenue has increased due to a strong economy and its growing data-centric segments. At the same time, Intel has been cutting its operating expenses in order to increase its net income. The tax reform of 2017 also helped increase Intel's net income by 84% since fiscal 2015, due to the corporate tax rate being cut. Intel used 86% of its cash on additions to its property, plant, and equipment, the purchase of trading assets, the repurchase of its common stock, and payments of cash dividends in fiscal 2019. Intel has also been increasing the amount of cash used to pay dividends since fiscal 2015 in order to complete one of its top priorities, which is to return value to its shareholders. Intel is expected to continue its growth, because the industry is expected to grow by 3% until 2024.

Intel Corporation is a microprocessor and semiconductor manufacturing business. Intel was founded in 1968 in California (AYIR, Intel's 2018 Annual Report, 2019). This paper will show an analysis of Intel's financial statements, as well as an analysis of the financial statements of its largest competitor, Advanced Micro Devices (AMD). After examining the last 5 years of financial statements and annual reports for both companies, I created common size financial statements, a horizontal analysis of year-to-year changes, and a trend analysis of overall changes for both companies. I have also calculated many financial ratios for each company.

### Company Information

Intel Corporation had its Initial Public Offering in 1971 at \$23.50 per share, raising \$6.8 million dollars (Introduction, Intel's 2018 Annual Report, 2019). Intel was reincorporated in Delaware in 1989 (Introduction, Intel's 2017 Annual Report, 2018). In 2015, Intel announced its transformation into a data-centric business, signaling growth in data-centric markets including artificial intelligence and autonomous driving (Introduction, Intel's 2018 Annual Report, 2019).

### Capital Allocation Strategy

Intel's strategy consists of three top priorities. First, Intel invests in its own business through capital expenditures and through research and development. Intel must invest in research and development in order to continue to lead the industry with new products and technology (AYIR, Intel's

2018 Annual Report, 2019). Also, Intel must invest in capital expenditures, because it is transforming into a data-centric business, so it is ramping up production of new products (AYIR, Intel's 2018 Annual Report, 2019).

The second priority of Intel's capital allocation strategy is to acquire and integrate companies around the world that complement Intel's investments in research and development and capital expenditures (AYIR, Intel's 2018 Annual Report, 2019). Intel purchases companies yearly. Two major acquisitions that Intel had in recent years included Altera in fiscal 2016 and Mobileye in fiscal 2017 (AYIR, Intel's 2018 Annual Report, 2019). Intel's acquisitions stimulate growth in its data-centric businesses (AYIR, Intel's 2018 Annual Report, 2019).

Intel's third capital allocation priority is to return cash to shareholders. Intel pays dividends and repurchases its common stock to help increase each share's worth and return cash to the shareholders. Intel has increased its dividends paid per share since fiscal 2014 (AYIR, Intel's 2018 Annual Report, 2019).

### Operating Segments

Intel has five main operating segments, including Client Computing Group, Data Center Group, Internet of Things Group, Non-Volatile Memory Solutions, and the Programmable Solutions Group. See Figure 1 below for breakdown of the revenues earned from each operating segment in fiscal 2018 (MD&A, Intel's 2018 Annual Report, 2019).



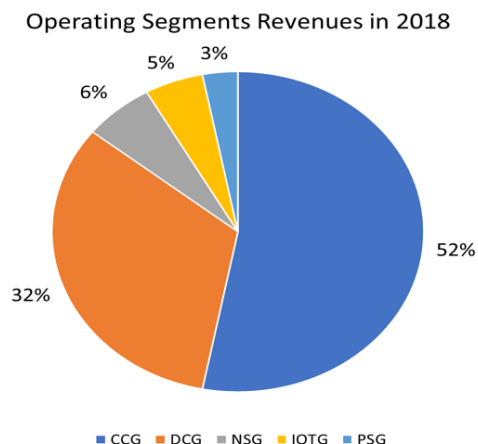


Figure 1: Revenue by Operating Segment

### PC-Centric Business

Intel's Client Computing Group (CCG) is Intel's largest operating segment based on revenue earned. The Client Computing Group consisted of 52% of Intel's revenues in fiscal 2018 (MD&A, Intel's 2018 Annual Report, 2019). The CCG's main products are computer processors. A large group of products in this business is called the Intel Inside Program, which includes Intel Pentium Processors and the Intel Core Series (MD&A, Intel's 2018 Annual Report, 2019). The CCG is the only operating segment in Intel's PC-centric business line.

### Data-Centric Businesses

Intel's Data Center Group (DCG) is Intel's second largest operating segment based on revenue earned. The Data Center Group earned Intel 32% of its revenues in fiscal 2018 (MD&A, Intel's 2018 Annual Report, 2019). The Data Center Group consists mainly of Intel's cloud, network data storage, and communication-based products (MD&A, Intel's 2018 Annual Report, 2019). The DCG grew faster than Intel's other segments (MD&A, Intel's 2018 Annual Report, 2019).

Intel's third largest operating segment in fiscal 2018 based on revenue earned was the Non-Volatile Memory Solutions Group (NSG). The Non-Volatile Memory Solutions Group earned Intel 6% of its revenue in fiscal 2018 (MD&A, Intel's 2018 Annual Report, 2019). The NSG's main product lines are Intel Optane and Intel 3D NAND, which are solid-state drives and memory and storage products (MD&A, Intel's 2018 Annual Report, 2019). The NSG's revenue grew 20% from fiscal 2017 to fiscal 2018 (MD&A, Intel's 2018 Annual Report, 2019).

Intel's fourth largest operating segment in fiscal 2018 based on revenue earned was the Internet of Things Group (IOTG). The Internet of Things Group earned 5% of Intel's revenue in fiscal 2018 (MD&A, Intel's 2018 Annual Report, 2019). The IOTG develops applications for retailers, manufacturers, health care providers, and governments (MD&A, Intel's 2018 Annual Report, 2019).

Intel's last operating segment is the Programmable Solutions Group (PSG), which earned 3% of Intel's revenues in fiscal 2018 (MD&A, Intel's 2018 Annual Report, 2019). The PSG works with other operating sectors, mainly the CCG. Its main products are Field Programmable Gate Arrays, which work with processors to add a specific function to systems (MD&A, Intel's 2018 Annual Report, 2019).

The Data Center Group, Non-Volatile Memory Solutions Group, Internet of Things Group, and Programmable Solutions Group make up Intel's data-centric business (MD&A, Intel's 2018 Annual Report, 2019). Intel is investing more in the data-centric business in order to broaden its product base and reach more customers (MD&A, Intel's 2018 Annual Report, 2019).

### Advanced Micro Devices, Inc.

Intel's main competitor, Advanced Micro Devices, Inc., was founded in 1969 in California, just one year after Intel was founded (AMD, 2020). AMD specializes in processors and graphics cards for high performance computers, which aligns with Intel's largest operating segment, CCG (AMD, 2020). AMD and Intel are the two name-brands when it comes to computer processors for budget, business, and gaming computers. AMD's graphics cards also compete directly with those produced by Nvidia. Even as Intel's largest competitor, AMD's revenue of \$6.7 billion is much lower compared to Intel's revenues of \$72 billion in fiscal 2019 (AMD's and Intel's 2019 Annual Reports, 2020).

### Industry Outlook

The microprocessor and semiconductor industry includes many well-known businesses, such as Intel, AMD, Nvidia, Apple, Samsung, and Qualcomm. The industry is expected to grow by 3% from 2019 to 2024, according to a Marketwatch report (Marketwatch, 2019). China is expected to be the largest manufacturer of microprocessors, but these processors will continue to be of slightly lower quality (Marketwatch, 2019). The United States is likely to have better quality products and processors because the U.S. is home to the largest and wealthiest companies in the industry (Marketwatch, 2019). The wealthy companies have an advantage in disposable income for more research and production of higher quality products (Marketwatch, 2019).

### Fiscal Years

Intel and AMD both have fiscal years that end on the last Saturday of December (Notes, Intel's and AMD's 2018 Annual Report, 2019). Each of the five years represented in this analysis include 52 weeks.

### Income Statement

Intel's common size income statement is shown in Table 1. The common size income statement indicates that Intel has an inconsistent cost of sales, decreasing operating

expenses, and a fluctuating tax rate as they relate to total revenue. Table 1 also indicates that it is necessary to explain why Intel's expenses are fluctuating.

### Revenue

Intel's revenue from fiscal years 2015 to 2019 has increased (Figure 2). Intel's revenue has been increasing year-over-year because of growth in the data-centric businesses as well as growth in the Client Computing Group (MD&A, Intel's 2018 Annual Report, 2019). Growth in sales across Intel's business is due to an increase in demand, especially with high performance products (MD&A, Intel's 2018 Annual Report, 2019).

Intel's revenue has increased from \$55.4 billion in fiscal 2015 to \$72 billion in fiscal 2019. This is a growth of 30% over five years (MD&A, Intel's 2018 Annual Report, 2019). From fiscal 2017 to fiscal 2018, there was a 15% revenue increase (MD&A, Intel's 2018 Annual Report, 2019). Intel's revenue from its data-centric business grew 18% from 2017 to 2018 (MD&A, Intel's 2018 Annual Report, 2019).

### Gross Profit

Intel's gross profit margin decreased by 3% in fiscal 2019 to 59% of total revenue. Intel's gross profit margin is higher than AMD's and the industry average. The Gross Profit Margin is seen in Figure 3 below. In fiscal 2019, Intel's gross profit margin fell below 60% of revenue for the first time since

before fiscal 2015 (MD&A, Intel's 2017 Annual Report, 2018).

Intel's gross profit margin in fiscal 2019 decreased because of the increase in cost of sales. In fiscal 2019, cost of sales increased by 13%, compared to revenue increasing by only 2%. Figure 4 below shows the trend of revenue compared to cost of sales since 2015. The increase in cost of sales is due to an increased mix of performance products (MD&A, Intel's 2018 Annual Report, 2019). Intel's cost of sales will fluctuate year-over-year based on the demand for its different products. For example, Intel's processors in its Client Computing Group are more profitable than the Non-Volatile Memory Solutions Group's products (MD&A, Intel's 2018 Annual Report, 2019). Intel's cost of goods sold increased as a total percent of revenue in fiscal 2019, because Intel manufactured more products that have a lower gross profit margin than it did in the previous years (MD&A, Intel's 2018 Annual Report, 2019).

### Operating Profit Margin

The operating profit margin for Intel was 31% in fiscal 2019, according to the common size income statement. Figure 5 below shows the operating profit margin for Intel, AMD, and the industry. Operating expenses have been decreasing compared to total revenue, which has caused the operating profit margin to have a net increase of 2% in fiscal 2019, compared to fiscal 2017. The operating expenses for Intel

	2017	2018	2019
Net Revenue	100%	100%	100%
Cost of Sales	38%	38%	41%
Gross Margin	62%	62%	59%
Operating Expenses	34%	29%	28%
Operating Income	29%	33%	31%
Gains, Taxes, and Interest	21%	3%	7%
Net Income	15%	30%	29%

Table 1: Intel's Common Size Income Statement

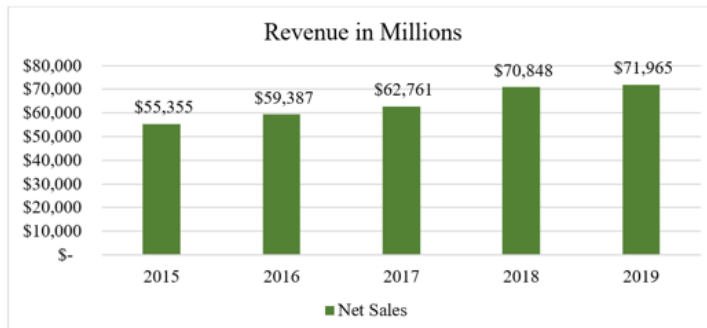


Figure 2: Intel's Revenue by Year

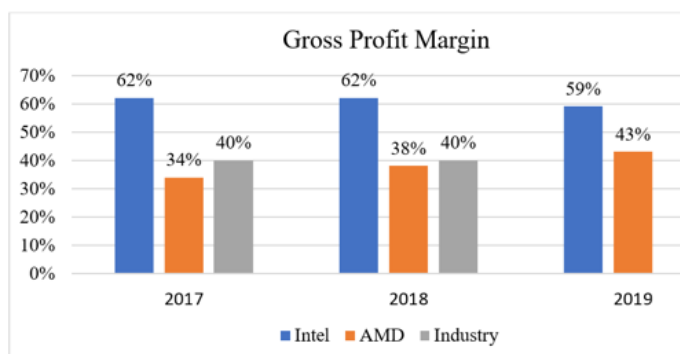


Figure 3: Gross Profit Margin

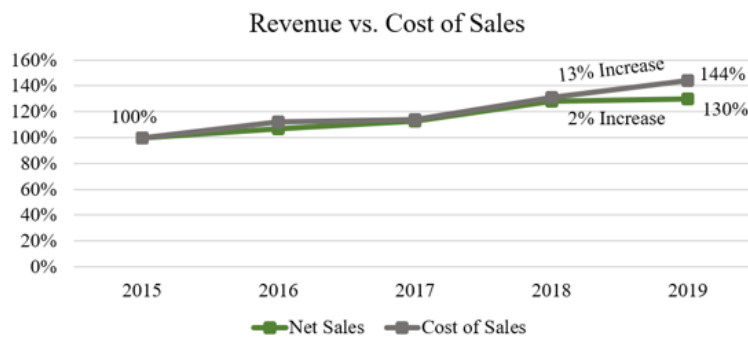


Figure 4: Revenue vs. Cost of Sales

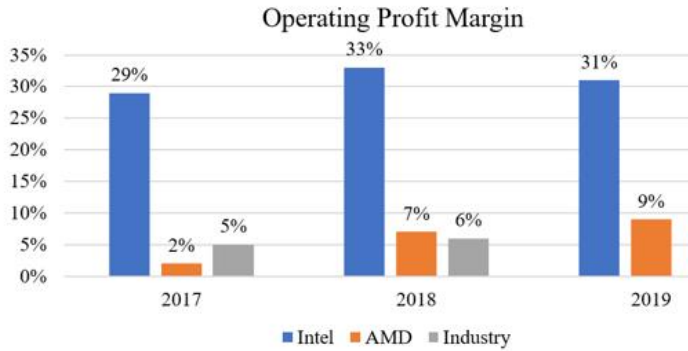


Figure 5: Operating Profit Margin

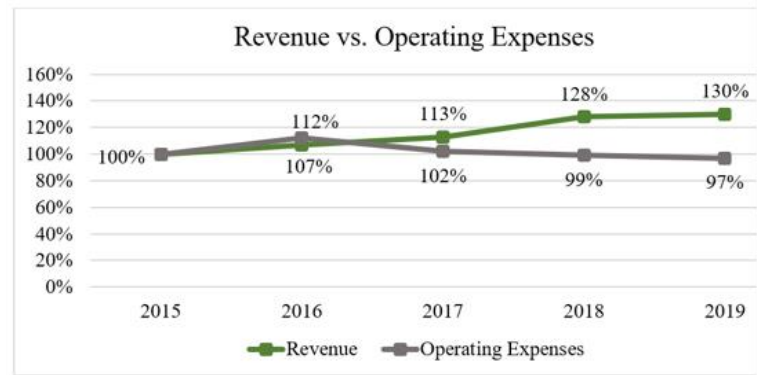


Figure 6: Trendline of Revenue vs. Operating Expenses

include research and development expenses and marketing, general, and administrative expenses (MG&A).

### Operating Expenses

Operating expenses have decreased by 3% since fiscal 2015. See Figure 6 for a trendline analysis comparing net sales to operating expenses. Revenue has increased by 30% since fiscal 2015, compared to operating expenses decreasing. While net operating expenses decreased from 2015 to 2019, research and development expense has increased. The decrease in net operating expenses is attributed to a decrease in MG&A expenses.

Research and development expense (R&D expense) is the first of the two main operating expenses. A trendline showing the growth of revenue compared to the growth of research and development expense is seen below in Figure 7. Research and development expense has increased a total of 10% from fiscal 2015 to fiscal 2019, but decreased by 2% in fiscal 2019 from fiscal 2018. Research and development expense has increased because Intel is investing in research in its data-centric businesses (MD&A, Intel's 2018 Annual Report, 2019). Research and development expense decreased from fiscal 2018 to fiscal 2019 by 2%, because Intel's divestitures of Intel Security Group in 2017 and Wind River in 2018 caused there to be fewer expenses. Intel had a goal to have its operating expenses be 30% of revenue by 2020 and the

company achieved that goal (MD&A, Intel's 2018 Annual Report, 2019).

Marketing, general, and administrative expense (MG&A) is the second main operating expense. See Figure 8 to see a trendline comparing the growth of MG&A expense to revenue. MG&A expense has decreased by 22% since fiscal 2015. This decrease is due to fewer marketing programs, the divestitures of Intel Security Group and Wind River, and a decrease in expenses in the Intel Inside Program (MD&A, Intel's 2018 Annual Report, 2019).

### Net Profit

The profit margin for Intel was 29% in fiscal 2019. Figure 9 exhibits the net profit margin for Intel, AMD, and the industry. The net profit margin has increased from 21% in fiscal 2015 to 29% in fiscal 2019. This increase is mainly due to the increase in the operating margin and the decrease of provision for income taxes. to the increase in the operating margin and the decrease of provision for income taxes.

In fiscal 2015 Intel's net income was \$11.4 billion. In fiscal 2019, its net income was \$21 billion. Figure 10 exhibits Intel's net income in millions. From fiscal 2015 to fiscal 2017, Intel's net income decreased by 16%. This decrease was due to the decrease in operating income and the increase in tax expense. Due to the Tax Cuts and Jobs Act of 2017, Intel paid 17% of its net revenue in income taxes in fiscal 2017 (MD&A,

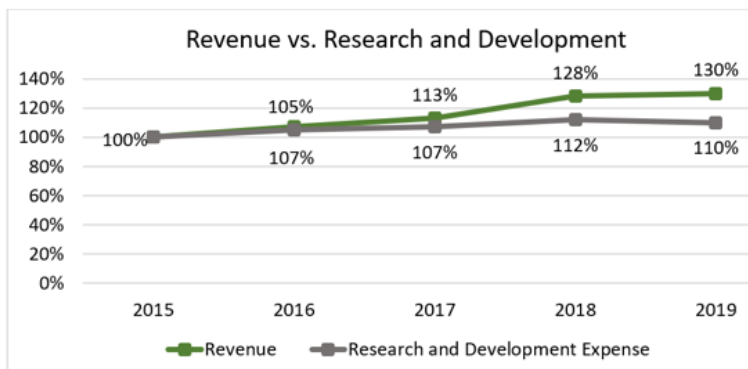


Figure 7: Trendline comparing Revenue to R&D expense

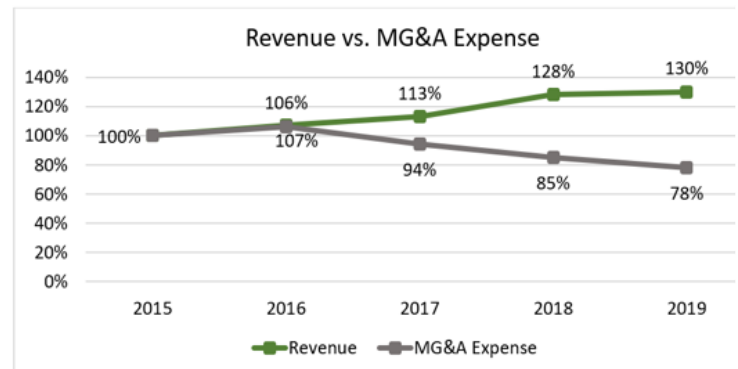


Figure 8: Trendline of Revenue vs. Marketing, General, and Administrative Expenses

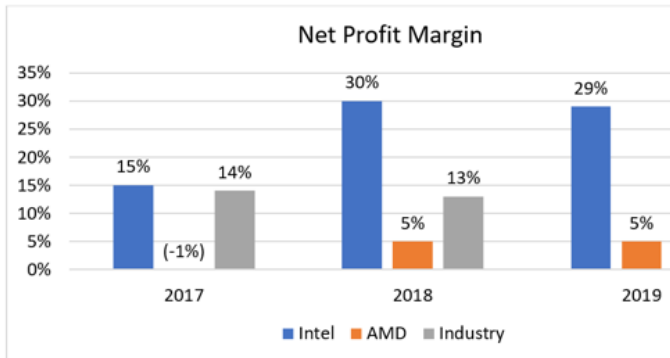


Figure 9: Net Profit Margin

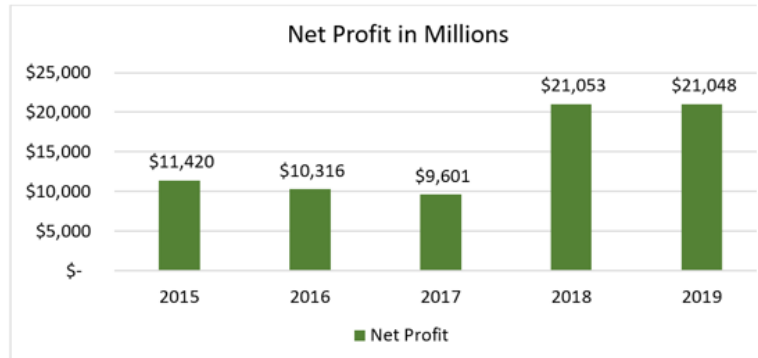


Figure 10: Net Income in Millions

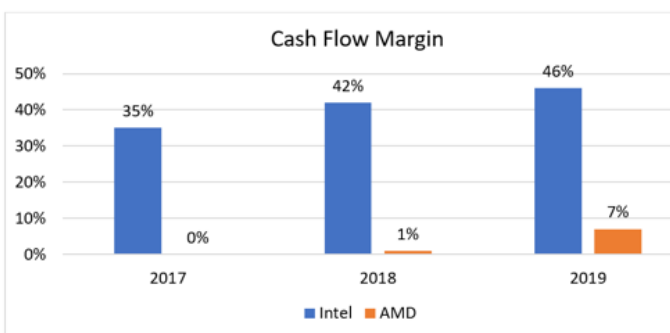


Figure 11: Cash Flow Margin

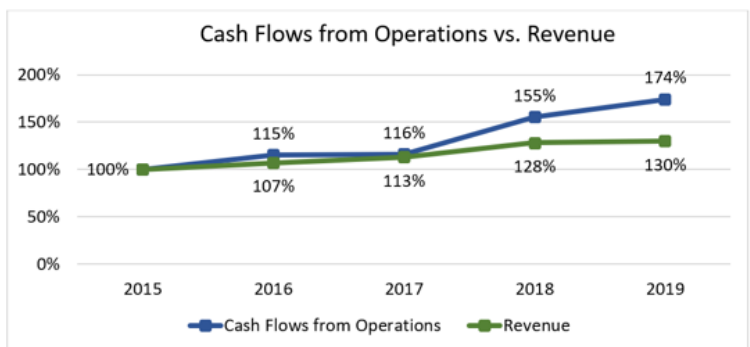


Figure 12: Cash flows from Operations vs. Revenue

Intel's 2017 Annual Report, 2018). The large increase in tax expense in fiscal 2017 was a one-time increase. After fiscal 2017, Intel paid 3% and 4% of its net revenues in taxes in fiscal 2018 and fiscal 2019, respectively.

### Cash Flow Margin

Intel's cash flow margin has increased from 35% in fiscal 2017 to 46% in fiscal 2019. Figure 11 compares Intel's cash flow margin to AMD's.

Intel's cash flow margin has been increasing because of an increase in cash flow from operations. Figure 12 shows the comparison of cash flows from operations and revenue. The cash flows from operations has been increasing due to higher net income (MD&A, Intel's 2018 Annual Report, 2019). Intel has paid less income taxes in fiscal 2018 and 2019 compared to fiscal 2017. Cash flows from operations has increased by 44% more than revenue since fiscal 2015, causing the cash flow margin to increase.

### Income Statement Summary

Intel's revenues have increased by 30% since 2015 due to increased demand for its products, while its operating expenses have decreased by 3%, due to fewer marketing programs. These changes, accompanied by the lower corporate tax rate, have contributed to the 84% increase in Intel's net profit from fiscal 2015 to 2019.

### Balance Sheet

Intel's total assets have increased by 35% since fiscal 2015. The increase in assets of \$35.1 billion was offset by a \$19.4 billion increase in liabilities and a \$16.4 billion increase in stockholders' equity.

### Assets

#### Current Assets

Intel's current assets have decreased 1 % as a percent of total assets since fiscal 2017. The current asset portion of Intel's balance sheet is shown in Table 2. Intel's cash decreased by 1% of total assets in fiscal 2018 compared to fiscal 2017 and then increased by 1% of total assets in fiscal 2019. Intel's short-term investments have decreased by 1% compared to total assets since fiscal 2017, and its inventory has not changed.

	2017	2018	2019
Cash and Cash Equivalents	3%	2%	3%
Short-term Investments	8%	7%	7%
Inventory	6%	6%	6%
Accounts Receivable	5%	5%	6%
Other Current Assets	2%	2%	1%
Total Current Assets	24%	22%	23%

Table 2: Common sized Current Assets

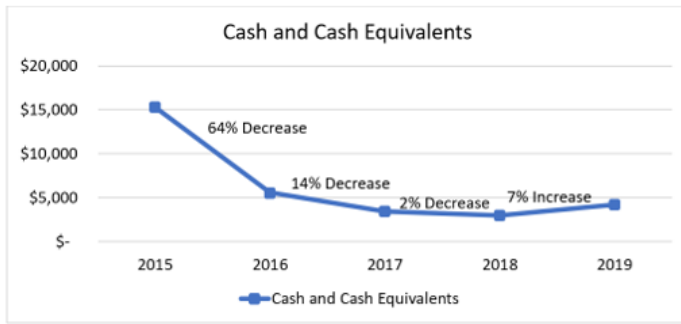


Figure 13: Trendline analysis of Cash and Cash Equivalents

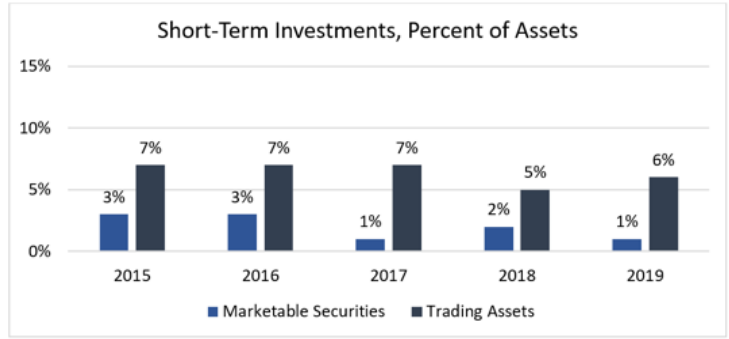


Figure 14: Breakdown of Short-term Investments' Percent of Assets

Intel's cash and cash equivalents have decreased since fiscal 2015. Figure 13 shows a trendline of Intel's cash from fiscal 2015 to fiscal 2019. At the end of fiscal 2015, Intel had \$15.3 billion of cash on hand. However, immediately after fiscal 2015, Intel purchased Altera for \$14.5 billion on December 28, 2015, causing cash to decrease 64% (Note 10, Intel's 2017 Annual Report, 2018). Cash then decreased by 14% from fiscal 2016 to 2017. This decrease was due to the repayment of long-term debt and the acquisition of Mobileye (MD&A, Intel's 2017 Annual Report, 2018). In fiscal 2018, Intel's net cash decreased by 2%, due to Intel repurchasing more common stock (MD&A, Intel's 2018 Annual Report, 2019). Finally, in fiscal 2019, Intel's cash increased by 7%, due to the increase in cash flow from operations and less cash being used by financing activities. The changes in cash have not been large enough to create a large change in its total percent of assets in recent years. Cash was still 3% of total assets in fiscal 2019, while in fiscal 2016 it was 5%.

Intel's final major current asset is inventory. Intel's inventory has consistently been 6% of its total assets since fiscal 2017, which is an increase of 1% since fiscal 2015. Figure 15 exhibits Intel's inventory's percent of assets compared to AMD's and the industry's.

Intel also invests in short-term investments. These investments are in trading assets (nonmarketable debt securities), marketable debt securities, and marketable equity securities (Note 2, Intel's 2018 Annual Report, 2019). Figure 14 shows marketable securities' percent of total assets versus trading assets' percent of assets from fiscal 2015 to fiscal 2019.

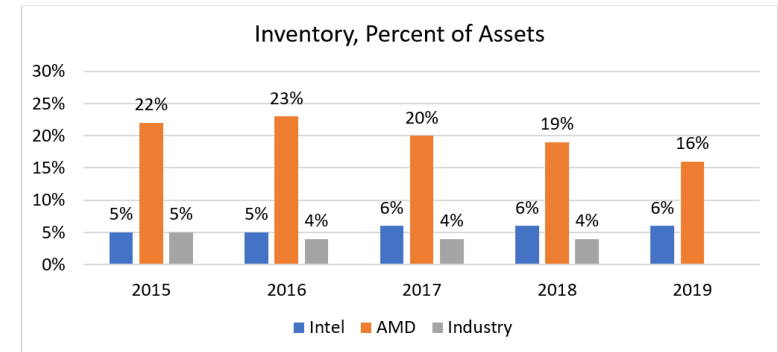


Figure 15: Inventory's Percent of Assets

Intel's inventory's value has increased by \$3.6 billion since fiscal 2015. It was worth \$5.2 billion in fiscal 2015, and it is valued at \$8.7 billion in fiscal 2019. Intel's inventory has increased because it has been manufacturing more inventory due to higher demand for its products, and Intel is manufacturing more products for its data-centric businesses (MD&A, Intel's 2018 Annual Report, 2019).

Intel's short-term investments had a value of \$10 billion in fiscal 2015. This value has decreased to \$8.9 in fiscal 2019. The decrease in value is due to fewer short-term investments and the maturities and sales of short-term investments (MD&A, Intel's 2018 Annual Report, 2019).

Intel's inventory was held for about 107 days on average in fiscal 2019. Figure 16 shows Intel's, AMD's, and the industry's inventory turnover ratio, and Figure 17 shows Intel's AMD's, and the industry's days inventory held ratio. Intel holds its inventory longer than its competitors do. Intel's

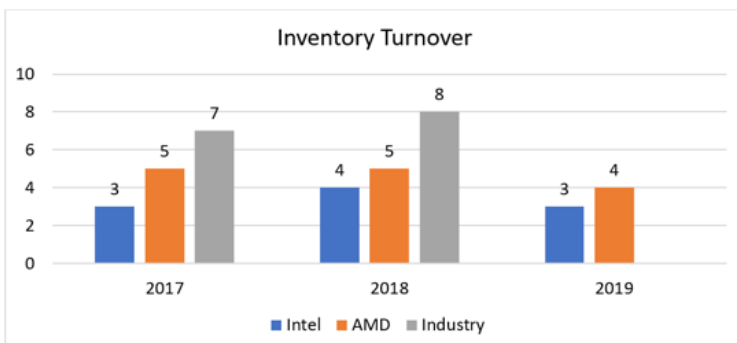


Figure 16: Inventory Turnover Ratio

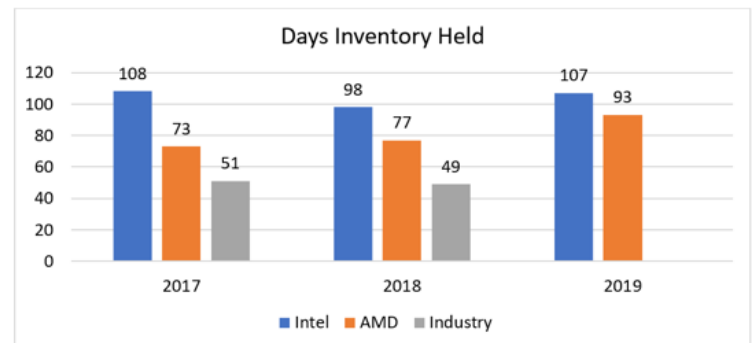


Figure 17: Average Days Inventory Held

inventory turnover ratio increased in fiscal 2018, due to its inventory increasing faster than its cost of goods sold. Intel may hold its inventory longer than competitors do, but Intel still has higher sales than AMD.

Intel's current ratio for fiscal 2019 was 1.40, which was a decrease of 0.33 from fiscal 2018. Figure 18 below shows the current ratio for Intel, AMD, and the industry. Intel's current ratio decreased in fiscal 2019, due to current liabilities increasing faster than current assets, specifically a \$2.4 billion increase in short-term debt and a \$2.7 billion increase in accrued liabilities. Current liabilities increased by \$5.7 billion in fiscal 2019, while current assets increased by only \$2.5 billion.

\$8.7 billion of Intel's current assets is in inventory, so the current ratio may not be the best indicator of how liquid Intel is. The quick ratio may be better, because it excludes inventory. Below in Figure 19 is a comparison of Intel's, AMD's, and the industry's quick ratios. Intel's quick ratio decreased by 0.29 in fiscal 2019, due to the increase in current liabilities stated before. However, Intel still has a quick ratio above a 1.00, which indicates that it is still liquid enough to pay off all current liabilities if needed.

The cash flow liquidity ratio compares cash from operating activities to current liabilities. In Figure 20, the cash flow liquidity ratio is shown for Intel and AMD. The 0.4 increase in fiscal 2018 was due to an increase of \$7.3 billion in

cash flow from operations. The ratio decreased by 0.4 in 2019, due to the increase in current liabilities.

**Noncurrent Assets**

Intel's noncurrent assets consist of property, plant, and equipment, goodwill, intangible assets, and equity investments. Noncurrent assets have increased by 1% of total assets since fiscal 2017. Shown below in Table 3 is the noncurrent assets portion of Intel's common sized balance sheet.

Intel's property, plant, and equipment account has increased by 8% as a percent of total assets since fiscal 2017. The account has increased by \$22.5 billion since fiscal 2015, which is a 74% increase. Intel's property, plant, and equipment is increasing because Intel continues to invest in it in order to continue growing the company (Fundamentals, Intel's 2018 Annual Report, 2019). Intel is also transforming into a data-centric business, so Intel invests in the development of those businesses (Fundamentals, Intel's 2018 Annual Report, 2019). As Intel continues its transformation into a data-centric business, it keeps investing into its data-centric businesses so that they can continue to grow and become profitable. Figure 21 shown below, exhibits Intel's and AMD's fixed asset turnover. Intel's fixed asset ratio has decreased by 0.23 since fiscal 2017 because its property, plant, and equipment account has increased faster than its revenue. Intel's investments in its property, plant, and equipment have not started to increase the fixed asset turnover. AMD's fixed asset turnover is higher than

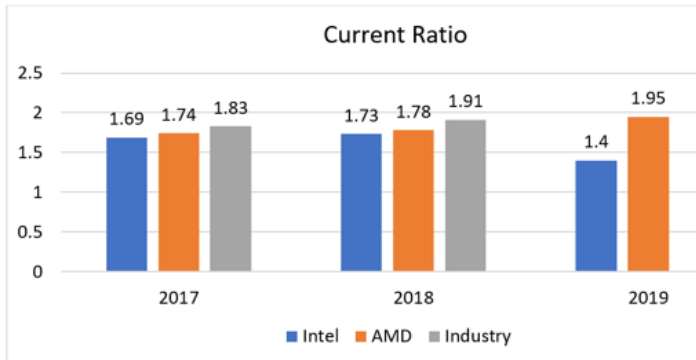


Figure 18: Current Ratio

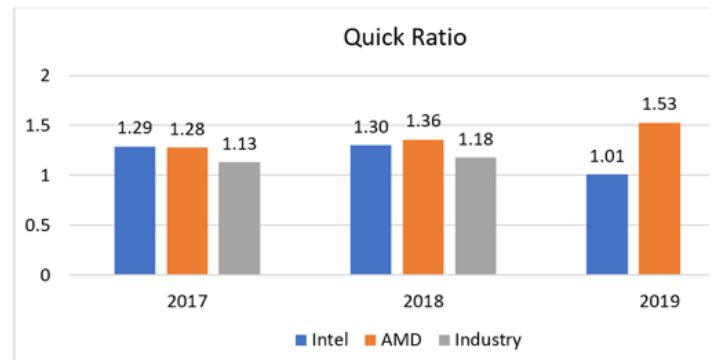


Figure 19: Quick Ratio

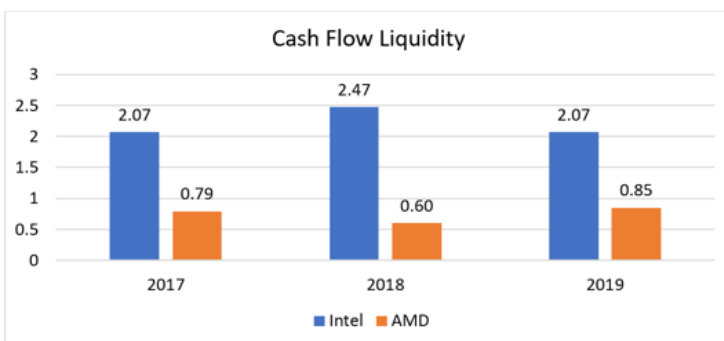


Figure 20: Cash Flow Liquidity Ratio

	2017	2018	2019
Current Assets	24%	22%	23%
Property, Plant, & Equipment	33%	38%	41%
Goodwill	20%	19%	19%
Intangible Assets	10%	9%	8%
Equity Investments	7%	5%	3%
Other Long-term Assets	6%	6%	6%
Total Assets	100%	100%	100%

Table 3: Common sized Noncurrent Assets

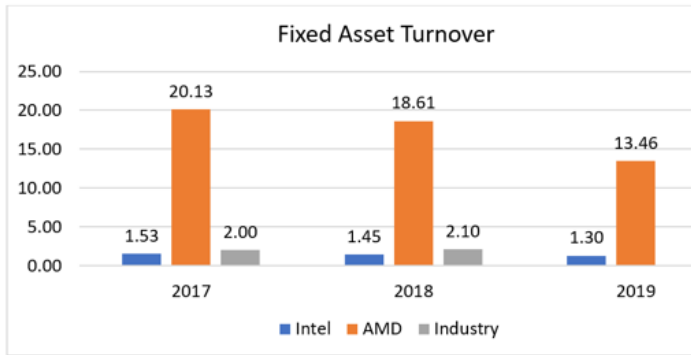


Figure 21: Fixed Asset Turnover

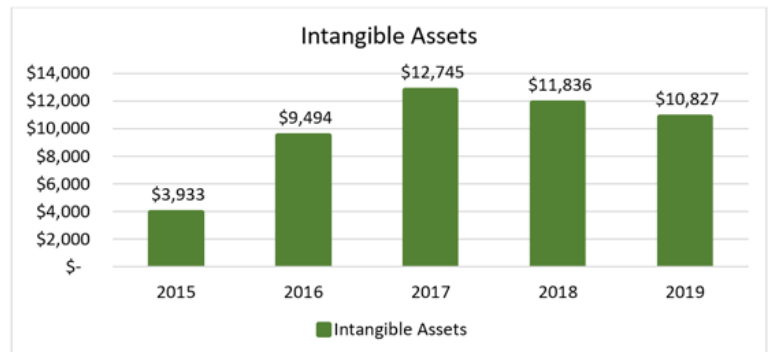


Figure 22: Intangible Assets

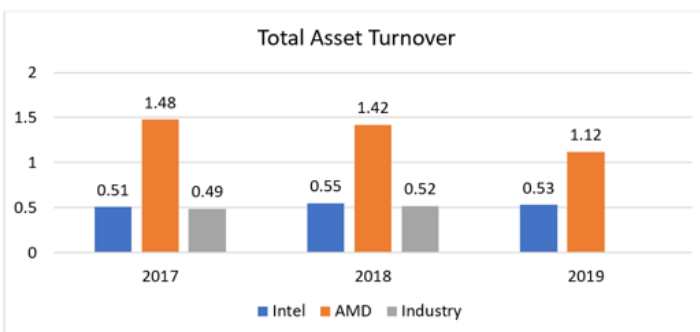


Figure 23: Total Asset Turnover

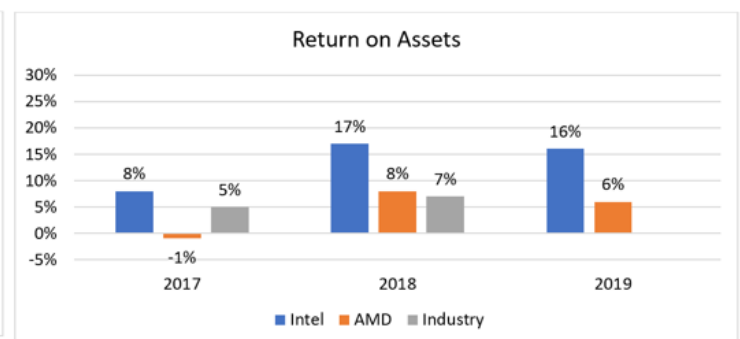


Figure 24: Return on Assets

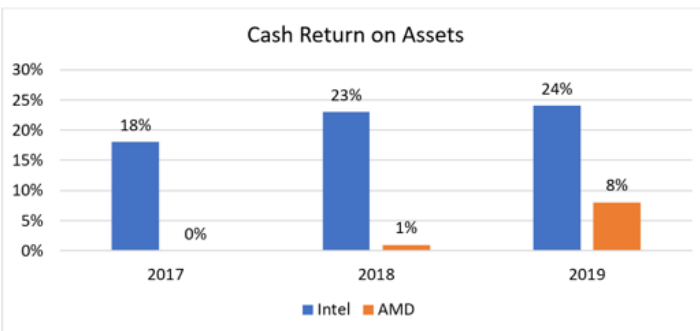


Figure 25: Cash Return on Assets

	2017	2018	2019
Accrued Liabilities	10%	9%	11%
Other Current Liabilities	4%	4%	5%
Total Current Liabilities	14%	13%	16%
Debt	20%	20%	19%
Other Long-Term Liabilities	9%	8%	8%
Total Liabilities	43%	41%	43%

Table 4: Common Sized Liabilities

Intel's because Intel owns equipment to design their own products and has a more diverse set of businesses (Fundamentals, Intel's 2018 Annual Report, 2019). This means that AMD will have a lower balance in the property, plant, and equipment account, which causes its ratio to be higher.

Intel also accounts for a large amount of goodwill earned from its acquisition of other companies. Intel's goodwill is 19% of its total assets. Intel's goodwill account has increased from \$11.3 billion in fiscal 2015 to \$26.3 billion in fiscal 2019. There was a \$10.3 billion increase in fiscal 2017, due to the purchase of Mobileye (Note 11, Intel's 2018 Annual Report, 2019).

Intel also has many intangible assets. The intangible assets account was 8% of total assets in fiscal 2019, which has decreased from 10% in fiscal 2017. Figure 22 shows the value of Intel's intangible assets from fiscal 2015 to fiscal 2019.

Intangible assets increased by \$5.5 billion in fiscal 2016 due to the intangible assets obtained in the acquisition of Altera. The \$3.2 billion increase in fiscal 2017 was due to the acquisition of Mobileye. Intangible assets have been decreasing from 2017 until fiscal 2019 because of amortization (Note 13, Intel's 2018 Annual Report, 2019).

Intel's total asset turnover has increased by 0.02 since fiscal 2017. Figure 23 below shows Intel's, AMD's, and the industry's total asset turnover ratios. Intel's total asset turnover has increased because its revenue has increased faster than its total assets have. AMD's total asset turnover is higher than Intel's because it has more income compared to its assets' values.

Intel's return on assets has increased by 8% since fiscal 2017. Figure 24 below shows Intel's, AMD's, and the industry's return on assets. Intel's return on assets has

increased by 8% because its net income increased from \$9.6 billion in fiscal 2017 to \$21 billion in fiscal 2018 and fiscal 2019. Intel's return on assets is higher than AMD's and the industry's.

Intel's cash return on assets has also increased by 6%, which is shown in Figure 25 below. The increase in the cash return on assets is due to Intel's cash flow from operations increasing faster than its total assets.

### Liabilities

Intel's total liabilities increased from \$39.5 billion in fiscal 2015 to \$58.9 billion in fiscal 2019. This increase is due to the increase in current liabilities and long-term debt. Table 4 shows the liabilities portion of the common size balance sheet.

Intel's long-term debt was 20% of its total assets in fiscal 2015, 2016, 2017, and 2018. Then, in fiscal 2019, it decreased by 1% of total assets. In fiscal 2017, Intel's long-term debt increased by \$4.4 billion, to \$25 billion. At that time, Intel signed more long-term debt notes to repurchase common stock and to invest in property, plant, and equipment (MD&A, Intel's 2018 Annual Report, 2019). Long-term debt did not increase as a percent of total assets because Intel's current liabilities had increased by \$7 billion since fiscal 2015.

Intel's long-term debt to total capitalization ratio has decreased by 0.02 since fiscal 2017. Figure 26 compares Intel's and AMD's long-term debt to total capitalization ratios. Intel's ratio was 0.25 in fiscal 2019, meaning that it finances 25% of

its assets with long-term debt. AMD's ratio decreased because its common stock account increased in fiscal 2019.

Intel's assets have increased faster than its total liabilities since fiscal 2017. This increase has caused its debt ratio to decrease by 0.01. Intel's debt ratio in fiscal 2019 was 0.43, as shown in Figure 27, which exhibits Intel's, AMD's, and the industry's debt ratios. AMD's debt ratio has decreased because its assets are increasing faster than its liabilities.

In fiscal year 2019, Intel could pay its interest on debt 45 times over. Figure 28 shows Intel's, AMD's, and the industry's times interest earned ratio. Intel has a substantially higher ratio than the industry and AMD have. Intel's ratio indicates that it can easily repay interest earned on its debt. Intel's ratio increased because its net income also increased in fiscal 2018.

Intel's cash interest coverage ratio is compared to AMD's in Figure 29. Intel's cash interest coverage ratio has increased by 33 since fiscal 2017. This increase is due to the increase in cash flow from operations (see page 34). Intel's ratio indicates that Intel could easily pay its interest expense with cash earned from operating activities.

### Stockholders' Equity

Intel's stockholders' equity section has increased as a percent of total assets since fiscal 2017. Intel's common sized stockholders' equity section of the balance sheet is shown in Table 5. Intel's retained earnings account is continuing to increase, due to net income increasing. Intel's stockholder's

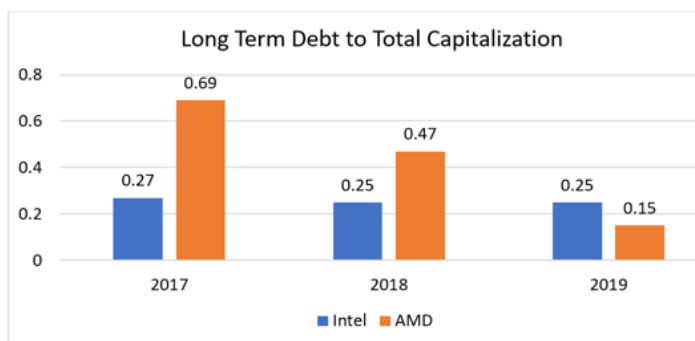


Figure 26: Long-term Debt to Total Capitalization

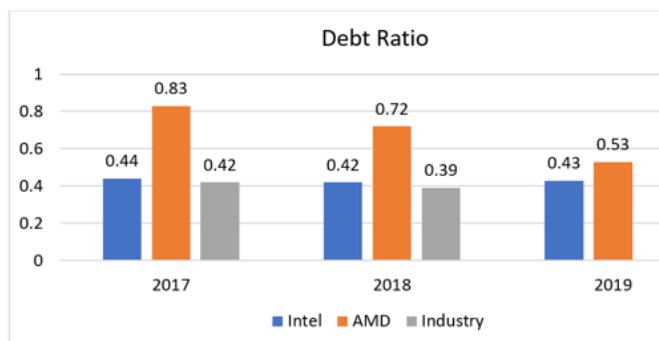


Figure 27: Debt Ratio

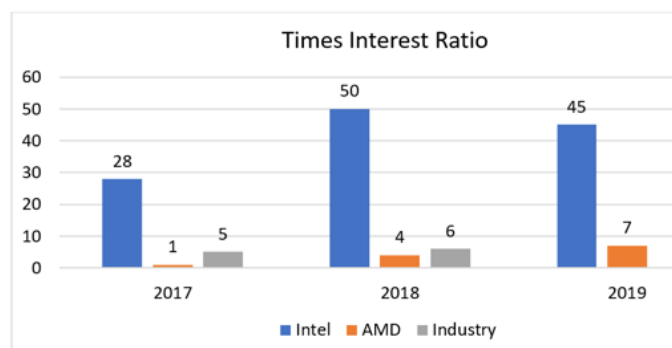


Figure 28: Times Interest Earned

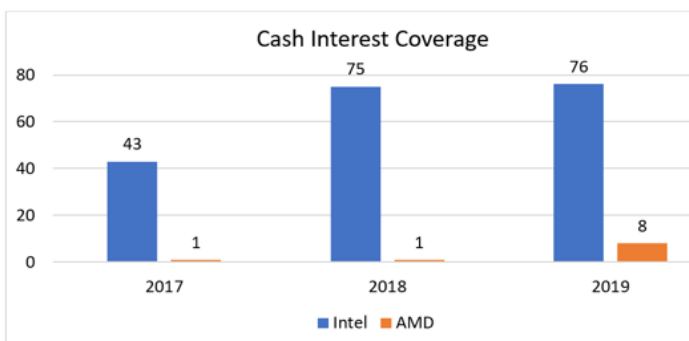


Figure 29: Cash Interest Coverage



equity section has increased from \$61.1 billion in fiscal 2015 to \$77.5 billion in fiscal 2019.

Intel's common stock has decreased as a percent of total assets by 2% since fiscal 2017. The account's value has increased from \$23.4 billion in fiscal 2015 to \$25.3 billion in fiscal 2019. Intel's stock-based compensation has caused a \$7.3 billion increase in the account since fiscal 2015 (Note 20, Intel's 2018 Annual Report, 2019). However, that \$7.3 billion increase was offset by the repurchase of common stock. Intel has recorded \$4.4 billion of treasury stock to its common stock account since fiscal 2015. Intel records its treasury stock using the par value method, which means that Intel records the par value of the stock that was repurchased instead of recording the price that it paid to repurchase the stock (Note 5, Intel's 2018 Annual Report, 2019).

Intel's return on equity ratio has increased by 13% since fiscal 2017, as shown in Figure 30. The increase is attributed to the increase in net profit, which is due to lower operating expenses and lower income taxes. Intel's net income increased faster than its equity, so the ratio increased. This ratio indicates that Intel's stockholders saw a 27% return in fiscal year 2019.

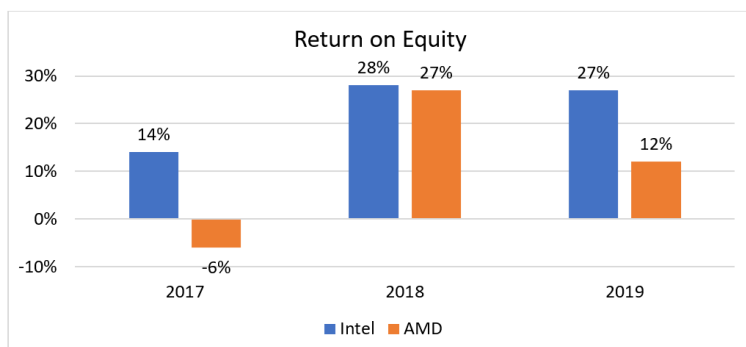


Figure 30: Return on Equity

### Balance Sheet Summary

Intel is transforming into a data-centric business and is investing in inventory and property, plant, and equipment. Its inventory account has increased by 69% since fiscal 2015, and its property, plant, and equipment account has increased by 74% since fiscal 2015. Intel's long-term debt has also increased by \$4.4 billion since fiscal 2015, and it was used to repurchase common stock and invest in property, plant, and equipment. Intel's common stock account has also increased, due to its stock-based compensation program.

### Statement of Cash Flows

Intel is a plus-minus-minus company, meaning that the only section of the statement of cash flows that provides cash is the operating section. This is because Intel is investing in its assets and stockholders (dividend payments and treasury stock purchases) and is through repaying debt. An overview of the statement of cash flows is seen in Table 6.

	2017	2018	2019
Cash Provided by Operating Activities	\$22,110	\$29,432	\$33,145
Cash Used by Investing Activities	(\$15,762)	(\$11,239)	(\$14,405)
Cash Used for Financing Activities	(\$8,475)	(\$18,607)	(\$17,565)
Change in Cash	(\$2,127)	(\$414)	\$1,175

Table 6: Statement of Cash Flows Overview

### Cash Inflows

Most of Intel's cash inflows are from operating activities. The second largest cash generator for Intel is the sale and maturities of trading assets. A summary of Intel's inflow sources is seen in Table 7.

	2017	2018	2019
Cash Provided by Operating Activities	37%	60%	62%
Maturities and Sales from Trading Assets	24%	25%	14%
Issuance of Long-Term Debt	13%	1%	6%
Maturities and Sales of Available for Sale Debt Investments	9%	6%	8%
Proceeds from Equity Method Investments	9%	6%	5%
Other	8%	2%	5%
Total Inflows	100%	100%	100%

Table 7: Summary of Cash Inflows

Intel's cash provided by operating activities has increased from 37% of inflows in fiscal 2017 to 62% of cash inflows in fiscal 2019. Fiscal 2017's cash from operating activities was lower than that of most years, because Intel paid higher taxes, due to the tax reform of 2017, and Intel issued long-term debt that offset the cash from operating activities. Intel's net income has also been increasing, which has caused the cash provided from operating activities to increase. Cash provided by operating activities has increased by 52% since fiscal 2016.

Intel's trading assets are maturing, and Intel is also selling its trading assets. The maturities and sales of trading assets provided 14% of Intel's cash inflows in fiscal 2019. Figure 31 shows the cash provided by the sale and maturities

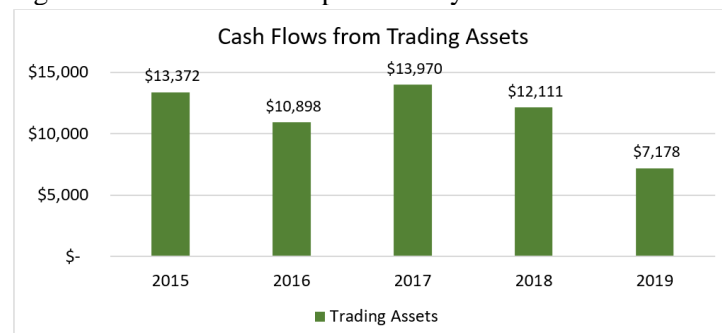


Figure 31: Cash Provided by the Sale and Maturities of Trading Assets

of trading assets. In fiscal 2015, Intel received \$13.3 billion from the sales and maturities of its investments. This amount has decreased to only \$7.1 billion in fiscal 2019. The cash provided by the sale and maturities from trading assets is decreasing because Intel is purchasing fewer trading assets.

### Cash Outflows

Intel's cash outflows mainly consist of additions to property, plant, and equipment, repurchases of common stock, purchases of trading assets, and the payment of dividends. Table 8 shows a summary of Intel's cash outflows.

Intel's cash outflows used on the addition to property, plant, and equipment consisted of 31% of all cash outflows in fiscal 2018 and 2019. The cash spent on additions to property, plant, and equipment was increased to \$16.2 billion in fiscal 2019. This increase is due to the transformation of Intel into a data-centric business (MD&A, Intel's 2018 Annual Report, 2019).

	2017	2018	2019
Additions to Property, Plant, & Equipment	19%	31%	31%
Repurchase of Common Stock	6%	22%	26%
Purchase of Trading Assets	22%	19%	18%
Payment of Dividends	8%	11%	11%
Repayments of Long-Term Debt	13%	6%	5%
Acquisitions	24%	0%	4%
Other	8%	11%	5%
Total Inflows	100%	100%	100%

Table 8: Summary of Cash Outflows

Intel has also started to repurchase more of its common stock. Figure 32 shows the amount spent on the repurchase of common stock from fiscal 2015 to fiscal 2019. In fiscal 2015, Intel spent \$3 billion on the repurchase of its common stock. In fiscal 2018, Intel increased its spending on the repurchase of common stock to \$10.7 billion, and then in fiscal 2019, it increased to \$13.6 billion. Intel's Board of Directors approved a \$15 billion increase in the stock repurchase program in fiscal 2018, which is why Intel started to increase its spending on common stock (MD&A, Intel's 2018 Annual Report, 2019). Intel has repurchased \$33.5 billion of its common stock since fiscal 2015, which has caused cash outflows to increase.

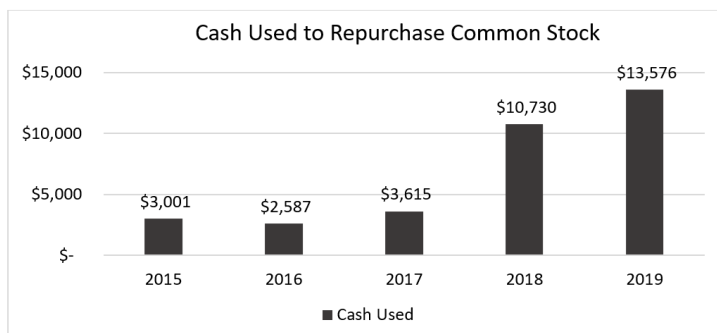


Figure 32: Cash Used to Repurchase Common Stock

Intel is purchasing fewer trading assets since 2017. In fiscal 2017, Intel purchased \$13.7 billion in trading assets. In fiscal 2019, this amount decreased to \$9.1 billion. Intel has started purchasing more common stock, so there is less available cash flow for trading assets.

### Cash Flow Adequacy

Intel invested 47% of its cash in capital expenditures, debt repayments, and cash dividends in fiscal 2019. Intel can continue to invest this much of its cash in these investments because it has an adequate amount of cash flow. The cash flow adequacy ratios for Intel and AMD are shown in Figure 33. In fiscal 2017, Intel's cash flows from operations covered 89% of Intel's cash used on capital expenditures, debt repayments, and dividends paid. Intel's cash flows from operations has increased by 50% since fiscal 2017, while the cash used on capital expenditures, debt repayment, and dividends paid has had a net decrease of 2%. The increase in cash flows from operations and the decrease in the cash used on capital expenditures, debt repayment, and dividends paid has caused the cash flow adequacy ratio to increase to 1.36 in fiscal 2019. This ratio indicates that Intel has an adequate amount of cash flows.

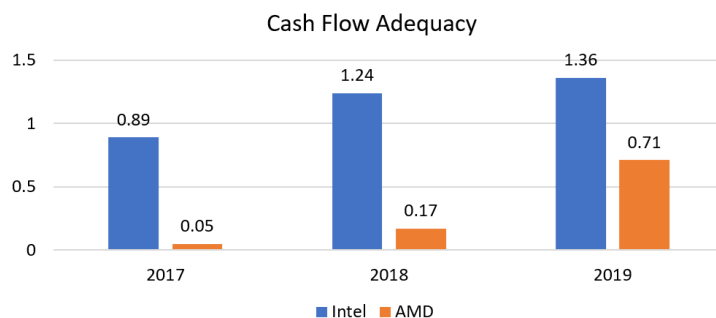


Figure 33: Cash Flow Adequacy Ratio

### Summary of the Statement of Cash Flows

Intel has an adequate amount of cash flows to continue investing in its assets and stockholders, as well as repay its debt and purchase its common stock. Intel's operating section is the only section of the statement of cash flows to provide cash for Intel. Intel has repurchased \$33.5 billion of common stock since fiscal 2015.

### Stock, Earnings, and Dividends

#### Intel's Stock

Within the last year, Intel's stock reached a high of \$69.29 per share, and its lowest point was at \$42.86 per share (Intel Corp Stock, 2020). Intel's stock was trading at \$58.20 after the market closed on April 7, 2020. Figure 34 compares Intel's, AMD's, and NASDAQ's stock values over the last 5 years. Intel is the blue line in the graph, while AMD is orange, and the NASDAQ index is the purple line. Intel and NASDAQ index have grown at almost the same rate over the last 5 years.



Figure 34: Stock Growth (Intel Corp Stock, 2020)

Rating	Number of Analysts
Buy	14
Overweight	2
Hold	19
Underweight	1
Sell	7

Table 9: Analyst Ratings (Intel Corp Stock, 2020)

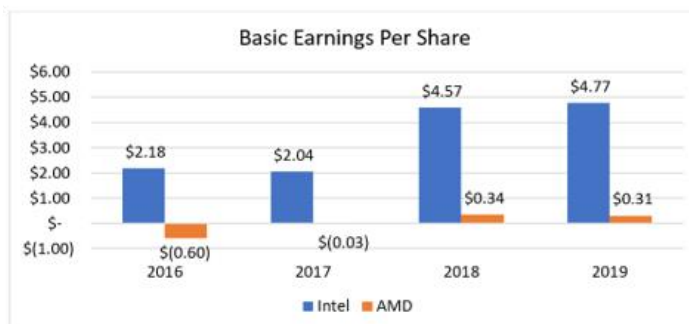


Figure 35: Basic Earnings Per Share



Figure 36: Price to Earnings Ratio



Figure 37: Dividends Paid Per Share

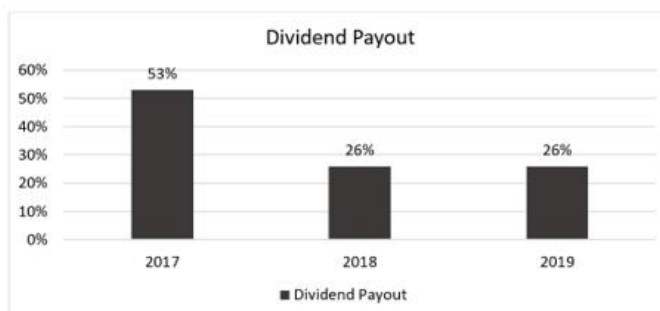


Figure 38: Dividend Payout

AMD's stock price has grown by over 15 times. AMD was operating at a loss until 2018, which contributed to its stock not performing well prior to 2018.

Analysts have advised investors to either hold or buy Intel's stock as of April 2020 (Intel Corp Stock, 2020). Table 9 exhibits 43 analysts' ratings retrieved from Marketwatch. Intel's stock increased by just under \$14 per share from fiscal 2018 to fiscal 2019 (Historical Stock, 2020). The increase in stock value has contributed to analysts advising investors to buy Intel's stock. The current coronavirus pandemic also caused Intel's stock to decrease in value temporarily, which caused analysts to advise shareholders to hold Intel's stock, because Intel stock is expected to recover.

### Earnings Per Share

The increase in net income and the decrease in shares outstanding has caused Intel's basic earnings per share to increase from \$2.18 per share in fiscal 2016 to \$4.77 per share in fiscal 2019. Figure 35 shows Intel's and AMD's basic earnings per share since fiscal 2016. Intel's earnings per share has increased by 98% since fiscal 2015.

Intel's basic earnings per share has increased faster than its stock price, which has caused Intel's price-to-earnings ratio to drop to 12.60 in fiscal 2019. Figure 36 compares Intel's and AMD's price-to-earnings ratios. In fiscal 2019, Intel's stock price was 12.6 times its earnings per share for that year. AMD had a net loss in fiscal 2017.

### Dividends

Intel has increased its cash dividends since fiscal 2015. In fiscal 2015, Intel paid \$4.6 billion in dividends. In fiscal 2019, Intel paid \$5.6 billion in dividends. Figure 37 shows Intel's dividends paid per share since fiscal 2015. AMD does not pay dividends; thus there is no comparison for Intel in this section. Intel has been repurchasing its common stock, and since Intel has continued to increase its cash dividends, the dividends paid per share has increased by \$0.30 since fiscal 2015.

Intel's dividend yield has been consistent at 2% since fiscal 2017, meaning shareholders have a 2% yield on their stock's market price. Intel also had a dividend payout of 26% in fiscal 2018 and 2019. Intel's dividend payout ratio is seen in Figure 38. The dividend payout percentage in fiscal 2017 was 53%. The dividend payout in fiscal 2017 was unique, because Intel had abnormally low earnings that year, and the company increased the dividends paid.

## SWOT Analysis

### Strengths

A major strength of Intel is its data-centric businesses. Intel is reaching out to new customers with its transformation into a data-centric business. Intel has also continued to increase its revenue, while controlling and decreasing operating expenses. Intel also has high quick and current ratios, so its liquidity is also a strength.

### Weaknesses

Intel's main weakness is that a total of 27% of its assets are in goodwill or intangible assets. The 19% of assets that are goodwill does not directly contribute to Intel's revenue. The intangible assets are also amortizing and will eventually expire, so these assets will also not always increase revenues, but it would increase the total asset turnover and return on assets ratios.

### Opportunities

Intel has two major opportunities. Intel's transition to a data-centric business is a major opportunity to continue its development and growth. Intel can continue to reach more individuals and businesses to capture more revenues with its new data-centric businesses.

Intel also could profit off people working at home due to the coronavirus. Intel sponsors many esports leagues, which are continuing to see increased viewership while most people are at home. These sponsorships may help Intel's revenues increase.

### Threats

The coronavirus pandemic has caused stock prices to drop. This will have a direct effect on Intel's marketable investment portfolio. Intel may see a decrease in its marketable assets values, due to this pandemic. Intel also competes with AMD for its PC-centric business. If AMD continues to grow, then it could become a stronger competitor and hurt Intel's revenues.

### Summary

Intel is continuing its transformation into a data-centric business. Intel must manufacture more inventory and invest in more property, plant, and equipment for these new businesses. Intel can do so because its revenue, net income, and cash flows from operating activities have been increasing since fiscal 2015. Net income has increased 84% since fiscal 2015. Intel is also repurchasing its own common stock and increasing dividends to return value to its shareholders. Intel continues to have an adequate amount of cash flows to continue its development, growth, and share repurchases.

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# The Ineffectiveness of the 1994 Assault Weapons Ban

Nathan Brown

*Faculty Mentor: Cindi Bearden, BS, Mac, CPA*  
Business and Nonprofit Studies, Accountancy

## Abstract

The 1994 Assault Weapons Ban (AWB) was enacted on September 13, 1994. The primary purpose of the ban was to reduce the frequency and lethality of mass shootings in the U.S. The ban had 3 provisions. It outlawed 9 groups of guns, semiautomatic weapons with 2 or more militaristic features, and large capacity magazines (LCMs). The 1994 AWB proved to be ineffective due to many loopholes and flaws, such as the grandfathering of LCMs and guns produced prior to the ban's enactment, the exemption of 650 gun models, the production of similar guns by manufacturers, and the fact that very few gun-related crimes were committed with AWs prior to the ban. All of these loopholes led to little success for the ban in accomplishing its goal of reducing the frequency and lethality of mass shootings in the U.S. Proponents of the ban argue that the recent rise in mass shootings in the U.S. is due to the lifting of the ban in September of 2004, but studies show that many other factors are to blame. These include increased social media usage and shooters' desire for fame, inspiration from previous shooters, and mental illness.

Mass shooting occurrences have increased in the U.S. since 2005. Many blame this increase on the lifting of the 1994 Assault Weapons Ban (AWB). The primary goal of the ban was to decrease the frequency and lethality of mass shootings in the U.S. (Ingraham, 2018). Studies show, however, that the ban did not accomplish its goals due to several loopholes and flaws. Studies also show that the recent increase in mass shootings in the U.S. can be attributed to a multitude of factors other than the lifting of the ban.

## Overview of the 1994 Assault Weapons Ban

The 1994 AWB was a 10-year ban enacted on September 13, 1994 (Koper, Woods, & Roth, 2004). The goal of the ban was to decrease the frequency and lethality of mass shootings in the U.S. (Ingraham, 2004). Provisions of the ban included prohibiting 9 groups of rifles, pistols, and shotguns (Koper, Woods, & Roth, 2004). The ban also outlawed other semiautomatic weapons with 2 or more of a group of features including grenade launchers and bayonet mounts, flash suppressors, pistol grips, and threaded barrels (Jacobs, 2015). The final provision of the ban was the prohibition of large-capacity magazines (LCMs), those holding more than 10 rounds of ammunition (Koper, Woods, & Roth, 2004).

## Loopholes/Flaws of the 1994 Assault Weapons Ban

The 1994 AWB did not accomplish its goals. Gun owners were able to continue purchasing assault weapons (AWs) and LCMs due to several loopholes and flaws in the law.

## Grandfathering Rule/Exemptions

One major loophole of the 1994 AWB was the grandfathering of guns manufactured before September 13, 1994. Banned models produced before this date were legal to own (Jacobs, 2015). This was an issue because about 1 million AWs were privately owned in the U.S. as of 1990, and another 500,000 were produced domestically from 1989-1993. This meant there were at least 1.5 million legal AWs in the U.S. at the time of the ban's enactment (Koper, 2004).

Another flaw in the 1994 AWB was that it excluded around 650 models of firearms (Jacobs, 2015). These firearms were used primarily for hunting and recreation and did not contain militaristic features. However, 86 of these weapons were semiautomatic, and many of them accepted LCMs; thus there were still many firearms available for legal purchase (Koper, Woods, & Roth, 2004).

## Substituting New Models for Banned Models

The 1994 AWB also made it easy to create legal substitutes for banned guns. To do this, manufacturers would make minor changes, such as removing banned features from the gun. For example, the AB-10 was identical to the TEC-9, a banned firearm, except for the removal of the threaded barrel and barrel shroud (Koper, Woods, & Roth, 2004). This demonstrates the ease with which manufacturers were able to maneuver around the ban to continue to produce the weapons.

### Large Capacity Magazines

The 1994 AWB also grandfathered all LCMs produced before the ban's enactment. This was a problem because as of 1994, 18% of all civilian firearms, or 25 million guns, were equipped with LCMs. As of 1995, 25 million LCMs were still available in the U.S., and another 4.7 million grandfathered LCMs were imported into the U.S. from 1995-2000, proving that the ban was very ineffective in removing LCMs (Koper, Woods, & Roth, 2004).

### Small Percentage of Gun Crimes Involve AWs

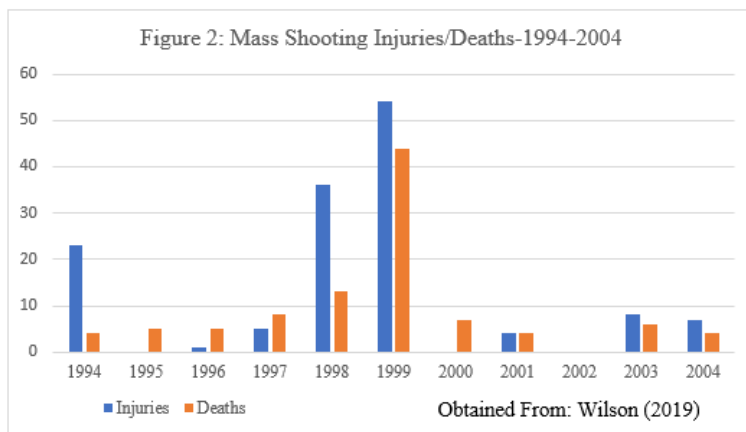
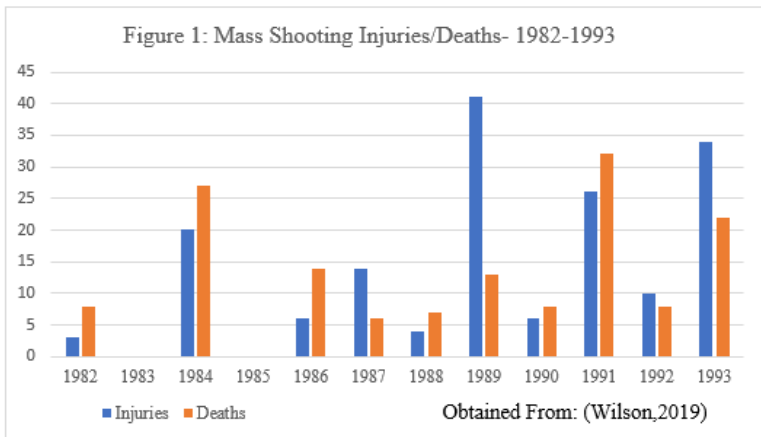
Perhaps the most significant flaw of the 1994 AWB was the fact that in the years prior to the ban, only a small percentage of gun crimes involved AWs. From 1992-1994, just 2% of gun thefts reported to police, 7-9% of guns used in the homicides of police officers, and 4-13% of guns used in mass shootings were classified as AWs (Koper, Woods, & Roth, 2004). With these statistics in mind, perhaps the government should have focused on handguns, which accounted for 86% of gun-related crimes in the U.S. in 1993 (Zawitz, 1995).

### Mass Shootings in the U.S

To determine the effectiveness of the 1994 AWB in accomplishing its primary goal, data from the 12-year period prior to the ban, the period during which the ban was in effect, and the post-ban period from 2005-present were compared.

#### 1982-1993: The Pre-Ban Period

As seen in Figure 1, more than 10 individuals died in mass shootings in just 3 of 7 years from 1982-1988. However, from 1989-1993, more than 10 individuals were killed in mass shootings in 3 out of 5 years (Wilson, 2019). Two major shootings in 1993, one in San Francisco that left 8 dead and 6 injured and another in Long Island that killed 5 and injured 19, ultimately led to the legislation being passed in 1994 (Ingraham, 2018). In total, 18 mass shootings occurred from 1982-1993, killing 145 and injuring 164 (Wilson, 2019).



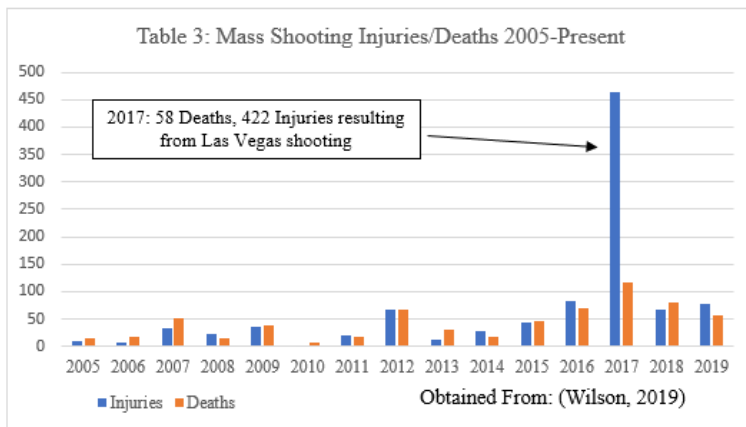
#### 1994-2004: Ineffectiveness of the Ban in Preventing Mass Shootings

During the ban, as Figure 2 shows, more than 10 individuals were killed in mass shootings just twice, leading proponents of the ban to argue that it was effective. A closer look at the data, however, shows that 17 mass shootings took place in the U.S. during the ban, leaving 100 individuals dead and 138 injured. This was only one less shooting, a 31% decrease in deaths, and a 15.85% decrease in injuries from 1982-1993. Higher percentage decreases and a greater decrease in the number of mass shootings would have been desirable, particularly considering that the ban period was one year shorter than the period from 1982-1993 (Wilson, 2019).

One of the 17 mass shootings that occurred during the ban was the Columbine High School massacre, which took place on April 20, 1999 at Columbine High School in Littleton, Colorado (Shepard, n.d.). This shooting involved the use of a TEC-9, which was outlawed by the 1994 AWB and could fire 36 rounds without reloading (Olinger, 2000). The use of the TEC-9 contributed to the catastrophic damage of the shooting, which left 15 dead and 20 injured (Shepard, n.d.). This shooting demonstrated that even guns that had been banned by the 1994 AWB were still obtainable to individuals with intent to commit deadly crimes, further proving the ineffectiveness of the ban.

#### 2005-Present: The Post-Ban Years

Since expiration of the 1994 AWB on September 13, 2004, mass-shooting frequency and lethality have increased in the U.S. Seventy-nine mass shootings have resulted in 974 injuries and 651 deaths in the U.S. since 2005, once again leading many to claim the ban's effectiveness. However, 59 shootings, 842 injuries, and 486 deaths have occurred since 2012, nearly 10 years after the ban was lifted (Wilson, 2019). The fact that the sharp increase did not occur immediately after the ban was lifted indicates that many factors other than the expiration of the ban contributed to the recent spike of mass shootings in the U.S.



### Reasons for Increased Mass Shootings in the United States

One of the many factors contributing to the increase in mass shootings in the U.S is increased social media usage. News of mass shootings is spread easily on these platforms, allowing potential killers to identify with criminal acts and carry out similar acts of their own (Lee, 2018). Another contributor to the increase in mass shootings is the narcissistic tendencies of mass shooters. Many shooters commit crimes because of how easily fame is spread in today's media environment. Studies have shown that mass shooters may receive millions of dollars' worth of media attention for their acts. Some shooters even go as far as to commit their crimes at certain times of the year in order to gain more extensive media coverage (Lee, 2018).

Shooters drawing inspiration from previous crimes is another reason for increased mass shootings in the U.S. Psychologists have found that mass shooters view themselves as part of a brotherhood with previous killers, who are seen as "idols and pioneers" (Carey, 2019). One last contributing factor to the rise of mass shootings in the U.S. is mental illness. Studies show that approximately 20% of mass shooters show signs of psychosis. In addition, individuals with mental illnesses such as schizophrenia are more likely than the average person to commit violent crimes (Carey, 2019).

### Conclusion

The 1994 AWB was passed with the intention of reducing the frequency and lethality of mass shootings in the U.S. The ban was not successful in accomplishing its goals, due to several loopholes and flaws. Among these were the grandfathering of guns and LCMs produced before the enactment of the ban and the exclusion of nearly 650 gun models. The ease of producing models similar to banned models and the fact that a small percentage of crimes were committed with AWs prior to the ban were also serious weaknesses of the legislation. Mass shootings have increased

since the ban was lifted, but evidence shows that this increase is due to many factors other than the lifting of the ban. These factors include increased social media usage and shooters' desire for fame, inspiration from previous shooters, and mental illness.

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# Shoe Carnival, Inc. Financial Analysis

Tyler Richards

*Faculty Mentor: Cindi Bearden, BS, Mac, CPA*  
Business and Nonprofit Studies, Accountancy

## Abstract

This financial analysis report on Shoe Carnival will cover the changes that the company has experienced from the years 2014 to 2019. Because Shoe Carnival has yet to release its official annual report for 2019, the results have limited detail given for the exact changes in financial measures. The statements that were analyzed include the Income Statement, Balance Sheet, and Statement of Cash Flows. Since 2014, Shoe Carnival has had a 10% increase in sales and a 30% increase in operating profit. For that same period, Cost of Sales has increased 9% and Selling and Administrative Expense has increased 11%. The company pays little interest because it does not leave Long-Term Debt outstanding and borrows only from its revolving credit facility. Although Shoe Carnival has closed over 77 stores since 2014, Total Assets have increased 35%, and Total Liabilities have increased 247% for the same period. This is due to the lease standard change, Accounting Standards Codification Topic 842, for the year 2019, which requires Shoe Carnival to begin recording store leases on the Balance Sheet. Cash inflows are driven through daily operations, and cash outflows are determined by the amount of share repurchases. Due to small shoe retailers being pushed out and online sales becoming more prominent, Shoe Carnival's future sales and earnings will be strongly affected by online marketing efforts.

Shoe Carnival is one of the country's largest family footwear retailers; it offers in-store or online purchasing options for its customers (SC, Annual Report, 2018). I will present common-size financial statements, financial ratio graphs, trend analysis graphs, and horizontal analysis explanations to interpret and compare changes from fiscal years 2014 to 2019 for Shoe Carnival. Trend analysis illustrates the overall change since 2014, and horizontal analysis presents year-to-year changes. Fiscal years consist of a 52- to 53-week period which ends on the last Saturday of January or first Saturday of February. Caleres, Shoe Carnival's competitor, and the industry will be used for comparison.

## Introduction

The company was created in 1978 by David Russell with the name "Shoe Biz." In 1993, the company went public on the NASDAQ Stock Market as the trading symbol "SCVL." In 2012, Shoe Carnival began its foreign expansion by opening 4 stores in Puerto Rico. Shoe Carnival has around 5,200 employees and is headquartered in Evansville, Indiana. (SC, About Us, 2020).

## Strategy

Historically, Shoe Carnival's strategy was to open more brick-and-mortar stores. In recent years, Shoe Carnival's goal has been to increase shareholder wealth through

maximizing operating income. Because all of its stores are leased, it has the flexibility to terminate or relocate underperforming stores. Due to the rise in online purchases and the demand for a variety of footwear, Shoe Carnival has been developing a multi-channel strategy. This multi-channel strategy includes Customer Relationship Management, Ship-from-Store, Shoes 2U, Buy Online and Pick Up, E-Commerce, and Mobile. These strategies allow Shoe Carnival to collect customer data for marketing efforts and to create an enjoyable shopping experience for customers (SC, Annual Report, 2018).

## Industry Outlook

As the footwear industry continues to evolve, small shoe retailers have been closing their stores. These small shoe retailers do not generate enough capital to fill the mandatory purchase requirements that manufactures such as Nike and Adidas are now requiring (Carpenter, 2019). Companies such as Shoe Carnival and Caleres are closing some of their locations as well. In 2018, 30% of footwear sales were made online, so shoe retail companies are having to develop new strategies for the online market. Also, large shoe manufacturers have been selling directly to customers rather than distributing their shoes to third-party retailers. According to Murray Carpenter, direct-to-consumer sales grew 12%, while general footwear sales grew only 4% in 2018 (2019). In order to retain their customer base, shoe retailers like Shoe Carnival are going to have to implement new strategies that revolve around online

sales. The retailers need to prove that their value and customer loyalty are unmatched compared to general shoe manufacturers.

### SWOT Analysis

Shoe Carnival uses its competitive strengths to drive online and in-store sales. Since Shoe Carnival was created in 1978, the company has developed a high-energy environment for its customers. The store layout attracts families and encourages spending through games, colors, music, and graphics. The company offers a very broad, cost-friendly merchandise selection for both children and adults. These options include athletic, casual, dress, and seasonal footwear. Shoe Carnival has continued to expand its customer loyalty by developing the program, Shoe Perks, which offers discounts and rewards for customers. In 2018, 68% of net sales were generated through Shoe Perks members (SC, Annual Report, 2018). The company's leadership team is very experienced in the footwear industry. The Chairman, Chief Executive Officer, and Chief Financial Officer have all been working for Shoe Carnival for the last 20 years. As the shoe retail industry continues to change, Shoe Carnival stays ahead of its competitors through its multi-channel strategy and through its online marketing efforts (SC, Annual Report, 2018).

Shoe Carnival also has weaknesses that could potentially hinder financial growth. Even though comparable store sales have increased, the store traffic has decreased each year since 2014. Shoe Carnival has been unable to expand physical locations since 2016. At the end of 2016, Shoe Carnival had 415 stores operating, and at the end of 2019, the company had 392 stores (SC, 2019 Financial Results, 2019). Even though the executive officers are experienced, they lack diversity, with all being males over the age of 45. With the recent changes in the shoe retail industry, new ideas and new influences could be extremely beneficial.

As Shoe Carnival implements its multi-channel strategy, the company has potential opportunities to benefit its financial position. Close to 2.4 million new members joined Shoe Perks in 2018, and those members generated almost 70% of sales (SC, Annual Report, 2018). Further development of Shoe Perks could increase sales and create quality brand awareness. Additionally, Shoe Carnival has the opportunity to expand into other foreign markets in the future. The company operates only in the United States and Puerto Rico, but by expanding into other international countries, Shoe Carnival could gain worldwide popularity and generate more foreign sales. Shoe Carnival has relaunched its e-commerce and mobile platforms. With more customers going online to purchase footwear, Shoe Carnival's online business segment has the opportunity to capitalize on making customers' shopping experiences easier.

Shoe Carnival has many threats that can negatively

impact its business. Customer demand is much higher during Easter, back-to-school, and Christmas periods. If customer demand during these seasons were to decrease, then the company would have a lot of excess inventory left over and would require a markdown in prices. The shoe retail industry contains many competitors. These competitors include family footwear retailers that offer in-store and online purchasing. Shoe Carnival is also impacted by the state of the economy. The company relies heavily on consumer spending, and when unfavorable economic conditions occur, people are less likely to spend money on shoes. Weather and temperatures surprisingly impact the company as well (SC, Annual Report, 2018).

Shoe Carnival specializes in a wide variety of inventory, including sandals for the summer and boots for the winter. If weather and temperatures fluctuate during summer or winter months, then this can lead to a decrease in sales and profit margins. Lastly, Shoe Carnival is threatened by the increase in online purchases and direct-to-consumer spending (Carpenter, 2019). If Shoe Carnival is not able to produce sales from its new multi-channel strategy, and if manufacturers no longer need retailers, then the company's financial position will be negatively impacted.

**Table 1:** Common Size Income Statement

	2016	2017	2018	2019
Net sales	100.0%	100.0%	100.0%	100.0%
Cost of sales	71.1%	70.9%	70.0%	69.9%
Gross profit	28.9%	29.1%	30.0%	30.1%
SG+A Expense	25.1%	25.4%	25.2%	24.9%
Operating income	3.8%	3.7%	4.8%	5.2%
Other	0%	0%	0.1%	0.0%
Income before income taxes	3.8%	3.7%	4.9%	5.3%
Income tax expense	1.4%	1.8%	1.2%	1.1%
Net income	2.3%	1.9%	3.7%	4.1%

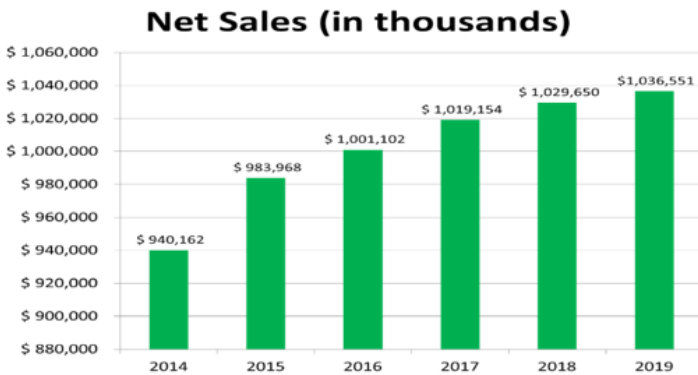
### Income Statement

Table 1 is a Common-Size Income Statement from fiscal years 2016 to 2019. This illustrates the individual accounts as a percentage of Net Sales. I will be focusing on the two largest expense accounts, Cost of Sales and Selling, General, and Administrative Expense. I will analyze the changes in these expense accounts and how they affect Operating Income and Net Income.

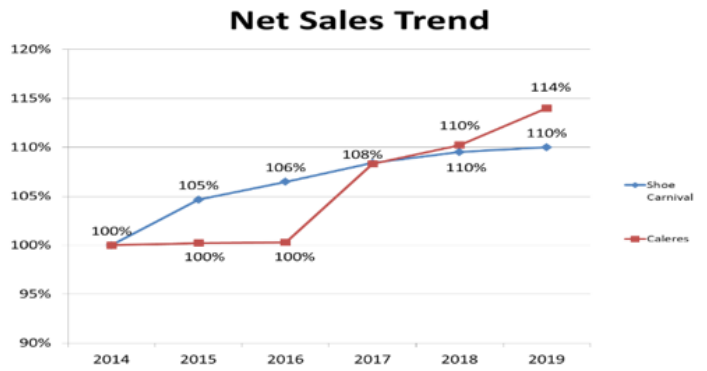
### Net Sales

Figure 1 shows the growth in Net Sales from 2014 to 2019. The dollar amounts are in thousands, and the graph

**Figure 1: Net Sales Amount**



**Figure 2: Net Sales Trend**



illustrates that sales have increased each year. Since 2016, Shoe Carnival has recorded more than \$1 billion in Net Sales.

Figure 2 shows that Shoe Carnival’s Net Sales increased 10% since 2014, while Caleres’s increased 14%. The largest increase in Net Sales was 5% from 2014 to 2015 for Shoe Carnival. This was primarily due to opening 51 stores, while closing 22 stores from 2014 to 2015. Also, Shoe Carnival experienced a 3% increase in comparable store sales due to a large focus on inventory selection for men and women customers (SC, Annual Report, 2015). Comparable store sales refer to the sales of particular stores that have been open for a year or more.

Net Sales increased 2% from 2016 to 2017. This was driven by the additional 53<sup>rd</sup> week in 2017 and by a 0.3% increase in comparable store sales. The store-to-store increase in sales came from a focus on inventory selection for women and children’s athletic footwear, men’s boots, and adult dress shoes (SC Annual Report, 2017). From 2018 to 2019, Net Sales increased 1%, with the company’s comparable store sales increasing 1.9% (SC, 2019 Financial Results, 2019).

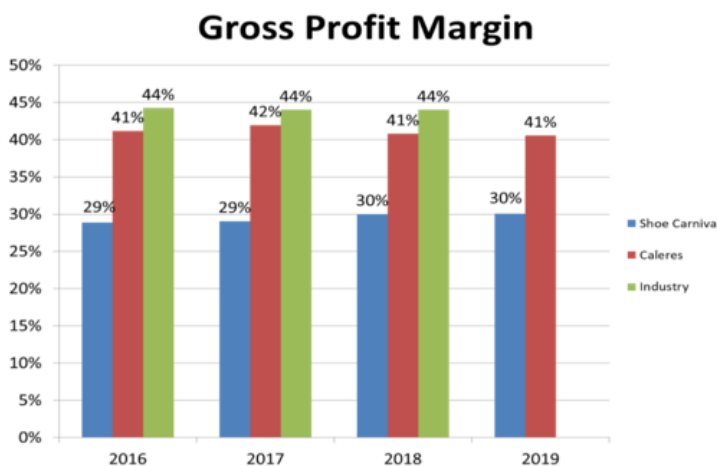
**Gross Profit**

Figure 3 includes the Gross Profit Margin ratio for Shoe Carnival, Caleres, and the industry. Shoe Carnival’s Gross Profit Margin is below that of both Caleres and the industry, but it remains constant around 30%. The industry ratio for 2019 is not present because the financial results have yet to be released.

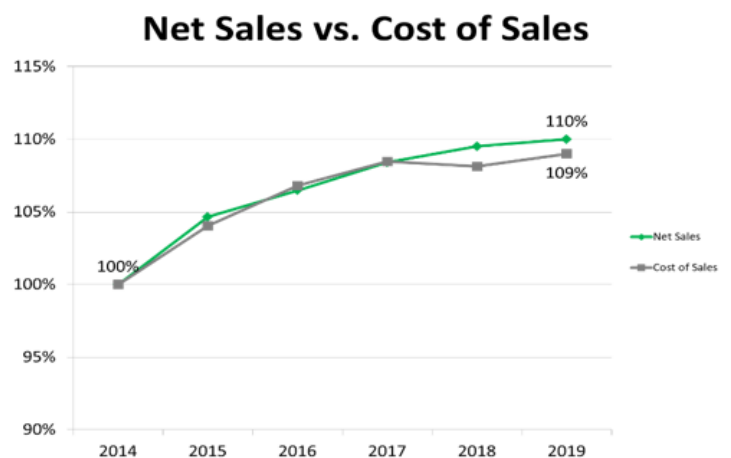
The 1% increase in Gross Profit Margin from 2017 to 2018 was a result of a higher increase in Net Sales compared to Cost of Sales. Net Sales increased 1% from 2017 to 2018, while Cost of Sales experienced a 0% change. Figure 4 shows that Net Sales increased 10% and Cost of Sales increased 9% since 2014.

Gross Profit increased 6% from 2014 to 2015, with a 0.1% increase in merchandise margin and a 0.3% decrease in buying, distribution, and occupancy costs as a percentage of Net Sales (SC, Annual Report, 2015). Another 4% increase in Gross Profit came from 2017 to 2018. This resulted from a 0.3% increase in merchandise margin for women’s non-athletic footwear and because of leveraging expenses and lowering

**Figure 3: Gross Profit Margin Ratio**



**Figure 4: Net Sales vs. Cost of Sales Trend**



occupancy expenses (SC, Annual Report, 2018). Leveraging expenses means slowing the growth of increases in expenses compared to the growth increase in sales.

**Operating Profit**

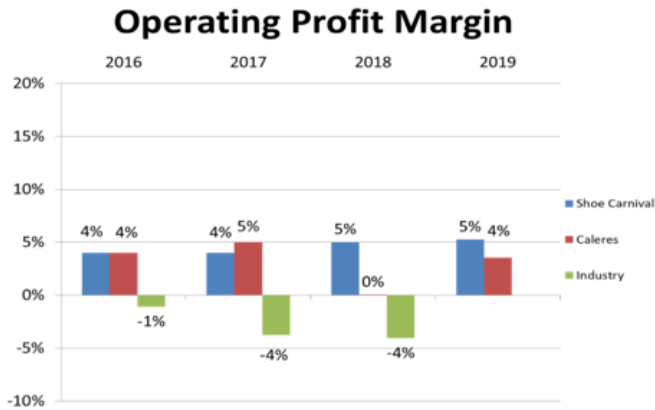
The Operating Profit Margin ratio can be seen in Figure 5. Shoe Carnival and Caleres have similar percentages, while the industry has a negative Operating Profit Margin due to operating losses since 2016. In 2018, Caleres also had a very small Operating Profit compared to its Net Sales. Overall, Shoe Carnival’s Operating Profit Margin has remained consistent and makes up about 4% or 5% of its Net Sales.

Since 2014, Net Sales has increased steadily compared to the fluctuation in Operating Profit. Operating Profit decreased 19% from 2015 to 2016 and decreased 1% from 2016 to 2017, primarily due to increases in Selling and Administrative Expense. Because of limiting Selling and

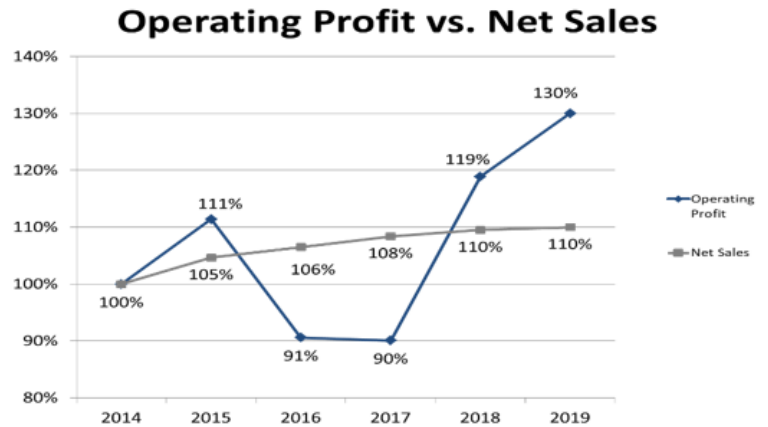
Administrative expenses in 2018 and 2019, Operating Profit increased for these years. Overall, Operating Profit has increased 30% since 2014.

Selling and Administrative Expense is the second largest expense for Shoe Carnival. As a percentage of Net Sales, Selling and Administrative expense was 24.9% in 2019. From 2015 to 2016, Selling and Administrative Expense increased by 3% because of \$4.5 million in non-cash impairments. Of this \$4.5 million, \$3.6 million resulted from stores located in Puerto Rico. Also, another \$2.3 million was for operational costs of 15 additional stores (SC, Annual Report, 2016). From 2016 to 2017, Selling and Administrative Expense increased similarly at 3%. This increase was for \$1.4 million in consultation fees for the company’s Customer Relationship Management initiative and for \$1.2 million in stock-compensation expense (SC, Annual Report, 2017). From 2017 to 2018, Selling and Administrative Expense experienced

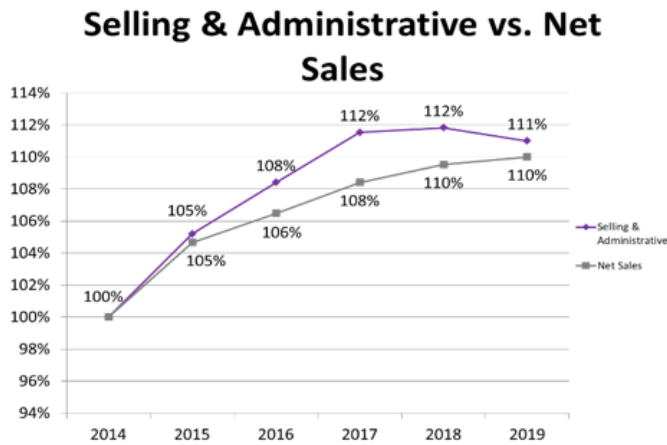
**Figure 5: Operating Profit Margin**



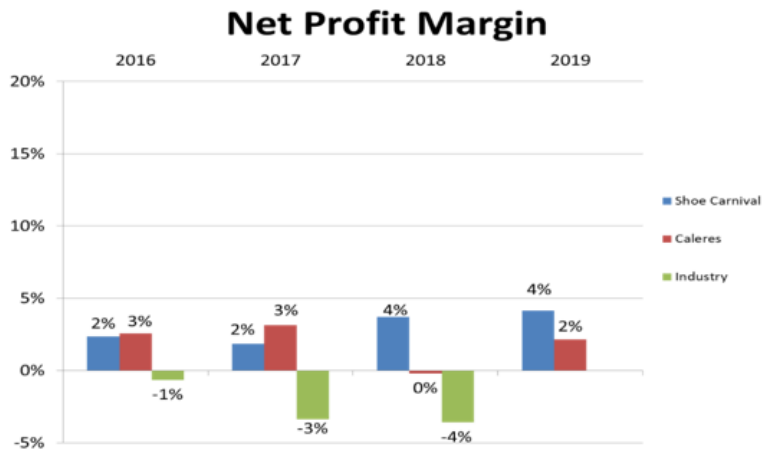
**Figure 6: Operating Profit vs. Net Sales Trend**



**Figure 7: Selling & Administrative Expense vs. Net Sales Trend**



**Figure 8: Net Profit Margin Ratio**



a 0% change by reducing operating costs from closing 40 stores in 2017 and 2018. Also, deferred compensation plan costs were reduced from \$1.8 million in 2017 to \$154,000 in 2018 (SC, Annual Report, 2018). The 11% increase for Selling and Administrative Expense since 2014 can be seen below.

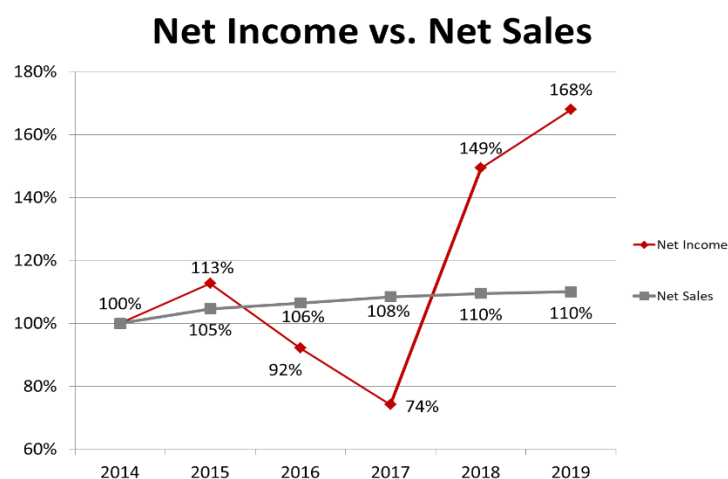
### Net Income

Net Income is directly linked to Shoe Carnival’s ability to manage operating costs. Figure 8 shows how Shoe Carnival’s Net Profit Margin is fairly steady compared to that of Caleres and the industry. Caleres had a small net loss for 2018, and the industry has had net losses since 2016. The 2019 results for the industry have yet to be released.

For Shoe Carnival, Net Income decreased 18% from 2015 to 2016 because merchandise margin decreased 0.6% for expenses pertaining to multi-channel sales initiatives and because of the \$4.5 million in store impairments (SC, Annual Report, 2016). The Tax Cuts and Jobs Act was enacted in 2017, which forced Shoe Carnival to remeasure its deferred taxes, which in turn required an additional \$4.4 million in income tax expense be recorded. The new tax provision also led to \$1.9 million in stock-based compensation expense (SC, Annual Report, 2017). These tax changes are the main reasons why Net Income decreased 19% from 2016 to 2017.

Net Income increased 101% from 2017 to 2018 because of comparable sale increases in all major product and seasonal product categories (SC, Annual Report, 2018). Shoe Carnival was able to limit Cost of Sales and Selling and Administrative Expenses to a 0% change. Also, the new tax provision led to a decrease in the corporate tax rate from 35% to 21% in 2018. Since 2014, Net Income has increased by 68%, which can be seen in Figure 9.

**Figure 9:** Net Income vs. Net Sales Trend



### Income Statement Summary

Since 2014, Net Sales has increased 10% with increasing comparable store sales and focusing on inventory that customers find appealing. Operating Profit and Net Income have seen large increases in 2018 and 2019. Operating Profit has increased due to expense leverage by managing Cost of Sales and Selling and Administrative Expense growth. Similarly, Net Income has increased 68% since 2014 because of the corporate tax rate reduction in 2018 and limiting operating expenses in 2018 and 2019. These increases in Net Income have also led to an increase in Earnings per Share.

### Balance Sheet

The major changes for the Balance Sheet will be presented in order from Assets, Liabilities, and Stockholders’ Equity. Shoe Carnival was required to make major changes to its Balance Sheet for 2019, with the Accounting Standards Codification (ASC) Topic 842 becoming effective for the company on February 3, 2019. This new accounting standard heavily impacted Total Assets and Total Liabilities. Because Shoe Carnival leases all of its 392 store locations, it was required to present these facilities under Noncurrent Assets and the lease contract obligations under Long-Term Liabilities.

### Assets

Table 2 presents the Total Assets portion of the Common-Size Balance Sheet. Current Assets make up a majority of the Total Assets. Cash and Merchandise Inventory are the largest Current Assets accounts. The table presents how Property and Equipment has decreased each year as a percentage of Total Assets. Due to the new lease guidelines issued from ASC Topic 842 that increased Total Assets, each major asset account decreased as a percentage of Total Assets.

**Table 2:** Common Sized Assets

	2016	2017	2018	2019
Cash and cash equivalents	13.7%	11.6%	16.0%	9.9%
Accounts receivable	1.0%	1.5%	0.3%	0.4%
Merchandise inventories	61.0%	62.7%	61.6%	41.3%
Total Current Assets	76.7%	77.1%	80.7%	52.5%
Property and equipment – net	21.0%	20.8%	16.9%	10.8%
Deferred income taxes	2.1%	2.0%	2.3%	1.2%
Operating lease right-of-use assets	0%	0%	0%	34.2%
Other	1.2%	1.4%	2.9%	2.3%
Total Assets	100.0%	100.0%	100.0%	100%

Figure 10: Current Ratio

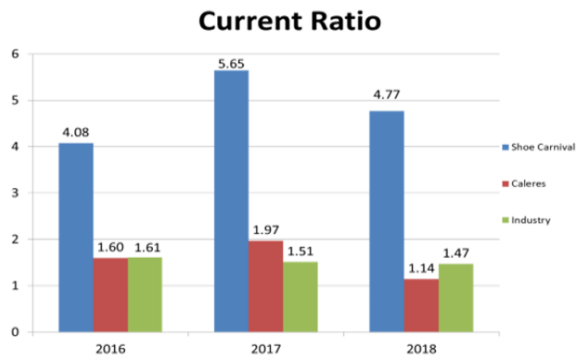


Figure 11: Current Assets vs. Current Liabilities Trend

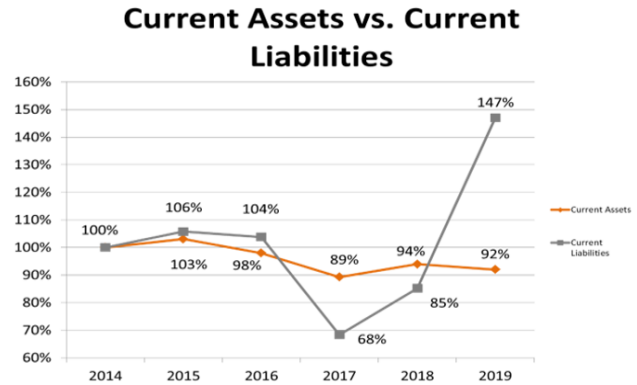


Figure 12: Cash vs. Current Assets Trend

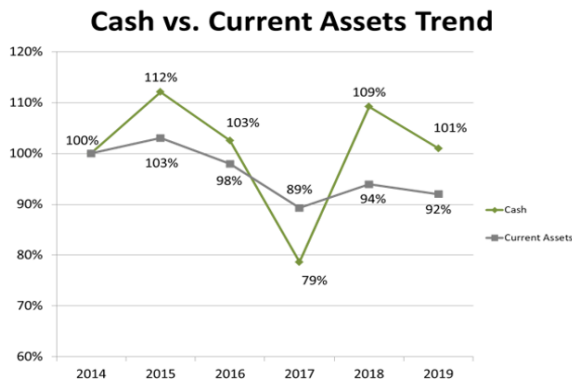


Figure 13: Cash Amount vs. Current Assets Amount

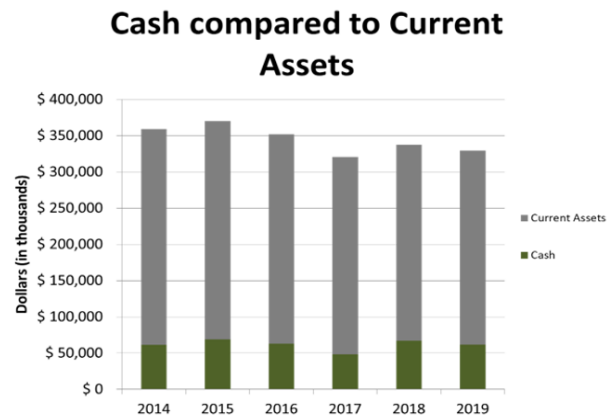


Figure 14: Quick Ratio

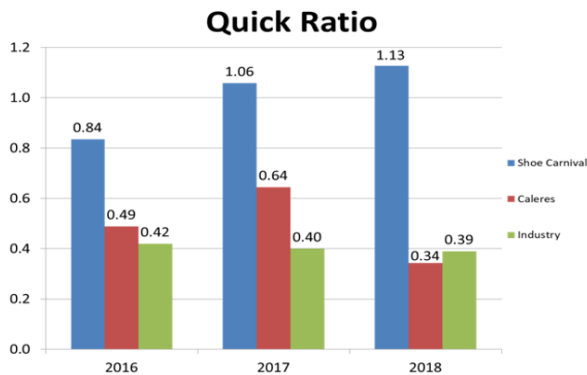
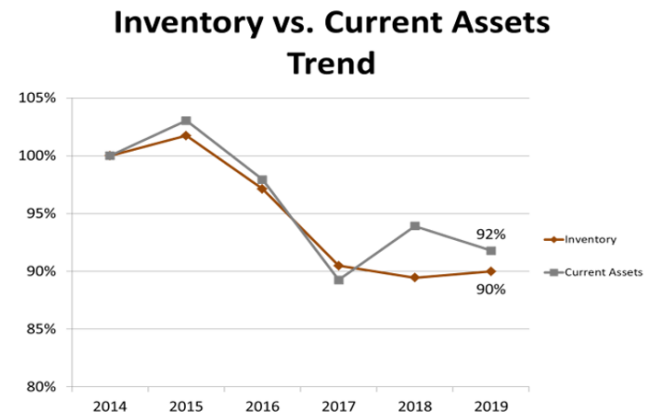


Figure 15: Inventory vs. Current Assets Trend



**Current Assets**

Figure 10 presents the Current Ratio from 2016 to 2018. Shoe Carnival's Current Ratio is much greater than that of Caleres and the industry for these years. The Current Ratio demonstrates the ability of a company to pay off its current obligations with its Current Assets.

Besides 2019, the trend line for Current Assets

increases or decreases along with the trend line for Current Liabilities. Figure 11 shows that Current Assets have decreased by 8% since 2014.

The changes in the Current Assets trend line are reflected on the increases or decreases for the Cash trend line. Figure 12 shows the trend comparison since 2014.

A change in Cash affects Current Assets because it

makes up around 15% to 20% of Current Assets. Figure 13 below illustrates that each year that Cash decreases or increases, so does Current Assets.

From 2015 to 2016, Current Assets decreased 5% because Cash decreased 9%. Shoe Carnival spent \$42.6 million on repurchases of common stock in 2016 (SC, Annual Report, 2016). The company paid \$29.5 million to vendors and suppliers and spent \$29.8 million on repurchases of common stock in 2017 (SC, Annual Report, 2017). This led to a 23% decrease in Cash and contributed to a 9% decrease in Current Assets from 2016 to 2017.

Merchandise Inventory is the largest asset account at around 41% of Total Assets in 2019. The Quick Ratio is shown in Figure 14. This ratio demonstrates the ability of a company to pay off its current obligations with inventory being excluded from Current Assets. Shoe Carnival's ratio is much higher than that of Caleres and the industry because of its ability to obtain Cash from its operations.

Since 2014, Inventory has decreased 10%, which is the main reason why Current Assets have decreased 8%. Since 2016, Shoe Carnival has been opening fewer and closing more store locations in hopes of increasing operating income and maximizing shareholder value (SC, Annual Report, 2018). This has resulted in fewer products that Shoe Carnival needs to have on hand. Figure 15 has the overall change in Inventory compared to Current Assets since 2014.

Inventory Turnover is a ratio that determines how many times inventory is sold throughout the year. Shoe Carnival's Inventory Turnover was less than that of Caleres and the industry in 2016. However, Shoe Carnival's ratio has increased since 2016 and was higher than that of Caleres and the industry in 2018. Figure 16 presents the Inventory Turnover ratios.

Days Inventory Held is a ratio used to determine the

average number of days that inventory is held in stores before being sold. Shoe Carnival's was higher than Caleres's and the industry's in 2016. In 2018, Shoe Carnival's Days Inventory Held was less than both Caleres's and the industry's. The Days Inventory Held ratio can be seen in Figure 17 below.

Changes in the two inventory ratios are a result of Cost of Sales increasing 9% and Merchandise Inventory decreasing 10% since 2014. Shoe Carnival has focused on implementing its multi-channel strategy, which has led to an increase in Cost of Sales. Part of the strategy includes collecting customer data and using it to implement better inventory selection (SC, Annual Report, 2018). Because Shoe Carnival has closed 55 stores since 2016, the company does not need as much inventory on hand. Figure 18 shows the percentage changes for Cost of Sales and Merchandise Inventory since 2014.

### Noncurrent Assets

Since 2016, Shoe Carnival's Fixed Asset Turnover ratio has increased each year. This ratio indicates how well sales are generated from investments in fixed assets. In 2016, it was lower than that of both Caleres and the industry. In 2018, the ratio was higher than that of both Caleres and the industry. Figure 19 presents the Fixed Asset Turnover ratio.

Since 2014, Shoe Carnival has opened fewer stores and spent less on capital expenditures. In 2014, the company opened 31 new stores, and 73% of total cash outflows were spent on capital expenditures (SC, Annual Report, 2014). In 2019, Shoe Carnival opened 1 store and spent 20% of cash outflows on capital expenditures (SC, 10-K, 2019). Figure 20 is a visual of how Property and Equipment has decreased 33% since 2014. The majority of this change is a result of Shoe Carnival closing underperforming store locations. However,

Figure 16: Inventory Turnover Ratio



Figure 17: Days Inventory Held Ratio

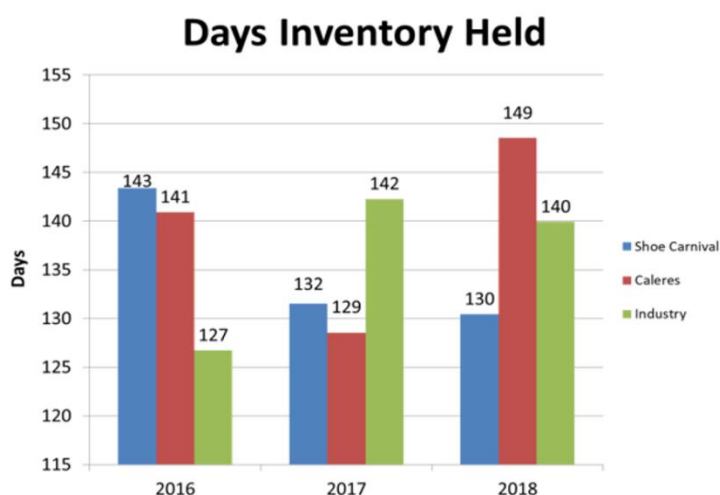


Figure 18: Inventory vs. Cost of Sales Trend

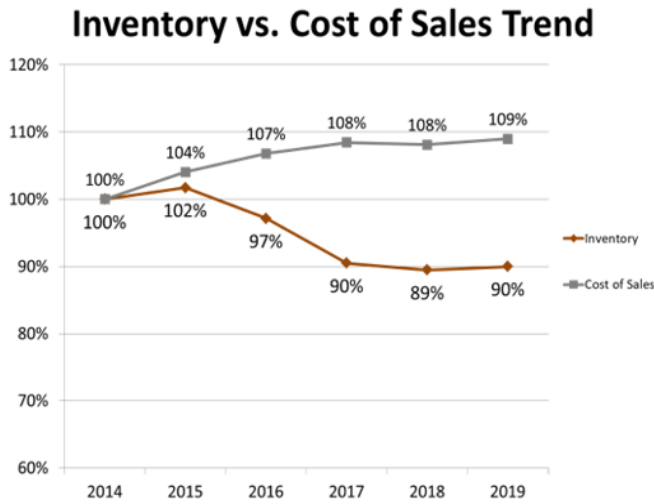


Figure 19: Fixed Asset Turnover Ratio

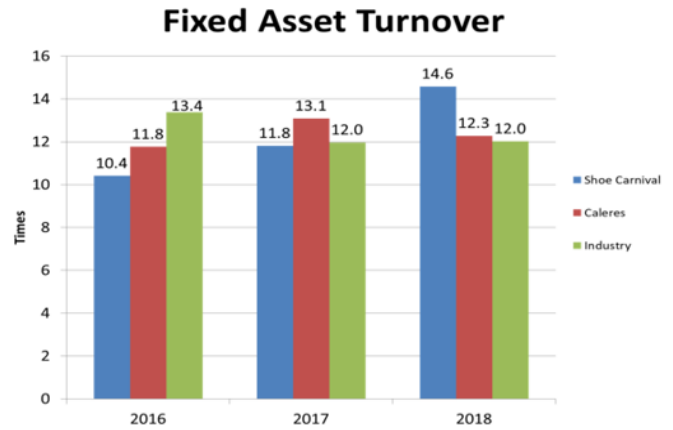


Figure 20: Net Property and Equipment vs. Net Sales Trend

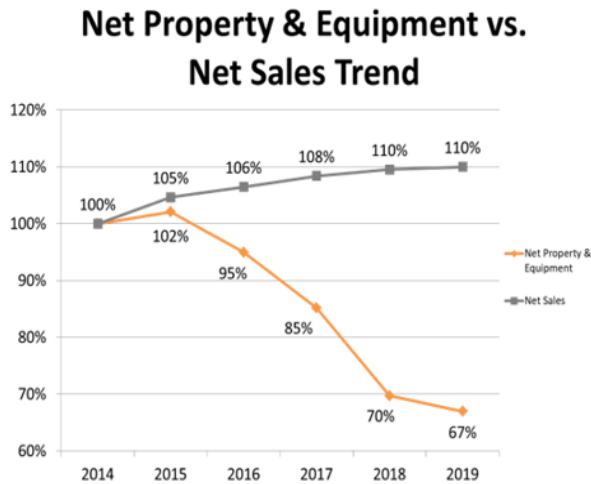


Figure 21: Total Asset Turnover Ratio

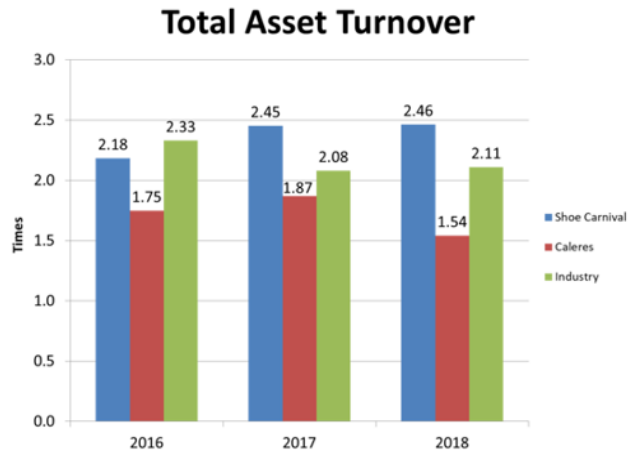


Figure 22: Total Assets vs. Net Sales Trend

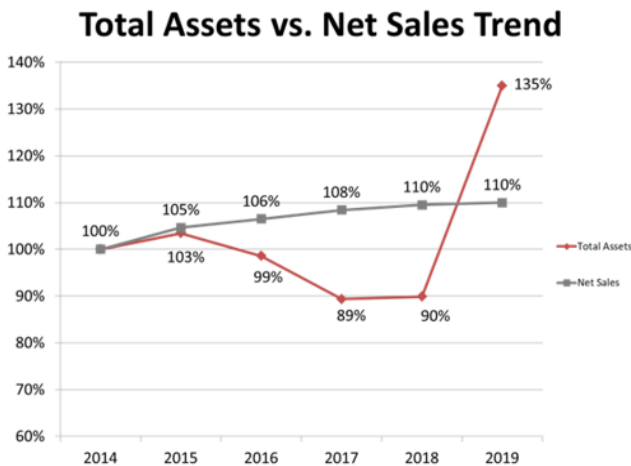
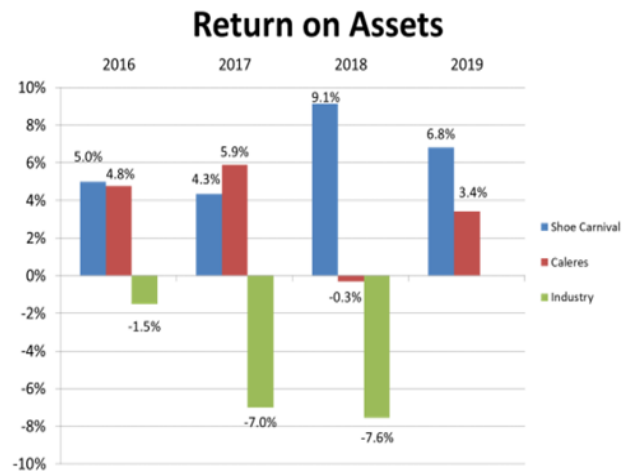


Figure 23: Return on Assets Ratio





this has not negatively affected sales. Sales continue to this continue to increase due to the multi-channel marketing strategy and because of the company's focus on generating online sales.

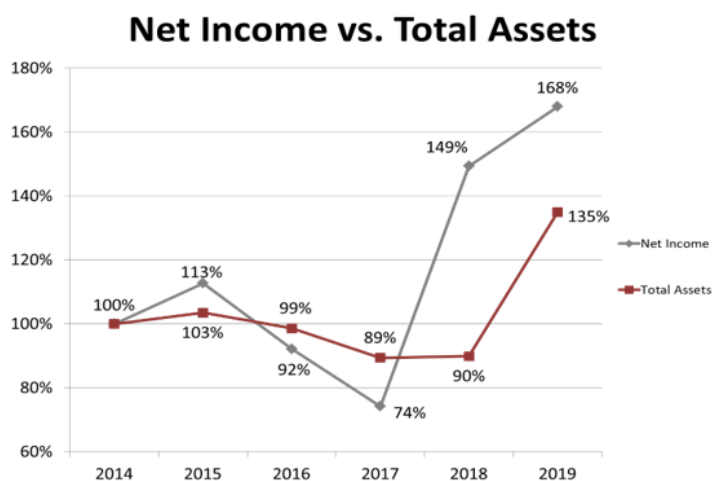
Total Asset Turnover ratio measures a company's ability to generate sales from Total Assets. Shoe Carnival's ratio is higher than Caleres's and increased from 2016 to 2018. Figure 21 contains the Total Asset Turnover ratio.

Figure 22 shows the overall change in Total Assets compared to Net Sales since 2014. Total Assets decreased each year from 2014 to 2017 for Shoe Carnival. The company has been identifying underperforming stores and either closing or relocating these stores. Total Assets increased 50% from 2018 to 2019. Due the Financial Accounting Standard Board issuing ASC Topic 842, all of Shoe Carnival's store locations were required to be recorded on the balance sheet as Operating Leased Assets. This resulted in an additional \$215 million being added to Total Assets, while Net Sales increased by only \$10 million.

Figure 23 shows the ratio for Return on Assets. This ratio measures the ability of Total Assets to generate income. Shoe Carnival experienced a large increase from 2017 to 2018 and a decrease from 2018 to 2019. The industry has seen large decreases and a negative ratio since 2016 due to net losses.

Net Income increased at a much faster rate than did Total Assets from 2017 to 2018 for Shoe Carnival. The corporate tax rate reduction, along with the ability to manage operating expenses, was the reason for the large increase in Net Income. Cash increased 39% from 2017 to 2018, which caused Total Assets to increase 1%. Although Net Income increased 13% from 2018 to 2019, Total Assets increased at 35%. This increase came from the operating lease assets being recorded. Figure 24 shows how Total Assets have increased 35% since 2014.

Figure 24: Net Income vs. Total Assets Trend



## Liabilities

Table 3 presents the liabilities section of the Common Size Balance Sheet. Accounts Payable has historically been the largest liability account up until 2019. The ASC Topic 842 caused Shoe Carnival to record their store lease contracts under liabilities. This change created two additional accounts: The Current Portion of the Operating Lease Liability and the Long-Term Portion. The company had very little debt before 2019, but the new standards change caused Shoe Carnival's liabilities to increase dramatically.

Table 3: Common Size Liabilities

	2016	2017	2018	2019
Accounts payable	14.8%	10.0%	11.7%	9.7%
Accrued and other liabilities	4.0%	3.6%	5.3%	3.0%
Current portion of operating lease liabilities	0.0%	0.0%	0.0%	6.9%
Total Current Liabilities	18.8%	13.7%	16.9%	19.5%
Long-term portion of operating lease liabilities	0.0%	0.0%	0.0%	30.9%
Deferred lease incentives	6.7%	7.0%	5.3%	0.0%
Other	4.9%	5.4%	4.9%	2.3%
Total Long-term Liabilities	11.6%	12.4%	10.2%	33.2%
Total Liabilities	30.4%	26.1%	27.2%	52.7%

## Current Liabilities

Until 2019, Current Liabilities made up a majority of Total Liabilities. Calculating the averages from 2014 to 2018 reveals that Current Liabilities made up 60% of Total Liabilities, while Long-Term Liabilities made up 40%. These percentages are given in Figure 25. However, Long-Term Liabilities increased to around 63% of Total Liabilities in 2019 due to the addition of long-term lease contracts.

Payables Turnover is a ratio that demonstrates how many times Accounts Payable is paid each year. Shoe Carnival's ratio is much greater than Caleres's and the industry's. For 2018, Shoe Carnival's payables remained outstanding for 25 days, while Caleres's payables remained outstanding for 69 days. Figure 26 shows Payables Turnover below.

Accounts Payable makes up the largest portion of Current Liabilities. Since 2014, Accounts Payable has decreased 11%. From 2016 to 2017, Accounts Payable decreased 38% because Shoe Carnival paid \$26.1 million to suppliers and because merchandise inventory decreased 7%. From 2017 to 2018, Accounts Payable increased 17% solely because the company paid less cash to suppliers. Figure 27 shows the overall changes since 2014.

Figure 25: Percentage of Total Liabilities

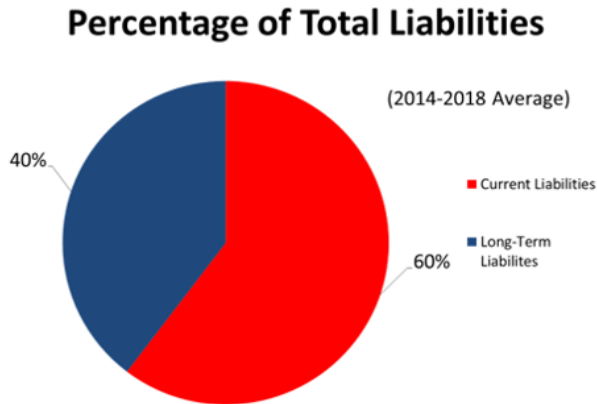


Figure 26: Payables Turnover

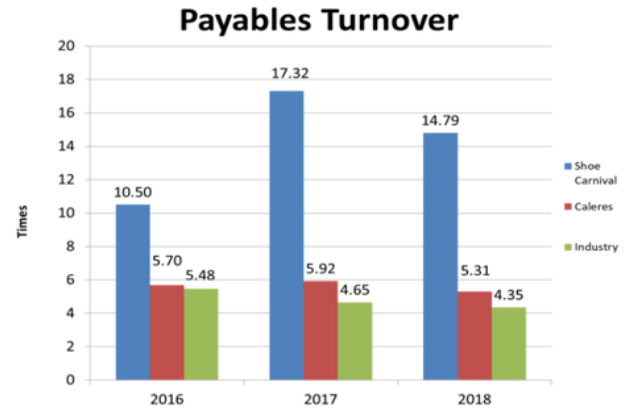


Figure 27: Accounts Payable vs. Cost of Sales

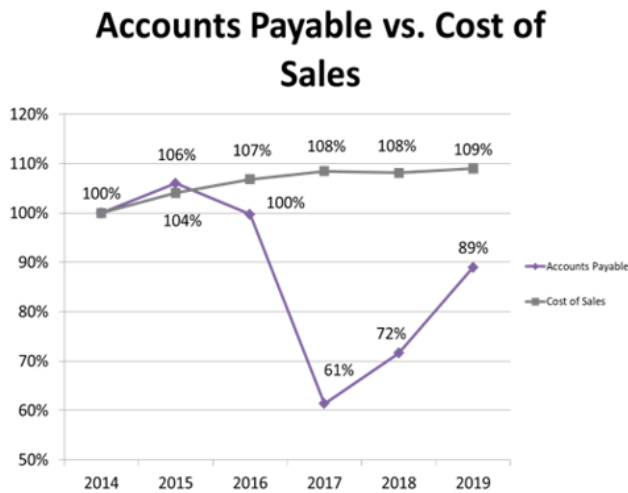


Figure 28: Debt Ratio

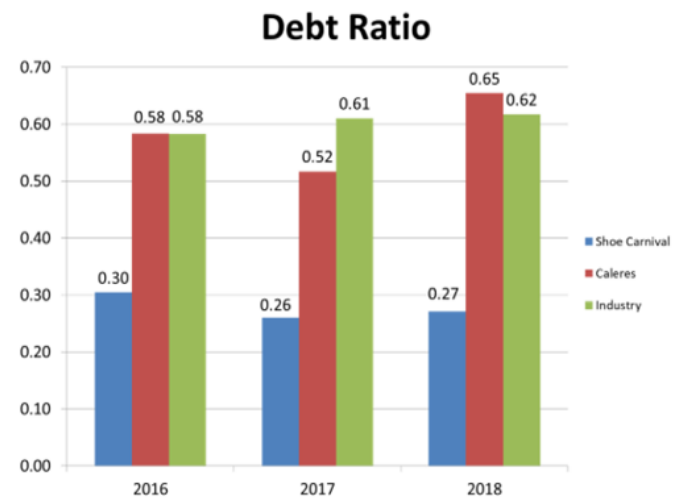


Figure 29: Total Liabilities vs. Total Assets Trend

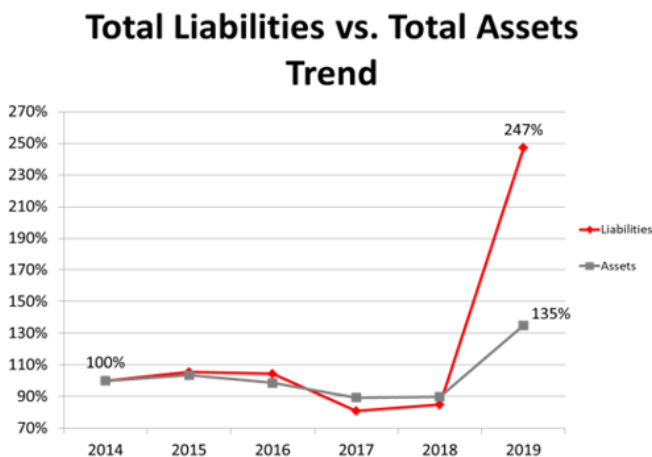
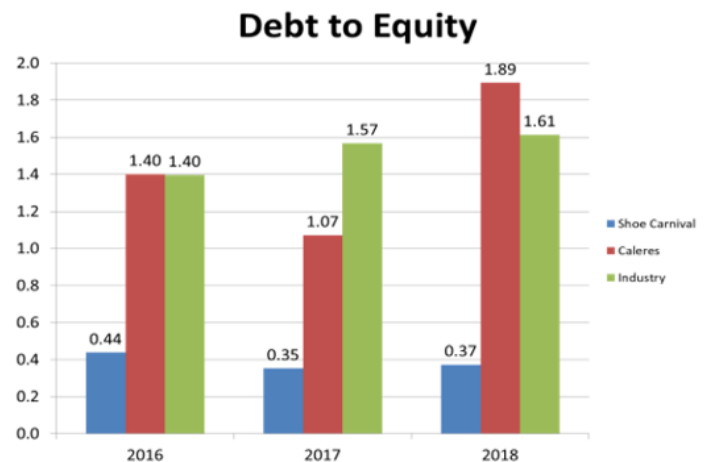


Figure 30: Debt to Equity Ratio



**Long-Term Liabilities**

Until 2019, Shoe Carnival’s Long-Term Liabilities made up around 37% of its debt. Figure 28 shows the Debt Ratio from 2016 to 2018. This ratio identifies what percentage of assets is funded through debt. Shoe Carnival’s ratio was well below Caleres’s and the industry’s from 2016 to 2018.

Since 2014, Total Liabilities has increased 147%. This is because of the new lease recording guidelines for lessees in the ASC Topic 842. Because all of Shoe Carnival’s stores are long-term leases, the company’s Long-Term Liabilities increased 387% from 2018 to 2019. The company recorded \$194.1 million of Long-Term Portion of Operating Lease Liabilities for 2019. This major change can be identified in Figure 29, which shows the overall change in Total Liabilities since 2014.

**Table 4:** Common Size Stockholders’ Equity

	2016	2017	2018	2019
Common stock	0.0%	0.0%	0.0%	-
Additional paid-in capital	14.2%	15.8%	18.1%	-
Retained earnings	68.2%	78.6%	86.2%	-
Treasury stock	-12.9%	-20.5%	-31.5%	-
Total Shareholders’ Equity	69.6%	73.9%	72.8%	47.3%
Total Liabilities and Shareholders’ Equity	100.0%	100.0%	100.0%	100%

**Stockholders’ Equity**

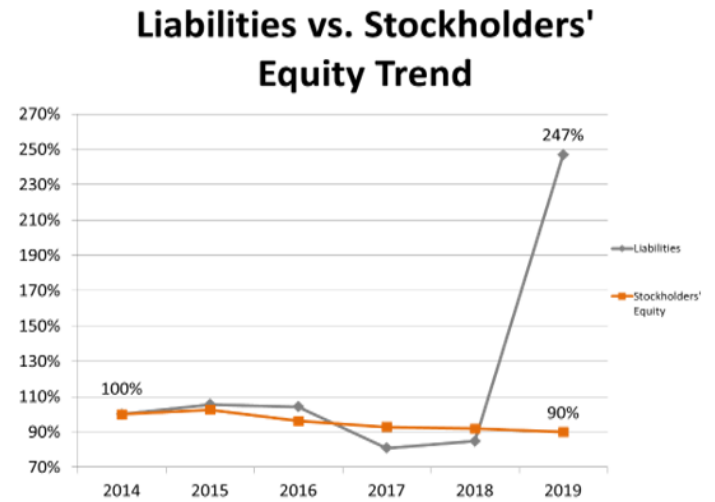
Table 4 is the Stockholders’ Equity portion of the Common Size Balance Sheet. The two largest accounts are Retained Earnings and Treasury Stock. As a percentage of Total Liabilities and Stockholders’ Equity, Total Stockholders’ Equity has decreased since 2017. Shoe Carnival has yet to release its full 2019 results for individual Stockholders’ Equity accounts.

Figure 30 shows the Debt to Equity ratio. This illustrates how a company finances its operations through either debt or equity. Until 2019, Shoe Carnival had a much lower Debt to Equity ratio because of its ability minimize Liabilities by financing with operating leases. The company’s ratio was much lower than Caleres’s and the industry’s from 2016 to 2018.

Shoe Carnival’s Total Stockholders’ Equity has decreased 10% since 2014. The company has been repurchasing common stock in hopes of increasing shareholder value. Figure 31 compares the overall changes of Stockholders’ Equity and Total Liabilities since 2014.

Stockholders’ Equity has decreased since 2014 because of the company’s stock repurchasing plan. Since 2014,

**Figure 31:** Stockholders’ Equity vs. Total Liabilities Trend



Treasury Stock has increased 1761%. The largest increases in Treasury Stock were in 2016 and 2018. Shoe Carnival spent \$42.6 million in 2016 and \$46 million in 2018 on repurchasing stock. Even though Retained Earnings, the largest equity account, has increased 33% since 2014, the Stockholders’ Equity account continues to decrease each year because of treasury stock. Figure 32 shows the large increase in Treasury Stock compared to Retained Earnings since 2014.

**Balance Sheet Summary**

Since 2014, Current Assets have decreased 8% because of the 10% decrease in Merchandise Inventory. Shoe Carnival has been closing underperforming stores, which means the company does not need as much inventory on hand. Property and Equipment has decreased 33% since 2014 due to Shoe Carnival closing 55 stores since 2016. Although a majority of individual asset accounts have been decreasing,

**Figure 32:** Treasury Stock vs. Retained Earnings Trend



Total Assets increased by 50% from 2018 to 2019 as a result of the new lease guidelines from ASC Topic 842. This lease guideline change also created a 191% increase in Total Liabilities from 2018 to 2019. Shoe Carnival's Stockholders' Equity account has decreased 10% since 2014 because of the company's emphasis on repurchasing common stock.

### Statement of Cash Flows

Table 5 presents a summary of the Statement of Cash Flows with all three activities and with the overall change in cash for the years 2015 to 2019. Shoe Carnival generates cash through its daily operations to issue dividends, repurchase common stock, and finance capital expenditures. The company had decreases in cash for 2016, 2017, and 2019.

**Table 5:** Statement of Cash Flows Summary

	2015	2016	2017	2018	2019
Net cash provided by operating activities	58,555	63,789	40,348	74,141	66,946
Net cash used in investing activities	(27,651)	(21,832)	(19,653)	(4,415)	(17,751)
Net cash used in financing activities	(23,466)	(47,827)	(35,385)	(50,959)	(54,317)
Net change in cash	7,438	(5,870)	(14,690)	18,767	(5,122)

### Cash Inflows

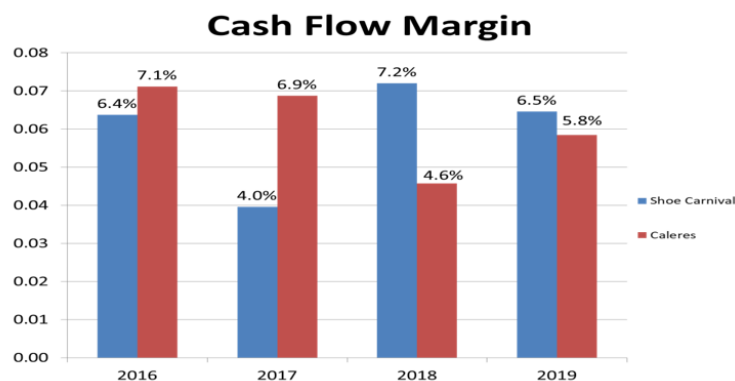
Table 6 summarizes the activities that generate cash for Shoe Carnival by percentages of total inflows. The two main inflows are from operating activities and from borrowings received under Shoe Carnival's credit facility.

Cash Flow Margin (figure 33) is a ratio that demonstrates how well cash is generated from sales. Shoe Carnival's ratio decreased in 2017 and 2019 because of a

**Table 6:** Percentage of Cash Inflows

	2016	2017	2018	2019
Net cash provided by operating activities	99.6%	31.2%	95.9%	76.2%
Borrowings under line of credit	0.0%	68.6%	0.0%	22.8%
Other	0.4%	0.2%	4.1%	1.0%
<b>Total Inflows</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100%</b>

**Figure 33:** Cash Flow Margin Ratio



decrease in cash from operating activities compared to the previous years.

Cash Flows from Operations decreased 37% from 2016 to 2017. This was a result of Net Income decreasing 19% and Shoe Carnival paying \$29.5 million in cash to its suppliers and vendors. The decrease to Net Income was primarily due to \$4.4 million being recorded under Income Tax Expense for remeasuring deferred taxes and also the costs of closing 26 stores in 2017 (SC, Annual Report, 2017). Cash Flows from Operations increased 84% from 2017 to 2018. This came from the reduced corporate tax rate and paying less cash to suppliers and vendors. Since 2014, Cash Flow from Operations has increased 16%, which can be seen in Figure 34.

### Cash Outflows

Table 7 summarizes Shoe Carnival's outflow activities as percentages of total outflows. The company's largest outflows consist of repurchasing common stock, purchasing property and equipment, and paying dividends. Shoe Carnival also made payments on the credit facility in 2017 and 2019.

Since 2014, Shoe Carnival has been repurchasing more common stock. In 2016 and 2018, the company used more than \$40 million in cash for this activity. Figure 35 shows this.

Figure 36 shows how the company is now less focused

**Table 7:** Percentage of Cash Outflows

	2016	2017	2018	2019
Purchase of common stock for treasury	61.0%	20.7%	78.6%	40.6%
Purchases of property and equipment	31.2%	13.7%	12.7%	19.9%
Dividends paid	7.2%	3.3%	8.1%	6.1%
Payments on line of credit	0.0%	61.6%	0.0%	21.5%
Shares surrendered by employees to pay taxes on restricted stock	0.6%	0.7%	0.6%	11.9%
<b>Total Outflows</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100%</b>

Figure 34: Cash Flow from Operations vs. Net Sales Trend

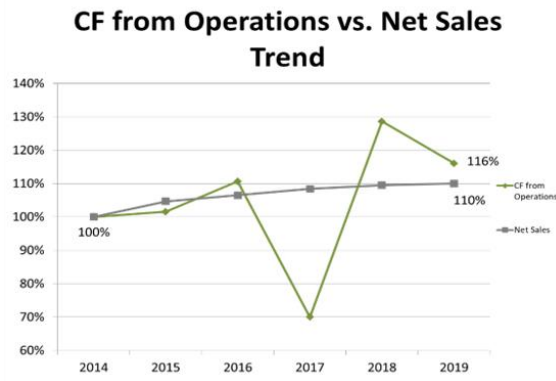


Figure 35: Repurchases of Common Stock

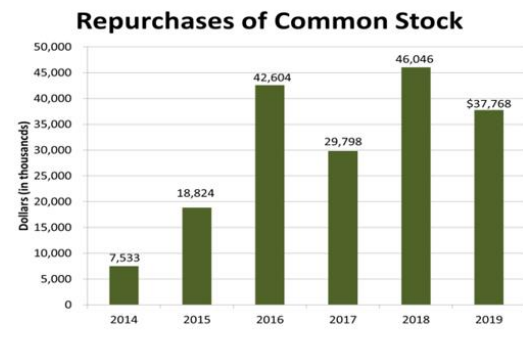


Figure 36: Purchases of Property and Equipment



Figure 37: Cash Dividends



Figure 38: Cash Flow Adequacy Ratio

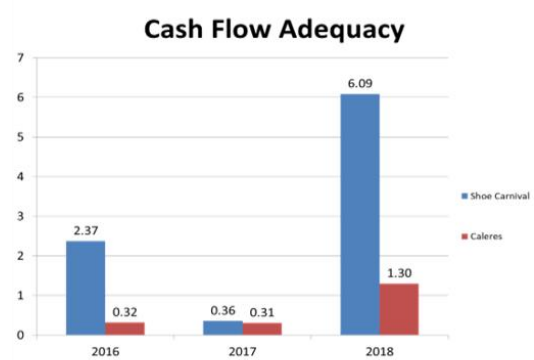


Figure 39: Stock Prices



on physical expansion. From 2014 to 2018, the amount of cash spent on opening, remodeling, and relocating stores has decreased. The amount of cash used in 2019 was expected to be for activities related to the corporate headquarters and remodeling stores (SC, Annual Report, 2018).

Since 2014, Shoe Carnival has paid around \$5 million each year in dividends. One of the requirements for Shoe Carnival to qualify for its current credit facility agreement is that the company cannot distribute more than \$10 million in dividends annually (SC, Annual Report, 2018). Figure 37 measures the total dividends paid each year since 2014.

Figure 38 shows the Cash Flow Adequacy ratio. This ratio measures the ability to pay for capital expenditures, debt, and dividends with cash generated from operations. In 2017, the ratio decreased because Shoe Carnival repaid \$88.6 million of borrowings from its credit facility. These borrowings were used to fund operations and working capital requirements and to purchase merchandise (SC, Annual Report, 2017).

### Summary of Cash Flows

Cash Flow from Operations generates most of the cash for the company. Cash Flow from Operations is used for inventory purchases, capital expenditures, repurchases of common stock, and dividend payments. Capital expenditures used to be the largest cash outflow, but since Shoe Carnival has been closing stores, the company's largest outflow has been repurchasing common stock. When cash generated from operating activities is not enough to pay for outflows, the company borrows from its credit facility.

### Market Activity

Figure 39 shows the stock price growth for Shoe Carnival and Caleres over the last 5 years. As of March 30, 2020, Shoe Carnival's stock price was \$24.25 and Caleres's stock price was \$5.43 (Yahoo, 2019). Due to the recent Coronavirus Pandemic, the two companies have seen a large reduction in stock prices. Shoe Carnival has closed all of its store locations as a result of the pandemic; however, this has not stopped online sales. The company has reported that e-commerce business has grown triple digits since the closures were announced (SC, News Releases, 2020).

From 2017 to 2018, Shoe Carnival's Earnings Per Share increased 181%. From 2018 to 2019, the company's Earnings Per Share increased 18%. These increases were a result of the large increases in Net Income for 2018 and 2019. Caleres had a loss per share in 2018 due to its overall net loss. Shoe Carnival's earnings per share in 2019 was \$2.97. Figure 40 shows Shoe Carnival's and Caleres's earnings per share from 2014 to 2019.

The Dividend Payout ratio, shown in Figure 41, measures the percentage of earnings that are actually received

by investors through dividends. Shoe Carnival's Dividend Payout decreased in 2018 because of the large rise in Earnings Per Share compared to dividends paid per share. In 2017, Shoe Carnival's dividend per share was \$0.23, and Earnings Per Share was \$1.15. In 2018, the company's dividend per share

Figure 40: Earnings per Share



Figure 41: Dividend Payout Ratio

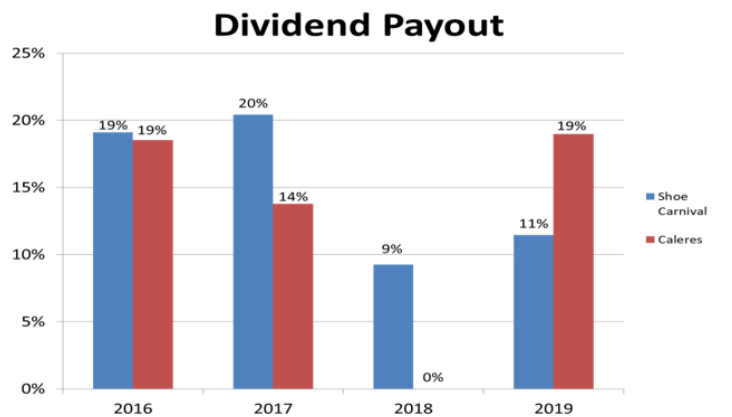
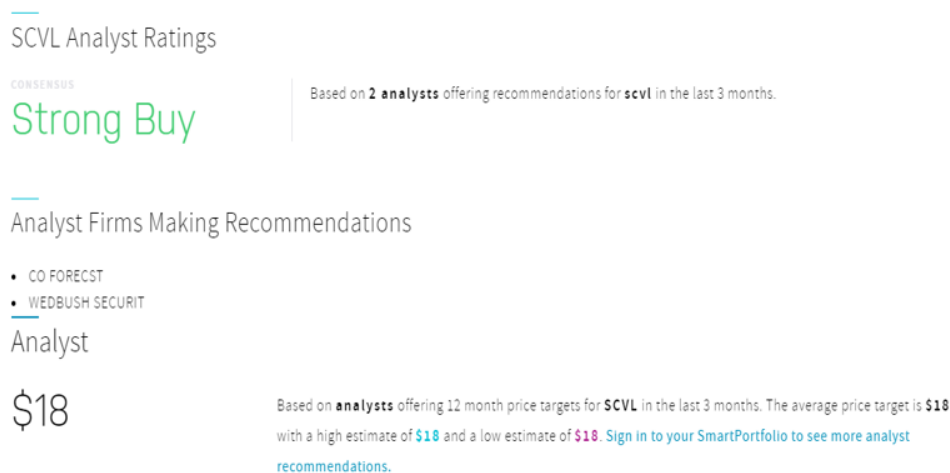


Figure 42: Price-to-Earnings Ratio



**Figure 43:** Analysts Opinions



grew to \$0.32, even though Earnings Per Share increased to \$2.51. Caleres did not have a ratio in 2018 because it experienced a net loss.

Figure 42 is the Price-to-Earnings ratio. Since 2016, the ratio has decreased for Shoe Carnival because the company's Earnings Per Share has been increasing faster than the January or February year-end market price per share.

According to two analysts, Company Forecast and Wedbush Securities, Shoe Carnival is a strong buy (NASDAQ, 2020). These analysts recommend purchasing Shoe Carnival shares because of the company's ability to adapt to customer preferences and its ability to return value to investors (Butler-Young, 2019). Figure 43 presents their opinions.

### Conclusion

Since 2014, Shoe Carnival's Net Income has increased 68%. The main reasons for this are a 10% increase in Net Sales and slowing growth of operating expenses. Also, the corporate tax rate was reduced from 35% to 21%, which became effective in fiscal 2018. Although Shoe Carnival has been closing stores, Total Assets rose 50% and Total Liabilities grew 191% from 2018 to 2019. The Accounting Standards Codification Topic 842 states that companies must present all long-term lease contracts on the balance sheet. Because Shoe Carnival leases all 392 store locations, this standard change led to large increases in Noncurrent Assets and Long-Term Liabilities in 2019.

Since 2014, Stockholders' Equity has decreased 10%, despite Net Income increasing, because of the 1761% increase in Treasury Stock. Cash Flow from Operations generates almost all cash inflows. When general operations will not supply the company with enough cash for outflow activities, the company borrows money from its credit facility. Shoe retail companies, especially smaller retailers, have been struggling

with a lack of customer traffic and with direct consumer interaction from large shoe manufacturers. Shoe Carnival has been implementing its multi-channel strategy to adapt to its customers' demands by collecting online data and generating online sales. Even though Shoe Carnival has been successful in producing financial results with its new strategies, it will continue to face many more challenges in the future.

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# Crime and Punishment... as Well as Rehabilitation and Re-enfranchisement?

## Should States Allow Non-Violent Felony Offenders the Right to Vote?

Tia Braxton, Payton Smith, Melanie Chambers, Natalie Glass, Porter Law, Jaydon Parrish, Elijah Robertson, Jason Timms, Caleb Tyler, Andrew Valbuena, Ben Womack, and John A. Tures, PhD

Faculty Mentor: John A. Tures, PhD  
History and Social Science, Political Science

### Foreword

When we learned about this 2019 opportunity to present before the Georgia Senate Study Committee on Revising Voting Rights for Nonviolent Felony Offenders (SR-153) by Study Committee Chair Randy Robertson, we jumped at the chance to provide the committee with some research on whether or not states should allow non-violent felony offenders the right to vote. Our presentation took place the Senate Study Committee on October 22, 2019 at LaGrange College (with Senators Randy Robertson, Mike Dugan, Burt Jones, Harold Jones, and Michael Rhett) and was also presented at the Georgia Political Science Association (GPSA) in Savannah in November of 2019. This essay constitutes research done since the presentation of our initial findings and new research conducted on the topic in November and December of 2019, which was presented at the Georgia Conference on Undergraduate Research (GUR) at the Georgia Capitol in February of 2020. The authors would like to thank the Undergraduate Research Committee, as well as the Senate Study Committee, GPSA, and GUR.

### Literature Review

#### The Origins of Felony Disenfranchisement

“Civil death” is not a new idea. The origins of such a policy go back to Greek and Roman civilizations, where those who were guilty of certain infractions could not participate in leadership selection, court cases, or even military service (Hull 2006, 16). This was supported by philosophers such as Aristotle, who felt that certain crimes reflected a breach of the “social contract” (Padraic Hamilton-Smith and Vogel 2012, 411). Such policies persisted through English Common Law policies. Hull (2006, 16) contends that such citizens not only suffered a loss of civil rights upon conviction, but also forfeited all holdings and became unable to inherit anything. As with the Greeks and Romans, such thinking was influenced by the philosophers of the day; for example, Thomas Hobbes and John Locke contended that criminals did not deserve citizenship because their actions had violated the bond between citizens and the state (Padraic Hamilton-Smith and Vogel 2012, 411-412).

The English practice was exported to the United States via colonial law. Yet it is significant to note that the United States’ Founding Fathers did not incorporate such language into its Constitution or national law.<sup>1</sup> Such matters, like most

electoral politics, were left to the states and their legislatures (Padraic Hamilton-Smith and Vogel 2012, 407). Even then, only a third chose to keep disenfranchisement for felony crimes around early in American history. Perhaps they were influenced by philosophers such as John Stuart Mill, who (in *Considerations on Representative Government*) argued “Whoever, in an otherwise popular government, has no vote, and no prospect of obtaining it, will either be a permanent malcontent, or will feel as one whom the general affairs of society do not concern, for whom they are to be managed by others, who has “no business with the laws except to obey them” (Brenner and Caste 2003).

After the Civil War, that number of states adopting such severe penalties had jumped to 75% (Hull 2006, 22). Judge Henry Wingate, ruling in a federal case in the 1950s, felt that civil death was “the harshest civil sanction imposed by civil society. When brought beneath the axe, the disenfranchised is severed from the body politic and condemned to the lowest form of citizenship” (Hull 2006, 5). Despite liberalizing attitudes toward prisoners in the 1950s and 1960s, the return to “law and order” policies returned.

As a result, today “The US prison population continues to rise despite the significant decrease in crime rates” (Mayba 2015). In response to the recent reformers who would do away

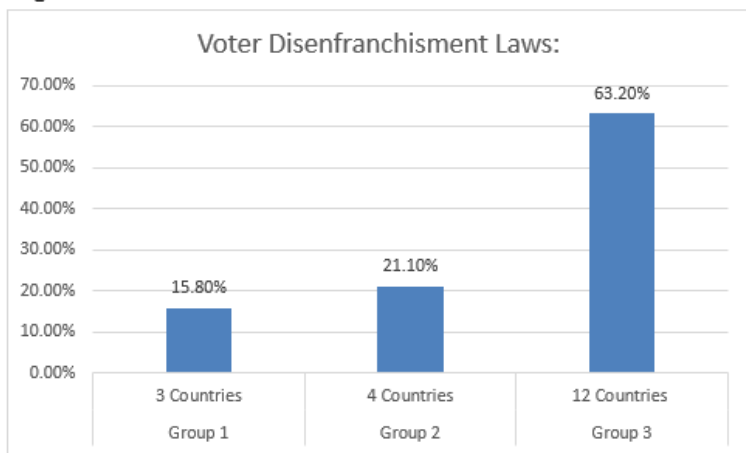
with felony disenfranchisement, Alabama Senator Jeff Sessions, a Republican, argued that to do so would go against America's democratic origins. He pointed to the presence of such a policy since the founding of the United States (Manza and Uggen 2008).

### What Other Democracies Are Doing

Despite the origins of civil death being connected to Greek, Roman, and English civilization, the United States is considered unique among democracies for taking the vote away from ex-felons (Chiricos et al. 2012). Other democratic countries find America's felony disenfranchisement to be unfair and too harsh a penalty (Hull 2006, 9; Heath 2017). Some other democratic countries even allow the incarcerated to vote (Paikowsky 2019).

In a survey of nearly 20 democracies (BBC 2012), three countries (Australia, New Zealand, Taiwan) strictly enforce disenfranchisement laws, coming to 15.8 percent. There were four countries (U.K. Italy, France Netherlands) that have partial voting disenfranchisement (21.1 percent of the total), and twelve countries (Ireland, Germany, Croatia, Czech Republic, Denmark, Finland, Latvia, Lithuania, Montenegro, Spain, Switzerland, Canada) that enforce no voting disenfranchisement, or 63.2 percent of our survey (Figure 1).

Figure 1.



### Theories and Hypotheses

#### Crime Factors

The first set of potential independent variables that could impact whether states adopt civil death for ex-felons are crime-based. The general argument here is that this is a law enforcement issue, and thus has more to do with stopping crime or serving as a powerful deterrent to bad behavior. The sheer volume of felons in a state could influence how its citizens feel about them. The number affected is quite staggering. "To grasp how many 'fellow citizens' are unable to vote because of a felony conviction, imagine this. If all of them congregated in a single geographical area, it would become the nation's second largest city, right behind New York. It would be larger than Los Angeles or Chicago. If those deprived of their suffrage

lived in a single state, it would be the country's twenty-sixth most populous—right after Kentucky, right before South Carolina" (Hull 2006, 1).

Such a large number of ex-felons in general would be enough to scare people in a state. The prospects of these numbers of former felons voting might induce voters to support measures to take away their right to vote, hoping that the threat of such a sanction might induce better behavior among the members of the community. In a Hill-HarrisX poll, Sheffield (2019) claims that most respondents in polls are opposed to having criminals vote, though Holtfreter et al. (2008) finds that different attitudes toward criminals depend upon the type of arrest.

But not all who view the felony disenfranchisement issue from a crime-based perspective favor taking those rights away. Gerber et al. (2017) find that those affected by the criminal justice system have a decrease in trust in the government. That's why Shineman (2018) claims that one of the benefits of Virginia restoring voting rights could be restoring that trust in ex-felons, as well as possibly lowering the crime rate.<sup>ii</sup> In their focus on the Vermont case, White and Nguyen (2019) note that the state, which allows prisoners to vote from jail, has a low crime rate, and a small prison population as well.

One of the reasons given for this potential connection between a lower crime rate and rehabilitative efforts is the attempt to reduce recidivism, or repeat offenses. Van Den Haag (1982) takes a cynical view of such a connection, claiming that "although recidivists, including career criminals, undoubtedly commit a disproportionate number of many crimes, they do not commit most crimes in most categories... Total rehabilitation would make only a modest dent in the crime rate." But Kirby (2009) contends that rehabilitation helps not only the criminal but also the quality of the community. And Frazier (2011) finds in Florida that the recidivism rate for ex-felons who did not get their voting rights back was 33%. That percentage of repeat offenders fell to 11% among those who had their voting rights restored (Frazier 2011).

Another law enforcement subject connected to civil death is the potential for voting fraud. Kiefer (2019) claims that voting fraud, in fact, is used as a threat to take away political rights for former felons. DeLoretto-Chudy (2018) states that most ex-felons fear voting because they think that their rights have been taken away and that voting would be considered illegal and another felony on their record.

Other factors are linked to law enforcement explanations for curtailing voting rights. Miller and Spillane (2012) find that criminal background checks are conducted when someone wants to reestablish their voting rights. Purnell (2013) focuses on the impact of ex-felon disenfranchisement and the conduct of criminal background checks on subjects such as housing.

Even political corruption has its connection to the democratic process. Part of this is the link between corruption and crime (Ferguson 2012, 24; Interpol 2019; UNODC 2019). Kostadinova (2009) finds that the perception of corruption is enough to erode faith in participation in the political process. Though most of her cases are beyond U.S. borders, Berry (2016) reveals that there is criminality in the absentee voting process, as gatherers collude with local election officials, something that affected a North Carolina congressional race in 2018 (Caldwell and Gardella 2018).

### Political Factors

A second set of factors contends that felony disenfranchisement is not about crime, but rather about politics. Here, politicians have used civil death for an electoral advantage, for ideological purposes, to depress turnout for rivals, and maybe even to appeal to voters based on religion. There is less of an emphasis on rehabilitation, recidivism, or even retaliation against a person for committing a serious crime. It's about winning contests at the ballot box.

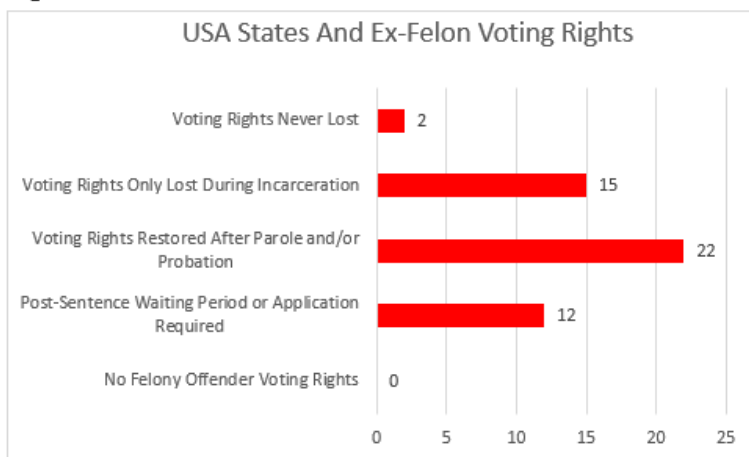
On December 20, 2019, the Associated Press broke the story that Trump reelection adviser Justin Clark admitted that voter suppression was a Republican tactic (Bauer 2019). "Traditionally, it's always been Republicans suppressing votes in place," Trump's adviser stated. The recording of Clark speaking at the Republican National Lawyers Association's Wisconsin chapter, in front of many leading members of the state's GOP, was obtained by a liberal group (Bauer 2019).

Just as the GOP has wrapped itself in keeping people away from the ballot box, Democrats have awoken to ending civil death. Vermont Senator Bernie Sanders has aggressively targeted felon disenfranchisement in his 2020 campaign (Sheffield 2019). It's not hard to see why. An examination of the Florida election shows that had the state voters passed Amendment 4 in 2016, Democratic Party Senator Bill Nelson would have won reelection in 2018 instead of suffering a loss by the narrowest of margins (Grant 2019). The party's nominee for governor, Andrew Gillum, might have even been Florida's first African-American governor (Grant 2019).

Such arguments aren't limited to the era of Trump. As Manza and Uggen (2008) contend, felony disenfranchisement helped elect GOP candidate George W. Bush in 2000. Democratic state legislator Daryl Jones told the story of Republican lawmakers changing the policy of having those guilty of cashing two welfare checks illegally moved from 365 to 366 days, so it could be considered a felony by state law, taking the vote away from even more voters (Hull 2006, 6). And Ghosh and Rockey (2019) reveal that more African Americans would be elected to the House of Representatives if felony disenfranchisement were ended.

The issue is more than just a battle of political parties. It's got an ideological component as well. Poama and Theuns (2019) point out that "expressive disenfranchisement" has been employed, an argument that feels that felony

Figure 2.



disenfranchisement is justified because it is the will of the voters, expressed in democratic fashion. And the Heritage Foundation argues that felony disenfranchisement "hurts blacks" because ex-felons may vote against stronger law enforcement that would protect the community (Hull 2006, 28). And many states that adopt such laws are Southern states (Uggen et al. 2003; Webster, 2007; Bryant and de la Cruz 2016), which tend to be more conservative. And Ghosh and Rockey (2019) contend that more relaxed felony disenfranchisement can also lead to more state policy liberalism.

But perhaps the issue isn't painted in partisan or ideological colors. Zeitlin (2018) claims that ex-felons don't always necessarily vote for one political party; even though African-Americans make up a disproportionate number of former felons, whites make up the biggest bloc of this group. And Mayba (2015, 54) points out that while the "tough on crime" movement was bipartisan, the criminal justice reform movement has also been bipartisan (Mayba 2015, 68).

Hull (2006) also finds that liberal and conservative states have reestablished voting rights. And Beauchamp (2013) reveals that although Southern states are more likely to target African-Americans, this may be changing, as Alabama passed House Bill 282 to reform which crimes are listed as felonies, leading to the reenfranchisement of many ex-felons previously barred from voting (Beauchamp 2013). Beauchamp (2013) speculates that Georgia might be next, and with the State Senate Study Committee meeting to examine restoring voting rights to nonviolent felony offenders, he may be right.

### Research Design

#### The Dependent Variable: Felony Disenfranchisement Data

To determine which states deprive ex-felons of the right to vote, we gathered data from the National Conference on State Legislatures (2018). We discovered that two states (Maine and Vermont) allow even felons to vote in prison. NCSL data (2018) also reveals that another 15 states allow former felons to vote immediately upon release. Another 22

states allow felons to vote only after parole and/or probation. The remaining states require parole, a probationary period (often the duration of the original sentence, not the reduced time served), and a special application to a higher institution, one that seems rarely likely to succeed (Figure 2).

## Independent Variables

### *Measuring Crime-Based Factors*

For this data on felons as a percentage of each state, we gathered our cases from the Sentencing Project (2019). Our categories for this variable are as such: 0-1.99%, 2-3.99%, 4-5.99%, 6-7.99%, 8-9.99% and 10%+. Our crime rate data come from the FBI's data (2018) on state crime rates. We compare the states located in the top half of 2018 state crime rates with those making up the bottom half, i.e., those with lower crime rates.

The data on recidivism was retrieved from Prison Policy Initiative's 2018-2019 annual report (2019). Data was available for only 34 states, thanks to missing data and inconsistent reporting for the most contemporary cases. We compared the top half of states for recidivism to the bottom-half of states for repeat offenders. Data on voter fraud came from the Heritage Foundation's (2018) list of cases per state. We divided the cases by the population, comparing the states in the top 25 for voting fraud to those bottom 25 states for voting fraud episodes.

Data on state corruption came from Enten (2015). He ranks the states from 1-50 on the number of public officials convicted of corruption, with 1 being the most corrupt and 50 being the least corrupt, and similarly ranks states on a corruption per capita basis. Enten's (2015) data also rank states from 1-50 based upon the "State Integrity Investigation" site, which rated each state's anti-corruption laws with journalist rankings. A similar measure of reporter assessments covers how well such laws are enforced.

Our information on background checks by state came from Scott (2019). The Federal Fair Credit Reporting Act (FCRA) may require background checks, but as Scott writes, "According to the FCRA, felony convictions can be reported on background checks for seven years after being released from prison.... However, several states have legislated restrictions for how long in the past background check information can be referenced and recorded into background check final reports. No criminal convictions older than seven years can be looked at." We compare these states that have limited background checks to those that follow the longer FCRA background checks.

### *Measuring Politics-Based Factors*

For political factors, we look at how the states voted in the 2016 election, with data on Trump's voter percentage coming from CNN (2016). We look at the top 50% of states that voted for the Republican candidate in 2016, and we

compare them to bottom 50% of states that gave Trump the least support in their vote percentage.

In studying how states voted over the last five elections, we looked at the U.S. Election Project (McDonald 2019). We compared states that voted for Republicans all five times to those that voted for the Democratic Party all five times and to a middle category for those states that split their votes in the Electoral College.

A state's ideology comes from the Gallup Polling (2018). We compare states where the modal category in ideology is conservative, states where the most responses were "moderate," as well as states which have "liberal" as the category with the most responses.

Information on voting barriers has been made available by the Brennan Center (2018). States that passed voting restrictions from 2010 to 2018 are compared with states that did not. We found data on the cases of state voter turnout at the United States Elections Project (McDonald 2019) and Ballotpedia (2019). States in the top half of voting turnout in 2018 are compared to those with lower voting percentages in a binary measure.

Data on religious beliefs per state come from the Pew Research Center (Lipka and Wormald 2016). As with several other measures, we look at differences among the states, comparing the most religious (top 50% of states) to the least religious (bottom 50% of states). Data on race and ethnicity came from the U.S. Census Bureau (2018), which is the total population minus the non-Latino white population, with all states above the median scoring a one and those below receiving a zero.

## Statistical Findings

### **Crime-Based Factors**

#### *State Percentage of Felons:*

The results of a  $\chi^2$  test (Table 1) reveal that the percentage of felons in a state is related to whether or not ex-felons are granted voting rights. States with felons that make up less than two percent of the population are more likely than expected to let them vote in prison or immediately upon release and are less likely than expected to make the former felon have to go through parole, probation, and extra restoration, (if such rights are granted at all). The more felons there are in the state, the more restrictive ex-felon voting rights get. The findings are statistically significant at the .05 level.

#### *Crime Rate:*

Our  $\chi^2$  test on ex-felon voting rights and a state's crime rate also show a degree of association (Table 2). For those who feel that restricting a former felon's voting rights will somehow reduce crime will be surprised to learn that the opposite result occurs. States that re-enfranchise ex-felons are more likely than expected to have a below-average crime rate.

Table 1.

FelonsByState \* FelonVoteBinary Crosstabulation

FelonsByState		Count	FelonVoteBinary		Total
			Can Vote in Prison or After It	Can Vote in Probation/Parole or Restoration	
0%-1.99%	Count		17	16	33
	Expected Count		22.4	10.6	33.0
2%-3.99%	Count		8	0	8
	Expected Count		5.4	2.6	8.0
4%-5.99%	Count		2	0	2
	Expected Count		1.4	.6	2.0
6%-7.99%	Count		5	0	5
	Expected Count		3.4	1.6	5.0
8%-9.99%	Count		1	0	1
	Expected Count		.7	.3	1.0
10%+	Count		1	0	1
	Expected Count		.7	.3	1.0
Total	Count		34	16	50
	Expected Count		34.0	16.0	50.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.121 <sup>a</sup>	5	.033
Likelihood Ratio	16.970	5	.005
Linear-by-Linear Association	7.856	1	.005
N of Valid Cases	50		

a. 9 cells (75.0%) have expected count less than 5. The minimum expected count is .32.

Table 2.

BinaryCrimeRate \* FelonVoteBinary Crosstabulation

BinaryCrimeRate		Count	FelonVoteBinary		Total
			Can Vote in Prison or After It	Can Vote in Probation/Parole or Restoration	
Below Average Crime Rate	Count		13	13	26
	Expected Count		17.3	8.7	26.0
Above Average Crime Rate	Count		21	4	25
	Expected Count		16.7	8.3	25.0
Total	Count		34	17	51
	Expected Count		34.0	17.0	51.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.630 <sup>a</sup>	1	.010		
Continuity Correction <sup>b</sup>	5.188	1	.023		
Likelihood Ratio	6.897	1	.009		
Fisher's Exact Test				.017	.011
Linear-by-Linear Association	6.500	1	.011		
N of Valid Cases	51				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.33.

b. Computed only for a 2x2 table

Those states that make it harder for felons to vote upon release from prison are more likely, on average, to have a higher crime rate. The results are statistically significant at the .05 rate.

*Other Crime-Based Factors:*

None of the other crime-based factors we examined displayed a statistically significant result. Variables for voting barriers, background checks, and corruption differed little in their observations from the expected models. Places that are tougher on ex-felons getting the vote back had slightly lower recidivism rates on average, though the results were statistically insignificant (even at the .10 level), and data was available for only two-thirds of all states. States with a below average number of vote fraud cases per capita were more likely to reestablish voting rights for ex-felons, but the chi-square statistic just missed statistical significance at the .10 level.

**Politics-Based Factors**

*Trump Vote:*

Among the states in the top half of those that gave their votes for Donald Trump, there is a connection to a state's policy toward civil death. In particular, states that had more Trump voters were more likely to have punitive sanctions against ex-felons in the form of taking away their vote, or making it harder to get the vote back. States that had fewer

votes for Trump were more likely to return those right to ex-felons. The results of the chi-square statistic were statistically significant at the .01 level (Table 3).

*Voting Patterns over the Last Five Elections:*

The trend linking Republicans to tougher sanctions against ex-felons has persisted for years, according to these findings. Red states (who voted for the GOP over the last five elections) were more likely than expected to restrict the return of voting rights, while blue states (who voted for the Democratic Party in the last five elections) were more likely to get those rights back to those who have served their time in prison for a felony. The results were statistically significant at the .05 (Table 4).

*State Ideology:*

The political trends of restricting or restoring voting rights go beyond political party support and extend to ideology. In particular, we observed that conservative states were far more likely than expected to make it harder for ex-felons to vote again, while states with more liberal citizens were more likely to allow prison voting or immediate post-prison voting. The chi-square statistic of 6.252 is also statistically significant at the .05 level (Table 5).

Table 3.

**BinaryTrumpVote \* FelonVoteBinary Crosstabulation**

		FelonVoteBinary		Total	
					Has to Serve Probation or Parole, And Some Post-Probation/Parole Restoration
BinaryTrumpVote	Below Average Trump Vote	Count	13	13	26
		Expected Count	17.3	8.7	26.0
	Above Average Trump Vote	Count	21	4	25
		Expected Count	16.7	8.3	25.0
Total		Count	34	17	51
		Expected Count	34.0	17.0	51.0

Table 4.

**VotingPatterns5 \* FelonVoteBinary Crosstabulation**

		FelonVoteBinary		Total	
					Has to Serve Probation or Parole, And Some Post-Probation/Parole Restoration
VotingPatterns5	Blue State: Voted Dem All 5 Elections	Count	7	9	16
		Expected Count	10.7	5.3	16.0
	Purple State (Mixed In Last 5 Elections)	Count	8	5	13
		Expected Count	8.7	4.3	13.0
	Red State: Voted GOP All 5 Elections	Count	19	3	22
		Expected Count	14.7	7.3	22.0
Total		Count	34	17	51
		Expected Count	34.0	17.0	51.0

**Chi-Square Tests**

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.630 <sup>a</sup>	1	.010		
Continuity Correction <sup>b</sup>	5.188	1	.023		
Likelihood Ratio	6.897	1	.009		
Fisher's Exact Test				.017	.011
Linear-by-Linear Association	6.500	1	.011		
N of Valid Cases	51				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.33.  
b. Computed only for a 2x2 table

**Chi-Square Tests**

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.776 <sup>a</sup>	2	.020
Likelihood Ratio	8.146	2	.017
Linear-by-Linear Association	7.571	1	.006
N of Valid Cases	51		

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.33.

*State Religious Percentage*

These trends of Republicans and conservatives favoring tougher policies toward felons, even after prison, persist for people who consider themselves religious. States that are in the top half of states for percentage of residents who are religious are more likely to make former felons jump through a lot of hoops before restoring voting rights, if at all. It is another story for those states where fewer folks declare themselves to be religious; these states seem to favor more redemptive policies to ex-felons, keeping or quickly restoring the right to vote. The findings are statistically significant at the .05 level (Table 6).

*State Minority Percentage*

When it comes to felony disenfranchisement, no factor is more controversial than the subject of race. Critics of civil death contend that minorities in general, and blacks in particular, have been disproportionately targeted by policies that hit ex-felons with a loss of voting rights. Supporters point out that whites still make up the largest faction, and criminals are not being picked on because of their race.

Our results (Table 7) show that in fact, states with a higher percentage of minorities are in fact more likely to keep ex-felons away from the ballot box than an expected model would project. Those states with a below-median percentage of minorities are actually more likely to allow ex-felons to vote in prison or immediately upon release. The chi-square

statistic from this measure is significant at the .05 level. (Actually, it is closer to .01.)

*Other Politics-Based Factors:*

Though most political-based factors influence where voting rights are restored for former felons, that was not the case for either voting turnout measure, both for the 2018 mid-term election voting rates as well as for additional voting barriers. Neither measure had observations that significantly differed from expectations.

**Conclusion**

One might suspect that a law enforcement solution might be driven by a crime problem. Depriving an ex-felon of the vote would be conducted as a means of keeping the peace. As philosophers from Aristotle to Hobbes and Locke have reasoned, a serious crime would be a breach of the social contract and would require what an American judge would consider the most severe of sanctions. But the civil death penalty does not seem to have lowered crime rates; in fact, states that are quick to restore voting rights to former felons

Table 5. ConservativeStateLevel \* FelonVoteBinary Crosstabulation

		FelonVoteBinary			
		Felon Offender			
		Has to Serve			
		Probation or Parole, And			
		Some Post-Probation/Parole			
		Restoration	Can Vote in		Total
			Prison or After It		
ConservativeStateLevel	Liberal State	Count	7	7	14
		Expected Count	9.5	4.5	14.0
	Moderate State	Count	8	6	14
		Expected Count	9.5	4.5	14.0
	Conservative State	Count	19	3	22
		Expected Count	15.0	7.0	22.0
Total		Count	34	16	50
		Expected Count	34.0	16.0	50.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.252 <sup>a</sup>	2	.044
Likelihood Ratio	6.632	2	.036
Linear-by-Linear Association	5.582	1	.018
N of Valid Cases	50		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 4.48.

Table 7. BinaryMinorityPct \* FelonVoteBinary Crosstabulation

		FelonVoteBinary			
		Felon Offender			
		Has to Serve			
		Probation or Parole, And			
		Some Post-Probation/Parole			
		Restoration	Can Vote in		Total
			Prison or After It		
BinaryMinorityPct	Below Median Minority Pct	Count	13	12	25
		Expected Count	17.0	8.0	25.0
	Above Median Minority Pct	Count	21	4	25
		Expected Count	17.0	8.0	25.0
Total		Count	34	16	50
		Expected Count	34.0	16.0	50.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.882 <sup>a</sup>	1	.015		
Continuity Correction <sup>b</sup>	4.504	1	.034		
Likelihood Ratio	6.086	1	.014		
Fisher's Exact Test				.032	.016
Linear-by-Linear Association	5.765	1	.016		
N of Valid Cases	50				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.00.  
b. Computed only for a 2x2 table

Table 6. BinaryReligious \* FelonVoteBinary Crosstabulation

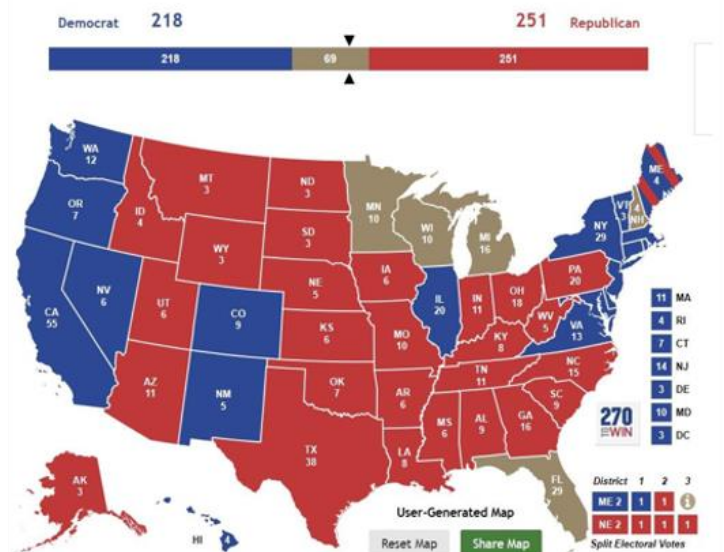
		FelonVoteBinary			
		Felon Offender			
		Has to Serve			
		Probation or Parole, And			
		Some Post-Probation/Parole			
		Restoration	Can Vote in		Total
			Prison or After It		
BinaryReligious	Below Average Religious	Count	16	14	30
		Expected Count	20.0	10.0	30.0
	Above Average Religious	Count	18	3	21
		Expected Count	14.0	7.0	21.0
Total		Count	34	17	51
		Expected Count	34.0	17.0	51.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.829 <sup>a</sup>	1	.016		
Continuity Correction <sup>b</sup>	4.462	1	.035		
Likelihood Ratio	6.244	1	.012		
Fisher's Exact Test				.019	.016
Linear-by-Linear Association	5.714	1	.017		
N of Valid Cases	51				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.00.  
b. Computed only for a 2x2 table

Figure 3.



have a smaller percentage of felons and lower crime rates. Punitive sanctions against one's vote after a severe crime does not seem to have led to lower voting fraud or corruption, and even the findings on recidivism are mixed at best.

However, we have seen that voter disenfranchisement has been a political tool. And taking the right to vote away from ex-felons is strongly supported by states that (a) gave more votes to Donald Trump, (b) consistently vote for GOP candidates, and (c) have a conservative ideology. Moreover,

we have found that states with a higher percentage of those who identify themselves as religious are more likely to support punitive measures against former felons than embrace the redemptive side of their belief system in a higher power that ironically offers both justice and mercy. These factors to determine disenfranchisement were stronger than even voting turnout and the presence or absence of other voting barriers.

The rationale becomes quite clear when we look at the results of the 2016 election. Critics may claim that there are

few ex-felon voters, and their numbers wouldn't be enough to make a difference. But our research shows that the percentage of felons in each state could have changed the voting outcomes of Minnesota, Wisconsin, Michigan, Florida, and New Hampshire (Politico 2019). Putting these states in play (and their 69 Electoral College votes) would have reduced Donald Trump's lead over Hillary Clinton to 251-218, putting the entire election "in play" based upon how those ex-felons voted (270toWin.com 2019; Figure 3). And if they had strongly voted for the Democratic Party, then it would have altered the outcome of the 2016 election.

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<sup>i</sup> Only the harshest of penalties ("corruption of the blood") were kept, and for matters involving high treason (Hull 2016, 17).

<sup>ii</sup> Such progressive views as part of rehabilitation could not only depress the crime rate, but also save the taxpayers money (Dawson-Edwards 2008). Scholars have claimed that lower crime rates can help not only potential victims, but taxpayers as well (Cocklin 1977).

# The Dismantling of Democracy by Elected Representatives: Destroying Direct Democracy One Citizen Initiative at a Time

Payton Smith

Faculty Mentor: John A. Tures, PhD

History and Social Science, Political Science

## Introduction

One of the finest and most explicit forms of democracy in the United States is the citizen initiative. Through this process, residents have a direct voice in policymaking. Everyday citizens have the ability to gather petitions, bring an original idea forward to the ballot, and possibly vote this objective into legislation. Through ballot initiatives, the common man or woman can bypass politicians and legislatures to put forth their own law, or so it may seem. Lawmakers are shutting down these acts of legislative participation and stripping Americans of one of the purest forms of direct democracy. Legislatures rationalize this behavior with the claim that they know what is best for their uninformed electors, when in reality they are blatantly going against the expressed wants and needs of their constituents. In this research, I evaluate these injustices, why they are happening, when they are happening, where they are happening, and what party is making them happen. Ultimately, I look to propose an answer to fight these acts against democracy.

This is not a procedure for which one political party can be held responsible. Through my findings, I determined that legislatures of the Democratic Party and legislatures of the Republican Party are guilty of walking back these ballot initiatives. Overturned citizen initiatives can be found in states that have recently voted primarily for the Democratic Party and states that have recently voted primarily for the Republican Party. This is not a case of one political party against the other, but rather an instance of elected representatives directly pushing back against their electors. I discovered that out of the 22 states that allow citizen-initiated statutes, only 6 have not repealed or altered a statute between the years of 2008 and 2019. This means that 72.73% of state legislatures exercised their ability to annul or alter laws passed by the majority of their constituents. I was also able to detect that initiatives regarding elections comprised was one of the categories that endured the most repeals or alterations by lawmakers. Alarming, my research also made it apparent that there has been a recent spike in legislatures putting to use their abilities to overturn direct democracy. I discovered that 70% of the retractions or modifications of citizen initiatives occurred

within the last four years. These pushbacks of democracy are on an upward trajectory.

There has been a limited quantity of scholarly research around this topic of initiatives. Nearly all sources of the subject matter come from reporting and journalism. This lack of investigation motivated me even more to tackle this paradox. I was propelled into exploring the topic further and expanding the knowledge around legislatures' infringement upon citizens' democratic practices. I hope to minister to the scarcity of research by delving into what is going on, why it is happening, and how to combat this repression of democracy. I hope that my research may be a catalyst for further research and exploration.

## Literature Review

A debate that is as old as the Founding Fathers themselves has been circulating through our nation. Where does the power in the United States of America lie: with the people or their elected officials? Not all states give their residents a form of direct democracy, and those that do find ways to compromise this right. In one of the most famous speeches in American history, "The Gettysburg Address," President Abraham Lincoln states, "Government of the people, by the people, for the people, shall not perish from the earth." Are legislatures depriving our nation of a government that is both by the people and for them?

## Direct Democracy in the United States

Direct democracy is a valuable tool for citizens to use in the legislative process. In their book *Direct Democracy in the United States: Petitioners As a Reflection of Society*, Shauna Reilly and Ryan M. Yonk (2012) describe direct democracy as "the set of procedures that allow individuals and groups the opportunity to put policy decisions in the hands of voters and provide an alternative to the regular procedures through which elected representatives make decisions about policy." Citizens can exercise direct democracy through ballot initiatives and referendums. The 2014 book, *The Initiative: Citizen Law-making*, by Joseph Francis Zimmerman, describes initiatives as "a petition process allowing voters to place one or more propositions on the ballot by collecting a specified



so that they would receive the same minimum wage as non-tipped employees by 2026 (Ballotpedia, “Washington, D.C., Initiative 77, Minimum Wage Increase for Tipped Workers”). A “yes” vote was a vote in favor of increasing the minimum wage for tipped employees to match the city's standard minimum wage by 2026. A “no” vote was a vote against increasing the minimum wage for tipped employees to match the city's standard minimum wage by 2026. City Council members quickly repealed the legislation that the citizens had proposed and passed: “It took about 45,000 Washington, D.C., voters to pass a ballot initiative this June raising the minimum wage for tipped workers. It took only eight city council members out of 13 to begin the process of repealing it only a few months later” (Holder 2018).

In addition to these examples, there have been several different instances when lawmakers have struck down initiated statutes, amendments, and referendums created and passed by the people. These are evident illustrations of lawmakers defying the expressed wants of the majority of their constituents: “Despite the effort of citizens, lawmakers can use their power to limit, block, or reserve the votes, both preemptively and after the fact” (Ballotpedia, “Initiative and Referendum”). In order to challenge these legislatures that are hindering Americans’ from practicing direct democracy it is vital to learn more. To identify how, when, and why these voters’ legislative efforts are being walked back, I will be conducting several analytical tests to get to the root of this dispute.

### **Analytical Model**

#### **Developing a Theory**

To begin my exploration, my analytical model will generate the foundation of my tests. In his book *Essentials of Political Research*, Alan D. Monroe states that “Science starts and ends with theories.” A theory is expressed as “a set of empirical generalizations about a topic” (Monroe 2000, 17). For this study, my theory is that citizen initiatives are likely to be repealed by lawmakers in order to protect their legislative power within the state. In order to fully delve into this idea, I will need to evaluate my theory.

#### **Testable Hypotheses**

A hypothesis is an “empirical statement derived from a theory” (Monroe 2000, 18). Continuing, hypotheses consist of variables. A variable is defined as “an empirical property that can take on two or more different values” (Monroe 2000, 18). A hypothesis is complete with an independent variable and a dependent variable; “Independent variables are those presumed in the theory underlying the hypothesis to be the cause, and dependent variables are the effects or consequences” (Monroe 2000, 20). From my overarching theory and hypotheses, I hope to answer three distinct questions about this phenomenon.

My first question is: *Is the alteration of citizen initiatives a partisan issue?* I want to determine if one political party is responsible for these repeals. The Democratic Party is more likely to favor government solutions and might not be in favor of citizens bringing forth their own statutes: “The current Democratic Party was shaped by the Great Depression and the New Deal.... The Democrats, as exemplified in the New Deal, generally take the view that the state has an active and significant role to play in securing the good of the people” (LaBossiere). Is this active role within the government described in the views of the Democratic Party leading to the appeals of these citizen initiatives? The Republican Party often favors representative government. The GOP tends to oppose direct democracy, by backing institutions such as the Electoral College instead of the popular vote: “Currently, only 19% of Republicans and Republican-leaning independents favor basing the winner on the popular vote” (Swift 2016). Does this disconnect between these forms of direct democracy and the Republican Party lead to these ballot initiatives being walked back?

In order to investigate this question, I have three hypotheses. To begin this search, I first wanted to see if one political party favored direct democracy more than the other. So, Hypothesis #1 is this: States that allow citizen initiatives are more likely to be favoring the Democratic Party. The independent variable is the presence or absence of citizen initiatives and the dependent variable is whether or not the state primarily voted for the Democratic Party in the last three general elections. To specify my question further and focus in on one type of citizen initiative, I want to look at states that allow their citizens to bring forth new laws in the form of initiated statutes. From this I arrive at Hypothesis #2: States that allow citizens to bring forth initiated statutes to the ballot are more likely to favor the Democratic Party. The independent variable is the presence or absence of initiated statutes, and the dependent variable is whether or not the state primarily voted for the Democratic Party in the last three general elections.

On the other end of this scenario, I want to see if there is a certain political party that is repealing these initiated statutes that constituents are putting on the ballot. This would bring me to Hypothesis #3: States that repeal or alter citizen initiatives are more likely to be associated with the Democratic Party. The independent variable is the presence or absence of a repealed or altered initiated statute between the years of 2008-2019, and the dependent variable is whether or not the state primarily voted for the Democratic Party in the last three general elections. Lastly, Hypothesis #4: State legislatures that repeal or alter citizen initiatives are more likely to be controlled by the Republican Party. The independent variable is the presence or absence of a repealed or altered initiative, and the dependent variable is whether or not the Republican Party was in control of the state legislature at the time of the repeal or alteration. Each hypothesis expresses a positive relationship between the variables.

My second question is this: *Are legislatures more inclined to walk back citizen initiatives that involve political participation?* Are the legislatures repealing these initiatives out of their own interest? I want to determine if initiatives regarding elections are the ones that elected lawmakers seek to strike down. Here I reach Hypothesis #5: Citizen initiatives are more likely to be repealed or altered by legislatures if they deal with the topic of elections. The independent variable is the presence or absence of a repealed or altered initiative, and the dependent variable is whether or not the initiative dealt with the topic of elections. There is a positive relationship between the two variables.

My third question is this: *Is the annulment and revision of citizen initiatives a power that legislatures are recently exercising?* Have lawmakers consistently walked back initiatives brought forth by their constituents, or is this a new operation? I want to verify if this is a “new normal” developing. Finally, I have Hypothesis #6: Citizen initiatives are more likely to have been repealed or altered within the last four years. The independent variable is the presence or absence of a repeal or altered initiative, and the dependent variable is whether or not the initiative was repealed or altered within the last 4 years. Once again, there is a positive relationship between the two variables.

## Research Design and Results

### Creating My Database

I wanted to expand my knowledge on a topic that is unique and untouched by the majority. Because my topic is new, there is a limited amount of data collected and assembled. To ensure accuracy and efficiency in my tests, I found it beneficial to essentially create my own database for my research. I wanted to create a list of citizens’ initiatives that were repealed or altered. To narrow down my search, I focused only on initiatives that brought forth new statutes (initiated statutes) and cases that were repealed or altered between the years of 2008 and 2019. I was able to cross-check my data with a similar database created through Ballotpedia. Ballotpedia’s database was titled “Legislative Alterations of Ballot Initiatives,” and it was created on April 16, 2019 (Ballotpedia, 2019 “Legislative Alterations of Ballot Initiatives”).

To begin my search, I contacted the Director of the National Conference of State Legislature’s (NCSL) elections and redistricting team, Wendy Underhill, for information and direction. Underhill’s colleague and fellow NCSL member, Amanda Zoch, provided me with a database that contained every citizen initiative that had ever been put on a state or District of Columbia ballot. For my database, I needed only the initiatives that had been passed by voters. For each state that allowed a form of direct democracy, I recorded each passed initiative for every year, starting with 2008 and ending with 2009. After organizing these cases by year on a spreadsheet, I found that 170 ballot-initiatives were passed between the years of 2008-2019. From here I wanted to narrow my cases down

further to initiated statutes only. By using the ProQuest Newspaper database, in Lewis Library, I was able to narrow down my list even further to initiated statutes within the twenty-one states, and the District of Columbia, that give their citizens the right to bring forth original legislation through initiated statutes. Using key search words, such as “repeal”, “overturned”, “reversed”, “annulled”, “rescinded”, “revoked”, “amended”, and “altered”, I was able to find articles about specific initiated statutes that had been repealed or changed by legislatures between the years of 2008 and 2019. Partnering my findings with the “Legislative Alterations of Ballot Initiatives” database, I was able to generate a case list of thirty repealed or amended initiated statutes in the United States, within my timeframe.

### Question 1 – *Is the Alteration of Citizen Initiatives a Partisan Issue?*

I began my quest to answer my first question by performing tests for Hypothesis #1: States that allow citizen initiatives are more likely to favor the Democratic Party. I explored this idea by conducting a series of chi-square tests. A chi-square test is “a test of the statistical significance of the association between two nominal variables” (Manheim et al. 2008, 411). A chi-square test can examine the two variables by “comparing results actually observed to those that would be expected if no relationship existed” (Manheim et al. 2008, 299). My chi-square tests compared the independent variable, the presence or absence of citizen initiatives, and the dependent variable, whether or not the state primarily voted for the Democratic Party in the last three general elections, for Hypothesis #1.

For my independent variable, I assigned each state and the District of Columbia a value of 0 or 1. If a state or the District of Columbia was assigned a value of 0, then they did not give their citizens any form of direct democracy through initiatives or referendums. If a state or the District of Columbia was assigned a value of 1, then they allowed their citizens to practice some form of direct democracy. The data was found through Ballotpedia and are displayed in Figure 1. To show my dependent variable, again I gave each state and the District of Columbia a value of 0 or 1. If a state or the District of Columbia was assigned a value of 0, then they voted primarily for the Republican Party in the last three general elections. If a state or the District of Columbia was assigned a value of 1, they primarily voted for the Democratic Party in the last three general elections. This information for the 2008, 2012, and 2016 general elections was gathered from the Historical Presidential Election Information by State database (270 to Win, 2020 “Historical Presidential Election Information by State”). I personally created a visual map to show which states were considered “Red States” and which were considered

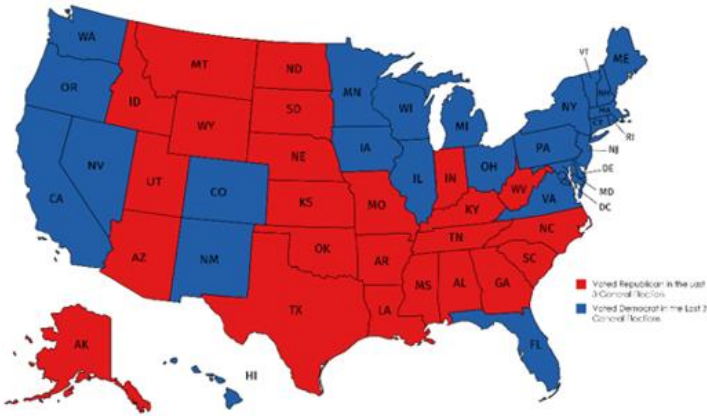


Figure 2. Republican and Democratic States. The state's political party association was determined by how the state voted in the last three general elections.

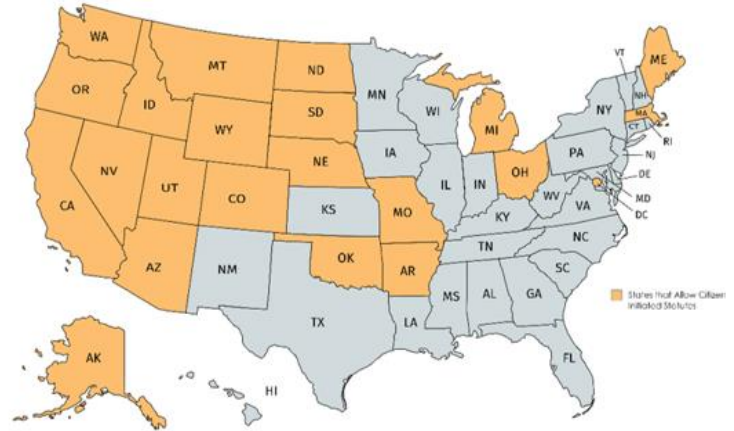


Figure 3. Map showing which states allow citizen initiated statutes.

“Blue States” in this test and throughout my research.

When completing the chi-square test, I found that states that allow their citizens a form of direct democracy and voted for the Democratic Party in the past three general elections had an expected value of 14.29. The actual number of states that fit the criteria was 14. These states were assigned a value of 1 for both the independent and dependent variable. In addition, I found that states that allow their citizens a form of direct democracy and voted for the Republican Party in the past three general election have an expected value of 12.71 and an actual value of 13. These states were given a value of 1 for the independent variable and a value of 0 for the dependent variable.

On the other hand, when performing the chi-square test, I discovered the states that do not give their citizens a form of direct democracy and voted for the Democratic Party in the past three general elections had an expected value of 12.71, when the actual number of states that fit this mold was 13. These states were given a 0 value for the independent variable and a 1 for the dependent variable. Additionally, states that did not give their citizens a form of direct democracy and voted for the Republican Party in the last three general elections had an

expected value of 11.29 and an actual value of 11. These states were given a 0 value for both the independent and dependent variable. I created Table 1 to show how each state scored based on the criteria for Hypothesis #1.

Despite the proximity of the expected values to the actual values, are these numbers statistically significant? In order to determine statistical significance of the two variables we must look at the Pearson Chi-Square value. The value reflects the differences in the expected values and the observed values. The chi-square value needs to be greater than 3.841 in order to be statistically significant at the 0.05 level for a 2x2 table. In this chi-square test for Hypothesis #1, the Chi-Square value is only 0.027, meaning that the relationship is not statistically significant. Table 2 displays these numerical results.

Hypothesis #2: States that allow citizens to bring forth initiated statutes to the ballot are more likely to support the Democratic Party. When moving to Hypothesis #2, I preformed the same chi-square test with one modification. I

**DV: Did the State Vote With the Democratic Party in the Past 3 General Elections?**

	Yes (Value of 1)	No (Value of 0)
Yes (Value of 1)	California Colorado Florida Illinois Maine Maryland Massachusetts	Michigan Nevada New Mexico Ohio Oregon Washington District of Columbia
No (Value of 0)	Connecticut Delaware Hawaii Iowa Minnesota New Hampshire New Jersey	New York Pennsylvania Rhode Island Vermont Virginia Wisconsin Alabama Georgia Indiana Kansas Kentucky Louisiana North Carolina

Table 1. Each of the 50 states and the District of Columbia scored based on the criteria of Hypothesis #1.

Independent Variable	Dependent Variable (Y) Dem Vote Over Past 3 Elections Y=1, N=0			Row Total
	Yes	No		
Allow Citizen-Initiatives	14	13		27
Y=1	14.294118	12.70588		24
N=0	12.705882	11.29412		24
Column Total	27	24		51
Pearson Chi-Square	0.0273277	3.841		
Degrees of Freedom = (# of rows-1)(# of columns-1)				
Is Chi-Square Statistic Statistically Significant At The .05 Level?				
Not Statistically Significant				

Table 2. Chi-square test performed for Hypothesis #1.

**DV: Did the State Vote With the Democratic Party in the Past 3 General Elections?**

**IV: Does the State Allow Initiated Statutes?**

	Yes (Value of 1)		No (Value of 0)	
Yes (Value of 1)	California	Oregon	Alaska	North Dakota
	Colorado	Washington	Arizona	Oklahoma
	Maine	District of Columbia	Arkansas	South Dakota
	Massachusetts		Idaho	Utah
	Michigan		Missouri	Wyoming
	Nevada		Montana	
	Ohio		Nebraska	
	No (Value of 0)		Alabama	Tennessee
	Connecticut	New Jersey	Georgia	Texas
	Delaware	New Mexico	Indiana	West Virginia
Florida	New York	Kansas		
Hawaii	Pennsylvania	Kentucky		
Illinois	Rhode Island	Louisiana		
Iowa	Vermont	Mississippi		
Maryland	Virginia	North Carolina		
Minnesota	Wisconsin	South Carolina		
New Hampshire				

Table 3. Each of the 50 states and the District of Columbia scored based on the criteria of Hypothesis #2.

Independent Variable	Dependent Variable (Y)			Row Total
	Yes	No	Dem Vote Over Past 3 Elections Y=1, N=0	
<b>Allow Initiated Statutes</b>	<b>Yes</b>	<b>10</b>	<b>12</b>	<b>22</b>
<b>Y=1</b>	<b>No</b>	<b>17</b>	<b>12</b>	<b>29</b>
<b>N=0</b>		<b>15.352941</b>	<b>13.64706</b>	
	Column Tot	27	24	51
Pearson	Chi-Square	0.8704284	3.841	
Degrees of Freedom = (# of rows-1)(# of columns-1)				
Is Chi-Square Statistic Statistically Significant At The .05 Level?				
Not Statistically Significant				

Table 4. Chi-square test performed for Hypothesis #2.

wanted to narrow my independent variable's focus in on only the twenty-one states (as well as the District of Columbia) that give their citizens the right to bring forth a new law or statute in the form of a citizen initiative. My chi-square test compared the independent variable, the presence or absence of initiated statutes, and the dependent variable, whether or not the state primarily voted for the Democratic Party in the last three general elections.

To show my independent variable, I assigned each state and the District of Columbia a value of 0 or 1. If a state or the District of Columbia was assigned a value of 0, then they did not give their citizens the ability to put initiated statutes on the ballot. If a state or the District of Columbia was assigned a value of 1, then citizens of that state could bring initiated statutes to the ballot for popular vote. For visual purposes, I created Figure 3, which is a color-coded map to distinctly show these states that allowed initiated statutes. The states that allowed initiated statutes and scored a 1 are labeled orange on the map. The states with a score of 0 are labeled grey. The data was, once again, found through Ballotpedia. The data used for my dependent variable, was the same as the Republican-leaning and the Democratic-leaning states used in Hypothesis #1 and showed in Figure 2.

Focusing in on only the states that allowed initiated statutes, caused five states to score differently in my chi-square test for Hypothesis #2 than they did in Hypothesis #1. These five states were Florida, Illinois, Maryland, Mississippi, and New Mexico. Table 3 was generated to show how each state scored based on the criteria for Hypothesis #2. When performing the chi-square test, I found that states that allow initiated statutes and voted for the Democratic Party in the past three general elections had an expected value of 11.64. The actual number of states that fit the criteria was 10. These states were assigned a value of 1 for both the independent and dependent variable. Continuing, I found that states that allow initiated statutes and voted for the Republican Party in the past three general elections have an expected value of 10.35 and an actual value of 12. These states were given a value of 1 for the

independent variable and a value of 0 for the dependent variable.

Oppositely, when conducting the test, I determined that the states that do allow initiated statutes and voted for the Democratic Party in more than half of the past three general elections had an expected value of 15.35, when the actual number of states that fit this mold was 17. These states were given a 0 value for the independent variable and a 1 for the dependent variable. Also, states that did not allow initiated statutes and voted for the Republican Party in a majority of the last three general elections had an expected value of 13.65 and an actual value of 12. These states were given a 0 value for both the independent and dependent variable. In my chi-square test for Hypothesis #2, the Pearson Chi-Square value is 0.87, far below the 3.841 number needed to show statistical significance in a 2x2 table. This means that the relationship is not statistically significant. Table 4 shows these numerical results.

The lack of statistical significance alerts us that this is not a problem contained to one political party. This is an issue that is being found in states that voted primarily for the Republican Party, as well as in those states that voted primarily for the Democratic Party in the last three general elections. The results show that both political parties are just as likely to walk back citizen initiatives, and neither party can be solely targeted for these antidemocratic acts.

Moving forward, I wanted to focus on instances where these citizen initiatives were repealed or changed by state lawmakers, after they had been voted through by the majority of state voters. I wanted to see if there was a specific party reversing these initiatives that are being passed by constituents. Hypothesis #3: States that repeal or alter citizen initiatives are more likely to be aligned with the Democratic Party. To test Hypothesis #3, I performed another chi-square test. My test compared the independent variable, the presence or absence of a repealed or altered initiated statute, and the dependent variable, whether or not the state primarily voted for the



**DV: Did the State Vote With the Democratic Party in the Past 3 General Elections?**

**IV: Did the State Repeal or Amend a Citizen Initiated Statute?**

	Yes (Value of 1)		No (Value of 0)	
Yes (Value of 1)	California Colorado Maine Massachusetts Michigan	Nevada Oregon Washington District of Columbia	Arizona Idaho Missouri Montana North Dakota	South Dakota Utah
No (Value of 0)	Ohio		Alaska Arkansas Nebraska Oklahoma Wyoming	

Independent Variable	Dependent Variable (Y)		Dem Vote Over Past 3 Elections Y=1, N=0	Row Total
	Yes	No		
Repeal/Alteration	9	7		16
Y=1	7.2727273	8.727273		
N=0	1	5		6
	2.7272727	3.272727		
Column Tot	10	12		22
Pearson	Chi-Square	2.7576389	3.841	
Degrees of Freedom = (# of rows-1)(# of columns-1)				
Is Chi-Square Statistic Statistically Significant At The .05 Level?				
Not Statistically Significant				

Table 5. Each of the 22 states and the District of Columbia scored based on the criteria for Hypothesis #3.

Table 6. Chi-square test performed for Hypothesis #3.

Democratic Party in the last three general elections. For Hypothesis #3 I looked at only the 22 states that allowed citizen-initiated statutes, because these states are the only states that have the ability to repeal or alter the proposed legislation brought forward.

To show my independent variable, I used the same tactic of assigning each state and the District of Columbia a value of 0 or 1. If a state or the District of Columbia was assigned a value of 0, then state had not repealed or altered an initiative between 2008 and 2019. If a state or the District of Columbia was assigned a value of 1, then the state had repealed or altered an initiative between 2008 and 2019. The data was gathered from my personal database. Figure 4 is a map that I independently created to show which states allow citizen-initiated statutes and which states exercised their ability to repeal or alter these initiatives. The states labeled in the dark orange had repealed or altered an initiated statute and scored a value on 1. The data used for my dependent variable was the same as the Republican-leaning and Democratic-leaning states used in Hypothesis #1 and Hypothesis #2, which is shown in Figure 2.

I personally constructed Table 5 to show the score that each state was given based on the criteria for the independent and dependent variables of Hypothesis #3. After completing the chi-square test, I recorded that states that had repealed or altered a citizen initiative and voted for the Democratic Party in the past three general elections had an expected value of 7.27. The actual number of states that fit this description was 9. These states were assigned a value of 1 for both the independent and dependent variable. I also noticed that states that had repealed or altered a citizen initiative and voted for the Republican Party in the past three general elections have an expected value of 8.72 but had an actual value of 7. These states were given a value of 1 for the independent variable and a value of 0 for the dependent variable.

On the other side of the test, I discovered that the states that had not repealed or altered a citizen initiative within the years of 2008 and 2019 and voted for the Democratic Party in the past three general elections had an expected value of 2.73. Ohio was the only state that fell into this category. Ohio was the one state, in this chi-square test, that received a 0 value for the independent variable and a 1 for the dependent variable. Furthermore, states that did not repeal or alter a citizen initiative and voted for the Republican Party in the last three general elections received an expected value of 3.27 and an actual value of 5. These states were given a 0 value for both the independent and dependent variable. In my chi-square test for Hypothesis #3, the Pearson value is 2.76, meaning that the relationship is not statistically significant. See Table 6 for these details.

Despite the chi-square test for Hypothesis #3 not showing a statistically significant relationship between variables, there is still a lot to take away from the information gathered. When looking at the map, shown in Figure 4, it becomes evident that out of the 22 states that allow citizen-initiated statutes, only 6 states had not repealed or altered a statute between 2008 and 2019. This means that 72.73% of state legislatures exercised their ability to annul or alter laws passed by the majority of their constituents. I was also able to

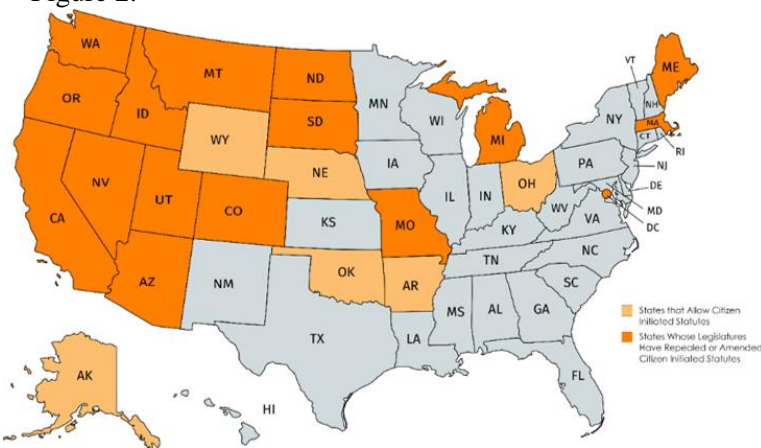


Figure 4. Map showing which states allow citizen-initiated statutes and which states have repealed or amended a statute. All states that are colored (not grey) allow citizen-initiated statutes. The states that are labeled with the darker orange allow citizen-initiated statutes and have repealed or amended a statute.

identify that 56% of the states that had repealed or altered these initiatives had voted largely for the Democratic Party in the last three general elections. Contrarily, states that voted primarily for the Republican Party in the last three general elections made up the other 44% of the retracted or amended statutes. Figure 5 is a pie chart that I created in order to visually show these percentages.

States That Repealed or Altered Citizen Initiatives Between 2008 and 2019

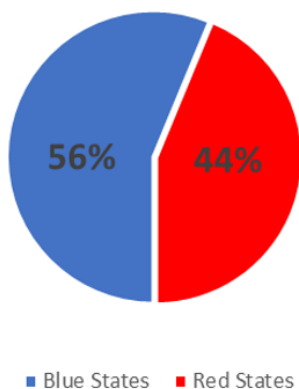


Figure 5. Percentages of states, that have repealed or altered an initiative, are Democratic-leaning states and what percentage are Republican-leaning states.

I performed one more test to explore my first question, regarding citizen initiatives and their modifications being a partisan issue. For this test, I decided to look at the political parties in power of the state legislatures that were walking these initiatives back. Hypothesis #4: State legislatures that repeal or alter citizen initiatives are more likely to be controlled by the Republican Party. The independent variable is the presence or absence of a repealed or altered initiative, and the dependent variable is whether or not the Republican Party had been in control of the state legislature at the time of the repeal or alteration. For my test, I looked at each case of a retracted or amended citizen-initiated statute and determined which political party had controlled the state legislature at the time. The data of each case of repeal or alteration came from the database that I created. The information regarding the political party in power within the state legislature came from the National Conference of State Legislatures database titled “State Legislative Partisan Composition.”

For this test, the state legislatures could fall into one of three categories. At the time of the retracted or changed initiative, the state legislature had been either Republican, Democratic, or Split. These labels are given to state legislatures based on which political party controls the state Senate and State House of Representatives. If the state’s legislature consisted of a Senate and a House of Representatives with the Republican party in power, then it was considered a

Republican legislature. If the state’s legislature comprised a Senate and a House of Representatives with the Democratic Party in power, then it was considered a Democratic legislature. If the state’s legislature contained a Republican Senate and a Democratic House of Representatives, or vice versa, then it was labeled a split legislature (National Conference of State Legislatures).

After administering my examination of the repealed or altered cases, I determined that between the years of 2008 to 2019, there had been 12 instances with a Republican state legislature, 9 instances with a Democratic state legislature, and 9 instances with a split state legislature. This equaled to Republican state legislatures being responsible for 40% of the repealed or altered initiated statutes. Also, 30% of these cases occurred in a Democratic state legislature, leaving the remaining 30% to take place in a split state legislature. Figure 6 is a pie chart that I created to visually express the percentages of repeals or alterations that occurred in each of the three types of state legislatures.

Political Party In Control of the State Legislature That Repealed or Altered a Citizen Initiative

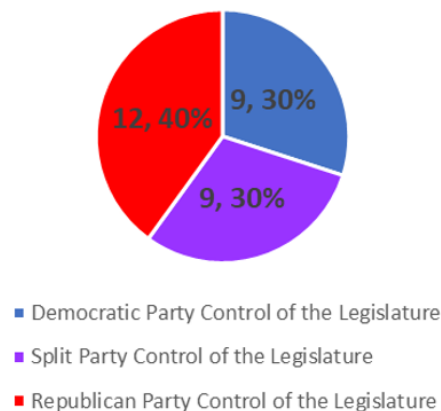


Figure 6. Percentages of repeals or alterations that occurred in each of the three types of state legislatures. The chart displays the number of cases and the percentages for each type of legislature.

**Question 2 – Are Legislatures More Inclined to Walk Back Citizen Initiatives That Involve Political Participation?**

In order to resolve my next question at hand, I tested Hypothesis #5: Citizen initiatives are more likely to be repealed or altered by legislatures if they deal with the topic of elections. The independent variable is the presence or absence of a repealed or altered initiative, and the dependent variable is whether or not the initiative dealt with the topic of elections. I performed a test to determine what initiative topic was being rescinded or edited the most by state legislatures. With the categorizing help from Ballotpedia, I was able to put each initiative repeal or alteration into a group based on the topic that it concerned. I found that between the years of 2008 to

### Topic of Repealed or Altered Initiatives

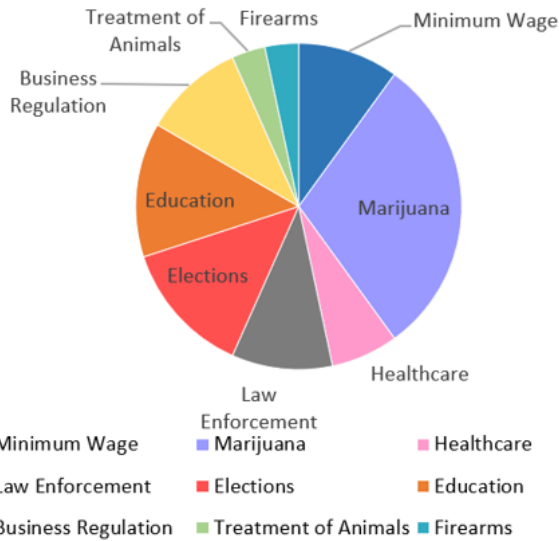


Figure 7. Proportion each initiative topic held of the overall number of repeals and alterations that occurred between the years of 2008 to 2019.

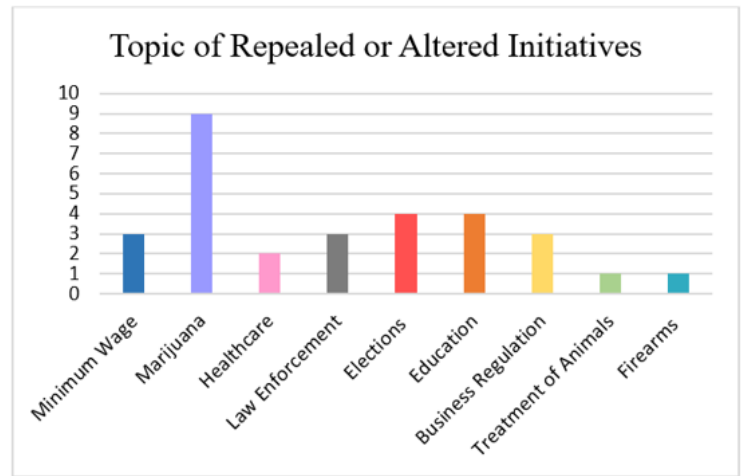


Figure 8. Number of repeals or alterations each initiative topic had between 2008 to 2019. The chart is color-coded to correspond with the pie chart in Figure 7.

2019, these cases had been spread across a variety of categories. These modified initiative topics were marijuana, healthcare, law enforcement, elections, education, business regulation, treatment of animals, firearms, and minimum wage.

From the numbers that I gathered for the given timeframe, it was determined that the initiative topic that of marijuana had gained the most revisions, with 9 occurrences. We find the topic of elections tied for second place with education. Both categories displayed 4 instances of revocation or modification between the years of 2008 and 2019. Figure 7 is a pie chart I constructed to demonstrate the proportion of repeals or alterations that each topic held. To show exact numbers, I generated the bar graph that can be seen in Figure 8.

### Question 3 – Is the Annulment and Revision of Citizen Initiatives a Power That Legislatures Are Recently Exercising?

To test my concluding question, I wanted to determine if this practice of repealing or altering citizen initiatives is a recent phenomenon. In order to do so, I put my sixth and final hypothesis to the test. Hypothesis #6: Citizen initiatives are more likely to have been repealed or altered within the last four years. The independent variable is the presence or absence of a repeal or altered initiative, and the dependent variable is whether or not the initiative had been repealed or altered within the last 4 years. I conducted my test by identifying how many repeals or alterations of initiatives had occurred each year from 2008 to 2019. This data came from my personal database that I created.

After I revealed the year that each retraction or revision took place, it was clear that a prominent number of these cases

took place in one particular year. The year of 2017 saw 13 instances of initiative repeal or alteration by state legislatures. I discovered that 70% of the retractions or modifications of citizen initiatives occurred within the last four years, and 43.33% of these cases occurred in 2017. Figure 9 is a line graph that I personally created to visually express the number of overturned or edited initiatives that occurred each year. The line graph makes the 2017 spike very apparent and distinctly shows an upward trajectory.

Table 7 shows a summary of what I have found in my research. The table is broken down by Question, Hypothesis, and Result.

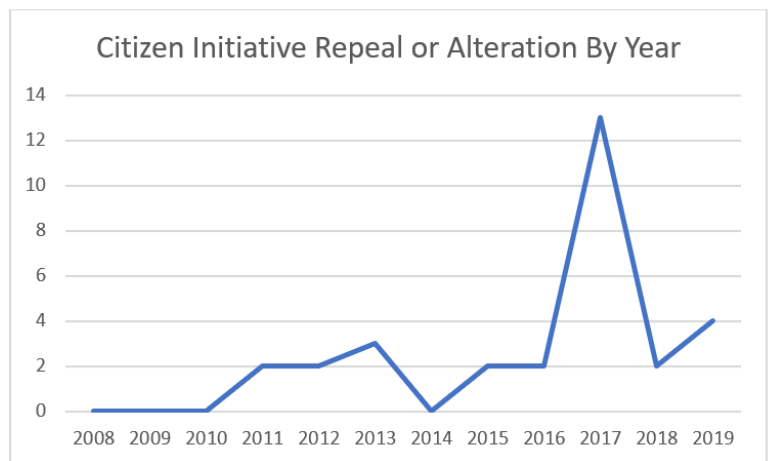


Figure 9. Number of overturned or edited initiatives that occurred each year, from the years 2008 to 2019.

Table 7. Results of each question and hypotheses.

Question	Hypothesis	Result
Q1: Is the alteration of citizen initiatives a partisan Issue?	H1: States that allow citizen initiatives are more likely to be favoring the Democratic Party.	A state's partisanship does not impact whether the state allows a citizen initiative.
	H2: States that allow citizens to bring forth initiated statutes to the ballot are more likely to support the Democratic Party.	A state's partisanship does not impact whether the state allows initiated statutes, a special example of citizen's
	H3: States that repeal or alter citizen initiatives are more likely to be aligned with the Democratic Party.	A state's partisanship does not impact whether the state repeals or alters citizen initiatives or not.  The walking back of initiatives is a strike down of democracy that is happening throughout the states, regardless of their political alignment.  This means 72.73% of state legislatures that had the ability to annul or alter laws passed by the majority of their constituents exercised the process between the years of 2008 to 2019.
	H4: State legislatures that repeal or alter citizen initiatives are more likely to be controlled by the Republican Party.	The political party in control of a state's legislature does not impact whether the state repeals or alters citizen initiatives or not.  Both lawmakers of the Republican Party and legislatures of the Democratic Party are responsible for the destruction of these proposed laws brought forth by citizens.
Q2: Are legislatures more inclined to walk back citizen initiatives that involve political participation?	H5: Citizen initiatives are more likely to be repealed or altered by legislatures if they deal with the topic of elections.	Initiated statutes dealing with elections was among the most repealed or altered initiative topics.  State lawmakers are challenging the citizen initiatives that involve political participation and directly affect their position of power.
Q3: Is the annulment and revision of citizen Initiatives a power that legislatures are recently exercising?	H6: Citizen initiatives are more likely to be repealed or altered within the last four years.	Initiatives have been repealed or altered more often recent years.  The number of initiatives being reversed or edited by lawmakers has spiked lately, with 70% of these cases (between 2008 to 2019) taking place in the last four years.

### Conclusion

“The term ‘democracy’ is derived from two Greek words that translate into English as ‘power of the people.’ Hence, it appears direct lawmaking by citizens, whether in a New England open town meeting or by means of the initiative and its compulsory referendum, is the most democratic method for enacting statutes” (Zimmerman 2014, 19-20). If author Joseph Francis Zimmerman is correct in initiatives being the most democratic way to create new legislation, then why are lawmakers making this process so difficult? As previously stated, only 26 states and the District of Columbia have a form of direct democracy, and only 22 of these can exercise the full right of bringing forth a new statute. Even with these powers, the ability for citizens to pass legislation is hindered by complicated signature processes and a long list of qualifications.

Regardless of the majority of state voters passing a citizen-initiated statute, legislatures are still overturning these pieces of legislation. My various tests have shown that both legislatures of the Republican Party and legislatures of the Democratic Party are responsible for the destruction of these proposed laws brought forth by citizens. This is an issue that we as citizens are facing regardless of the political party in power. The contestants in this feud are not political parties but rather the constituents versus their elected officials. Lawmakers are heavily encroaching into voters' right to democracy, with 72.73% of state legislatures having annulled or altered laws passed by the majority of their constituents. State lawmakers are taking interest in the citizen initiatives that involve political participation and directly affect their position of power. “Elections” was one of the most retracted and modified initiative topics, to be preceded only by the controversial topic of “marijuana”. State legislatures have been

recently exercising their power of reversing or editing citizen initiatives, with 70% of these instances taking place in the last four years (i.e. between 2008 to 2019). This sudden increase in these repressive acts is of great concern for democracy as a whole in the United States.

In further research, I would want to look at the role that the court system plays in the repeal or alteration of citizen initiatives. In 2018, Michigan voters brought forth an amendment to their constitution, regarding the drawing of district lines. The amendment took the power of drawing district lines away from the state legislature and gave it to a thirteen-member independent commission. To stop the amendment, the state legislature argued that the selection process for members of the redistricting commission was unconstitutional and took the matter to court. Recently, on April 15, 2020, the court determined that the criteria did not violate the constitution (Macagnone 2020). This was an example of the courts fighting back against the state legislatures' attempt to walk back the citizen initiative passed by voters.

Political scientist Valentina Bali stated, "The large number of constraints suggests that the final policy outcome of an initiative can be quite limited after the initiative's implementation" (Bali 2003, 1141). With this study and further research, I want to expand knowledge on this new and almost unscathed topic of the continued battle between the people and their elected officials, direct democracy, and the creation and destruction of citizen initiatives.

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# Abortion Views on a College Campus

Madison Murphy

*Faculty Mentor: Bobby Jo Otto, PhD*  
History and Social Science, Sociology

## Abstract

I examined abortion views of students at a small private Liberal Arts college located in the Southeast United States. Many studies have been conducted on how people view abortion; however, there are not any studies examining if people's beliefs on when life begins influences their views on abortion and what people feel is most influential to their views on abortion. In my study, I explored these aspects as well as other factors that are commonly examined when researching how people view abortion. The other aspects I examined are how religious affiliation, political affiliation, gender, class standing, knowing someone who has had an abortion, and a wide variety of scenarios can influence a person's view on abortion. I gathered data by distributing an online survey through email to all students at the selected college. One hundred and twenty-five students completed the survey. After examining previous research on abortion views, I hypothesized that college students will be more supportive of abortion when the abortion is completed due to medical or traumatic reasons (traumatic abortion) rather than when the abortion is completed due to non-medical or non-traumatic reasons (elective abortion). Also, I hypothesized that the reason for the abortion (the scenario) and a participant's religious affiliation will be the most influential factors as to why someone supports or opposes abortion. In my study, the most influential scenario in support for abortion is that the mother will die during delivery. The most influential scenario against the use of abortion is when the child was conceived during an affair/cheating. The data supports my hypothesis that religion and the reason for the abortion greatly influence abortion beliefs. Additionally, Republican respondents are much less supportive of abortion than are members of other political parties. There is no difference between the abortion views of males and females.

## INTRODUCTION

Researching views on abortion can be difficult considering that it is a very controversial topic and there are a variety of views on the subject. To better understand why there are a variety of views on abortion, researchers have conducted a number of studies to determine what factors influence these beliefs. A few factors include religious and political affiliation, gender, race, and the reason for the abortion.

I surveyed students at a small private Liberal Arts college on their abortion beliefs to determine whether more students support or oppose abortion, what factors influence their stance on abortion, and whether students with similar demographic characteristics such as race, gender, and political affiliation view abortion similarly or differently. Even though many studies have been completed concerning how people view abortion, my study adds to the preexisting literature by supporting and contradicting other research as well as filling gaps in the literature.

## LITERATURE REVIEW

The debate on the legality of abortion in the United States has been around for decades. The debate was heightened

in 1973 due to the inception of *Roe v. Wade*. The Supreme Court passed *Roe v. Wade* allowing women the right to have an abortion, yet each state can still put restriction on the access to abortion.

While abortion has always been a controversial topic, within the past few years, discussion surrounding abortion views has significantly risen due to state abortion laws changing and politicians greatly leaning on abortion in order to gain votes. (Republicans often argue against abortion access and Democrats often argue for abortion access.) This has led many researchers to study the complexity of how people view abortion. Jozkowski, Crawford, and Hunt (2018) argue that many state abortion laws are becoming stricter, suggesting that the majority of people oppose abortion, even though many studies show that overall support for abortion is increasing. A recent study conducted by the Pew Research Center determined that the main concern of United States' citizens is that states are implementing abortion laws that are too strict. Also, the majority of people in the United States do not agree with completely overturning *Roe v. Wade*—seven out of ten people state that they do not want to see it completely overturned. In fact, 61.0% agree with the use of abortion in all

scenarios (27.0%) or in most scenarios (34.0%) (“U.S. Public Continues to Favor Legal Abortion, Oppose Overturning *Roe v. Wade*” 2019).

Currently, the United States Supreme Court is examining the case of *June Medical Services v. Russo*. After the first hearing, the case has been declared one of the most unpredictable Supreme Court abortion cases (Washington 2020). In other words, the media and United States citizens are unsure of which side the Supreme Court will rule in favor of. If the Supreme Court rules in favor of *Russo*, then all Louisiana abortion doctors will go out of business except for one due to complex restrictions that will be implemented through the new law (Berenson 2020). The main restriction that the new law will implement is that doctors will be required to have the authority to admit patients into a hospital that is within thirty miles of the abortion clinic; however, these privileges are extremely hard to obtain and are not truly a health and safety precaution (Berenson 2020). In addition, the third-party standing law, where doctors represent their patients in court, will be overruled due to possible conflicts of interest between doctors and patients (Washington 2020). This will cause women who are denied or do not have access to an abortion to have to file their own case to the federal court, which will more than likely not be reviewed until it is too late for the woman to have an abortion (Washington 2020). There will not be a final decision on the case until June of 2020. Similar to other abortion cases, *June Medical Services v. Russo* has sparked discussions on abortion and has made researching abortion views more beneficial and necessary.

For over fifty years, numerous studies have been conducted concerning what factors influence one’s view on abortion. Researchers have specifically examined the influence of religion, the type of abortion being completed, gender, scenarios, and political affiliation.

People have a variety of views on whether or not abortion should be allowed, and those views are affected by many factors. In numerous studies, religion has been an influential factor affecting personal beliefs on abortion. A person is more likely to view abortion the same way as their religious doctrine if they are extremely involved in the religion (Harris and Mills 1985). Similarly, a person is more likely to oppose abortion if they are a very religious person who attends many religious services and puts a great amount of faith into their religion (Harris and Mills 1985; O’Brien and Noy 2015).

Another factor found to significantly influence religious groups’ views on abortion is the type of abortion that is being completed (Hoffmann and Johnson 2005). Traumatic abortion occurs when a woman wants to have an abortion due to threatening reasons, such as medical complications for the pregnant woman and/or fetus or the fetus having been conceived during rape or incest. Elective abortion takes place when a woman wants to have an abortion because she does not want a baby or feels unprepared to have a baby. Elective abortion is often seen as morally wrong by people of many

religions because the abortion is completed due to the pregnant woman’s feelings and not due to life-threatening or emotionally threatening scenarios.

When looking at various denominations of Christianity, one finds there are a few denominations that are less accepting of abortion based on the type of abortion being completed. Hoffmann and Johnson (2005) found that Evangelicals, Fundamentalists, Protestants, and Catholics oppose elective abortion more than they oppose traumatic abortion.

In addition to opposing elective abortions, Evangelicals and Catholics are the main denominations who oppose traumatic abortions (Hoffmann and Johnson 2005). Up until the 1990s, Catholics were much less supportive of traumatic abortion than Evangelicals were; however, at the beginning of the 1990s, Evangelicals began to oppose the traumatic form of abortion much more than Catholics do (Hoffmann and Johnson 2005). Evangelicals have increased their opposition for both traumatic and elective abortion much more than any other Christian denomination (Hoffmann and Johnson 2005). Hoffmann and Johnson (2005) state that the increase in opposition may have happened for many reasons: increasing presence of abortion discussions within society, conflict between state governments and the federal government over abortion laws, and an increase in people with conservative views attending Evangelical churches.

Differences also exist between the way Protestants and Catholics view abortion (Hoffmann and Johnson 2005). Protestants have long been known to be more supportive of abortion than Catholics are; however, that support is decreasing, but Hoffmann and Johnson (2005) do not state why the views of Protestants are changing. Since many Protestants are beginning to oppose abortion, Protestants and Catholics are becoming more similar in their views of abortion (Hoffmann and Johnson 2005). People who identify as Protestant or Catholic currently have little, if any, approval for abortion practices (Barkan 2014).

Religion and gender often intersect when examining people’s views on abortion. When religion is a factor, females become more supportive of abortion (Barkan 2014). For example, Swank and Fahs (2016) found a relationship between attending religious services and views on abortion; however, the relationship varies based on the participants’ gender. Men who attend religious services are more likely to oppose abortion, yet attending religious services does not affect females’ views on abortion (Swank and Fahs 2016).

The data concerning gender and abortion views is inconsistent. Alvargonzález (2017) surveyed a sample of students (596 females and 427 males) and concluded that gender does not influence people’s views on abortion. The majority of studies align with Alvargonzález’s (2017) conclusion, but there are a few studies that argue otherwise.

Some researchers have concluded that there is a relationship between abortion views and gender. For example,



some studies show that females support abortion more often than males do (Siwek, et al. 2019). Siwek, et al. (2019) found that women are more likely to support abortion, whereas men are more likely to support limiting access to abortion or banning it altogether. Siwek, et al. (2019) states that gender is statistically significant when examining abortion views, but the relationship is weak.

Other studies show that gender does not have a significant influence on abortion views until certain factors are controlled for. Once other variables are controlled for, females often become more supportive of abortion, compared to males. For example, Strickler and Danigelis (2002) found that when they included other attitudes in their model, such as how the participants feel about sexual freedom and their belief in the holiness of human life, females became more supportive of abortion. When the attitudes were not included, there was no difference in male and female views on abortion. When both females and males oppose abortion, females usually oppose due to religious beliefs; however, males usually oppose abortion due to having an authoritarian personality (Swank and Fahs 2016).

Couture et al. (2016) examined how male and female views on abortion differ when applying different scenarios to their own life and when applying the same scenario to another person's life. The views of the male participants remained constant when applying the scenario to their own life and to someone else's life; however, the views of the female participants did not remain constant (Couture et al. 2016). Females are more likely to support abortion when they are applying the scenario to another person's life rather than to their own. Females are also more likely than males to think that abortion should not be allowed under certain conditions, such as after a woman has been pregnant for over three months (Carlton, Nelson, Coleman 2000).

Another aspect that many researchers have examined is how abortion views vary when various scenarios are explored. Carlton et al. (2000) examined how 1,118 college students from one midsized southeastern university feel when thinking about whether or not abortion is okay in presented scenarios. Siwek et al. (2019) also conducted a study where participants were asked about using abortion in given scenarios; both studies found similar results. People support abortion more when the pregnancy is due to rape, if the pregnant woman will have severe medical complications if she continues to carry the fetus, or if the fetus will have a physical or mental disability when it is born (Carlton et al. 2000, Siwek et al. 2019). Siwek et al. (2019) also found that people support abortion more when the pregnancy is due to incest. Many people do not support abortion when it is used as a method of birth control or after the woman has been pregnant for three or more months (Carlton et al. 2000). As these studies show, abortion views are complex.

Jozkowski, et al. (2018) used data from the General Social Survey and also surveyed college students to examine

the complexity of abortion views. They concluded that the majority of people do not have a one-sided view of abortion, but instead their views of abortion fluctuate due to the scenario of the woman who is pregnant.

Jozkowski, et al. (2018) also examined the complexity of abortion views in relation to political affiliation. Complexity in abortion views is measured by examining how much or how little a person's feelings on abortion fluctuate in various scenarios (more fluctuation in a person's view means more complexity). They found that Republicans have more complex abortion views compared to Democrats. People who identify as Democrat, Independent, and "Other" are much more accepting of abortion compared to Republicans (Jozkowski, et al. 2018).

There is limited research concerning how people of various racial/ethnic groups view abortion. Strickler and Danigelis (2002) found that before the 1980s, Caucasians were more approving of abortion than African Americans were; however, at the beginning of the 1980s, African Americans became more supportive of abortion compared to Caucasians. African American support for abortion may have risen due to the increase in black reproductive rights activists (Strickler and Danigelis 2002). Strickler and Danigelis (2002) also found that when attitudes and socioeconomic variables are controlled for, African Americans are more supportive of abortion than Caucasians are. To help fill this gap in the literature, I will compare race/ethnicity with views on abortion to see if a relationship exists.

There is also limited research concerning how knowing someone who had an abortion affects how a person views abortion. People who know someone who has had an abortion are more supportive of abortion than are those who do not know someone who has had an abortion ("U.S. Public Continues to Favor Legal Abortion, Oppose Overturning Roe v. Wade" 2019).

As the research shows, religion greatly influences abortion views. Gender has been proven to be an inconsistent variable throughout the literature, but many researchers are leaning toward the belief that women are more supportive of abortion than men, especially when certain factors are controlled for (Couture et al. 2016; Siwek, et al. 2019; Strickler and Danigelis 2002; Swank and Fahs 2016). Another key factor that researchers have discovered is that people's (especially Christians') views on abortion will often fluctuate depending on the reason for the abortion. In my study, I plan to examine a number of variables that may or may not influence people's stances on abortion, which will add to the existing literature on the topic.

Although abortion views have been thoroughly researched, there are two gaps in the literature concerning abortion views: how abortion views are affected by when a person feels that life begins and what aspects (religion, morals, media, family, friends) people feel affects their views on abortion. Since no research exists in these areas, I examined

these relationships, among others, to see if there are any significant differences in the data.

### METHODS

I examined how undergraduate and graduate students at a small private Liberal Arts college view abortion by electronically distributing a survey that I created. The survey consisted of a variety of questions measuring how a student's view of abortion can fluctuate due to a number of factors (e.g., scenario, religion, political affiliation, gender, and so on).

On my behalf, the Dean of Students and Vice President of Student Engagement at the college distributed the link to my survey to all of the students through email on March 23rd, 2020. The email addressed who I am and what my research study examined. The email also addressed that participation in the study was completely voluntary, all answers were anonymous, and completion and submission of the survey indicated the student's willingness to participate in the study. The survey closed on April 3rd, 2020. The email and survey are located in the Appendix\*.

The online survey was designed using SurveyMonkey. Participants who submitted a survey where fewer than three of the eleven questions were completed were excluded from the analysis. Answers that appeared to be "falsified" were also excluded from the analysis. Once all responses were collected, the data was exported from SurveyMonkey to the Statistical Package for the Social Sciences (SPSS) to be analyzed.

My dependent variable is whether each participant supports or opposes abortion (in different scenarios). The independent variables are the participants' religious affiliation, political affiliation, when the participant feels that life begins for a fetus, whether or not the participant knows someone who has had an abortion, and the scenario of the woman who is pregnant/reason for the abortion. Based on previous literature, I made the following hypotheses: the scenario of the woman who is pregnant/reason for the abortion and a participant's religious and political affiliation will have significant influences on whether or not participants support or oppose abortion; gender and race will not have significant influences on whether or not participants support or oppose abortion; respondents will be more supportive of traumatic abortion and less supportive of elective abortion; and respondents who feel that conception is the beginning of life will be less supportive of abortion.

### RESULTS AND DISCUSSION

#### *Descriptive Statistics*

After eliminating seven respondents for submitting a survey where fewer than three questions are answered, the total sample was 125 students; this produces a response rate of 13.9%.

#### *Demographic variables.*

When examining gender, the sample is 68.9% female, 27.0% male, 2.5% transgender, and 1.6% identify as "Other,"

yet the "Other" respondents provided answers that appear to be falsified.

The majority of the sample identify as Caucasian (86.1%). Of the remaining respondents, 9.8% identify as African American, 2.5% identify as Hispanic, 0.8% identify as Multiracial, and 0.8% are falsified data.

When examining class standing, 14.8% of the respondents are freshmen, 21.3% are sophomores, 34.4% are juniors, 23.0% are seniors, and 6.6% are graduate students.

When examining religious affiliation, 82.0% of the sample identify as Christian. Of the respondents who identify as Christian, the main two denominations that the respondents identify with are Baptist (49.0%) and Non-denominational (23.0%). Of the non-Christian respondents, 10.7% identify as non-religious, 1.6% identify as Atheist, and 5.7% identify as "Other." Of the "Other" respondents, 28.6% misunderstood the question and stated "Catholic" instead of initially identifying as "Christian," and 14.3% are falsified data.

The main political affiliations that the sample identifies with are Republican (43.1%), Democratic (18.7%), and no political affiliation (24.4%). The two other political affiliations that respondents identify with are Independent (8.1%) and Libertarian (5.7%). To display the most significant results, each table and graph concerning political affiliation examines only the responses from respondents who identify as Republican, Democratic, and no political affiliation.

**Table 1**

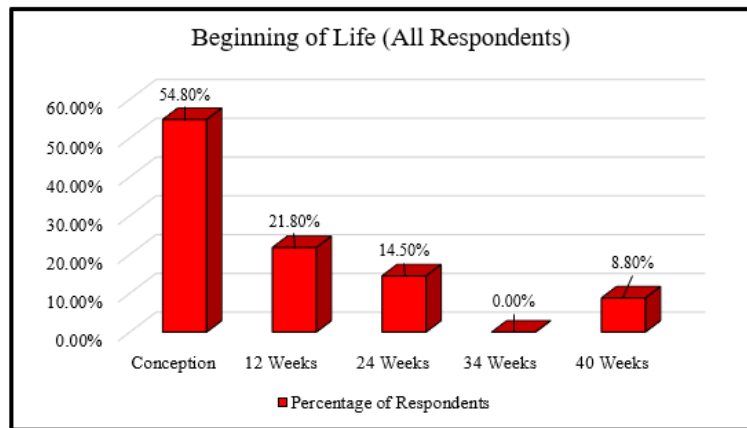
**Abortion Views of All Respondents and Scenarios**

Abortion Scenarios	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Cannot Afford to Care for the Child	37.9%	17.7%	13.7%	16.9%	13.7%
Plan to Send the Child to Foster Care	37.9%	20.2%	12.1%	19.4%	10.5%
Pregnancy due to Rape	12.9%	13.7%	14.5%	16.9%	41.9%
Pregnancy due to Incest	18.5%	12.9%	9.7%	23.4%	35.5%
Mother Will Die During Delivery	8.9%	6.5%	23.4%	23.4%	37.9%
Child Conceived During an Affair/Cheating	51.6%	20.2%	12.9%	8.1%	7.3%
Mother is Under the Age of 18	36.3%	17.7%	22.6%	7.3%	16.1%
Unwanted Pregnancy	43.5%	17.7%	12.9%	12.9%	12.9%
Unplanned Pregnancy	46.8%	17.7%	16.1%	9.7%	9.7%
Abnormal Fetus Development	32.3%	16.9%	21.8%	14.5%	14.5%

*Abortion views.*

When examining the reason for the abortion, I found that the majority of respondents agree with the use of abortion due to medical complications or traumatic scenarios, which supports my hypothesis. When “agree” and “strongly agree” responses are combined, the majority of respondents agree with the use of abortion in three scenarios: when the mother will die during delivery (61.3%), when the pregnancy is a result of incest (58.9%), and when the pregnancy is a result of rape (58.8%). The majority of respondents disagree with the use of abortion in the remaining scenarios (non-medical or non-traumatic scenarios), except for when the fetus is affected by abnormal development. When “disagree” and “strongly disagree” responses are combined, the majority of respondents disagree with the use of abortion when the child was conceived during an affair/cheating (71.8%), unplanned pregnancy (64.5%), unwanted pregnancy (61.2%), the child will be sent to foster care (58.1%), the parents cannot afford to care for the child (55.6%), and the mother is under the age of eighteen (54.0%). In the event of abnormal development of the fetus, 49.2% disagree with the use of abortion, while 29.0% agree (“agree”/“strongly” agree are combined and “disagree”/“strongly” disagree are combined). My findings align with previous findings that abortion views are complex because they fluctuate with each scenario. These findings are further examined in Table 1.

**Graph 1**



*Views on the beginning of life.*

The majority (54.8%) of the sample states that life begins at conception (when the egg is fertilized). Of the remaining sample, 21.8% state that life begins at 12 weeks into the pregnancy, 14.5% state that life begins at 24 weeks, 0.0% state that life begins at 34 weeks, and 8.9% state that life begins at 40 weeks (fetus is ready to be born). This data is displayed in Graph 1.

*Factors that influence abortion views.*

Respondents were asked to rank what they feel influences their views on abortion the most on a one-to-five scale (one being the most influential and five being the least

influential—each number could be only used once). Religion and morals ranked extremely close together as the most influential factor; however, religion had the highest percentage for being the most influential (38.1%)—morals was ranked as the most influential by 35.8% of respondents. Of the remaining factors: 14.5% of respondents ranked media as the most influential, 7.6% ranked family as the most influential, and 7.4% ranked friends as the most influential. Asking this question adds to the literature because it has not been asked before and produces data concerning what factors the respondents feel are the most influential to their views on abortion.

*Social network experiences with abortion.*

The majority of the sample does not have a close or non-close family member or friend who has had an abortion, at least that they know of. Of the sample, 16.3% have a close family member who has had an abortion, 14.8% have a non-close family member who has had an abortion, 25.2% have a close friend who has had an abortion, and 43.9% have a non-close friend who has had an abortion.

*Inferential Statistics*

I am 95% confident that religion has a significant impact on the respondent’s feelings about the use of abortion in various scenarios (as shown in Table 2). In each scenario, Christians are more likely to disagree with the use of abortion than are respondents who do not identify as Christian. Respondents who identify as Christian are most supportive of abortion when the mother will die during delivery (25.0% agree and 29.0% strongly agree). Respondents who identify as Christian are least supportive of abortion when the fetus was

**Table 2**

**Religion and Disagreement with the use of Abortion in Various Scenarios**

Abortion Scenarios	Non-Christian	Christian	Non-Religious	Chi-Square (X <sup>2</sup> )
Cannot Afford to Care for the Child	14.3%	66.0%	7.1%	.002
Plan to Send the Child to Foster Care	42.9%	66.0%	7.7%	.001
Pregnancy due to Rape	14.3%	32.0%	0.0%	.029
Pregnancy due to Incest	14.3%	38.0%	0.0%	.041
Mother Will Die During Delivery	14.3%	18.0%	0.0%	.013
Child Conceived During an Affair/Cheating	42.9%	79.0%	38.5%	.000
Mother is Under the Age of 18	14.3%	60.0%	23.1%	.008
Unwanted Pregnancy	14.3%	68.0%	38.5%	.018
Unplanned Pregnancy	28.6%	71.0%	38.5%	.009
Abnormal Fetus Development	57.2%	54.0%	23.1%	.039

\*Strongly Disagree and Disagree responses are combined\*

conceived during an affair/cheating (20.0% disagree and 59.0% strongly disagree).

Religion also has a significant influence on when respondents feel that life begins ( $\chi^2 = .027$ ). Christians (62.0%) are the most likely to feel that conception is the beginning of life. Respondents who do not identify with a religion have more scattered views but lean more toward the middle and end of the pregnancy. Of the respondents with no religious affiliation, 38.5% state that life begins at 24 weeks and 23.1% state that life begins at 40 weeks.

The respondents' Christian denominations are not significant in any of the scenarios, which is inconsistent with prior research. Hoffmann and Johnson (2005) state that Evangelicals, Protestants, and Catholics oppose abortion more than other Christian denominations do; however, due to a lack of respondents who identify with these denominations, my data cannot support these findings.

The number of religious services that a respondent has attended in the past month has a significant impact on five of the ten scenarios. The five scenarios that are significantly impacted by attending religious services are pregnancy due to rape ( $\chi^2 = .005$ ), pregnancy due to incest ( $\chi^2 = .007$ ), the parents cannot afford to care for the child ( $\chi^2 = .001$ ), the mother will die during delivery ( $\chi^2 = .009$ ), and unwanted pregnancy ( $\chi^2 =$

.025). In these five scenarios, approval for the use of abortion decreases as the number of religious services attended increases. These findings align with previous studies concerning abortion views and religious service attendance (Harris and Mills 1985; O'Brien and Noy 2015).

I am 95% confident that political affiliation has a significant influence on each scenario presented in the survey (as shown in Table 3). When examining political affiliation, I found that the main significant scenarios are that the parents cannot afford to care for the child ( $\chi^2 = .000$ ), pregnancy due to rape ( $\chi^2 = .000$ ), and pregnancy due to incest ( $\chi^2 = .000$ ). Data for the scenarios with the highest statistical significance are displayed in Graph 2. The majority of Republican respondents do not agree with the use of abortion in every scenario except for when the mother will die during delivery. When the mother will die during delivery, Republican respondents are split on their agreement (37.7%) and disagreement (30.2%) with the use of abortion (22.6% agree and 15.1% strongly agree while 13.2% disagree and 17.0% strongly disagree). Two scenarios where the views of respondents who identify as Republican or Democratic contrast sharply is the use of abortion due to financial concerns where 84.9% of Republicans disagree (24.5% disagree and 60.4% strongly disagree) while 63.7% of

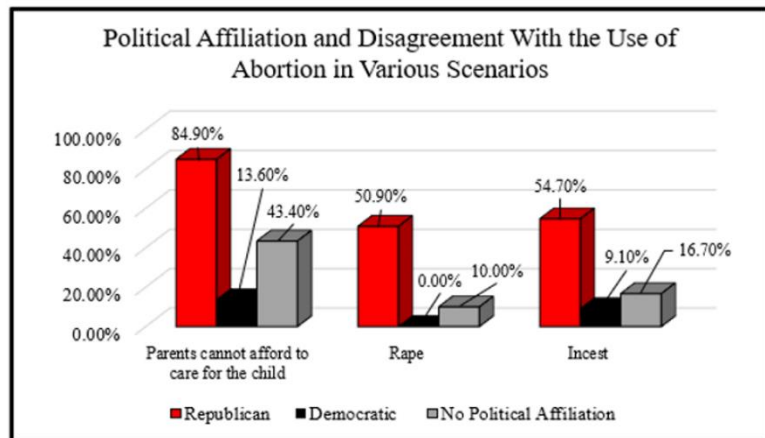
**Table 3**

**Political Affiliation and Abortion Views in Various Scenarios**

Abortion Scenarios	Republican Agreement	Republican Disagreement	Democratic Agreement	Democratic Disagreement	No Political Affiliation Agreement	No Political Affiliation Disagreement	Chi-Square (X <sup>2</sup> )
Cannot Afford to Care for the Child	11.4%	84.9%	63.7%	13.6%	40.0%	43.4%	.000
Plan to Send the Child to Foster Care	11.3%	79.2%	59.1%	22.7%	40.0%	50.0%	.004
Pregnancy due to Rape	26.4%	50.9%	95.4%	0.0%	80.0%	10.0%	.000
Pregnancy due to Incest	28.3%	54.7%	90.9%	9.1%	80.0%	16.7%	.000
Mother Will Die During Delivery	37.7%	30.2%	77.3%	0.0%	83.4%	6.6%	.002
Child Conceived During an Affair/Cheating	5.7%	88.7%	31.8%	40.9%	26.7%	63.4%	.002
Mother is Under the Age of 18	9.5%	77.4%	54.6%	22.7%	26.6%	43.4%	.003
Unwanted Pregnancy	11.3%	83.1%	54.6%	18.2%	30.0%	56.7%	.005
Unplanned Pregnancy	11.3%	83.0%	36.3%	27.3%	23.3%	63.3%	.008
Abnormal Fetus Development	15.1%	66.0%	50.0%	27.2%	40.0%	43.3%	.017

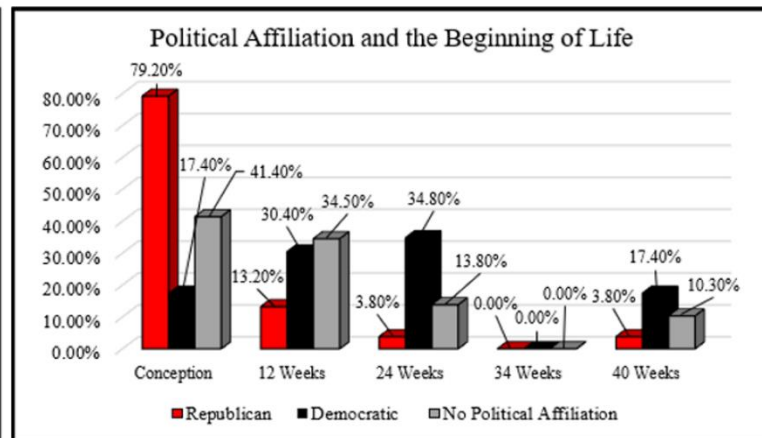
\*Strongly Disagree and Disagree responses are combined—Strongly Agree and Agree responses are combined\*

**Graph 2**



\*The scenarios analyzed in this graph have the most significant chi-square ( $\chi^2$ ) results. Chi-square for all three scenarios is  $\chi^2 = .000^*$

**Graph 3**



Democrats agree (36.4% agree and 27.3% strongly agree), and abnormal development of the fetus, where 66.0% of Republicans disagree (13.2% disagree and 52.8% strongly disagree), while 50.0% of Democrats agree (22.7% agree and 27.3% strongly agree). In every scenario except for three (pregnancy due to rape, pregnancy due to incest, and the mother will die during delivery), over 50% of the Republican respondents indicate that they “strongly disagree” with the use of abortion instead of just “disagree.” In the event of pregnancy due to rape or incest, the majority of Republican respondents disagree with the use of abortion, but the responses are closely divided between “disagree” and “strongly disagree.” My findings do not align with previous findings that Republicans have more complex views on abortion than other political parties because the majority of Republican respondents in this study consistently disagree with the use of abortion, yet their level of disagreement varies depending on the scenario. My findings do align with previous findings that Republicans are less supportive of abortion than other political parties are, which also supports my hypothesis (Jozkowski, et al. 2018).

I am 95% confident that there is a significant relationship between political affiliation and views on the beginning of life ( $\chi^2 = .000$ ). The majority of Republican respondents (79.2%) feel that conception is the beginning of life, whereas Democratic respondents and respondents with no political affiliation have more diverse views on the beginning of life (as displayed in Graph 3). As the data depicts, Republicans feel that life begins at conception and are less supportive of abortion than other political parties are, whereas Democrats have varying views on the beginning of life and are more supportive of abortion. This data also displays the relationship between abortion views and when a person feels that life begins.

When examining gender, I found a significant variable in four scenarios when transgender individuals are included in the analysis; however, when I exclude transgender individuals, the relationship is not significant in any scenario. Males and

females have similar views on abortion (when one agrees or disagrees, so does the other), whereas the majority of transgender respondents agree with the use of abortion in every scenario. I did not find a difference in the abortion views of males and females, which aligns with the majority of other researchers’ findings (Alvargonzález 2017). Some researchers argue that females are more supportive of abortion than males are; however, my data does not support this argument. More research needs to be conducted in order to develop a better understanding of the relationship between gender and abortion views.

When examining gender in relation to the beginning of life, I found that gender is significant when I include transgender individuals in the analysis ( $\chi^2 = .003$ ) and when I exclude them from the analysis ( $\chi^2 = .035$ ). The majority of transgender respondents (66.7%) state that life begins at 40 weeks. The majority of both males (57.6%) and females (55.4%) state that conception is the beginning of life; however, the views of the remaining male respondents lean more towards the middle and end of the pregnancy (24 and 40 weeks), whereas the remaining female respondents stay more towards the beginning of the pregnancy (12 weeks).

The race/ethnicity of the respondent is significant when determining whether abortion should be used if the parents plan to place the child in foster care ( $\chi^2 = .016$ ). The majority of Caucasian respondents (61.5%) do not agree with the use of abortion when the child will be sent to foster care (19.2% disagree and 42.3% strongly disagree), whereas the majority of African Americans (66.6%) agree with the use of abortion in this scenario (58.3% agree and 8.3% strongly agree). This data adds to the extremely limited literature concerning race/ethnicity and abortion views.

At what point in the pregnancy the respondents feel that life begins has a significant relationship with all ten scenarios. The chi-square ( $\chi^2$ ) for the beginning of life and each scenario is .000. Respondents who believe that life begins at conception disagree with the use of abortion more than do

respondents who believe that life begins at 40 weeks of pregnancy, which supports my hypothesis. Examining this data is important because it allows researchers to have more nuanced views of what factors affect abortion beliefs.

When analyzing how knowing someone who has had an abortion affects the respondents' views on abortion, I found that only five scenarios are significant. When the respondent has a close friend who has had an abortion, the only significant scenario is when the pregnancy is due to incest ( $\chi^2 = .024$ ). When the respondent has a close family member who has had an abortion, four scenarios are significant: the child was conceived during an affair/cheating ( $\chi^2 = .019$ ), the mother is under the age of 18 ( $\chi^2 = .023$ ), unwanted pregnancy ( $\chi^2 = .027$ ), and unplanned pregnancy ( $\chi^2 = .003$ ). In the majority of the statistically significant scenarios, respondents who know someone who has had an abortion are more supportive of abortion than are those who do not know someone who has had an abortion; this relationship is also depicted in data from the Pew Research Center ("U.S. Public Continues to Favor Legal Abortion, Oppose Overturning Roe v. Wade" 2019). This data adds to the limited literature concerning whether or not knowing someone who has had an abortion influences a person's view on abortion. From this data, it seems that the influence not only comes from knowing someone who has had an abortion, but it also stems from the scenario of the person having the abortion, which also displays complexity.

The respondents' class standing does not have a significant impact on their abortion views—one class is not more or less approving of abortion.

### LIMITATIONS

Due to the sensitive nature of the topic, respondents might not have been honest in their answers—which may explain some of the falsified data. I did not receive many diverse answers regarding the respondents' religious affiliations, political affiliations, and racial/ethnic groups; therefore, comparisons among groups were limited, and the data was skewed in some areas. This analysis would have benefited from having more respondents. Of the 899 students who received the survey, only 125 students completed it, yielding a response rate of 13.9%. Because of my low response rate, nonresponse error (i.e., a large percent of the population does not participate in the study) is an issue. Although I am confident in my sample estimates, specifically because my results align with other findings, I would be even more confident if my response rate had been higher. One reason for my low response rate could be because my survey was online; however, an online survey was unavoidable due to the current pandemic, COVID-19. Even though college students access their email often, COVID-19 has increased the use of email, which may have caused my email to become lost in some of the recipients' inboxes.

### CONCLUSION

This study used a random sample of undergraduate and graduate students at a small private Liberal Arts college, so the results can be generalized to all students enrolled at the college. The majority of respondents feel that life begins for a fetus at conception. The scenario in which an abortion would be used has a significant influence on whether or not the respondents agree or disagree with the use of abortion, which supports my hypothesis. Christian respondents are less supportive of abortion compared to non-Christian respondents and respondents who do not identify with a religious affiliation. Republican respondents are much less supportive of abortion in all ten scenarios compared to Democratic respondents.

While there has been a push to completely overturn Roe v. Wade, my study and other studies show that there are a number of factors that prevent this action from being the most representative of popular opinion. As shown in my study, abortion views fluctuate when one examines the scenario in which an abortion will be performed. The majority of respondents agree with the use of traumatic abortion. The majority of respondents disagree with the use of elective abortion. Asking about public views on abortion in various scenarios is beneficial because it allows policy makers to have more concrete ideas of how the United States population views abortion. My data displays that views on abortion fluctuate due to a variety of factors; therefore, policy makers must further examine the abortion views of United States citizens in order to create and/or remove laws that better reflect these views.

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\*Appendix: An online appendix is available for this publication at <https://www.lagrange.edu/academics/undergraduate/undergraduate-research/citations/index.html>

# The Importance of Audience in Jacobs's *Incidents* and Douglass's *Narrative*

Cary Burton

Faculty Mentor: Anthony Wilson, PhD  
Humanities, English

No story is ever written without the intent of being read; that is simply the nature of writing. No one writes a story or narrative without considering who is going to read a piece of literature, and, as with most things, any good piece of literature is meticulously crafted to deliver a very specific, targeted message to its audience. The audience is, whether directly stated or not, the driving force behind any work of literature.

Looking at slave narratives, this is doubly true. Historically, the narratives of enslaved people have been employed with a twofold purpose: firstly, to describe and visualize for 18<sup>th</sup>- and 19<sup>th</sup>- century audiences the atrocities of slavery; secondly, in relation to the first, to advocate for the abolition of the system of slavery. It is in this respect that we can see the relation to the audience. To deliver a powerful message that would influence its reader base to proactively seek out change in their local communities, authors of slave narratives had to have intimate knowledge of audience tastes.

The slave narratives *Incidents in the Life of a Slave Girl* by Harriet Jacobs and *The Narrative of the Life of Frederick Douglass* by Frederick Douglass perfectly personify the idea of specifically identifying, addressing, and catering to the intended audience. Douglass utilizes elements of romanticized violence and epic struggle to extract interest and empathy from a targeted male audience; in turn, Jacobs uses rhetoric similar to that of other women's literature of the time period, in that it is passive, focusing upon patience and endurance rather than on direct action to change circumstances. This initial target audience distinguishes both their style and approach to writing. However, what makes Jacobs's writing far more complex than Douglass's *Narrative of the Life* is that, unlike Douglass, while Jacobs's initial audience is other women from her era, specifically white Northerners, she has also structured her entire work, while not necessarily addressing a male audience, to match the expectations that men had at the time for the subject matter of women's writing.

Douglass released his slave narrative, *The Narrative of the Life of Frederick Douglass* in 1845, sixteen years before both the publishing of Jacobs's work and the start of the American Civil War. Douglass's *Narrative* is without a doubt crafted for a predominantly male audience and, considering the

time period, subject matter, and political nature of the piece, white Northerners. This is evident in both what Douglass writes about in his narrative and how he writes about events in his narrative. Douglass writes *The Narrative* like an epic; like *Beowulf*, *The Odyssey*, *The Iliad*, or *Gilgamesh*, Douglass utilizes violence, fate, and a journey to align his personal story of being enslaved and escaping bondage. By doing this, he seeks to appeal to a male, predominantly Northern audience that enjoyed these narratives of struggle and burden. Douglass employs this narrative style consistently throughout the narrative, but it is best seen in Chapter Ten, in which Douglass says, during an attempt by Mr. Covey to punish Douglass, "I resolved to fight; and, suiting my action to the resolution, I seized Covey hard by the throat; and as I did so, I rose.... He trembled like a leaf.... I held him uneasy, causing the blood to run where I touched him with the ends of my fingers" (Douglass 1203). This passage provides much to unpack about how Douglass employs both masculine language and violence in the pursuit of attracting his target audience. Like Odysseus standing up to the cyclops Polyphemus or Gilgamesh battling Humbaba, Douglass uses Mr. Covey as his monster to overcome; by setting up in the first half of the chapter the sheer vileness of Covey in his treatment of the enslaved people around him, Douglass is mythologizing his conflict with him. It transforms from a simple fist fight between two people to an epic clash of wills, a fight to determine whether Douglass will be willing to fight for his freedom, or wallow in needless pain and bondage. This would without a doubt have resonated with his contemporaries, in that Douglass has utilized this action to place himself on the same level as Odysseus, Beowulf, and Gilgamesh, a hero fighting against all odds. Furthermore, the way that Douglass describes his victory also adds to his heroic myth that he creates in order to build sympathy. After finally standing up to him, Douglass describes Mr. Covey as "like a leaf," as weakened and triumphed over. Overall, what this serves as is a prime example of how Douglass address his audience: by transforming himself into this epic mythical hero, he transcends the mundane and embeds himself in the minds of his audience. While he is a real person, his story isn't forgettable; it becomes memorable.



Jacobs's *Incidents in the Life of a Slave Girl* shares some similarities with Douglass's *Narrative* in that they are both slave narratives; however, the similarities start and end there. Jacobs's work differs from Douglass's work in language, action, and events, and this is due to the fact that she is not addressing the same audience that Douglass sought to address in his own narrative. Jacobs's audience is white female Northerners predominantly, and her goal, based upon the nature of the text, is to persuade them to advocate for the abolition of slavery, similar to Douglass. Where Douglass's text caters to a male audience, Jacobs's is the opposite, catering to a female audience instead. This is done through the use of passivity and endurance. Unlike Douglass's story of physical rebellion and almost mythological battles of willpower and strength, Jacobs's narrative is not one of constant direct confrontations, but rather an almost divinely-given endurance. This can be found throughout her work. In Chapter Ten, Jacobs says, "He hoped I had become convinced of the injury I was doing myself by incurring his displeasure. He wrote that he had made up his mind to go to Louisiana.... However that might be, I was determined that I would never go to Louisiana with him" (Jacobs 916). Jacobs's clashes with Dr. Flint stand in stark contrast with, for example, those between Douglass and Covey; rather than direct, head-on violence being utilized as an expression of rebellion and freedom, Jacobs expresses rebellion through passive means. Her narrative here becomes far more aligned with captivity narratives, the best example and the one sharing a common audience being Mary Rowlandson's. In Rowlandson's captivity narrative, the hallmark of her resistance to captivity is not in proactive physical defiance, but rather in a passive, inner resistance tied deeply to religion. As she says, "I have thought since of the wonderful goodness of God to me in preserving me in the use of my reason and senses in that distressed time, that I did not use wicked and violent means to end my own miserable life" (Rowlandson 273). As Rowlandson shows, like in slavery narratives, the basis of the strength of passivity is drawn from religious faith. These same themes, seen across a plethora of literature written to a female audience around this time, are also blatantly seen throughout Jacobs's *Incidents in the Life of a Slave Girl*.

However, beyond simply sharing a connection in that they are both slave narratives, and being distinctly different in that they primarily are designed to address a singular, distinct audience, Jacobs's text has an additional layer of complexity in the way that it addresses its audience that is not present in

Douglass's work. Unlike Douglass, who is, for the most part, addressing a male audience, along with her predominantly female audience, Jacobs also meticulously crafts her narrative to meet the male expectation of women's writing of the time. As Fanny Fern points out in her text "Male Criticism on Ladies' Books," "Is it in feminine novels *only* that courtship, marriage, servants, and children are the staple? Is not this true of all novels? ---of Dickens, of Thackeray, of Bulwer, and a host of others?" (Fern 899). As Fern perfectly articulates, the topics and nature of female literature, in the minds of men from the period, were to fit an expected, specific narrative. Jacobs wrote her narrative not only to appeal to women, but also so that it could be approved by whatever male audience might come into contact with the text and read it, thus boosting overall the amount of people the piece reaches. This showcases a complexity in audience understanding that is not present in Douglass's work.

Overall, there is a definite connection between Jacob's and Douglass's works, in that they are both authors of slave narratives who expertly identify and address their intended audiences by adapting each text to attract a specific demographic. Furthermore, when comparing their complexity of audience consideration and engagement, it is easily arguable that Jacobs clearly has taken far more steps to both acknowledge and engage a wider audience than Douglass has taken.

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# A Review of the Effects and Changes in Air Pollution in the State of Georgia

Katie Farr

Faculty Mentor: Laine A. Scott, PhD  
Humanities, English

## Abstract

This report examines how air pollution has affected the state of Georgia over the years, specifically since 1990. Although Georgia began a fight against air pollution in the early 20<sup>th</sup> century, it was not until the Clean Air Act was passed by the federal government in 1970 that real changes began to take place and air quality started to improve consistently. Since then, it has only become clearer how harmful the effects of air pollution can be on the human body as well as on the environment. Pollutants can cause serious respiratory and cardiovascular issues when inhaled, even in small concentrations. Moreover, poor air quality is a major contributor to environmental issues such as climate change and pollen count. Even though pollution in Georgia has decreased since 1990, it is still not at a healthy level in several regions. Therefore, it is important to continue to strive for advancements until the whole state consistently maintains healthy air.

## Introduction

### Background

Air pollution has been an issue around the globe for centuries. However, it was not always understood as the problem that it is. In Rome, air pollution was called *gravioris caeli*, which translates to “heavy heaven.” It was considered part of Rome’s charm, along with the noisy streets and tremendous wealth. Air pollution was a concern wherever wood was burned and craftsmen worked. When the Industrial Revolution began, air pollution became even more prevalent. It caused serious health issues, but no one attributed those health issues to the rise in the use of products such as coal. Many people saw those products as a solution to air pollution. Moreover, in many of the large, industrial cities, smoke was symbolic of wealth and progress (Kovarik).

It wasn’t until the turn of the 20<sup>th</sup> century that people began to realize the effects that their actions were having on air quality. In 1915, the state of Georgia filed a suit against the Tennessee Copper Co., claiming that their Copper Basin smelters were causing environmental problems and health issues on the Georgia border. As a result of this case, the federal government ruled that sulfur and other toxic emissions could be limited (Kovarik).

In 1970, the air pollution issue took a drastic turn when the Clean Air Act was put in place. This act involved the beginning of federal regulation of the major air pollutants as well as the creation of National Ambient Air Quality Standards

(NAAQS). States were to implement individual strategies to reach NAAQS by a specified date (“Air Quality Act”).

### Problem

Air pollution is of serious concern regarding human and environmental health in the state of Georgia, but it is often overlooked since it is not always visible (“Air Quality Policy,” 2019). About 200 pollutants have been identified across Georgia (“Learn About Air”; “Georgia’s Air Monitoring”). While air quality has improved overall since 1990, it has begun to decrease again since 2016, and Atlanta still ranks as one of the U.S. cities with the top air pollution numbers, suggesting that Georgia’s air quality policies may need to be revisited in order to continue striving for improvement (“Facing the Facts,” 2005; Miller, 2019; Rhone, 2020).

### Purpose

The purpose of this report is to show how air quality in the state of Georgia has changed over the past 30 years. Following the guidelines set forth by the Clean Air Act as well as Georgia’s own air quality policies has positively impacted air health. However, future actions should be taken to further increase the air quality in Georgia.

### Scope

This report examines issues surrounding air pollution in the state of Georgia and how air pollution has changed in recent decades. It suggests future changes that could be

implemented in order to decrease air pollution more and reverse the negative changes that have appeared in the past several years. Understanding these issues and implementing the changes suggested can lead to an increase in air quality along with a decrease in lung disease and ozone deterioration.

## Discussion

### Causes

There are several common factors to blame for the prevalence of air pollution. It is often caused by the use of energy by industries and manufacturing companies. Many industries burn fossil fuels for energy, which releases particles and gases into the atmosphere (Mackenzie, 2016). Driving is one of the leading causes of air pollution. Particles that enter the air from vehicle exhaust can be full of heavy metals that can cause cancer (“Air Quality Policy,” 2019). Air pollution is typically worse in heat, meaning that Georgia summers may be even more dangerous. Moreover, air pollutants such as carbon dioxide can further increase the Earth’s temperature, creating a cycle that can lead to consistently worse effects of pollution if strict regulations are not maintained (Mackenzie, 2016).

### Environmental Concerns

One major environmental concern that is a result of air pollution is climate change. The Earth’s ozone layer helps regulate the amount of ultraviolet radiation that enters from the sun (“Air Pollution”). When air pollutants are released into the atmosphere, they can cause heat from the sun to be trapped on Earth, leading to higher temperatures (Mackenzie, 2016). They can also cause chemical reactions in the ozone that can destroy that layer of the stratosphere. Man-made ozone depletion takes place faster than natural ozone creation, leading to less protection from ultraviolet radiation and further increase of temperatures on the Earth (“Air Pollution”). The pollutants that cause warmer temperatures are known as greenhouse gases. Carbon dioxide and methane make up the majority of greenhouse gases. Carbon dioxide is released when fossil fuels are burned, a common practice among industries. Methane is released by other industrial practices, such as drilling oil (Mackenzie, 2016).

Climate change is also expected to lead to an increase in harsh weather conditions such as hurricanes, floods, droughts, and wildfires. It causes changes to the oceans, increasing sea level and the amount of acid in the water (Bai et al. 2018; Mackenzie, 2016). These environmental issues could lead to food scarcity in certain regions of the world, leading to further health problems and even death, and may cause political and trade issues for the United States in the process. The environmental damages caused by climate change over the years have already caused serious economic loss for the United States, along with the natural harm to various ecosystems (Mackenzie, 2016).

Another environmental concern impacted by air pollution is the increase of allergens produced by carbon dioxide consuming plants. Studies show that plants that grow in a carbon dioxide rich environment produce significantly more pollen than do trees in an environment with good air quality. This means that on top of the health effects caused by breathing air pollution itself, people suffer more pollen allergy symptoms such as runny noses and fevers (Mackenzie, 2016).

### Health Concerns

Research shows that air pollution is positively correlated with heart disease and risk of lung cancer as well as other serious health issues (“Facing the Facts,” 2005). When the NAAQS were set in 1970, six main pollutants were identified, and limits were set in order to regulate emissions. The six pollutants were carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter, or PM (Anderson, Thundiyil, & Stolbach, 2012). Each of these pollutants can cause serious health problems after entering into the lungs.

For example, PM is “a complex mixture of extremely small particles and liquid droplets made up of acids, organic chemicals, metals, and soil or dust particles” that can be created by industries and machines (Anderson, Thundiyil, & Stolbach, 2012). Inhalation of PM has been associated with atherosclerosis due to inflammation as well as heart attacks. It can also cause the development of blood clots, which leads to coronary artery disease. PM can also lead to oxidative stress and asthma (Anderson, Thundiyil, & Stolbach, 2012). Moreover, ground-level ozone can cause lung and trachea muscles to constrict, resulting in air trapped in the lungs. This can lead to a variety of symptoms, including shortness of breath, coughing, and infection (“Health Effects”).

People with preexisting cardiovascular or respiratory illnesses are more susceptible to the negative effects of air pollution. Children and the elderly are also at a higher risk for adverse effects (“Annual Report,” 2019; Pope 3<sup>rd</sup>, 2000). When ground ozone levels are higher than usual in Atlanta, emergency room visits increase significantly (“Facing the Facts,” 2005). In addition, hazardous air pollutants (HAPs) can cause cancer (“Learn about Air”). It is estimated that 800,000 early deaths each year are due to air pollution, making it the 13<sup>th</sup> most common cause of death in the world (Anderson, Thundiyil, & Stolbach, 2012). Surprisingly, these deaths are not always a result of long-term exposure to air pollution. Acute exposure to heavily concentrated pollutants can cause serious health problems as well and often leads to fatalities (Pope 3<sup>rd</sup>, 2000). Moreover, studies suggest that even lower levels can lead to health problems in the healthiest people (“Air Quality Policy,” 2019).

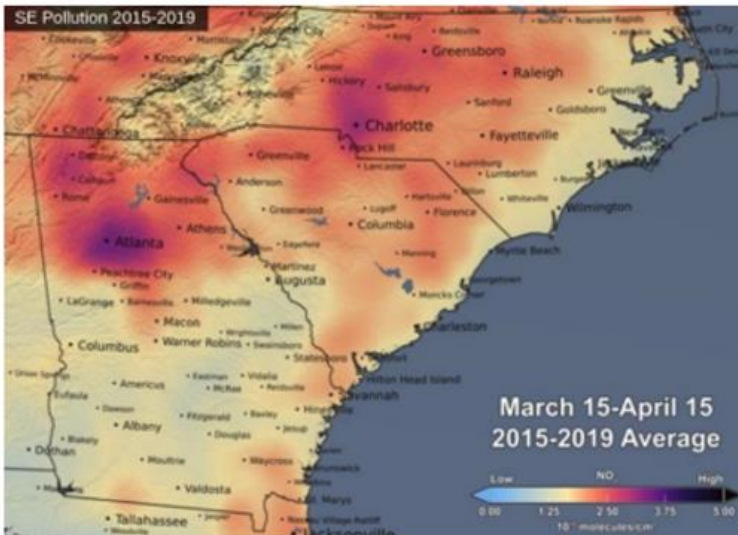


Figure 1. *Source: Dunston, Mike. (2020) Coronavirus closures cause big drop in Georgia pollution. CBS46.*  
[https://www.cbs46.com/news/coronavirus-closures-cause-big-drop-in-georgia-pollution/article\\_621636be-8a80-11ea-93db-a78f8866cf5e.html](https://www.cbs46.com/news/coronavirus-closures-cause-big-drop-in-georgia-pollution/article_621636be-8a80-11ea-93db-a78f8866cf5e.html)

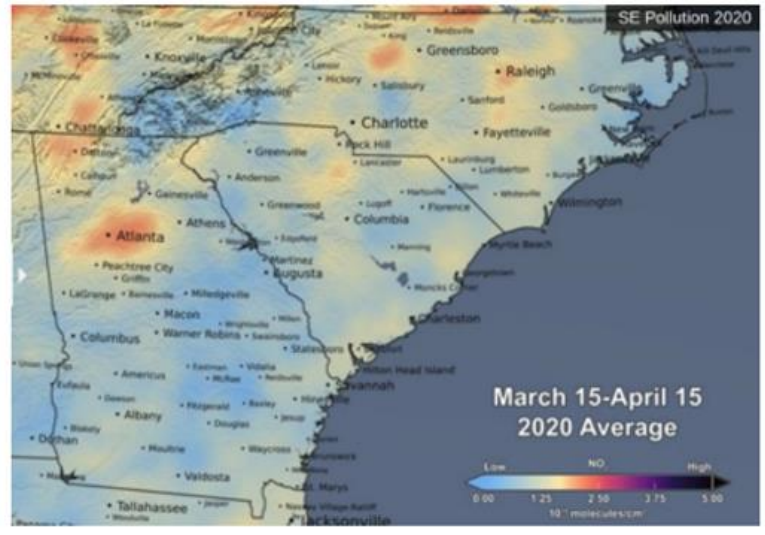


Figure 2. *Source: Dunston, Mike. (2020) Coronavirus closures cause big drop in Georgia pollution. CBS46.*  
[https://www.cbs46.com/news/coronavirus-closures-cause-big-drop-in-georgia-pollution/article\\_621636be-8a80-11ea-93db-a78f8866cf5e.html](https://www.cbs46.com/news/coronavirus-closures-cause-big-drop-in-georgia-pollution/article_621636be-8a80-11ea-93db-a78f8866cf5e.html)

### Effects of Quarantine (COVID-19)

A recent Harvard study has linked areas with more air pollution to a greater number of COVID-19 related deaths. The study included a sample of over 3,000 counties in the United States and found a positive correlation between small particulate matter (PM-2) particles in the air and COVID-19 death rates (King, 2020). This is likely due to the fact that breathing in pollutants harms the same parts of the body as COVID-19, worsening the overall effects of the virus (Rhone, 2020).

However, a drastic change in air quality in the state of Georgia has been noted as a side effect of the shelter-in-place order made on April 2. Even before the order, people were beginning the practice of “social distancing,” choosing to remain at home when possible and avoiding large gatherings. Some businesses and industries began to cut back on hours, while others shut down completely. Then, with the administration of a shelter-in-place order, the rest of the state was forced to shut down, causing traffic to reduce immensely. This decrease in travel and energy usage has led to a significant reduction of nitrogen dioxide, a common pollutant that comes from vehicles, plants, and industries (Rhone, 2020). There has also been a decrease in ground-level ozone in several Georgia counties, such as Cobb, DeKalb, and Fulton (Dunston, 2020). Images from NASA show the average air pollution from 2015 to 2019 in Figure 1, while Figure 2 shows the decrease in air pollution during the April 2020 shelter-in-place order (Dunston, 2020).

The sudden decrease in air pollution will likely be short-lived, though, since pollutant numbers are expected to

rise back to normal levels as soon as travel restrictions are lifted (King, 2020; Rhone, 2020).



Figure 3. Georgia's Air Monitoring Program. *Ambient Air Monitoring Program.*  
<https://airgeorgia.org/georgiasairmonitoringprogram.html>

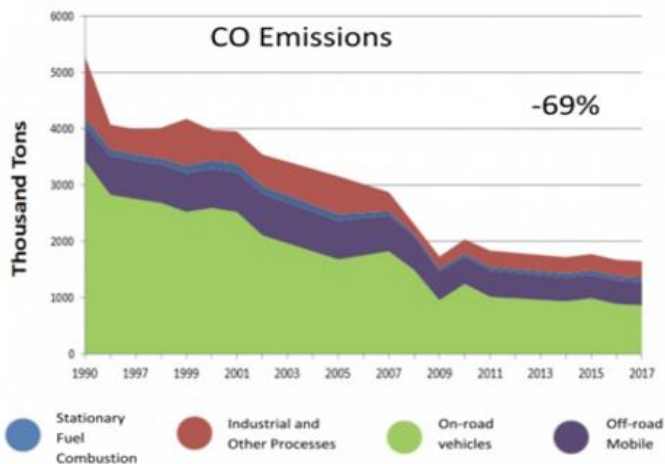


Figure 4. Source: Georgia's Air Quality Trends. Environmental Protection Division. <https://epd.georgia.gov/outreach-educational-programs/georgias-air-quality-trends>

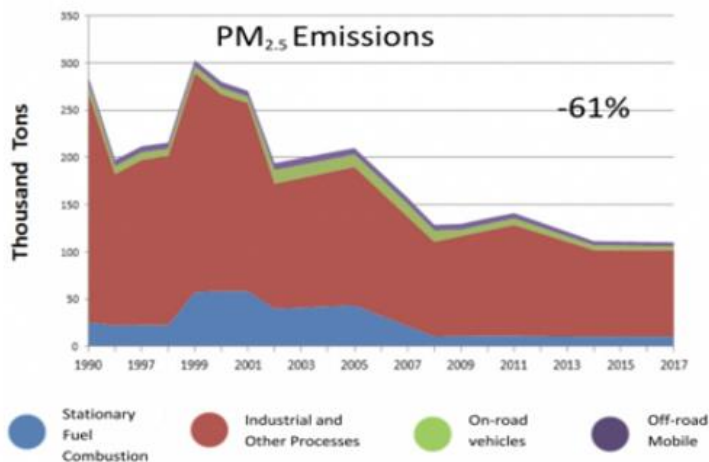


Figure 5. Source: Georgia's Air Quality Trends. Environmental Protection Division. <https://epd.georgia.gov/outreach-educational-programs/georgias-air-quality-trends>

## Interventions

The Ambient Monitoring Program (AMP) of the Georgia's Environmental Protection Division's (EPD) Air Protection Branch monitors air quality in about 40 different places across the state of Georgia. Figure 3 shows where these monitors are located. AMP collects data from each monitoring site and tests the air for pollutants. The data is then published for public use within a live map. This information is also used to alert the public when pollution levels are especially high and dangerous ("Georgia's Air Monitoring").

The Mobile and Area Sources program within the EPD regulates vehicle emissions as well as area emission sources. It also enforces the inspection and maintenance of vehicles. The Stationary Source Compliance Program and the Stationary Source Permitting Program of the EPD oversee stationary sources of emissions and work to ensure that they remain within state and federal guidelines ("Air Branch Programs").

## Recent Trends

Air quality has greatly improved since 1990, but it is still not at a healthy level in many regions of the state of Georgia. Each of the six main air pollutants has been significantly reduced. Carbon monoxide emissions have decreased by 69%, as shown by Figure 4. Nitrogen oxide emissions have decreased by 60%. Particulate matter (PM<sub>2.5</sub>) emissions have decreased by 61%, as shown by Figure 5 ("Georgia's Air Quality Trends"). Figures 6-9 depict data for the four other main air pollutants: particulate matter, nitrous oxide, sulfur dioxide, and volatile organic compounds.

According to the American Lung Association's "State of the Air" report, Atlanta had the 25<sup>th</sup> highest ozone level in the nation. However, in the 2020 report, Atlanta has improved and now has the 33<sup>rd</sup> highest ozone level in the nation. Augusta

also saw similar improvements in ozone levels ("Georgia's Air Quality Improved," 2020).

The Clean Air Act is the primary reason for these impressive overall reductions in air pollution. This federal intervention led to increases in controls over smokestacks and fuel usage, as well as to the initiation of practices and guidelines specific to the state of Georgia. However, the Clean Air Act does not include policies regarding actions such as people's typical preference for driving instead of using transits, walking, or riding bicycles. Therefore, further reducing air pollution has proven challenging, meaning that Georgia should continue to strive toward cleaner air ("Air Quality Policy," 2019).

## Conclusion

Air pollution has been a serious concern for the state of Georgia for many years. The situation has greatly improved since Georgia's suit against the Tennessee Copper Co. in 1915 and the approval of the Clean Air Act in 1970. Overall, pollutant levels in Georgia have dropped significantly over the past 30 years, but it is clear that even the smaller amount of pollution in the air today is having an effect on the environment and human health. While previous research already supported the idea that a reduction of vehicle emissions can decrease air pollution, the current shelter-in-place in Georgia is providing more evidence that the idea is true. Unfortunately, any improvements that have occurred due to the shelter-in-place order are likely to reverse once the order is completed and all social and work contexts return to normal. Current intervention

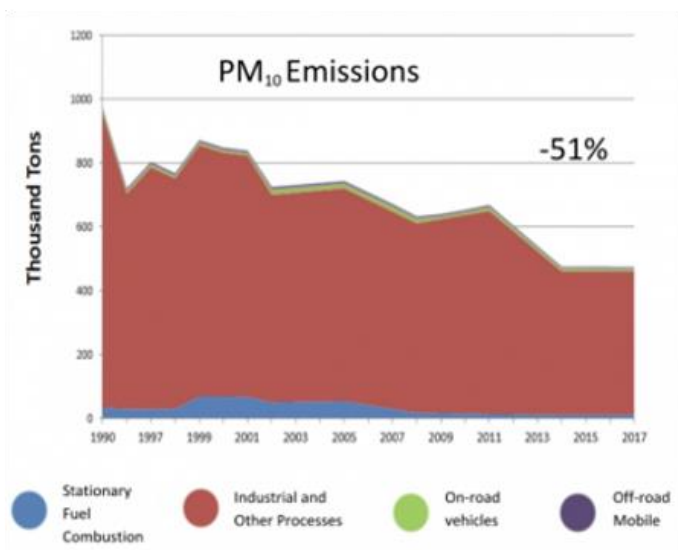


Figure 6. Particulate Matter (PM10)

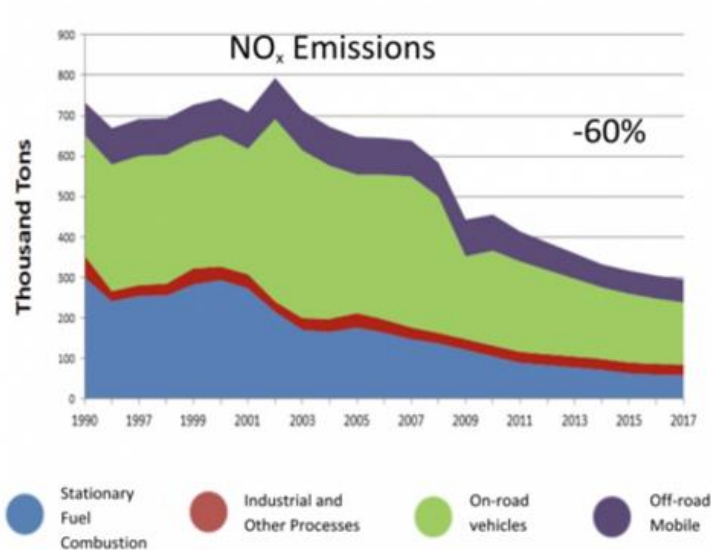


Figure 7. Nitrogen Oxide Levels 1990-2017

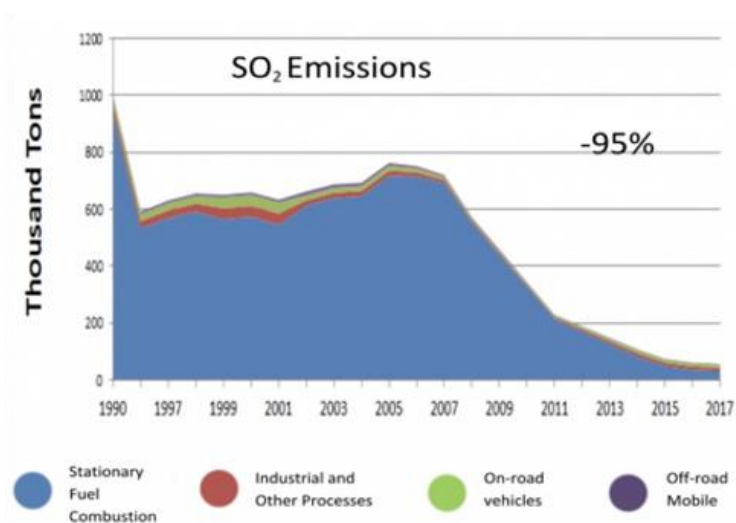


Figure 8. Sulfur Dioxide Levels 1990-2017

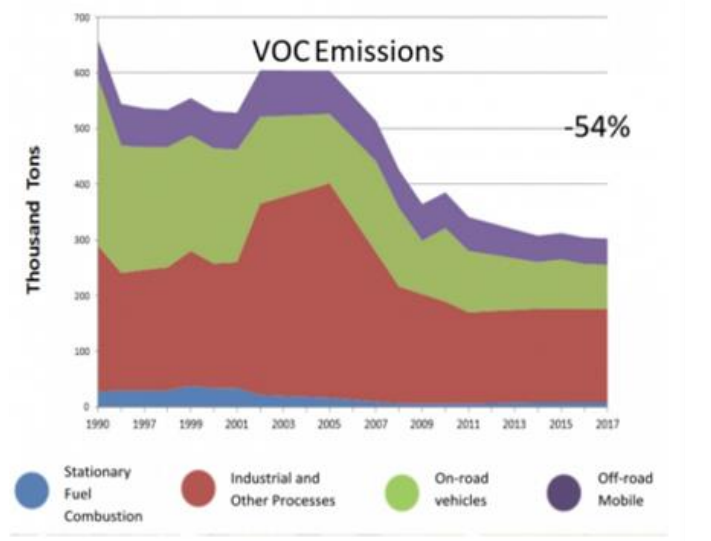


Figure 9. Volatile Organic Compound Levels 1990-2017

Source: Georgia's Air Quality Trends. Environmental Protection Division.  
<https://epd.georgia.gov/outreach-educational-programs/georgias-air-quality-trends>

plans are certainly helping reduce air pollution, but there are still several areas of life that are challenging to change. Activities such as driving as well as pollution-producing industries are top causes of the unhealthy air that still exists today. It is important to continue working on new intervention plans that address these issues until the air quality in Georgia reaches a healthy, stable level.

### Recommendations

One step that the state of Georgia can take in order to address the issue of air pollution is to implement an education plan. Unfortunately, many Georgia residents are unaware of the damages that even acute exposure to pollutants can cause ("Air Quality Policy," 2019). Many residents may not even

realize that the air they are breathing is unclean at all. Several organizations such as Georgia's Clean Air Force and the Georgia Conservancy are already taking steps to increase awareness about air pollution. However, these organizations are not reaching across the state like a middle school or high school education plan would. I suggest implementing a public-school program that would reach every public school in the state and begin educating children and adolescents while they are still at such an impressionable age.

For people already in the workforce, awareness campaigns should be increased and prioritized in the state. Providing education could be a great way for Georgia residents to understand their impact on the air quality in their home state and encourage them to make healthier decisions, such as using

transit systems more often. These campaigns should also encourage people to stay updated on air pollution levels so that they can avoid going outside on heavily polluted days.

I would also suggest continued and even increased funding for research on the causes and effects of air pollution. Much has been learned about air pollution, but there is still much left to be learned. New research may be able to direct us toward more effective strategies for reducing pollution. Moreover, new monitoring technology can help reduce the cost of monitoring air pollution while providing accurate data to keep Georgia residents informed (“History of Air Pollution”).

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# Ode to Trees

Mary Helen Jeffreys

Faculty Mentor: Patricia Marchesi, PhD  
Humanities, English

I love trees—the trusty plant can brighten my low-spirited and dull days. For that trees more than provide; they guide. I notice them at every place. Trees are steady; they never change.

Observance of the free, billowing, friendly trees which stand beyond my view regardless of rain or shine bestows quiet wisdom, peace, and comforting friendship. Beautifully tall, sturdy bunches of trees rest like patient people in a long line at a store past the outside my window, quietly living despite standing still. In my backyard, birds of varying kinds perch on the branches of strong cedar trees. Yesterday there was a single bluebird upon the limbs of the tree. Today there are many. Often, I realize from observation, the birds will have ventured to soar above the various trees. *Acer palmatum* stands in a bed of pine straw in the middle of spacious grass between houses. *Quercus* blooms around it, spread out amid the lawn. Small flecks of green sway gently from the ends of its long limbs. Leaves—the food source for trees—fall onto the blades of vibrant grass, floating to extend across the turf to lie gently in a wide array upon the grass, upon the roofs of neighboring houses, upon the pavement.

“Nourish Me!” I say to myself as I watch the lovely tree that has been swaying during several bursts of wind. The sun must have forgotten to shine its light today. I don’t resist stopping to let the shawl-like breeze pass over us.

Occasionally, while living at my childhood home, I gazed upon a pond that dwelled across the street from my house. Its tranquil waters were often the comforting home to geese, even though they encountered predators like foxes and often were intruded upon by noisy, reckless golfers with varying degrees of success in hitting their target. The small pond was so surrounded that it rarely kept the little goslings from encountering golf balls that skimmed at the surface. Such frequent nuisance was oddly comforting but still annoying. A rugged tree acted as shade on the water, as covering for the geese. I was content to watch this small section of life, happy a piece of the world provided harmony, beauty, and activity. Though I no longer live at that place, I remember the view of the tree on the pond. I imagine the shine of the sun, close my eyes, and wistfully reminisce about the reflections of the tree on the pond.

Thinking about the wonderous legions of trees that stand gallantly outside my window, I nevertheless worry about

their future, a bright future that is dampened by the effects of climate change. So often there are distressing tales of the loss of trees and the destruction of forests; I wonder if these magnificent creations of nature that have always surrounded us will be damaged beyond repair.

This past year, wildfires spread throughout the New South Wales region of Australia and burned up to 11 million hectares of land. The fire’s mass destruction meant that firefighters from Australia and around the world needed to come and help get rid of the deadly flames. Persistent heat and droughts helped exacerbate the fires, and climate change made it worse.

When I was younger, my family and I would travel to see my grandparents in a small town in South Georgia. Frequently, in the car, I’d look out the window to watch the trees and the sun, which was always shining yet not overpowering, between the gaps in the trees. It was the prettiest sight I’d seen. Every time, I’d lean my head against the window to watch the trees pass by for the long hours we were in the car.

Those steady, beautiful, blinding glimpses of light behind the trees are as precious to me as the resources they give off. Just like a breath of fresh air, I lovingly appreciate the flashes through the trees, the moment of peace, and carry it with me in my everyday moments.

Trees serve within a variety of ways all over the world. The resources produced by trees—many physical products like apples and oranges, as well as intangible oxygen—are extremely invaluable. As long as there are trees in the world, the world is plentiful and will remain nourished as each new generation takes care of the natural world.

I marvel at the way trees in their natural state of being give so much for us to live and grow without wanting in return, just existing as providers and keeping us safe, just absorbing all our pollution and toxic chemicals. But sometimes I wonder if we do enough to help them in return. Similar to the lives of humans, trees exist every single day, slowly changing more or less, as life goes on. Yet, the trees will be destroyed to become materials for us to use. I wonder if it is enough to watch the trees grow, just to observe and admire. The more I think about it, the less I think so; the need to plant, to renew, lies beneath, to sustain the earth so that new trees can come to be marveled.

Thankfully, there seems to be a glimmer of hope for my beloved trees. People pay attention to the fire which harms,



or at worst destroys them, ready to lend a helping hand to save them, whatever is left, like a friend helping a friend, in need. There resides a recognition that our lives depend on one another, us and the trees: that we rely on each other to survive and live better together.

During the lonesome and anxious lockdown because of COVID-19, my window and its view provide solace despite sickness and death around the world, allowing a small, precious moment that encourages beyond the presence of uncertainty. The lively trees outside my room inspire me every time I watch them. Like many others, I experience interactions outside of my home sparingly. It is the most bothersome part of self-isolation. When I look at my neighbors the trees outside, the way some people watch their human neighbors, it is as if a wave of reassurance and contentment has come pouring out of the trees, like a comforting hug, to remind me of the precious nature of being. Trees live upon the earth while humans and

animals perish in different spots around the vast world we share as a collective. Trees are outliving us all. They survive horrible tragedies. They endure in the toughest of environments amongst hurricanes and floods. Trees act as nobly still as we are acting now staying home together, a single person alone, a marvelous forest together, trying to continue.

In my life, I have experienced a disconnect with nature a lot. And it's only lately, through looking to view outside of my window, that I've been able to appreciate the all-knowing wisdom and prolific guidance provided by the trees. It seems to me that the example of trees to exist in rain or shine offers cherished insight. People who survive keep going through hard times. Trees each day grow and bloom, not caring about the environment. They stay strong, waiting for the sun to come around to them. Like the enduring, noble trees, my life waits for the storm to pass, even as it may last for a while.

# Kimmerer and Oliver's Views on Fellowship

Jayne Middleton

Faculty Mentor: Patricia Marchesi, PhD  
Humanities, English

Fellowship is often seen as a very human trait. Humans are programmed to be social creatures, building on a give and take style of relationship between each other. It is a friendly feeling between people who have a common shared interest, or a group of people with the same purpose. While these definitions are usually seen in light of human groups, such as fellowship at a church between congregational members or fellowship between friends, this can also be applied to the relationship between humans and nature. There is a mutual reciprocity between humans and the natural world, and this can be seen in humans' daily interactions with the outside world.

Often, fellowship is only considered to be a type of relationship, but it can be strengthened by gifts. This is the stance that Mary Oliver and Robin Wall Kimmerer take on the idea of fellowship in nature. They approach the ideas differently. Kimmerer tends to focus on the idea of gifts in their typical connotation, while Oliver focused on the gifts we can gain from the act of fellowship itself. While they look at the ideas of gifts differently, they both seem to focus on the same few relationships and types of gifts: relationship with gifts, the gift of thanks, the gift of well-being, the gift of education, and the gift of motherhood. Both of these authors present fellowship throughout their works, often using the idea that fellowship is given through gifts, both tangible and intangible.

Kimmerer focused on her relationship with gifts with the idea that relationships are fostered by the giving and receiving of gifts. This led to the knowledge that humans have a relationship with all things, in some sense. Eskildsen writes, "The people she refers to includes more than humans. For many indigenous nations, 'people' also refers to the many-legged, the winged, the finned, and those who just slither along...By calling them *people*, they are no longer *things*, but our relations." Kimmerer builds off of this idea that all things are a relation to humans in some sense and should therefore be treated as another living being that can be fellowshipped with. The maples of the Maple Nation fellowship with humans by offering their sap and providing wood. Lakes fellowship by providing peace and water. Humans fellowship by taking care of nature in return. This creates the unique reciprocity between the two worlds. Part of this may be fueled by the fact that "When we receive a gift from someone, it changes our relationship. We may feel obligated by social norms to return the favor, or we may feel a heartfelt desire to give something

in return, to show we value the relationship" (Eskildsen). Either way, that cycle of gift giving is Kimmerer's basis of fellowship.

Oliver considers the idea of gifts outside of their normal connotation, instead choosing to apply the idea of fellowship more literally. Instead, she writes about the importance of the relationship aspect of fellowship with nature. She emphasizes the importance of connecting with nature on a semi-spiritual level, often using nature as a pattern to follow in order to pursue happiness. In her writings, it is reflected that she feels she inherited her responsibility to nature from her ancestors but learned how to do so from other writers, such as Whitman and Emerson. Oliver also writes that while she did get gifts from nature, but her main reason for fellowship was to make a connection with natural found delight.

Kimmerer approaches the gift of thanks from fellowship based on the idea that people should thank the world regularly, including each part of it. This can be seen especially in "Allegiance to Gratitude." Kimmerer tells the story that students are required to recite the allegiance of gratitude of the Onondaga Nation. They say a pledge of thanks to everything in their life, including Mother Earth, the waters of the world, fish, plant life, berries, the Three Sister plants, medicinal herbs, trees, and animals. Each of these parts of nature are recognized as members of the world, circling back to Kimmerer's theme of fellowship in terms of giving and taking from each other. Kimmerer writes, "Each person, human or no, is bound to every other in a reciprocal relationship. Just as all beings have a duty to me, I have a duty to them" (115). This duty can be seen in the idea of an honorable harvest. This type of harvesting is all about what one can give in return to nature as a measure of thanks. People living in the maple nation do this by using what they have with wisdom and not taking more than they need. The Pigeon people do not waste a single scrap from the black ash tree they use to make their baskets. It can even be seen in the cleaning of the pond behind Kimmerer's house that provides peace and sanctuary.

Mary Oliver approaches the idea of thanks in terms of devotion. She writes, "Attention is the beginning of devotion" (8). Devotion is the ultimate form of thankfulness, since it means that there is a constant stream of attention and understanding for that object. In Oliver's case, that devotion is aimed at nature. Her idea is that if humans devote themselves

to nature and its preservation, they have no better way to effectively say thank you to the world that provides so willingly. Oliver extends this devotion of thankfulness to the things in nature that have somehow passed under the radar. This is seen in her writing, *Ponds*, "Most of these ponds have traditional names. Those without, I have named. Why not? The ponds are uprisings from the water table, shallow and shape-shifting as sand from the dunes blows into them, creating mass here, causing the water to spread" (42). Oliver shows that by giving native things names equates to giving them power. It also shows a respect for nature and an amount of devotion given to the things which might have otherwise been forgotten. This is the ultimate form of thankfulness in Oliver's eyes.

The gift of well-being is also a theme between these two authors. Kimmerer points out that if humans realize other things are people, or at least members of the world in the same way, they are better able to grasp the concept of providing well-being to nature. She highlights this idea in "Maple Nation," where she writes, "My Onondaga Nation neighbors call the maple the leader of the trees. Trees constitute the environmental quality committee...They're on every task force, from the historical society picnic to the highway department, school board, and library. When it comes to civic beautification, they alone create the crimson fall with little recognition" (169). If people were to consider the maples, the streams, or the animals as a member of the community, they would better be able to grasp the idea of how to give better well-being. They could even follow the rules of the Maple Nation sap workers: waste nothing unnecessarily, keep the forests intact so they can continue to provide, take what you are given and treat it correctly. By maintaining the honorable harvest and rules of the Maple Nation, humans are able to better learn how to provide the gift of well-being back to nature, the same way it is provided from nature.

Mary Oliver writes on how we can take care of nature and its inhabitants as well, specifically in the sense of the animals. Part of a fellowship relationship is taking care of one another, not simply being taken care of. As nature gives to humans, they give back by using sustainable energy or resourcing, as well as protecting and caring for the hurt animals they may come across. Oliver writes about the day she brought home an injured black-backed gull. She took it in, giving it water and food. She notes, "M. and I talked to it, it looked at us directly. It showed neither fear nor aggression, and we sensed quickly that it did not like to be alone" (128). The bird was not left alone much as Oliver attempted to nurse it back to a health where it may live on its own. They took care of the bird by inventing games for it, drawing things for the gull to peck at, throwing feathers for it to catch, playing in water with it. However, she knew the inevitable would happen and that the gull would die. Even though she knew that her attempts to help the bird would be futile, Oliver insisted that her way of providing well-being would be to give the gull as long of a life as she could while maintaining its entertainment with the

various games. This way her way of providing the gift to one of nature's members.

Kimmerer believes the gift of education is required for the reciprocal nature of humanity's relationship with the natural world. She wrote, "If an animal gives its life to feed me, I am in turn bound to support its life. If I receive a stream's gift of pure water, then I am responsible for returning a gift in kind. An integral part of a human's education is to know those duties and how to perform them" (115). By being educated on the workings of nature and the inner relationships between the other members of it, humans are able to effectively give back that gift of well-being. And humans learn this education by observation. This can be seen in her writing, *The Teachings of Grass*. As she leads her student on this case study of sweetgrass and its growing habits, she combines her two loves, nature and science, in a way that both can benefit. This education was helpful to the native tribes that use sweetgrass as part of their culture, showing that through compensatory growth, the sweetgrass is thriving. It supported the old ancestral advice that if one does not take more than they need, then nature will continue to provide.

Oliver approaches the idea of education from nature from a spiritual standpoint. Heitman noted, "She finds the most durable connections with the divine in the woods, a bond forged more through intuition than formal logic." She does not focus on the education humans get from nature considering the logistics and traits that can be used to best survive, instead on more of an idea of how to mirror nature in order to live the best life humans are capable of. By mimicking things in nature, from a fox to an adopted dog to a spider, humans can learn how to best approach a lifestyle ensuring happiness. All things and members of nature can be teachers, if only one looks closely enough. However, this knowledge of nature is not only to be used for survival. Oliver writes, "The palace of knowledge is different from the palace of discovery, in which I am, truly, a Copernicus. *The world is not what I thought, but different, and more! I have seen it with my own eyes!* But a spider? Even that? Even that" (125). The knowledge gained from nature is more of a spiritual type of discovery rather than the logistics of a simple education.

Finally, the gift of motherhood is provided by nature. Of course, this is an obvious statement in the sense of science and the workings of the world. This gift is the ultimate link between the previous three, and it links humans with the ultimate over-arching idea of Mother Nature. As a mother, it is an inherent instinct to want a relationship with the offspring. Mothers want their child to be healthy and happy, and they want to teach the child the important parts of life, while also letting them learn on their own. In the human version of maternity, there is the reflection of the gifts nature provides and the gifts a mother provides her young. In order to take care of future generations, humans have to take care of the earth now. This is the best way a person can prepare their child for the world, succeeding and fulfilling the ultimate goal of a mother.

This is the success of the fellowship all humans and beings on earth can relate to.

Kimmerer has a continuous theme through her writings that instills the ultimate goal but also the saddest part of maternity. A mother doing her best job is preparing her child to eventually leave and stand on their own. This is a parallel of the fact that Mother Nature does her best job to give humans what they need in order to succeed. This can be seen in the gift given by showing native ancestors the three sister plants, or by the fact that humans have always been able to observe nature in order to learn. This even comes from the very idea that Skywoman brought down the world from the heavens and was pregnant at the time. Mothers give love through lessons, and Mother Nature does the same. Humans have always found a type of maternal love in nature, and it can be seen by watching the mothers of other animals.

Oliver approaches the idea of maternity in a similar way to Kimmerer. She agrees with the fact that humans can learn maternal values from even the smallest creatures in nature. This is highlighted in her essay *Swoon*. By observing the spider in the stairway closet, Oliver observes the pattern of motherhood this small creature takes part in. One part of this story that sticks out is the fact that the male is seen, but he takes no real part in the cycle of the offspring. While it takes two to mate in any species that reproduces sexually, it is always the mother that is seen and observed. This shows that it is mothers who are the ones held more responsible for offspring, but the fellowship between these two creatures is interesting as well. Oliver points out that the male of the species does not have the biologic makeup necessary to spin webs in order to catch food. This shows that the mothers are the ones that are more capable for caring for the offspring. Oliver takes this as lesson in motherhood by observing the fellowship between the male and

female species of various species. And Oliver offers her own gift of fellowship by employing the idea that the best way to care for something might just be to leave it alone and let it live in peace.

Both of these authors approach the idea of fellowship in their own way, but they also tend to follow the same trends. They look at fellowship with nature as a relationship of reciprocity, where gifts are exchanged in terms of well-being, education, and motherhood. With these writings, readers can begin to understand how a fellowship with nature might impact more than just daily living styles or health effects. Nature has a way to balance mental behaviors, lessons for how to interact with others, human or not, and shows ways that women can grow as mothers, while also showing that motherhood is a lasting way to take care of the world.

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# Overcoming the OCD Myth

Madison Murphy

Faculty Mentor: Laine A. Scott, PhD  
Humanities, English

Many people have misconceptions about Obsessive-Compulsive Disorder (OCD). People often believe that someone has OCD if the person is extremely organized and keeps everything that surrounds him or her clean; however, OCD is much more than that. Understanding what OCD truly is helps prevent people from classifying someone as having OCD when they more than likely do not. Informing people of the correct definition of OCD will help decrease myths about the disorder, such as the myth that people with OCD are “neat freaks.”

OCD means that a person has obsessions and/or compulsions on a daily basis. The fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)* defines obsessions as intrusive and unwanted thoughts, urges, or images; a person must try “to ignore or suppress such thoughts, urges, or images, or to neutralize them with another thought or action” (American Psychiatric Association). The thoughts or actions that a person uses to neutralize their obsessions are compulsions. Compulsions are the repetition of a behavior or mental act that someone feels they must complete in order to satisfy their obsessions. People engage in compulsions hoping to prevent or reduce feelings of distress or to prevent an unwanted scenario; however, the compulsions either are clearly excessive or else have no realistic connection to preventing a certain scenario or emotion. People with OCD experience obsessions and/or compulsions so intensely that it prevents them from engaging in daily activities.

Many people have thoughts and complete actions that resemble OCD; however, in order for a person to have OCD, his or her symptoms must meet the criteria for the disorder. According to the *DSM-5*, a person must identify with four diagnostic criteria in order to be clinically diagnosed with OCD:

- (a) The patient experiences obsessions and/or compulsions daily,
- (b) the obsessions and/or compulsions occupy at least one hour a day, cause distress, or interfere with important areas of functioning (e.g., social or occupational),
- (c) the symptoms are not effects of a substance (e.g., medication or drugs) or a different medical condition, and

- (d) the symptoms cannot be better explained by a different mental disorder (e.g., hoarding disorder or generalized anxiety disorder).

The diagnostic criteria for OCD provide guidelines to help correctly identify people who have OCD.

There are many scenarios where “normal” people engage in thoughts and actions that someone with OCD engages in. For example, when leaving for work, people sometimes worry about whether or not they have locked their house. Someone without OCD will more than likely check the lock once and then leave the house. Someone with OCD will more than likely check the lock many times. The person will continue checking the lock until his or her mind is at ease that it is okay to leave; this process can take a short or long amount of time. If the process takes a long amount of time, then there is a possibility that the person will be late for work and get fired. In severe cases of OCD, the person might become so anxious and/or afraid that he or she decides not to leave the house for the rest of the day. Being late for work or not showing up for work due to OCD displays how the disorder can interfere with a person’s daily life.

The cause of OCD remains unknown, due to a lack of scientific understanding; however, researchers continuously search for causes of the mental disorder (Gavin). Previous studies about OCD lead researchers to believe that two main influencers of OCD are genetics (genes) and biology (functioning of the brain) (Mayo Clinic Staff).

Researchers have conducted studies with various families that have many members with OCD. Each study shows a pattern where “people with first-degree relatives (such as a parent, sibling, or child) who have OCD are at a higher risk for developing OCD themselves” (“Obsessive-Compulsive Disorder”). Studies also show that when several family members have OCD, they often engage in the same type of compulsions (repetitive checking, counting, hand washing, etc.) (Hollander 142). After conducting studies on genetics and OCD for seventy-five years, researchers have concluded that there is a strong connection between the two (Hollander 142-143).

Researchers at Michigan Medicine recently conducted a study and concluded that the brain of someone with OCD operates differently than the brain of someone without OCD.

Luke Norman, lead author of the Michigan Medicine study on OCD and a postdoctoral researcher in the Psychiatry Department at the University of Michigan, states that when people have OCD, their “brain responds too much to errors, and too little to stop signals” (Gavin). Kate Fitzgerald, Co-Director of the Pediatric Anxiety Disorders Program at Michigan Medicine and a psychiatry faculty member at the University of Michigan, elaborates on Norman’s conclusion by stating, “This analysis sets the stage for therapy targets in OCD, because it shows that error processing and inhibitory control are both important processes that are altered in people with the condition” (Gavin). Overall, the study displays that people with OCD know that they do not have to act on their obsessive thoughts in order to prevent a certain scenario; however, that idea does not reach the part of the brain that helps them refrain from engaging in obsessions, which explains why people often engage in obsessions.

People with OCD experience various symptoms, such as the need to repetitively tap, organize, or clean. Each physical symptom of OCD leads to a set of psychological symptoms that a majority of people with OCD experience: anxiety, fear, and depression. Anxiety is constantly worrying or fearing everyday scenarios. Fear is being afraid of certain things, such as a scenario ending badly. Depression is constantly feeling sad and having no interest in everyday life. All three of these symptoms have a major role in OCD.

The majority of OCD symptoms are driven by anxiety and/or fear and also produce anxiety or fear. Renee Fabian lives with OCD every day; her experience with OCD displays how fear and anxiety have a major role in the disorder. Fabian’s OCD began with a nightly ritual. “It starts with a prayer, listing my mom, dad, brother, grandparents, cats, rabbit, all my family, and asking for them to be safe. I repeat this list over and over until it feels ‘just right,’” states Fabian. Next, “I ask forgiveness for my sins and ask for help to be a better person, repeating the phrase in a manic hushed voice in my head until it’s ‘right.” (Fabian). Then, Fabian recites the Lord’s Prayer. “I have to say it at least two times in a row exactly perfect, but I can never say it a total of three times, ever. So if I mess up the first one, I have to say it twice in a row perfectly again, but that’s a total of three attempts, which isn’t allowed, so I have to say it also a fourth time, but I always have to say two exactly in a row perfectly” (Fabian). Then Fabian explains that if she does not recite the prayer perfectly, then she will be punished by her parents, grandparents, or pets passing away. Fabian’s obsession with her nightly ritual causes her to be anxious (anxiety) and afraid (fear) that the universe will punish her if she does not complete it; these feelings lead her to act on her compulsions by completing her ritual perfectly every night. Fear and anxiety enhance OCD because people often struggle to overcome those emotions. When people feel that something bad will happen if they do not engage in a certain action, then they more than likely will engage in it.

There are two main ways that OCD can contribute to a person developing depression. First, OCD often causes people to feel as if they have no control over their mind or body. People can become depressed when they constantly experience uncontrollable and unwanted thoughts that cause them to feel obligated to engage in certain actions. Johnathon Abramowitz, a clinical psychologist and professor in the Department of Psychology and Neuroscience at the University of North Carolina, argues that it is easy for someone with OCD to develop depression because that person’s “life consists of unwanted thoughts and urges to engage in senseless and excessive behaviors.” Second, OCD can cause depression through interfering with someone’s daily life. Abramowitz states that “OCD can be devastating to interpersonal relationships, leisure activities, school or work functioning, and to general life satisfaction.” When OCD causes a person to stop engaging in daily activities, that person could lose their job, friends, spouse, and other things. People with OCD often lose the things that make them happy and mean the most to them, which increases their chance of developing depression.

Since OCD is a complex disorder that is difficult to understand, researchers struggle to find effective treatments for it; however, many medical professionals currently use medication and behavioral therapy when attempting to treat OCD (“Obsessive-Compulsive Disorder”).

Medical professionals often prescribe a selective serotonin reuptake inhibitor (SSRIs) to patients who suffer from OCD (“Obsessive-Compulsive Disorder”). Serotonin is a chemical inside the brain that produces feelings of happiness. SSRIs provide people with more serotonin, which increases their level of happiness and helps treat OCD. Researchers have studied how various doses of SSRIs impact the improvement of OCD. In one study, researchers found that some people respond to small doses (200mg) of SSRIs, but some do not. In the study, those who did not respond to small doses were given higher doses (between 250mg and 400mg), which “resulted in significantly greater and more rapid improvement in OCD symptoms” (Zohar 42). When a person does not respond to SSRIs, some medical professionals will prescribe “antipsychotic medications”; however, “research on the effectiveness of antipsychotics to treat OCD is mixed” (“Obsessive-Compulsive Disorder”). As seen throughout many studies, SSRIs are the most effective medication that researchers have found to help treat OCD, which is why the majority of medical professionals prescribe SSRIs before trying other medications (such as antipsychotics).

Medical professionals, such as therapists, also use behavioral therapy to help treat OCD. The type of behavioral therapy that a therapist often uses is exposure and response prevention therapy (ERP). In ERP, clients are exposed to something that causes them anxiety or fear in hopes to reverse their feelings toward the subject. A therapist often uses ERP to help clients overcome OCD by having them come face-to-face

with a situation that usually causes them to engage in a compulsion. Then the therapist will help each client refrain from engaging in the compulsion. For example, when a client feels that he or she must wash his or her hands after interacting with other people, the therapist will have the client interact with others and then help the client refrain from washing his or her hands.

While many therapists use ERP, each therapist has his or her own approach to it. For example, some therapists practice ERP with a client in their office, some practice with a client outside of their office, and some ask a client to practice without them entirely (Davidson 96). “Yet in all cases, the goal is the same: facing obsessions and tolerating discomfort without engaging in compulsions so you can change your expectations about the consequences of facing your fears,” states Joan Davidson, licensed psychologist and Co-Director of the San Francisco Bay Area Center for Cognitive Therapy (96).

OCD is a serious disorder that deserves to be understood correctly. In 2013, the *DSM-5* gave OCD its own section in the diagnostic manual, which acknowledges OCD as its own mental disorder. (It had been previously categorized as an anxiety disorder.) Establishing OCD as its own mental disorder allows more opportunities for people to become aware of the disorder, better understand it, and possibly influence researchers to conduct more research on it. As of now, OCD is not a well-established mental disorder; however, researchers and medical professionals continue working hard to better understand it. Hopefully, discovering and spreading more information about OCD will help the “neat freak” myth disappear.

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# A Forgotten Language

Reece Phillips

*Faculty Mentor: Patricia Marchesi, PhD*  
Humanities, English

Flowers—roses, lilies, sunflowers, azaleas—are one of nature’s most beloved creations. From the time we are young, we are enthralled by their beauty. Often would little girls pluck dandelion flowers from the dirt and, smiling a missing-tooth smile, present the bright yellow and white tufted bundle they’d gathered to their teachers. As for myself, once I discovered a cicada’s shell—still clinging to one of the playground’s many oak trees—and frightened my second-grade teacher with the exoskeleton. But I digress. What the little girls who so diligently picked flowers from the playground hadn’t known was the symbolism of the dandelion: happiness. The downy tuft of a flower can flourish anywhere, in the smallest handful of soil, in cracks in the sidewalk. It is symbolic of joy and determination—quite fitting that little girls would gift bundles of the flower to their mothers and teachers. Every flower tells a story, but their language is one that is foreign to us, lost to the passage of time. But it is a language we should not forget, for the beauty and intricacy of floriography speaks a language we should be desirous of.

According to Jayne Alcock, the language of flowers came into existence in Ottoman Turkey, in the court of Constantinople. Thanks to Mary Wortley Montagu and Aubry de La Mottraye, floriography’s roots flourished throughout Europe amidst the Victorian era. And by Constantine Samuel Rafinesque, Elizabeth Wirt, and Dorothea Dix, the language of flowers had become the second language to numerous men and women within America (“Language of flowers”). Such a beautiful language, isn’t it? Wild daisies symbolize innocence, childhood days of picking wildflowers from fields in the summer heat of July. The forget-me-not is symbolic of true love and remembrance, nostalgic for a loved one lost (Allende). The scent of gardenias, light and sweet, reminds me of my great-grandmother, how she wore the sweetest of gardenia perfumes—a symbol of purity and gentleness. Meanwhile, I have always loved hyacinths. The scent is not quite as strong as the scent of the gardenia flower, and the flower, heavy with blossoms, often topples over itself, but again and again I find myself drawn to the hyacinth’s beautiful blooms, the small, silent blossoms a tower of perfect beauty. Blue hyacinths symbolize constancy and sincerity. White hyacinths suggest tenderness, yellow, jealousy. Bloomed from the blood of Hyákinthos, perhaps it, too, symbolizes humanity.

The way in which flowers are presented is a crucial

detail of the flowery language. If answering “yes,” the flowers would be accepted with the right hand; if answering “no,” the flowers would be accepted with the left hand. Similarly, if the flowers were held upside down, they conveyed the inverse of the traditional message. If a woman was gifted a bouquet of red roses but returned it to her suitor with the head of the roses pointing downward, it signified refusal and nonreciprocity (“Floriography: The Secret Language of Victorian Florals”). The rejection was final. Flowers and plants could symbolize averse feelings, as well, such as the “bitterness” of the aloe plant. If she feels strongly enough, a woman may “gift” her unwanted suitor a yellow carnation to signify her disdain for him. The thought amuses me greatly, but it is a gentle rejection, the beauty of flowers to soothe the hurt of refusal.

The way in which flowers are presented is important, as is the manner in which the flowers are worn. The nearer the flowers to the woman’s heart, the more accessible to love she is (Allende). The tradition of the corsage is still practiced to this day—most notably seen at school formals—however, the flowers are now often worn around the woman’s wrist to symbolize consideration and generosity. The ribbon added to the flower arrangement, too, is an important detail. If the ribbon is tied to the left, the symbolism of the flower has to do with the giver. If the ribbon is tied to the right, the symbolism is regarding the recipient (O’Connor). Such a detail reminds me of the tying of a kimono; the left side of a kimono is always tied over the right side. The only exception is when the deceased is dressed for his or her funeral, where the right side of the kimono is tied over the left. To wear a kimono with the right side tied over the left is considered to be bad luck in Japanese culture. The two details—the tying of a ribbon to a flower arrangement, the tying of a traditional kimono—are complex, but I believe that there is beauty to be found in intricacy.

Blooms of improbable beauty are still gifted to this very day: to mothers for Mother’s Day, to lovers for Valentine’s Day—perhaps even to yourself, for the fact that you simply could not resist the delicate beauty of the local grocery store’s orchids, the enthusiasm of the orange, the elegance of the white. We never truly lose our childhood awe for all things beautiful, the desire to run into a field of wildflowers and *pick, pick, pick* the tufty dandelions, the yellow daffodils and daylilies, the white daisies, and the orange



butterfly weeds to your heart's content. Flowers are Mother Nature's gift to her children of humanity, her sweet, unspoken words of adoration. Accept her gift, and one day return the favor to her by planting violets of loyalty and hydrangeas of gratitude.

It is unfortunate that the language of flowers is all but gone, for it is a beautiful language. Gone but not forgotten. The flowers—the roses, the sunflowers, the daffodils and daisies, all of the wildflowers—sing their language, quiet and poignant. Listen to their songs, again and again. Learn to speak their language. Open the door to your heart. Pick dandelions and wild daisies and give them—their innocent joy, downy tufts and white petals—freely. No more words of insult and offense, no more hatred and cruelty—we must speak like the flowers: fine and delicate, always.

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# Fellowship and Harmony in *Upstream* and *Braiding Sweetgrass*: Humankind's Kinship with the Natural World

Alexis Westrick

Faculty Mentor: Patricia Marchesi, PhD  
Humanities, English

Throughout the centuries, people from various cultures have found a sense of harmony and unity with the natural world. Whether it is through their cultivation of the land, religious beliefs, or ecological studies, humankind has not only benefited from the natural world, but has also helped nourish that world in return. In their respective books, Mary Oliver and Robin W. Kimmerer praise the kinship between the natural world and humans through discussions of motherhood, unlikely friendships, and reciprocity, showing that this fellowship brings us not only closer to nature, but also closer to one another.

A large portion of Kimmerer's book, *Braiding Sweetgrass*, focuses on her role as a mother. As she raised her children, and even after they were grown and had left home, she saw her care for nature as a maternal act. In "A Mother's Work," she discusses how she tried to make the pond in her yard swimmable for her daughters. In the process, however, she began to consider the various life forms residing in the pond, and as a mother, she could not entirely destroy the home and lives of another mother's children. Kimmerer says, "I could work so much faster if I didn't have to stop and pick tadpoles from the tangle of every moral dilemma.... I sighed, but I knew what I had to do. I was driven to this chore by a mothering urge, to make a swimmable pond. In the process, I could hardly sacrifice another mother's children, who, after all, already have a pond to swim in" (89-90). While she was disrupting their environment, Kimmerer made sure to minimize the damage she was causing. She was driven to take extra care because of the kinship she felt with the other mothers in the natural world. In this case, the most prominent mother in her mind was the frog, and while she could not save every microscopic life in that pond, the preservation of the tadpoles was within her control.

In a chapter of her book discussing the relationship between humankind and rivers, Andrea Vianello states, "When we look at rivers and how humans used and adapted them, it is necessary to understand that changes are not necessarily negative or causing devastation to the environment.... The historical-archaeological approach, however, also suggests that heavy changes in the natural environment are not necessarily devastating per se, as long as humans maintain sustainability

in their management of natural resources through awareness of their environment and its development along with human activities" (9-13). In Kimmerer's case, she made the pond healthier both for her own children and the surrounding natural world. The living beings in the pond were no longer strangled by rampant, excess algae, and she even used the organic matter that she removed to sustain and nourish life in her garden. Her actions were sustainable as well as nurturing. She acted as a maternal figure for her own children and for the natural life around her.

Kimmerer worked in this pond even after her children had left for college. After they left, this work was a way for her to remain close to her children and prevent herself from losing her sense of purpose as a mother. But this project that she had originally started for her children caused her to form a relationship with all of the living beings in the environment. It expanded her role as a mother to encompass her neighbor's pond, which received runoff, frogs, geese, spores, and her future grandchildren. She says, "The pond has shown me that being a good mother doesn't end with creating a home where just my children can flourish. A good mother grows into a richly eutrophic old woman, knowing that her work doesn't end until she creates a home where all of life's beings can flourish" (97). While she still maintained her bond with her own children, her interaction with the natural world enabled Kimmerer to expand her idea of motherhood and work in harmony with and for the betterment of nature.

In "Swoon," Oliver shows a slightly different approach to motherhood. In her case, she essentially protects a mother spider from danger, allowing her young to range forth from the stairwell where the mother spider resides. In his essay discussing the destruction of the bond between Native Americans and the natural world due to relocation and colonization, Wayne Dodd says, "In addition, of course, the Indians represented a relationship to the natural world that was, whatever else it might represent to the predominantly European whites, a constant source of challenge to the entrepreneurial zeal to exploit, to develop, to change" (640). Oliver does not conform to the desire to change the natural elements around her as so many people do. Even though the spider is residing in the stairwell of the house that she has

rented, Oliver does not force her out. Through her act of maternal protection, Oliver provides another living being with a safe place to live, eat, and become a mother. She even passes on this maternal task to the cleaning crew and the next inhabitant, by leaving a note for the stairwell to remain untouched. While she will likely never meet any of these people, they are still engaging in this nurturing act together.

Both authors also discuss the forming of unlikely friendships through a bond with the natural world. In "Witch Hazel," this name labels both a plant and a woman. Reflecting on this figure from her childhood, Kimmerer's daughter says, "I'd never heard of a person named Hazel, but I'd heard of Witch Hazel and was quite certain that this much be the witch herself" (73). Kimmerer and Hazel became friends by "trading recipes and garden tips" (73). While Kimmerer was a college professor and Hazel was a poor old woman who could not return to her home, they were still able to form a bond through their shared love of the natural world. In his essay, Dodd asks, "And what can most of us in America today, great layers of concrete and steel and asphalt and artificial light between us and the physical life of the continent, nature now only an abstract concept—what can we know of the once elemental power of the words for water and sunlight and the parent soil to call forth the mystery of the living earth, to utter the wonder of our existence on it?" (655). Hazel and Kimmerer, however, had not lost their curiosity and respect for the natural world. Because of that one commonality, they were able to become friends, even though their different positions in life would ordinarily prevent them from ever crossing paths.

In "Bird," Oliver makes friends not just across economic differences, but also across species. Her care for this injured bird could also be considered a maternal act, but Oliver and her partner both developed a bond with this bird. They both cared for and played with the bird as if it was their friend, and over time, she began to see that the bird had a personality. She describes their interactions, saying, "I would fling the water around with my finger, he, again, would follow with that spirited beak, dashing the water from the bowl, making it fly in all directions. His eyes sparkled. We gave him a stuffed toy—a lion as it happened—and he would peck the lion's red nose very gently, and lean against him while he slept" (129). In her description of the bird, it is clear that she recognized a personality in the animal and formed a friendship based on that personality and the act of caring for him.

As the bird slowly loses the ability to walk and other motor functions, she suffers along with him. When he finally dies, Oliver grieves for him. In most circumstances, a human would not form a bond with a beach gull. We are always discouraged from feeding them and from getting too close to them, because they might carry diseases or be dangerous in some other way. But through her respect for the natural world, Oliver saw only a fellow living being in trouble, and she sought to help him.

Friendship and fellowship are largely built on reciprocity. Kimmerer was taught the importance of reciprocity since she was a child, which she discusses in "An Offering." Her father pouring the first cup of coffee on the ground was meant to be a way of saying "thank you" for all of the things that the natural world had provided and given to his family. She says again and again that her family were "the ones who know how to say thank you" (34). For Kimmerer's family, this solidified their relationship with each other as well as with the natural world.

This relationship has been lost in the majority of cultures today. In his essay "Ecosystem Services, Nonhuman Agencies, and Diffuse Dependence," Keith Peterson explains, "Unsurprisingly, the dominant metaphors employed in them to express the vital relations between humanity and nonhuman nature are primarily economic. Humanity is encountering an 'ecological credit crunch,' and 'we' must reduce our impact on 'the services provided by the Earth's natural systems,' as well as become better at 'managing the ecosystems that provide those services'" (2). The interactions between humans and the natural world have been reduced to statistics and economics rather than sustained as an actual relationship. He goes on to explain that, "In this discourse nature provides valuable 'services.' This rhetoric might be seen as an advance beyond the more traditional term 'natural resources,' since 'services' connote both some attention to processuality as well as a modicum of intentional recognition, where 'resources' are perceived to lie passively at one's disposal" (2). If the resources provided by the natural world do not contribute to the GDP or in some monetary or economic capacity, then people tend to disregard the importance of that resource. What many people have forgotten is that these resources do not passively exist for humanity to take and use them; people must find a way to nurture and give back if that relationship is to continue.

In "The Gift of Strawberries," Kimmerer gives an example of what that sort of reciprocal relationship could look like. She assists the strawberry vine in finding a place to root, and as a result, it provides fresh strawberries for her to eat. She goes on to explain the difference between a gift and a resource, saying, "From the viewpoint of a private property economy, the 'gift' is deemed to be 'free' because we obtain it free of charge, at no cost. But in the gift economy, gifts are not free. The essence of the gift is that it creates a set of relationships. The currency of a gift economy is, at its root, reciprocity" (28). The strawberries grown in the wild were different from the ones purchased in the grocery store, because instead of a monetary exchange, there was an exchange of care. Kimmerer had respect for the strawberry plants, and while she wanted to pick them as soon as she saw them, she waited until the plant was ready to relinquish its fruit. In this way, she valued the plant even more and received a richer, better fruit as a gift.

This relationship between humankind and the natural world is exemplified in the tale of Skywoman. This folktale is evident throughout Kimmerer's writing and guides her through

her interactions with nature. Skywoman's historical relationship with the animals and nature is quite different from humankind's modern-day relationship with the natural world. As Antoine C. Dussault explains, "This concept rests on a human/nature dualism which defines the natural in opposition to the cultural and the artefactual, and thus in principle places humans outside the natural realm. This makes it conceptually impossible for humans to intervene in nature without denaturing it" (1). This prevents any kind of relationship between humankind and the natural world, and thus eliminates the possibility of reciprocity. Dussault goes on to say

the concept of wilderness is tied to an outdated Christian and Cartesian mind/matter dualism, which sets humans apart from nature on the grounds that their immortal soul distinguishes them from purely material beings. This dualism is incompatible with the Darwinian discovery that we are part of nature insofar as we are the result of the same evolutionary processes as all other living beings. In the context of ecology, this dualistic view has often undergirded the increasingly questioned assumption that nature, in the absence of human intervention, exists in an unperturbed state of equilibrium (a balance of nature). As Callicott remarks, this assumption tends to downplay the omnipresence of change and perturbations in the ecological world. (2)

Dussault saying that an equal exchange and relationship between humankind and the natural world is not only beneficial, but also necessary.

As Kimmerer explains in "Wisgaak Gokpenagen: A Black Ash Basket" and in "Mishkos Kenomagwen: The Teachings of Grass," the natural world sometimes needs the assistance of humankind in order to thrive. By cutting down some of the ash trees to make their baskets, the Pigeon family thins the forest enough so that new trees have room to grow tall and strong. But they do not cut down so many trees as to endanger their existence. The gatherers of sweetgrass do the same. Thinning the groupings of sweetgrass gives the plant more room to thrive and flourish. In each of these relationships, however, the people always ask permission, and they give back with a gift of tobacco or simply by providing a healthy environment, continuing the relationship of reciprocity. These methods brought the people within those communities closer together, and as they introduced their practices to outsiders, they expanded their relations and communities, forging new bonds. In the case of "Mishkos Kenomagwen: The Teachings of Grass," the aspiring PhD created a relationship between the

harvesters of the grass and the faculty committee, people who never even met each other.

In a less culturally-based way, Oliver also discusses the act of reciprocity. In "Winter Hours," she says,

I would say that there exist a thousand unbreakable links between each of us and everything else, and that our dignity and our chances are one. The farthest star and the mud at our feet are a family; and there is no decency or sense in honoring one thing, or a few things, and then closing the list. The pine tree, the leopard, the Platte River, and ourselves—we are at risk together, or we are on our way to a sustainable world together. We are each other's destiny. (154)

Oliver's idea of a link between everything is an example of reciprocity, because if that link is not nurtured by all parties, then all will suffer. Her viewpoint does not distinguish between human and non-human or breathing and photosynthesizing organisms. Every living thing in the world is connected in some way, so reciprocity is necessary to create a healthy, thriving planet.

In both Kimmerer's and Oliver's work, the themes of motherhood, unlikely friendships, and reciprocity solidify the concept of fellowship and harmony between humankind and the natural world. Through maternal, cultural, and empathetic connections with nature, people are also able to strengthen their bonds with one another. Whether it is an act of solidifying already existing relationships or forging new ones, this harmony brings all of humanity together in order to make a better, more compassionate world for all of the living beings that come after us.

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# Singular Value Decomposition: Applications to Image Processing

Elizabeth A. Compton and Stacey L. Ernstberger, PhD

Faculty Mentor: Stacey L. Ernstberger, PhD  
Mathematics

## Abstract

Digital images require large amounts of memory, and often we would like to reduce the required memory storage and still retain as much of the image quality as possible. We can consider using the singular value decomposition (SVD) to manipulate these large sets of data, which will allow us to identify the components of the image which contribute the least to overall image quality. In this paper we explore the SVD in general as well as how computing the SVD and removing the singular values can reduce the size of stored images.

## Introduction

When we consider a digital screen, we rarely think about the composition of the images that we are viewing. A screen that displays in color actually has a separate saturation scale of 0 to 255 for red, green, and blue per pixel. If we consider only grayscale, there is a saturation scale of 0 to 255 per pixel [2]. Thus, images can be interpreted as a matrix with pixels represented as individual numerical entries. Rows and columns of a matrix hold the position of the pixel, and each value in the matrix represent the corresponding saturation level. These components can ultimately result in a large amount of memory used to produce a single image. For instance, if we were to save a  $100 \times 100$  image in grayscale, there would be 10,000 different pixel values stored. We would like to address a way in which computers can save images without taking up such large amounts of memory.

We consider using the method of Singular Value Decomposition to compress the size of the saturation matrices, retaining the most important components, to save an image using less memory while also retaining the image quality.

## Singular Value Decomposition

The process of Singular Value Decomposition (SVD) involves breaking down a matrix  $A$  into the form  $A = U\Sigma V^T$ . This computation allows us to retain the important *singular values* that the image requires while also releasing the values that are not as necessary in retaining the quality of the image. The singular values of an  $m \times n$  matrix  $A$  are the square roots of the eigenvalues of the  $n \times n$  matrix  $A^T A$ , which are typically organized by magnitude in decreasing order [4]. The *Singular Value Decomposition* is so named due

to the singular values that are identified and isolated from matrix  $A$ .

## How to Compute the SVD of a Matrix

We will rewrite an  $m \times n$  matrix  $A$  in the form  $A = U\Sigma V^T$ , where  $U$  is an  $m \times m$  matrix orthonormal columns,  $\Sigma$  is an  $m \times n$  matrix with singular values on the main diagonal, and  $V$  is an  $n \times n$  matrix with orthonormal columns.  $V^T$  is the transpose of matrix  $V$ , which is found by exchanging the rows and the columns of the matrix.

Note: If two column vectors form an *orthonormal* set, it means that the inner product of the columns with each other is 0, and the inner product of any column with itself is 1. Hence, any matrix  $B$  that has orthonormal columns has the property  $B^T B = I = B B^T$ , where  $I$  is the identity matrix.

Before we apply the SVD to image processing, we will first demonstrate the method using a small ( $2 \times 3$ ) matrix  $A$ :

$$A = \begin{bmatrix} 3 & 2 & 1 \\ 2 & 1 & 4 \end{bmatrix}.$$

and then follow a step-by-step process to rewrite the matrix  $A$  in the separated form  $U\Sigma V^T$ .

## Step 1: Form $A^T A$

We begin by forming  $A^T A$  for our given matrix  $A$  by performing basic matrix multiplication as follows:

$$A^T A = \begin{bmatrix} 3 & 2 \\ 2 & 1 \\ 1 & 4 \end{bmatrix} \begin{bmatrix} 3 & 2 & 1 \\ 2 & 1 & 4 \end{bmatrix} = \begin{bmatrix} 13 & 8 & 11 \\ 8 & 5 & 6 \\ 11 & 6 & 17 \end{bmatrix}.$$

This process will result in a square matrix of dimension  $n \times n$  with non-negative values, and here we can see that we have only non-negative values in our resulting  $3 \times 3$  matrix.

**Step 2: Determine the eigenvalues of  $A^T A$**

In order to determine the eigenvalues of  $A^T A$ , we need to compute the determinant of the matrix  $A^T A - \lambda I$ . In general, we compute the determinant of a  $3 \times 3$  matrix in the following way:

$$\begin{vmatrix} a & b & c \\ d & e & f \\ h & i & j \end{vmatrix} = a \begin{vmatrix} e & f \\ h & i \end{vmatrix} - d \begin{vmatrix} b & c \\ h & i \end{vmatrix} + g \begin{vmatrix} b & c \\ e & f \end{vmatrix} \\ = a(ei - fh) + d(bi - hc) + g(bf - ce).$$

We could clearly extend this computation to an  $n \times n$  matrix as needed. For our example, we compute the determinant of  $A^T A - \lambda I$  which is:

$$\begin{bmatrix} 13 & 8 & 11 \\ 8 & 5 & 6 \\ 11 & 6 & 17 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{vmatrix} 13-\lambda & 8 & 11 \\ 8 & 5-\lambda & 6 \\ 11 & 6 & 17-\lambda \end{vmatrix} \\ = (13-\lambda)[(5-\lambda)(17-\lambda) - (6)(6)] - 8[(8)(17-\lambda) - (11)(6)] + \\ 11[(8)(6) - (11)(5-\lambda)] \\ = \lambda^3 + 35\lambda^2 + 150\lambda \\ = \lambda(\lambda - 5)(\lambda - 30).$$

By setting this determinant equal to zero, we solve what is called the *characteristic equation* for  $\lambda$ , and here we see that  $\lambda = 0, 5, 30$ . We reorder the eigenvalues in decreasing magnitude, so that:  $\lambda_1 = 30, \lambda_2 = 5$ , and  $\lambda_3 = 0$ .

**Step 3: Form the matrix  $V^T$**

Once we have determined the eigenvalues, we then compute the corresponding eigenvectors and normalize them to produce the matrix  $V$ . In general, we compute eigenvectors by using the matrix  $A^T A - \lambda I$  and simplify the matrix for each eigenvalue. For example, for  $\lambda_1 = 30$  we have:

$$A^T A - \lambda_1 I = \begin{bmatrix} 13-30 & 8 & 11 \\ 8 & 5-30 & 6 \\ 11 & 6 & 17-30 \end{bmatrix} = \begin{bmatrix} -17 & 8 & 11 \\ 8 & -25 & 6 \\ 11 & 6 & -13 \end{bmatrix}.$$

We then solve the homogeneous equation  $(A^T A - \lambda I)\vec{x}_1 = \vec{0}$  to obtain the eigenvector  $\vec{x}_1$ , which here results in:

$$\vec{x}_1 = \begin{bmatrix} -\frac{323}{361} \\ -\frac{190}{361} \\ 1 \end{bmatrix}.$$

We then normalize the eigenvector by dividing by its magnitude to form a new vector:

$$\vec{v}_1 = \frac{\vec{x}_1}{|\vec{x}_1|} = \frac{1}{\sqrt{\frac{750}{361}}} \begin{bmatrix} -\frac{323}{361} \\ -\frac{190}{361} \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{-17}{5\sqrt{30}} \\ \frac{-10}{5\sqrt{30}} \\ \frac{19}{5\sqrt{30}} \end{bmatrix}.$$

We do this for each eigenvalue to produce a full set of eigenvectors that we will use to form the matrix  $V$ . For our example,

$$V = [\vec{v}_1 \quad \vec{v}_2 \quad \vec{v}_3] = \begin{bmatrix} \frac{-17}{5\sqrt{30}} & \frac{-6}{5\sqrt{5}} & \frac{7}{5\sqrt{6}} \\ \frac{-10}{5\sqrt{30}} & \frac{-5}{5\sqrt{5}} & \frac{-2}{\sqrt{6}} \\ \frac{19}{5\sqrt{30}} & \frac{8}{5\sqrt{5}} & \frac{-1}{5\sqrt{6}} \end{bmatrix}.$$

The matrix  $V^T$  can be easily obtained from  $V$ , which results in the columns interchanging with the corresponding rows. Thus, we have the resulting matrix

$$V^T = \begin{bmatrix} \frac{-17}{5\sqrt{30}} & \frac{-10}{5\sqrt{30}} & \frac{19}{5\sqrt{30}} \\ \frac{-6}{5\sqrt{5}} & \frac{-5}{5\sqrt{5}} & \frac{8}{5\sqrt{5}} \\ \frac{7}{5\sqrt{6}} & \frac{-2}{\sqrt{6}} & \frac{-1}{5\sqrt{6}} \end{bmatrix}.$$

**Step 4: Form the matrix  $\Sigma$**

To determine the matrix  $\Sigma$ , we list the nonzero singular values,  $\sigma_i$ , in decreasing magnitude down the main diagonal of  $\Sigma$ , where  $\sigma_i = \sqrt{\lambda_i}$ . Then we add any additional rows and columns of zeros as needed to retain the original dimension of  $A$  in  $\Sigma$ . In our example we have three singular values:  $\sqrt{30}$ ,  $\sqrt{5}$ , and 0. We only need to retain the non-zero values, and hence we form the matrix

$$\Sigma = \begin{bmatrix} \sqrt{30} & 0 & 0 \\ 0 & \sqrt{5} & 0 \end{bmatrix}.$$

Note that  $\Sigma$  has the same dimension as our original matrix  $A$ .

**Step 5: Form the matrix  $U$**

We form the matrix  $U$  by considering our modified form  $A = U\Sigma V^T$ , and isolating each column of  $U$ . Because of the diagonal nature of  $\Sigma$ , this results in

$$\vec{u}_i = \frac{1}{\sigma_i} A\vec{v}_i$$

for each of the singular values. We have two singular values in our example, and we use them to form the following vectors:

$$\vec{u}_1 = \frac{1}{\sqrt{30}} \begin{bmatrix} 3 & 2 & 1 \\ 2 & 1 & 4 \end{bmatrix} \begin{bmatrix} \frac{-17}{5\sqrt{30}} \\ \frac{-10}{5\sqrt{30}} \\ \frac{19}{5\sqrt{30}} \end{bmatrix} = \begin{bmatrix} \frac{3}{5} \\ \frac{4}{5} \end{bmatrix} \quad \text{and} \quad \vec{u}_2 = \frac{1}{\sqrt{5}} \begin{bmatrix} 3 & 2 & 1 \\ 2 & 1 & 4 \end{bmatrix} \begin{bmatrix} \frac{-6}{5\sqrt{5}} \\ \frac{-5}{5\sqrt{5}} \\ \frac{8}{5\sqrt{5}} \end{bmatrix} = \begin{bmatrix} \frac{3}{5} \\ -\frac{3}{5} \end{bmatrix}.$$

We then combine these column vectors to form the matrix:

$$U = [\vec{u}_1 \quad \vec{u}_2] = \begin{bmatrix} \frac{3}{5} & \frac{3}{5} \\ \frac{4}{5} & -\frac{3}{5} \end{bmatrix}.$$

Note that the columns of  $U$  are again orthonormal.

**Step 6: Rewrite matrix  $A$  as  $U\Sigma V^T$**

Finally, we rewrite  $A$  using the equation  $A = U\Sigma V^T$

$$A = \begin{bmatrix} \frac{12}{5} & \frac{4}{5} \\ \frac{4}{5} & -\frac{12}{5} \end{bmatrix} \begin{bmatrix} \sqrt{30} & 0 & 0 \\ 0 & \sqrt{5} & 0 \end{bmatrix} \begin{bmatrix} \frac{-17}{5\sqrt{30}} & \frac{-10}{5\sqrt{30}} & \frac{19}{5\sqrt{30}} \\ \frac{-6}{5\sqrt{5}} & \frac{-5}{5\sqrt{5}} & \frac{8}{5\sqrt{5}} \\ \frac{7}{5\sqrt{6}} & \frac{-2}{\sqrt{6}} & \frac{-1}{5\sqrt{6}} \end{bmatrix}.$$

This decomposition provides a broken-down form of the matrix  $A$  that has isolated the most important components from our original matrix. This returns a modification of our original matrix  $A$  in which the components are smaller in size, thus reducing the memory requirement in storing the information.

**Applications to Image Processing**

The process of Singular Value Decomposition can be used in many applications, including watermarking an image, computing weighted least squares, and optimal prediction. Here we will consider how this process could be used to produce reduced image sizes. We begin by

understanding that large images are formed by correspondingly large matrices, hence requiring a sizable amount of memory to store the image. By rewriting the image in its broken-down form and removing the smaller singular values, we can form smaller matrices which would in turn require less memory storage. We would lose some refinement with each loss of a singular value, but overall, we would retain the overall image features.

**Implementation in Grayscale**

In MATLAB, we use and modify existing code from Dr. Brady Matthews’ paper “Image Compression using Singular Value Decomposition” to load an image, isolate the corresponding saturation matrix, and then modify the matrix based on its singular values [2]. As an example, we use a high-contrast grayscale image of a feather seen in Figure 1.



Figure 1: Original high-contrast grayscale image [5]

We consider the individual saturation levels of each pixel in the original image as the numerical entries in a matrix. We compute the SVD of that matrix and remove the singular values (from smallest to largest), converting the modified matrices (with removed values) back into a series of images. This process of decomposition can reduce the image storage size without losing the quality needed to fully represent the image.

In Figure 2 we can see that as more singular values are included in the image matrix, the clarity of the image improves.

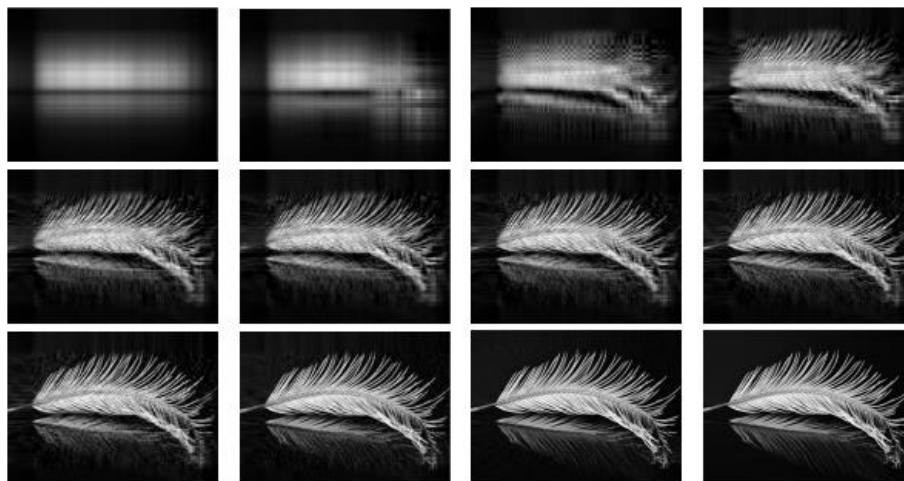


Figure 2: Number of Singular Values: {1, 2, 5, 10}{15, 18, 24, 30}{35, 60, 120, 680}

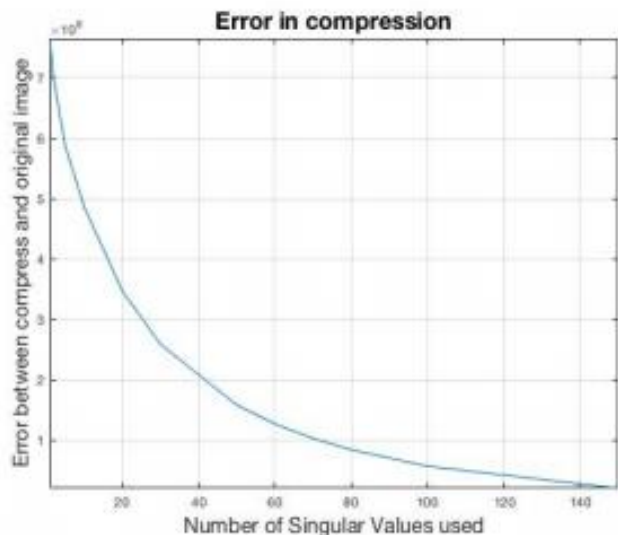


Figure 3: Error in compression when applied to the grayscale feather image.

The original image has approximately 680 singular values, but we were able to see a close resemblance to the original image using only 120 singular values [5]. The amount of storage space is not as significant in our example here as it would be in practice, because of our emphasis on image clarity. Our current process is to compress while still retaining the original number of pixels in order to show the details of the loss of image quality. In practice, we would see a more significant change in storage of an image if we allowed the overall image size (the number of pixels) to reduce as we removed the small singular values. For example, we can see this relation in photos that have been initially taken on a phone and then sent via text, often appear more coarse since they have been compressed along the way.

In Figure 3, we see the amount of error in saturation level differences from the original image. We observe the positive concavity of the error curve, which indicates that as the error decreases, the rate of change of the error loss also

decreases. This means that the rate of change of the error loss is less significant as more singular values are used. Here we see that the sharp negative slope that happens prior to approximately 20 singular values corresponds with the blurry images that were unrecognizable in Figure 2. As we continue to reintroduce a greater number of singular values, we can see the quality of the image increase, but we can see almost as many details with 30 values as we could with 680.

### Removing Larger Singular Values

We now extend this concept to the initial removal of larger singular values from an image instead of smaller singular values. We intuitively know that this would not be useful in retaining image quality but are curious as to the extreme nature of the image without the largest singular values. Originally the MATLAB code computed the SVD of the matrix of the image and removed the singular values (from smallest to largest). Then this process would convert the modified matrices (with removed values) back into images as shown in Figure 2. Through careful manipulation we redeveloped the code to build a series of matrices by instead starting with only the smallest values. Then these matrices were converted into images that have the same number of pixels as in the original image. This visualization is shown in Figure 4.

Through careful evaluation we are able to observe the same trend from Figure 2 that as more singular values are included in the image, the corresponding image clarity increases. However, where in the prior example we only required a few large singular values to produce a reasonable image, here we see that we need a very large number of singular values to produce a similar quality image since we are only using the smaller singular values first. In Figure 4 we can see that there are nearly 625 singular values needed for anything visible upon the black landscape. As we reintroduce



Figure 4: Number of Singular Values: {1, 250, 500, 550}{575, 600, 625, 650}{665, 678, 679, 680}



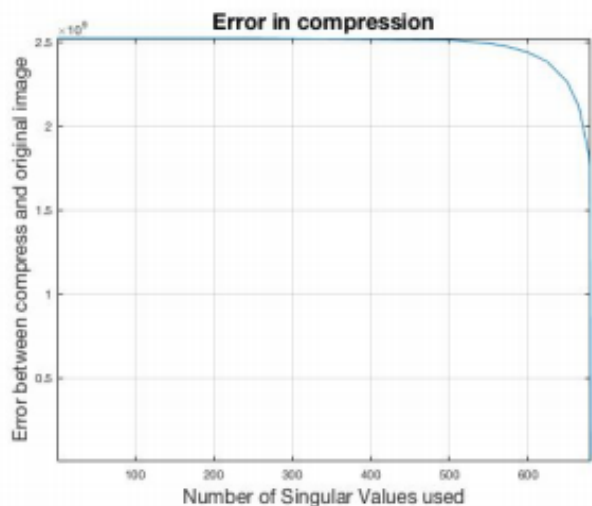


Figure 5: Error using this particular model.

the larger singular values, the corresponding quality of the images drastically increase.

We again view the error curve which displays a numerical representation for the difference between an approximated matrix with fewer singular values and our original matrix. The jump that occurs from the incorporation of a higher number of singular values is represented in Figure 5. The negative concavity of this error curve becomes visible as the number of singular values are reintroduced. There appears to be a point of when there are greater than approximately 550 singular values the error between the compress and original image decreases. This error curve is supported though the visual representation within Figure 4, that the image quality improves in a significant manner as the larger singular values are reincorporated.

Through this investigation of singular values, we have observed the significance of the largest singular value, and we now isolate the images using this value alone in Figure 6. This figure shows the representation of the largest singular value and how it contributes to the overall image quality. We note that there is a significant difference when we remove just the largest singular value, as it contributed the most to the information contained in the original image matrix that corresponded to our grayscale image.



Figure 6: Importance of the Largest Singular Value

### Implementation to full color images

We have been able to observe that the process of SVD can be used to compress images to conserve storage space by removing the singular values that contribute the least to the information contained in the image matrix. Thus far we have only demonstrated compression for a grayscale image, but we will now expand this process to full color images. For this simulation we will choose a full color detailed image that celebrates our favorite mathematical holiday, Pi Day, as seen in Figure 7.



Figure 7: Original Pi Day image [6]

Recall that each pixel in full color image has color saturation representation values of 0 to 255 for red, green, and blue. This adds complexity to the image, which requires a greater amount of storage space used to save a particular image. By showing the representation of each color relative to the full color image, we are able to see the amount of contribution each color has to each pixel as shown in Figure 8. In order to implement the SVD process we will have to first separate the full color image into its red, green, and blue layers, as each of these three colors has its own matrix of information for the image. We will remove the smallest singular values from each of the color matrices, and then we will reconstruct the full color image using the modified color matrices.

This decomposition is shown in a simplistic form in Figure 8. As we compute the SVD and only reintroduce specific singular values, we see the image quality increase within Figure 9. With only one singular value, there is very little we can recognize from the original image. As singular values are reintroduced, we are able to see the image more clearly to be a celebration of Pi Day. For this particular image, this compression process was able to save a considerable

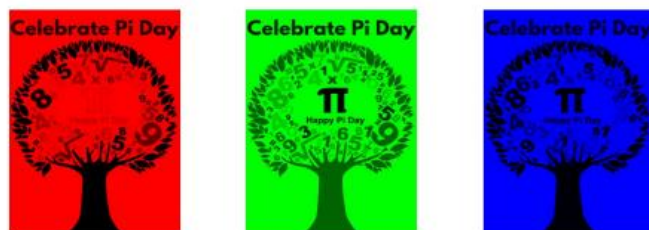


Figure 8: Pi Day image with red, green, and blue saturation layers isolated

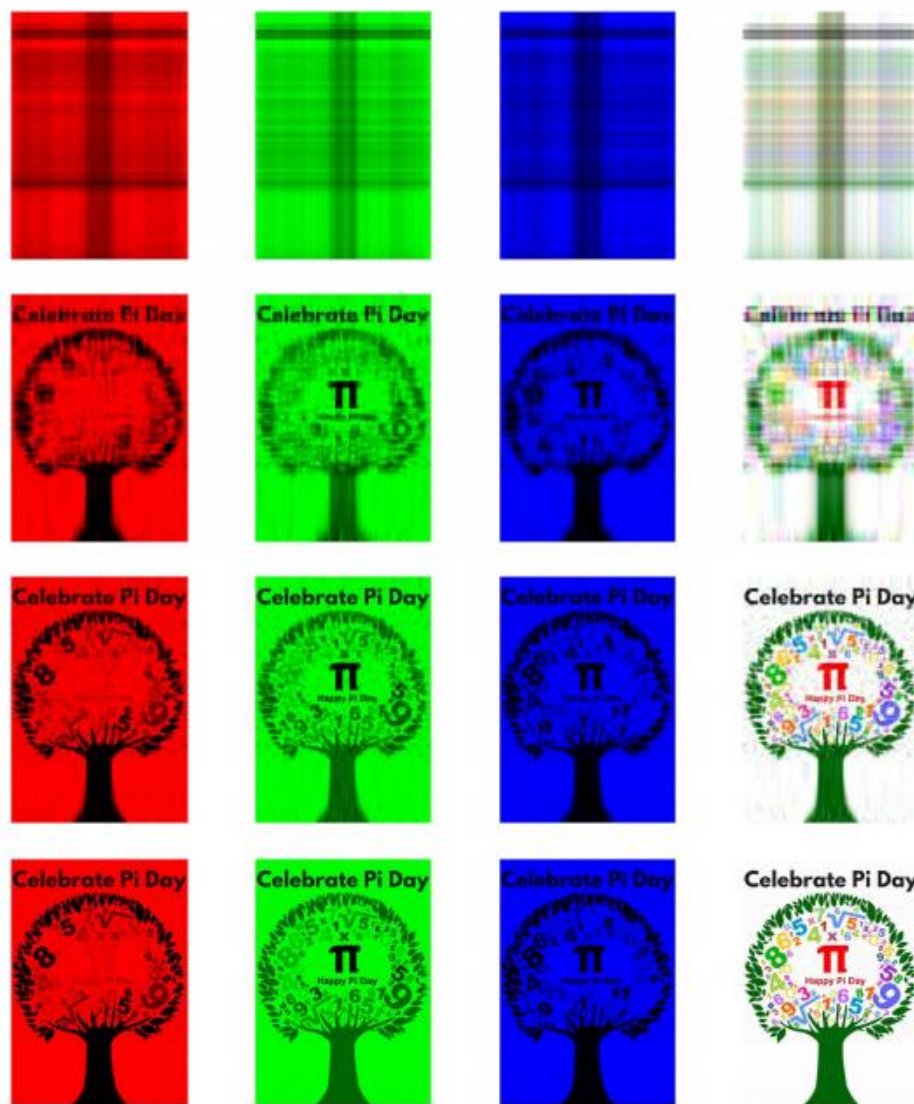


Figure 9: Number of singular values per row: {1, 10, 25, 100}

amount of space compared to our grayscale example observed in Figure 2.

The error for full color images is more complex to observe than the error corresponding to a grayscale image, due to the fact that we separated the color image into three separate color saturation matrices. The error curves in Figure 10 represent the accumulated error when comparing each modified color saturation matrix to the corresponding color saturation matrix from the original image. We are again able to notice a considerable change in clarity from the images compressed using a relatively low number of singular values. In addition to the obvious reduction of error with the addition of more singular values, we also observe a noticeable difference between the error curves within each pixel color. This original image in Figure 7 has a considerable amount of green which contributes largely to the image clarity when represented only with the green pixel contribution. In an opposing manner, there is not much representation from the

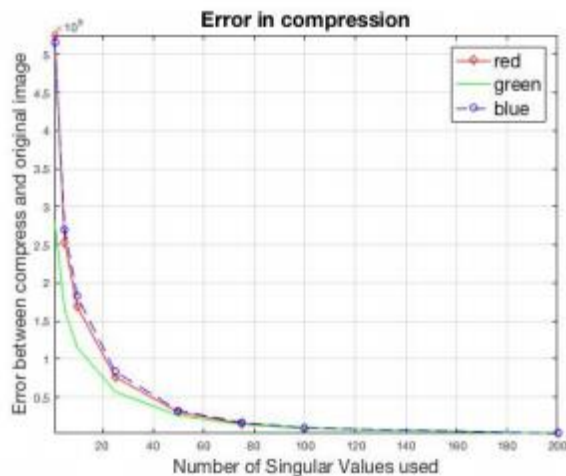


Figure 10: Error curves for the red, green, and blue pixel saturation levels from the Pi Day image

blue or red pixel saturation layers, and hence in Figure 10 we can see that the error changes more significantly in the green saturation layer than with the other two layers.

We consider our initial challenge of saving storage space using the SVD when applied to image processing, and we note that for this small full color image we were able to see a noticeable difference in storage size. The original image had 574 singular values for each of the color layers, and when we compare this image to the full color image with 100 singular values, we use approximately 50% of the original storage space. We can see in Figure 11 that they look almost identical when compared side to side, but the storage size and information matrices are much smaller. Recall that for the sake of direct comparison we have retained the original number of pixels in these comparisons, instead of naturally reducing the number of pixels as we removed each unimportant singular value. The corresponding storage size would drastically decrease if we allowed this to occur.



Figure 11: Original image and the compressed image

### Conclusions

By applying the process of Singular Value Decomposition to images by using pixel saturation matrices for grayscale or full color images, we can compress the storage size of an image even while retaining the number of pixels. We have isolated the least important pieces of information that are stored in the images and have removed them methodically,

leaving only the most important components of the images. This process of removing the smallest singular values from the saturation matrices allows us to retain as much of the image quality as possible. In the future we can further explore the usefulness when applied to image processing by allowing the image size to decrease when we remove the singular values, which would garner more extensive results in storage size reduction. Beyond this, we can additionally consider applying this method to each frame of a video, potentially resulting in a significant amount of storage size savings as well. These are some of the many ways that the Singular Value Decomposition Method can be helpful when applied to large matrices of information.

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# The Effect of Chlorpyrifos on the Concentration of $\alpha$ -synuclein

Trevor McLemore and Melinda Pomeroy-Black, MS, PhD

Faculty Mentor: Melinda Pomeroy-Black, MS, PhD  
Science, Biology

## Introduction:

People are continuously exposed to different chemicals, such as pesticides and food additives, whether they realize it or not. One class of pesticides commonly found in the environment are organophosphates. Organophosphate pesticides are found primarily in residential areas. They are used in an attempt to increase crop yields and backyard garden harvests. Chlorpyrifos (CPF) is the most widely used organophosphate pesticide in the world. It is known for causing neurotoxic effects in low doses (Polláková *et al.*, 2012, Chen *et al.*, 2017).

Synucleins are small proteins found in all neurons in the brain. The average  $\alpha$ -synuclein fibrils are approximately 200nm and weigh 14.5 kDa (Alpha Synuclein, 2018). Extracellular forms of synucleins function as receptors and are involved in the regulation of intracellular processes. However, the accumulation of  $\alpha$ -synuclein protein causes neurodegenerative complications, and evidence suggests that it plays a role in causing Parkinson's disease (Surguchev *et al.*, 2019). Bartels *et al.* found that overexpression of the  $\alpha$ -synuclein protein aggregated in a neuronal cell culture model, causing cytotoxic effects (2019).

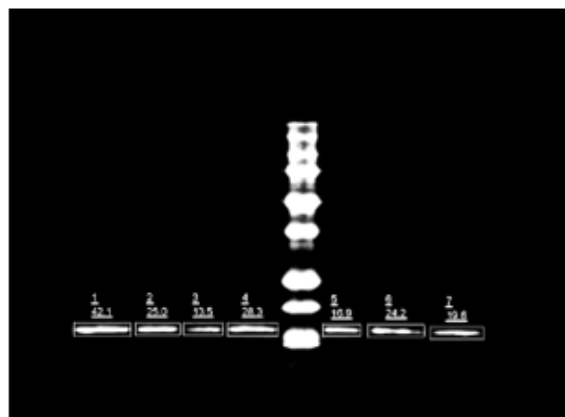
This study examined the effect of CPF on the concentration of  $\alpha$ -synuclein in dopamine-producing neurons. The dopamine-producing neurons were treated with different concentrations of CPF for 24 and 48 hours, and the concentration of  $\alpha$ -synuclein was determined. The hypothesis was that as the concentration of CPF increased, there would be a significant increase in  $\alpha$ -synuclein concentration in the cells.

## Materials and Methods:

Neuroblastoma cells (SH-SY5Y) were maintained in HAM F12 media with 10% fetal bovine serum in a humidified incubator at 37°C in 5% CO<sub>2</sub>. Once the cells reached 80% confluency, they were differentiated with 10<sup>-7</sup> M retinoic acid for three days. After three days, the cells were treated with either 25  $\mu$ M or 35  $\mu$ M CPF, or 0.2% ethanol (control) diluted in media for 24 or 48 hours. After 24 or 48 hours, cells were trypsinized and lysed with lysis buffer (50 $\mu$ l 100mM NaF, 25 $\mu$ l 200mM Na<sub>3</sub>VO<sub>3</sub>, and 25 $\mu$ l 1:200 Protease Inhibitor Cocktail III to 5 ml RIPA Lysis Buffer). Lysates were stored in 1.7 ml tubes at -20°C. Three replicates were conducted. A BCA Assay

was completed to determine total protein concentration in each lysate.

The cell lysate was diluted 1:1 with sample buffer. Diluted lysates were boiled for 5 minutes and immediately placed on ice to cool before conducting a Western blot. A total of 23  $\mu$ g of protein was loaded into each lane of a 12% SDS-PAGE gel. After electrophoresis, proteins were transferred to a nitrocellulose membrane which was treated with anti- $\alpha$ -synuclein (1:5000, Abcam) on a gentle rocker at 4°C overnight. The next day, the membrane was washed with 1X TBS and treated with goat anti-rabbit antibody (1:10,000, Abcam) at room temperature for 1 hour on a rocker. The concentration of  $\alpha$ -synuclein was determined using an Fc Odyssey (LiCor). The data were analyzed with a two-way ANOVA (Jamovi) with a Tukey's post-hoc analysis.

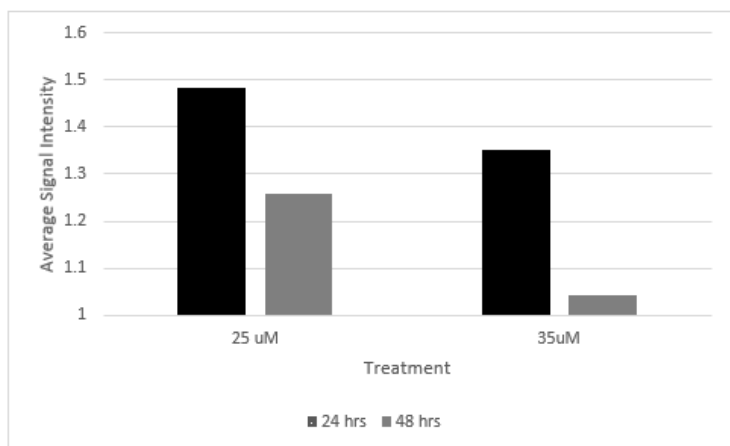


**Figure.1** Representative  $\alpha$ -synuclein concentration at 0  $\mu$ M, 25  $\mu$ M, and 35  $\mu$ M CPF for 24 hours and 48 hours.

## Results:

The average signal intensity of  $\alpha$ -synuclein of cells treated for 24 hours with 25  $\mu$ M CPF was 1.48 ( $\pm$  0.7) and was 1.35 ( $\pm$  0.6) for cells treated with 35  $\mu$ M CPF. The average signal intensity of  $\alpha$ -synuclein of cells treated for 48 hours with 25  $\mu$ M CPF was 1.26 ( $\pm$  0.3) and was 1.04 ( $\pm$  0.26) for cells treated with 35  $\mu$ M CPF.

There was a significant difference in  $\alpha$ -synuclein concentration due to treatment ( $p = 0.05$ ). There was a significant difference in  $\alpha$ -synuclein concentration between the control and cells treated with 25  $\mu$ M CPF ( $p = 0.03$ ). There was not a significant difference between the control vs. 35  $\mu$ M CPF treated cells ( $p = 0.38$ ), nor between 25  $\mu$ M CPF vs. 35  $\mu$ M CPF treated cells ( $p = 0.47$ ). However,  $\alpha$ -synuclein concentration was higher to some degree in all cells treated with CPF compared to control. There was not a significant difference between 24 and 48 hours ( $p = 0.14$ ), and treatment and time do not interact in a significant way ( $p = 0.56$ ).



**Figure.2** Average  $\alpha$ -synuclein signal intensity of each treatment as a percentage of control.

### Discussion:

There was a significant increase in  $\alpha$ -synuclein protein in cells exposed to 25  $\mu$ M CPF compared to the control. The effect was observed at 24 hours with no apparent increase or decrease over time. This partially supports the hypothesis that an increased concentration of CPF will cause an increase in  $\alpha$ -synuclein in the cell. However, there was no significant difference in  $\alpha$ -synuclein concentrations beyond 25  $\mu$ M CPF. The 35  $\mu$ M CPF concentration could have caused cell death, such that any effect of CPF on  $\alpha$ -synuclein was insignificant. Another possibility is that the increase in  $\alpha$ -synuclein proteins at 35  $\mu$ M CPF could have caused cytotoxic effects that killed the cells (Bartels *et al.*, 2019). The current study is supported by other research that found neurotoxic effects at concentrations as low as 0.1  $\mu$ M (Polláková *et al.*, 2012).

Exposure to CPF could be a contributing mechanism to the accumulation of the  $\alpha$ -synuclein protein. Such an accumulation can play a role in the development of Parkinson's disease (Surguchev *et al.*, 2019). Further studies could include using lower concentrations of CPF. For example, research suggests that the length of neurites is decreased after exposure to 20  $\mu$ M CPF for 24 hours (Powell & Pomeroy-Black, 2019). Experiments could also incorporate other organophosphate pesticides, such as parathion and malathion. If accumulation of  $\alpha$ -synuclein occurs due to exposure to specific pesticides, then

scientists may be able to find an inhibition to express  $\alpha$ -synuclein formation in people chronically exposed to these pesticides.

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# Investigating the Role of Protein Kinase C Expression as an Indicator of Apoptotic Activity after Deltamethrin Exposure

Shelby Olney and Melinda Pomeroy-Black, MS, PhD

Faculty Mentor: Melinda Pomeroy-Black, MS, PhD  
Science, Biology

**Introduction:** Apoptosis, or programmed cell death, is a mechanism by which a cell can effectively kill itself when it becomes damaged or poses a threat to an organism's health. While it is a tool that cells use to prevent irreparable damage to whole tissues, uncontrolled apoptosis has been linked to neurodegenerative disorders, such as Alzheimer's disease and Parkinson's disease. The apoptotic process occurs in a series of steps, but its exact mechanism is unclear (Hossain and Richardson, 2011).

A commonly used pyrethroid pesticide, deltamethrin, has been found to play a role in inducing apoptosis. Deltamethrin is a Type II pyrethroid that targets nervous system function in insects by delaying the closing of sodium ion channels within a neuron (Johnson *et al.*, 2010). This leads to accumulation of calcium in the neuron, which activates the ER stress pathway, in turn, denaturing proteins. The denaturation of these proteins likely contributes to neurodegenerative diseases, as protein unfolding phenomena have been observed as part of multiple cases of neurodegeneration (Hossain and Richardson, 2011).

There have been no chronic health effects attributed to deltamethrin in humans. It is less toxic to mammals than to insects, due to larger size, higher core body temperatures, and decreased ion channel sensitivity. As a Type II pyrethroid, deltamethrin is speculated to cause long-term effects on ion channels other than the sodium channel (Johnson *et al.*, 2010).

Caspases are a family of proteins that have various roles in the apoptosis cascade, with caspase-3 being the most widely studied. Caspase-3 is a major player in apoptosis, acting as a final effector protein in the apoptosis-inducing signaling cascade (Hossain and Richardson, 2011). Other proteins involved in apoptosis include Bcl-2, an anti-apoptotic protein, and protein kinase C (PKC), the different isoforms of which play different roles in cell death (Day *et al.*, 2009; Hardin *et al.*, 2016). In the apoptosis-inducing cascade, PKC lies upstream of the effector caspase-3. The isoforms of PKC associated with inducing apoptosis are PKC- $\alpha$  and PKC- $\beta$  while isoforms PKC- $\zeta$  and PKC- $\delta$  are linked to anti-apoptotic processes (Knox *et al.*, 1993; Newton, 1995; Pongracz *et al.*, 2002).

Previous studies have identified deltamethrin-concentration-dependent increases in caspases associated with apoptotic processes (Hossain and Richardson, 2011). It is unknown how caspases are activated in the apoptosis-inducing pathway after deltamethrin exposure, but it may be due to activation of an upstream protein.

This study was conducted to determine if PKC plays a role in activating caspases after deltamethrin exposure. To do so, SH-SY5Y cells were exposed to different concentrations of deltamethrin for 24 and 48 hours, and the concentration of PKC- $\alpha$ ,  $\beta$ , and  $\gamma$  were determined. The hypothesis stated that PKC concentrations would increase with time and with concentration of deltamethrin.

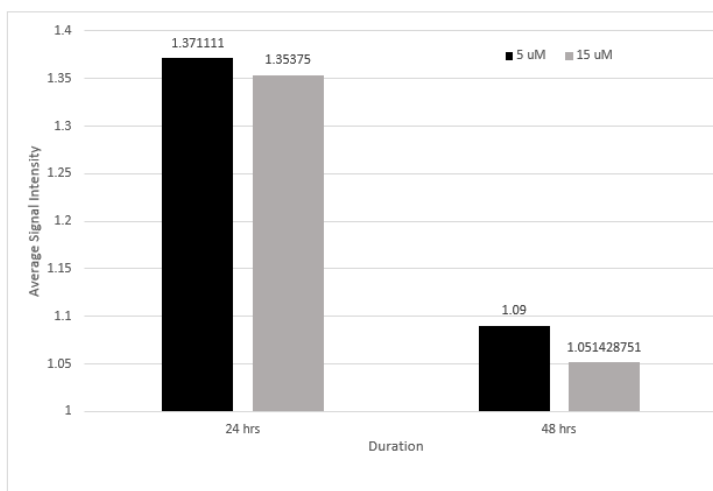
**Materials & Methods:** Neuroblastoma cells (SH-SY5Y, passages 15-19) were grown in HAM's F12 media with 10% fetal bovine serum (FBS) and incubated at 37 °C with 5% CO<sub>2</sub>. Media was replaced every three days until cells reached 80% confluency, when they were differentiated using 10<sup>-7</sup> M retinoic acid. After three days, cells were treated with 5  $\mu$ M or 15  $\mu$ M deltamethrin or exposed to 0.02% ethanol in media as a control. Cells were incubated for 24 and 48 hours, then lifted with 0.25% trypsin-EDTA, and lysed with lysis buffer (50  $\mu$ L 100 mM NaF, 25  $\mu$ L 200 mM Na<sub>3</sub>VO<sub>3</sub>, and 25  $\mu$ L 1:200 Protease Inhibitor Cocktail III to 5 mL RIPA Lysis Buffer). The lysate was frozen at -20 °C. A total of three replicates was conducted.

To determine the total concentration of protein in each lysate sample, a standard BCA protein assay was generated. The lysate samples were then diluted 1:1 using sample buffer, boiled for 5 minutes, then placed on ice. A total of 20  $\mu$ g of protein was loaded in each well for gel electrophoresis in 12% SDS-polyacrylamide gels. The gel, a nitrocellulose membrane, and filter papers were equilibrated in transfer buffer for 10 minutes, and proteins were transferred from the gel to the membranes. The nitrocellulose membranes were rinsed in 1X TBS for two minutes on a rocker at room temperature. The TBS was discarded, and the membranes were blocked in TBS Odyssey Blocking Buffer on a rocker for one hour at room temperature. The membranes were incubated overnight at 4°C with an anti-

PKC antibody (1:1000, Abcam) in blocking buffer. Membranes were brought to room temperature, then rinsed three times in 0.1% TBST for five minutes. The membranes were then incubated with light-sensitive secondary antibody (1:10,000, Abcam) in Blocking Buffer at room temperature on a rocker for one hour. The membranes were washed in 0.1% TBST three times for five minutes each, and finally, rinsed for five minutes in 1X TBS. Two pieces of filter paper were used to cover the light sensitive membranes as they dried. They were placed in the Fc Odyssey (LiCor) machine, which detected the protein signal. A two-way ANOVA was used to analyze the data (Jamovi).

**Results:** The BCA assay detected protein in all samples. The average signal intensities of PKC after 24 hours were 1.371 ( $\pm 0.551$ ) for 5  $\mu$ M deltamethrin and 1.354  $\pm$  (0.762) for 15  $\mu$ M deltamethrin. After 48 hours, the average signal intensities were 1.09  $\pm$  (0.116) for 5  $\mu$ M and 1.051  $\pm$  (0.344) for 15  $\mu$ M. While there was a trend of decreased PKC concentration from 24 to 48 hours, and the 15  $\mu$ M deltamethrin treatment had a consistently lower signal compared to the 5  $\mu$ M deltamethrin treatment, the statistical analysis of the data showed no significant difference in treatment ( $p=0.28$ ) or duration of treatment ( $p=0.13$ ). There was no interaction between these values ( $p = 0.55$ ) (Figure 1).

Figure 1.



**Discussion:** The hypothesis of a time- and dose- dependent increase of PKC concentration in response to deltamethrin exposure in SH-SY5Y cells was rejected. The data indicate that the changes in PKC concentration observed between treatments and time were not significant. This implies that PKC itself is not an effector in the deltamethrin-induced apoptosis cascade, thereby eliminating it as a subject from similar experiments in future.

Although PKC is not an option for further study, there are other proteins involved in apoptosis that could be

investigated to determine the mechanism for induced cell death due to deltamethrin exposure. According to Shi (2004), only the expression of caspase-9 has been studied. The activation of caspases necessitates the cleavage of their inactive zymogen forms. Caspase-9 has catalytic activity that is moderate in its zymogen form, and only somewhat more active in its cleaved form (Shi, 2004).

Cleavage of caspase-9 occurs when it binds an apoptotic protease activating factor, Apaf-1. In the presence of ATP/dATP, Apaf-1 recruits caspase-9 to form a complex known as the apoptosome. Once bound to Apaf-1, Caspase-9 can become active and then activates caspase-3, one of the effector caspases in the apoptotic cascade (Danial and Korsmeyer, 2004). Therefore, Apaf-1 is a potential protein target for future studies with deltamethrin, as it plays an essential role in the ultimate activation of caspase-3 (Brentnall *et al.*, 2013).

Not only could future studies focus on other proteins such as Apaf-1, but they may also include different pesticides. Deltamethrin is a Type II pyrethroid used as an insecticide that targets the nervous system (Chi *et al.*, 2013). Other classes of pyrethroids include the Type I pyrethroid Metofluthrin, a newer insecticide, which may have carcinogenic effects due to genotoxicity (Deguchi *et al.*, 2009). Although Type I and Type II pyrethroids have different mechanisms of action, they are both pyrethroids. Future studies could examine the effects on concentration of Apaf-1, PKC, or various caspases after treatment with Metofluthrin, a representative Type I pyrethroid.

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# Variation in Sediment Heavy Metal Concentrations in West Point Lake Tributaries

Lance Shealy and Molli M. Newman, PhD

Faculty Mentor: Molli M. Newman, PhD  
Science, Biology

## Abstract

Heavy metals are among the top three major contaminants within environmental pollution (Adki et al., 2014). In this study, sediment samples were collected from streams of varying surrounding land uses in LaGrange, Georgia. Sediment samples were tested for heavy metal concentrations and compared between forested and urban streams using a *t*-test to determine if there were significant differences in heavy metal concentrations between urban and forested streams. In this study, five heavy metals (calcium, chromium, magnesium, nickel, and zinc) were significantly higher in concentration in urban streams compared to the forested streams. However, based on previous literature, this does not appear abnormal for urban streams, as they are often more prone to runoff from highways and sidewalks. In addition to these five heavy metals, two replicates contained higher than average concentrations of cadmium. Cadmium is severely toxic to the body, and these high concentrations do appear alarming, although not all replicates from these sites had significantly high amounts of cadmium. Overall, urban streams appeared less healthy than the forested streams based on the significance of having higher concentrations of several heavy metals. Future studies should attempt to determine methods for reducing the concentrations of these metals in urban streams.

## Introduction

Heavy metals are naturally occurring substances that are high in density and can be harmful to human health (Wei et al., 1991). Heavy metals include mercury, cadmium, arsenic, chromium, lead, nickel, and zinc, to name a few. Some metals are of functional significance in the human body. For example, iron is an essential metal used in the hemoglobin of red blood cells to transport oxygen throughout the body (Gupta, 2014). Other metals, on the other hand, are classified as toxic and can lead to disease when present in higher concentrations. Cadmium, for example, can cause chronic obstructive pulmonary disease, emphysema, osteoporosis, hypertension, chronic damage to kidney tubules, and cancer to the lungs, kidneys, and pancreas (Vukićević, 2012). Lead is considered highly toxic, as it can affect children's brain development, and in high doses, lead can attack the nervous system and cause compulsions, seizures, and even death (Jiao et al., 2016).

Heavy metals are nonbiodegradable, which means that they cannot be broken down in nature. Due to this, heavy metals will accumulate in the environment. Although they are naturally occurring elements, many compounds such as pesticides, solvents, and by-products from metal and chemical industries are also adding heavy metals into the environment (UNEP, 2007). Of all the diseases that face the world today,

one quarter of those diseases are caused by environmental pollution (UNEP, 2007). Heavy metals are among the top three major contaminants to environmental pollution (Adki et al., 2014).

Heavy metals found in the environment as a result of pollution make their way into the environment via several pathways, including surface runoff into streams and rivers and sediment transport (Heim and Schwarzbauer, 2013). Heavy metals may enter streams and rivers as a result of surrounding land use practices such as irrigation with contaminated water, industrial emission, and the use of fertilizers that contain metals. These heavy metals can lead to adverse effects in the organisms that live in the stream and then travel throughout the food chain.

Due to the strong link between streams and the surrounding landscape, streams are often classified by their surrounding land use. Typically, land use can be broken into distinctive categories such as urban, agricultural, and forested. Agricultural streams are streams that are at or near land used for agricultural use, such as those running alongside pastures or agricultural fields. These streams are at risk of contamination with heavy metals through activities related to agricultural use, including pesticides and fertilizer application. During precipitation periods, the contaminated soil within



**Figure 1.** Site photos of Long Cane Creek (a), West Point Lake tributary (b), Oselige Creek (c), and Park Creek (d).

pastures and fields will run off into the nearby streams contaminating the streams with heavy metals from these agricultural practices. This results in heavy metal concentrations in agricultural streams often being significantly higher when compared to natural streams (Schulz 2001).

Urban streams are streams that run through cities and towns. Urban environments typically have much more impervious surface area relative to non-urban areas due to the paving of roadways and parking areas (Lepeška *et al.*, 2016). Increased impervious surface areas lead to an increase in the amount of runoff from these areas that often flows directly into surrounding streams. Urban streams frequently face contamination from oil leakage and wastewater from industrial buildings (Behbahaninia and Mirbagheri, 2008). Ewa Wojciechowska *et al.* (2019) found that when measuring heavy metal concentrations upstream and downstream from a surface runoff and stormwater retention tank, the downstream site was three times higher in certain heavy metals compared to the upstream site. Urban streams are often at a greater risk of exposure to some contaminants due to their proximity to industrial sites, whereas streams occurring in more rural or forested environments would not be exposed to these contaminants as readily.

Unlike urban and agricultural streams, forested streams do not have a point source for contamination of heavy metals. These streams occur in areas that are densely populated by plant species that make up a dense riparian buffer. Often

human activities do not significantly impact forested streams because the riparian vegetation filters out contaminants before they can enter the stream. Heavy metals found in forested streams are often a result of certain plant species dying in the stream and allowing the heavy metals to accumulate after the decomposition of the species, or of contaminants that make their way into a given stream as a result of upstream runoff within the surrounding watershed.

Given the intricate linkage between overall stream health and the surrounding landscape and the variability in potential sources of heavy metal contamination, it is important to assess the degree of heavy metal variation among streams in relation to surrounding land use. The overall objective of this study was to assess the variation in heavy metal concentrations found in four different freshwater streams with varying land use, including urban, agricultural, and forested. We hypothesized that if sediment cores were taken from agricultural, urban, and forested streams, then there would be a significant difference in the heavy metal concentrations among the streams with some heavy metals being more often associated with streams surrounded by certain land use.

## Materials and Methods

### Study Area

Four freshwater streams located in Troup County, GA (West Central GA, USA) were used as study sites (Fig. 1). These streams are all tributaries to the Chattahoochee River

**Table 1.** Values represent mean +/- 1 standard error (SE) for each in-stream site measurement.

Site	Width (m)	Conductivity (µS)	pH	Temperature (°C)	Dissolved Oxygen <sup>1</sup> (mg/L)
Park Creek	2.86 ± 0.53	145.3 ± 43.9	7.5 ± 0.05	12.13 ± 0.32	3.69
Oseligee Creek	2.3 ± 0.21	242 ± 0.57	7.56 ± 0.08	14.83 ± 0.33	9.09
West Point Lake Tributary	1.16 ± 0.34	42.46 ± 14.37	6.45 ± 0.19	14.2 ± 0.47	6.27
Long Cane Creek <sup>2</sup>	8.5	80.6	6.75	14.9	8.69

<sup>1</sup> Only one measurement was taken for dissolved oxygen at each site.

<sup>2</sup> Only one measurement was taken for all measures for this site.

and vary in their surrounding land use but are of similar size and order, with most being first-order streams. Long Cane Creek runs through farmland used for agriculture. The West Point Lake tributary is a forested creek located within Long Cane Park, a state park managed by the U.S. Army Corps of Engineers, and it is not in frequent contact with humans or urban runoff. Oseligee Creek and Park Creek are urban creeks that run through the city of LaGrange, GA.

### Sample Collection and Processing

In the fall of 2019, three replicate sediment core samples were collected at each site using a multi-stage sediment sludge sampler (AMS, Inc., USA). Replicate cores were taken from the middle, left, and right of the stream channel along a 100-m reach at each site. Sediment samples were placed into labeled, sterile Whirl-pak bags, placed in a cooler, and returned to the lab, where they were then frozen at -20°C until processing. Stream water conductivity, pH, temperature, and dissolved oxygen measurements were taken at each site using Extech ExStik meters (Extech Instruments, USA), and the channel width at each sediment collection site was also measured.

Upon processing, samples were thawed, placed into a crucible, and placed into a drying oven and baked for 48 hours at 20°C to remove all moisture. Samples were then placed into sediment collection bags and submitted for total elemental analysis of priority pollutants via acid digestion through the Agricultural and Environmental Services Laboratory at the University of Georgia, College of Agricultural and Environmental Sciences (Athens, GA).

### Data Analysis

All statistical analyses were performed using Jamovi (2019), and p-values less than 0.05 were considered significant. A principle component analysis was conducted to see how the samples were grouped based on their heavy metal profiles. A scree plot was created to discern how many principle components were required to explain the variation among the samples based on their heavy metal profiles.

Following this, and based on site surrounding land uses, study sites were grouped together as either urban or forested to allow for *t*-tests to compare heavy metal concentrations between the sites. Oseligee Creek and Park Creek were grouped together as urban sites, and Long Cane

Creek and the West Point Lake tributary were grouped together as forested, since Long Cane Creek had a dense riparian buffer. *T*-tests were then performed comparing the heavy metal concentrations between urban and forested sites.

### Results

Table 1 contains a summary of the site measurements for each stream. Both streams classified as urban showed conductivity and pH measures that were slightly higher than those of the streams classified as forested.

The results of the heavy metals analysis for each site are presented in Table 2. All heavy metal concentrations from all replicates, except two, were within normal range. However, one replicate from Park Creek and one from the West Point Lake tributary had higher than normal (>2.4 ppm) measures for cadmium.

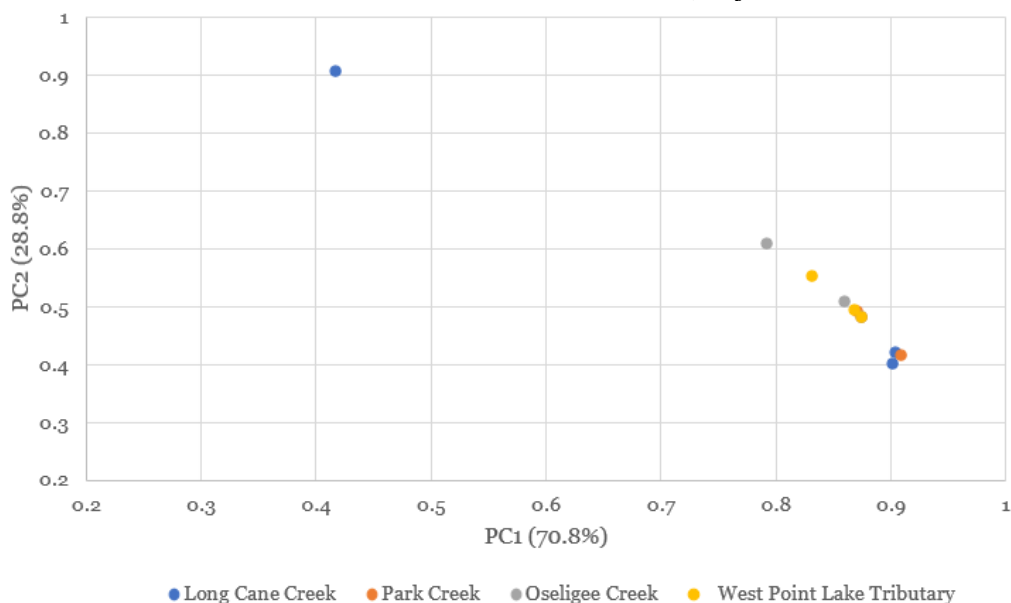
**Table 2.** Mean ± 1SE concentration in parts per million (ppm) of each heavy metal measured in the sediment samples for each study site. Values listed as "NaN" or without SE represent an n<2 due to heavy metal concentrations below the detection threshold.

Site	Al	As	B	Ca	Cd	Cr	Cu	Fe
Park Creek	6398 ± 2037	NaN	39.8 ± 13	738 ± 127	1.67 ± 0.51	59.6 ± 19.9	9.33 ± 2.47	16612 ± 4901
Oseligee Creek	7205 ± 570	NaN	33.2 ± 4.96	797 ± 200	1.5 ± 0.18	35.3 ± 16.5	7.46 ± 2.88	15359 ± 2012
West Point Lake Tributary	8031 ± 2046	NaN	37.8 ± 7.91	217 ± 26.4	1.68 ± 0.36	19.3 ± 1.97	10.1 ± 0.72	17599 ± 3230
Long Cane Creek	3514 ± 1809	2.4	10.2 ± 0.19	211 ± 55	0.55	15.8 ± 5.6	4.88	4802 ± 58.9

Site	K	Mg	Mn	Mo	Na	Ni	P	Pb
Park Creek	146 ± 17	370 ± 27	324 ± 154	0.85	NaN	5.32 ± 1.54	222 ± 55.7	6.48 ± 2.29
Oseligee Creek	568 ± 209	1071 ± 76.2	254 ± 95.8	0.54 ± 0.02	69.1 ± 43.4	4.07 ± 1.3	83.5 ± 40.9	10.4 ± 1.34
West Point Lake Tributary	129 ± 44.7	211 ± 61.8	268 ± 52.7	0.787 ± 0.077	NaN	2.57 ± 0.36	191 ± 50.8	8.09 ± 2.11
Long Cane Creek	187 ± 45.5	287 ± 138	585 ± 268	0.52	NaN	2.15 ± 0.96	90.7 ± 30.3	4.01 ± 2.54

Site	S	Zn
Park Creek	60.1 ± 19.4	19.5 ± 2.44
Oseligee Creek	68.8 ± 31.7	26.5 ± 3.36
West Point Lake Tributary	88.7 ± 1.73	18.2 ± 1.37
Long Cane Creek	50.9 ± 10.6	8.37 ± 1.87

sidewalks (Wojciechowska *et al.* 2019). Further research



**Figure 2.** PCA plot of PC1 and PC2 created from heavy metal concentrations measured in stream sediment at each site.

The scree plot produced during the PCA suggested two components that explained approximately 99% of the variation, and the resulting PCA plot was created using PC1 (70.8%) and PC2 (28.8%) (Fig. 2). No clear pattern was discerned from the distribution of points based on PC1 and PC2.

The results of independent *t*-tests comparing sediment heavy metal concentrations in urban versus forested streams showed significantly different heavy metal concentrations for five of the heavy metals quantified. Calcium concentrations were significantly different between the two groups ( $p < 0.001$ ), with urban creeks having a higher concentration. Similarly, chromium ( $p = 0.045$ ), magnesium ( $p = 0.023$ ), nickel ( $p = 0.051$ ), and zinc ( $p = 0.018$ ) all showed significantly higher concentrations in urban streams as opposed to the more forested streams.

### Discussion

Overall, all heavy metal concentrations were observed to be within the acceptable range except for the two sites in which one replicate at each had higher cadmium levels. Urban sites did show significantly higher measures for 5 additional metals when compared to forested sites. Wojciechowska *et al.* (2019) suggest that urban streams will naturally experience higher levels of heavy metal concentration, specifically in nickel, zinc, and chromium, which our results also indicated. This suggests that even though there was a significant difference between urban and forested streams, there likely would not be significance between different urban streams regarding heavy metals. The increase of heavy metals in urban streams is likely due to the runoff from highways and

should be undergone to support these claims.

The PCA plot does not show separation of urban and forested streams based on their heavy metal profiles. This is likely because Long Cane Creek does suffer from contamination through upstream pollution and is near land used for agriculture. West Point Lake tributary has also had a known history of its water levels rising and lowering. This constant change could also lead to contamination in the stream at the site where we sampled. Pobi *et al.* (2019) discovered through their research that there were higher levels of heavy metals in streams right after the monsoon season compared to the dry season. They suggest that runoff from around the stream will cause contamination. This supports the claim of contamination of channel sediment via rising and lowering water levels in the West Point Lake tributary.

One replicate from Park Creek and one from the West Point Lake tributary had higher than normal ( $> 2.4$  ppm) measures for cadmium. Cadmium is highly toxic (Vukićević, 2012). According to the Water Quality Association (WQA), cadmium may contaminate streams through corrosion of galvanized pipes, erosion of natural deposits, discharge from metal refineries, and from waste batteries and paints (WQA, 2020). Park Creek is an urban stream, so it is more likely to suffer from the wastewater runoff, whereas the West Point Lake tributary may suffer from natural erosion, since this stream is forested. In addition, the West Point Lake tributary may receive inputs and deposits of heavy metals from West Point Lake during times of high-water levels, given that West Point Lake is a potential sink for surrounding runoff.

Overall, levels of heavy metals in streams should not stay elevated. If they do, then the aquatic community could

suffer through heavy metal poisoning. The U.S. Environmental Protection Agency (EPA) has found several ways to reduce heavy metal concentrations in aquatic communities. One of these ways is through the usage of plants. Plants can be used to reduce wind and water erosion that spread materials containing heavy metals. Some plant species can absorb heavy metals and concentrate them in their tissues. Another way to decrease heavy metal concentrations in the stream is by adding chemicals to the soil that would create minerals with the heavy metals that would not be easily absorbed by plants, animals, or people (EPA, 2000). The heavy metal will stay in the environment, but it will be an adjuvant of a lesser harmful compound.

Additional studies to identify potential sources of the heavy metals found elevated in these specific sites would be beneficial and could be used to develop remediation methods to reduce the amounts of heavy metals entering streams. The data produced by this study also helps identify a potential subset of metals to target when doing heavy metal analysis so that researchers do not necessarily have to test for the full spectrum of heavy metals when examining the urbanization level of streams.

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# 16S rRNA Gene Sequencing of Bacterial Communities in Varying Depths within Freshwater Stream Sediment

Emsley Smith and Molli M. Newman, PhD

Faculty Mentor: Molli M. Newman, PhD  
Science / Biology

## Abstract

The distribution of bacterial communities in stream sediment profiles could provide insight to the ecological function of bacteria in first-order streams. In this study, bacterial communities in sediment from varying depths obtained from three first-order streams in West Central Georgia were characterized using 16S rRNA gene sequencing. Bacterial 16S rRNA gene abundance showed that the phyla Proteobacteria and Firmicutes had the highest relative abundance in both surface and subsurface sediments. Sediment depth was found to influence the average relative abundance of bacterial phyla based on aerobic or anaerobic abilities as well as the abundance of organic matter. More aerobic taxa were found in the surface sediment, while more anaerobic taxa were found in the subsurface sediment. These results give insight into the microbial processes in surface and subsurface sediments that may impact the compositions of bacterial communities in first order streams.

## Introduction

Microorganisms are associated with sediment and water in aquatic ecosystems and contribute greatly to the health of these systems. Exploring the diversity of freshwater sediment microbial communities can provide insight into distinct microbial processes that contribute to the natural purification of aquatic systems (Kumar et al., 2019).

A previous study by Kumar et al. (2019) suggested that in-stream nitrification may occur primarily in stream sediments, as well as degradation of organic matter and transformation of metal compounds. This study found that bacteria were the most abundant microbe in stream sediment, particularly the phyla Nitrospirae, Aquificae, Proteobacteria, and Firmicutes (Kumar et al., 2019). A comparison of microbial communities at varying depths in sediment could be insightful as to which microbial processes occur at different locations within the sediment depth profile.

In a study by Zhou et al. (2017) exploring bacterial and archaeal communities in mangroves, bacterial 16S rRNA gene abundance was found to decrease as sediment depth increased. Researchers concluded that sediment depth was an influential factor for the bacterial community composition and diversity. Aerobic bacterial taxa were largely found in the surface layer, while anaerobic bacterial taxa were largely represented in subsurface layers. Researchers concluded that oxygen availability and the distribution of other terminal electron acceptors along the depth profile shaped bacterial community distribution patterns. The surface layer had the lowest observed

number of bacterial species. The largest percentage of observed surface layer species included the phyla Cyanobacteria and Proteobacteria. The largest percentage of observed subsurface phyla included Chloroflexi and Proteobacteria (Zhou et al., 2017).

In the current study, bacterial communities were compared at different sediment depths and channel positions in three streams found in West Central Georgia using 16S rRNA amplicon sequencing. The goal of this study was to gain a better understanding of bacterial community composition and diversity patterns in stream sediment in relation to depth in the stream bed. In doing so, this research could provide insight into the ecological functions of bacterial taxa in lower-order streams. Based on the results of Zhou et al. (2017), we hypothesized that we would see more aerobic taxa in surface sediment and more anaerobic taxa in subsurface sediment.

## Materials and Methods

### Study Site Description and Sampling Procedure

Sediment samples were collected from three lower-order streams in Troup County, Georgia (Fig. 1a): Long Cane Creek, Oseligee Creek, and Park Creek. Oseligee and Park Creeks are located within the city of LaGrange, GA and were considered to have a more urban land use in the surrounding area. The land use surrounding Long Cane Creek, located just outside the city of LaGrange, was forested with agricultural inputs, as it was located within a cow pasture. A variety of in-



**Figure 1.** a) Sediment core collection and b) sediment core taken at Long Cane Creek

stream parameters were quantified at each sampling site. These parameters included stream water pH, conductivity, dissolved oxygen, temperature, and channel width. These stream water measurements were collected using Extech ExStik meters (Extech Instruments, USA).

Three replicate sediment samples were collected at each site using a multi-stage sediment sludge sampler (AMS, Inc., USA). The three replicates per site were collected from middle, left, and right positions in the stream channel. For a given replicate, an approximately 0.3-m deep sediment sample was retrieved (Fig. 1b), and the surface and subsurface portions of the sediment core (approx. 8 cm from the top and bottom of the core) were collected in a sterile Whirl-Pak bag. Samples were placed on ice and returned to the lab, where they were frozen at  $-20^{\circ}\text{C}$  until processing.

### DNA Analyses

In order to examine the bacterial community composition within the sediment, genomic DNA was extracted from 0.25 grams of sediment from each replicate using the E.Z.N.A. Soil DNA Kit from Omega Bio-tek (Norcross, GA).

Final extracts were eluted in 50  $\mu\text{l}$  of elution buffer and stored at  $-20^{\circ}\text{C}$  until processing.

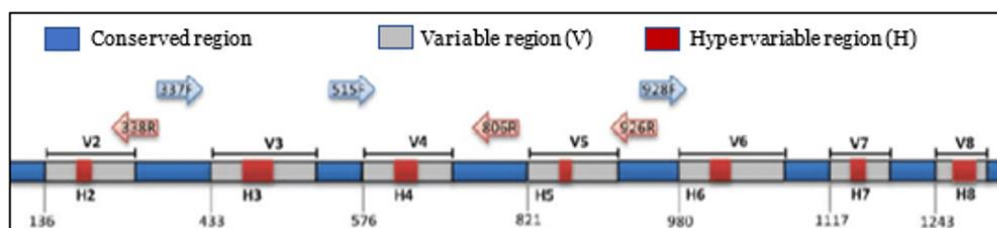
DNA extracts were quantified via Nanodrop (ThermoFisher, USA) and submitted to MR DNA Labs (Shallowater, TX) for 16S rRNA gene sequencing of the bacterial communities associated with stream sediment samples. The average DNA concentration from extracts was  $3.81 \pm 0.781 \text{ ng}/\mu\text{l}$ . Two DNA extract concentrations were low and therefore not submitted for sequencing. DNA sequence data was processed according to the analysis pipeline used by MR DNA Lab for 16S rRNA data, specifically using the 515F/806R primer pair targeting the V4 hypervariable region (Fig. 2).

### Statistical Analyses

The relative abundance of various bacterial taxa was compared between the surface and subsurface sediment samples using an independent t-test ( $\alpha = 0.05$ ). Sequence data were processed via a proprietary analysis pipeline (www.mrdnalab.com, MR DNA, Shallowater, TX, USA) and Operational Taxonomic Unit (OTU) clustering at 3% divergence and therefore a 97% similarity. Taxonomic classification of the OTUs was completed using BLASTn against a curated database from GreenGenes/RDP/NCBI. The statistical program used for data analysis was jamovi (2019), and significance reported for any analysis was defined as  $p < 0.05$ .

### Results

The average measures for each instream measure are presented in Table 1. Park Creek and Oseligee Creek both had higher conductivity measures than Long Cane Creek, and Long Cane Creek was moderately wider than Oseligee Creek and



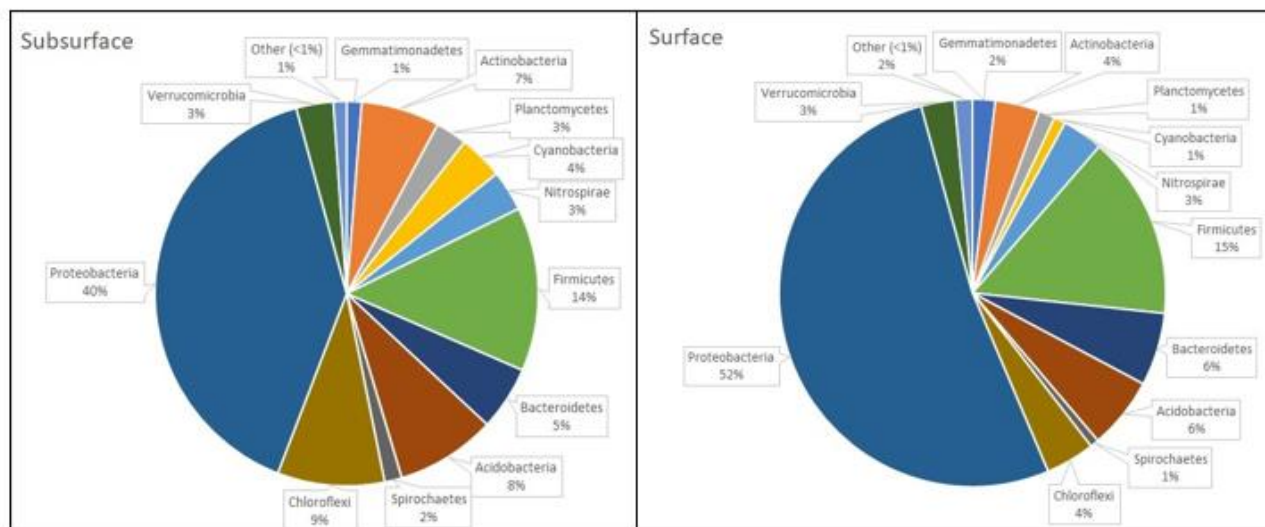
**Figure 2.** Illustration of conserved and variable regions within the 16S rRNA gene showing the 515F/806R primer pair.

**Table 1.** Instream water measurements for each site. Values represent the mean  $\pm$  1 SE.

Site	pH	Conductivity ( $\mu\text{S}$ )	Dissolved Oxygen ( $\text{mg/L}$ )**	Temperature ( $^{\circ}\text{C}$ )	Channel Width (m)
Long Cane Creek*	6.75	80.6	8.69	14.9	8.50
Oseligee Creek	$7.57 \pm 0.0882$	$242 \pm 0.577$	9.09	$14.8 \pm 0.0333$	$2.30 \pm 0.208$
Park Creek	$7.50 \pm 0.0577$	$145 \pm 43.9$	3.69	$12.1 \pm 0.318$	$2.87 \pm 0.533$

\*Only one replicate was recorded for Long Cane Creek.

\*\* Dissolved oxygen was only measured once at each site.



**Figure 3.** Average relative abundance of bacterial phyla within surface and subsurface sediment samples.

Park Creek. Stream water pH, temperature, and dissolved oxygen concentrations were relatively similar among all sites.

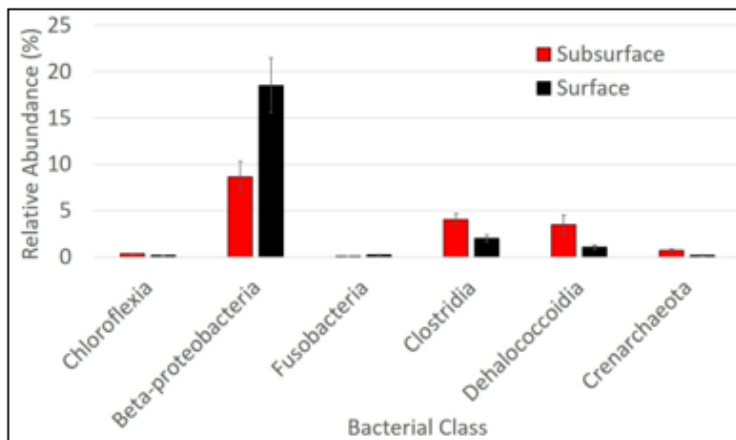
The composition of bacterial communities found in the surface and subsurface sediment samples from Oselige Creek, Long Cane Creek, and Park Creek is shown in Figure 3. The phyla Proteobacteria and Firmicutes had the highest relative abundance in both surface sediments and subsurface sediments. In the subsurface sediment, the phyla Proteobacteria was found in less abundance, 40%, compared with the surface, 52% (Fig. 3). With the Proteobacteria, the classes delta-, beta-, alpha-, and gamma-proteobacteria were the most dominant. Subsurface sediment samples contained significantly higher relative abundance of Actinobacteria ( $p=0.025$ ) compared to surface sediment samples. Figures 3 and 4 both summarize the average relative abundance of various bacterial taxonomic levels from surface and subsurface sediments. Of the 118 bacterial classes observed in the

sediment samples, 6 of them were significantly different in terms of relative abundance in surface versus subsurface sediment samples ( $p<0.05$ ) (Fig. 4).

### Discussion

Proteobacteria (17.2%), Actinobacteria (12.3%), and Firmicutes (7.4%) were the dominant phyla found in the Kumar et al. study (2018). These phyla were found at lesser amounts than our study, due to a larger percentage of unclassified sequences (36%) compared to 1-2% in our study. Actinobacteria were found in greater abundance in the Kumar et al. study (2018). However, Actinobacteria were found in greater abundance in water samples compared to the sediment samples, possibly because most of its members are aerobic (Kumar et al., 2018). Actinobacteria are often involved in the decomposition of organic matter, which increases as sediment depth increases (Kumar et al., 2018). Actinobacteria can be aerobic or anaerobic, and they can form spores, which could also account for the increasing abundance with depth.

In the Zhou et al. study (2017), the phyla Acidobacteria, Chloroflexi, Dehalococcoidia, Planctomycetes, Nitrospirae, and Spirochaetae were found in greater abundance at deeper sediment depths. Acidobacteria abundance in subsurface sediment samples (8%) was greater than its abundance in surface sediment samples (6%) (Fig.3). Chloroflexi abundance was greater in subsurface sediment (9%) than in surface sediment (4%) (Fig. 3). Dehalococcoidia abundance in subsurface sediment samples was significantly greater than its abundance in surface sediment samples (Fig. 4). Dehalococcoidia are well known for their anaerobic respiration on oxidizing hydrogen by halogenated organic compounds, which could account for the significant difference in its abundance between the sediment depths (Zhou et al., 2017). Planctomycetes abundance was greater in subsurface sediment samples (3%) than in surface sediment samples (1%)



**Figure 4.** Average relative abundance of six bacterial classes within surface and subsurface sediment samples that were significantly different ( $\alpha = 0.05$ ) between the two depths sampled.



(Fig.3). Spirochaetae abundance was greater in subsurface sediment samples (2%) than in surface sediment samples (1%) (Fig.3). However, the phylum Nitrospirae was found in equal abundance in both sediment depths (3%) (Fig.3). Chloroflexi may have been found in greater abundance in subsurface sediment samples due to the utilization of organic matter in subsurface sediments, and it is facultatively anaerobic (Zhou et al., 2017). Spirochaetae are often facultative anaerobes. Clostridia are predicted to metabolize aromatic compounds in anaerobic conditions which may explain why it was found in significantly greater abundance in subsurface sediment than in surface sediments (Kumar et al., 2018) (Fig.4). There is a correlation with sediment depth and oxygen tolerance, and the average relative abundance of anaerobic bacterial phyla was shown to be higher in subsurface sediment samples.

The average relative abundance of Beta-proteobacteria was found to be significantly greater in surface sediment samples compared to subsurface sediment samples (Fig. 4). Our finding is supported by the Zhou et al. study in which the bacterial phylum Beta-proteobacteria was found only in the surface level depth which is likely due to its aerobic characteristics (2017). Also, Beta-proteobacteria can use nitrite as a terminal electron acceptor during denitrification. The concentration of Beta-proteobacteria is significantly higher in surface layers, due to the availability of nitrate (Nedwell et al, 1999). Bacteroidetes abundance was found to decrease with depth in both this study and the Zhou et al. study (2017). In the Zhou et al. (2017) study, Cyanobacteria were enriched in the surface layer sediment, and their abundance drastically decreased with sediment depth. The majority of Cyanobacteria are aerobic and photosynthesize, which would explain their abundance in surface layer sediment (Zhou et al, 2017). However, the surface sediment samples (1%) of Cyanobacteria were in lower abundance than the subsurface sediment samples (4%) (Fig.3). Kumar et al. (2018) reasoned that although nitrification is an aerobic process, it could be inhibited by

sunlight, which may explain why Cyanobacteria abundance increased with sediment depth.

### Conclusion

In conclusion, this study gives a comprehensive comparison of bacterial community composition in surface and subsurface sediment samples from three first-order streams. The two most abundant phyla, Proteobacteria and Firmicutes, remain stable in surface and subsurface sediment samples. With respect to the hypothesis, more aerobic taxa were found in surface sediments, while more anaerobic taxa were found in subsurface sediments. The distribution pattern of the bacterial community determined by this study may be influenced by the oxygen availability in surface and subsurface sediments. Nitrification, which is typically expected to occur in the water or surface level sediment, was implied to occur in subsurface sediments. Our results give insight into the microbial processes in surface and subsurface sediments that may impact the compositions of bacterial communities in first-order streams.

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# Using Boltzmann Transport Theory to Compute Field Interaction Between Dark Matter and Dark Energy

Holston Sebaugh and Kevin J. Ludwick, PhD

*Faculty Mentor: Kevin J. Ludwick, PhD*  
Science, Chemistry and Physics

## Abstract

Within the literature, many different parameterizations of couplings between dark energy (DE) and dark matter (DM) as fluids in the continuity equation have been studied and examined, and observational data can constrain these parameterizations. Instead of a fluid coupling, we present here a study of DE-DM coupling as fields, which is a more fundamental description of interaction, and our method is novel in that we utilize the Boltzmann Transport equation to calculate the interaction. Since the equation-of-state parameter for DE is observationally negative, it is necessary to use a distribution function for DE in the Boltzmann Transport equation that leads to a negative equation-of-state parameter, which neither Bose-Einstein nor Fermi-Dirac distributions can supply. We utilize an effective distribution function derived from quantum field theory in curved spacetime that accounts for our negative state parameter. We present and examine our results for a Yukawa-type coupling between DE and DM, and we show how the DE-DM interaction term in the continuity equation depends on different parameters such as the DE and DM mass.

## Introduction

Our universe is expanding, and since several billion years after our universe began, it has been expanding outward more quickly with the progression of time; our universe is not only expanding but also accelerating, according to observations. We call the cause of this acceleration “dark energy” (DE). It is called “dark” because it is not observed via the electromagnetic spectrum. Instead, DE is detected via the “anti-gravitational” effect that it has on normal matter, causing the universe to accelerate outward rather than to gravitationally collapse inward upon itself. DE accounts for ~68% of the contents of our universe.

When observing our universe and how celestial bodies interact within it, cosmologists saw a discrepancy between their calculations and observations. In order for observations to make sense, there must be more mass present than is actually electromagnetically detected. This matter was called “dark matter” (DM) for its apparent lack of luminosity and lack of reaction to electromagnetic waves. DM still has the same gravitational effects as those of normal matter. DM makes up ~27% of our universe.

Our universe is continuously expanding and accelerating, and it is unknown if there is any interaction

between dark matter (DM) and dark energy (DE). The standard way of modeling the contents of our universe is to treat them as perfect fluids, and conservation of energy and momentum in an expanding universe implies

$$\nabla_{\alpha} T^{\mu\nu} = 0 \rightarrow \sum_i (\dot{\rho}_i + 3H(\rho_i + p_i)) = 0, \quad (1)$$

where  $\rho$  is the fluid energy density,  $p$  is the fluid pressure, and  $H$  is the Hubble parameter, which describes the expansion rate of our universe. We also use natural units here and throughout, so that  $c = \hbar = k_B = 1$ . In late cosmological times, DE and DM dominate over other constituents of our universe, such as radiation and ordinary matter. Therefore, it follows from Eq. (1) that

$$\dot{\rho}_{DM} + 3H(\rho_{DM} + p_{DM}) = Q, \quad \dot{\rho}_{DE} + 3H(\rho_{DE} + p_{DE}) = -Q. \quad (2)$$

### Calculating the Interaction

Typically, works in the cosmology literature assume that  $Q = 0$ , which means no interaction between DM and DE. When an interaction is assumed, an *ad hoc* parameterization is applied that treats DM and DE as fluids rather than fields. Instead, we model interaction on a more fundamental level in that we treat DE and DM as scalar fields. Since we are assessing the interaction as fields, we assume a standard Yukawa-type field interaction,

$$\frac{1}{2}g\psi^2\phi \quad (3)$$

where  $g$  is our coupling constant,  $\psi$  is the DM field, and  $\phi$  is the DE field. Assuming a 2-to-2 conversion, a pair of two dark matter particles and two dark energy particles can convert one to the other [1, 2]. It can then be shown using the Boltzmann Transport equation that [3]

$$Q = MB, \quad (4)$$

where  $M$  is the DM mass and  $B$  is given by

$$B = \int \frac{d^3k_1}{(2\pi)^3 2\sqrt{k_1^2 + M^2}} \frac{d^3k_2}{(2\pi)^3 2\sqrt{k_2^2 + M^2}} \frac{d^3k_3}{(2\pi)^3 2\sqrt{k_3^2 + m^2}} \frac{d^3k_4}{(2\pi)^3 2\sqrt{k_4^2 + m^2}} \times \quad (5)$$

$$(2\pi)^4 \delta^4(k_1 + k_2 - k_3 - k_4) [f_\psi(k_1)f_\psi(k_2) - f_\phi(k_3)f_\phi(k_4)] |\mathcal{M}|^2.$$

Within Eq. (5), we define  $m$  as the DE mass and  $M$  as the DM mass. Furthermore, our DM distribution function,  $f_\psi$ , is the Bose-Einstein distribution:

$$f_\psi(k) = \frac{1}{e^{\sqrt{k^2 + M^2}/T} - 1}. \quad (6)$$

The DE distribution function,  $f_\phi$ , is obtained in [3]. Due to its length, we do not reproduce it here, but it is a function that depends on the DE mass  $m$ , the scale factor of the expanding universe  $a$ , the DE non-minimal coupling parameter  $\xi$ , and momentum. The parameter  $a$  is a function of time that describes the expansion rate of the universe dominated by DE and DM, and  $\xi$  is the coupling between the curvature of spacetime and DE.  $\mathcal{M}$  refers to the DE-DM scattering amplitude, which is given by

$$|\mathcal{M}|^2 = g^4 \left( \frac{1}{M^2 - t} + \frac{1}{M^2 - u} \right)^2. \quad (7)$$

In the center-of-mass frame,  $t$  and  $u$  are defined as

$$t = -2\sqrt{k_3^2 + m^2}\sqrt{k_1^2 + M^2} + 2k_1k_3\cos\theta + m^2 + M^2 \quad (8)$$

$$u = 2m^2 + 2M^2 - 4M^2 \left( \left( \frac{k_1}{M} \right)^2 + 1 \right) - t. \quad (9)$$

We calculate  $Q$  and plot the result in Fig. 1, and we plot  $Q$  as a function of the scale factor  $a$ . We use  $a(t)$  for a universe dominated by DE, which is valid for late cosmological times:

$$a(t) = 1 + (1+w)(6\pi G\rho_{DE0})^{1/2}(t-t_0)^{2(1+w)/3}, \quad (10)$$

where  $\rho_{DE0}$  is the observational value of the present-day DE energy density,  $w = -0.9$ , and  $t_0$  is the present-day time, all of which are consistent with observational data [3].

### Results

For our plot in Fig. 1, the range of our horizontal axis corresponds to the time period over which dark energy dominates the universe, and  $a = 1.0$  corresponds to present time. Our vertical axis shows the coupling  $Q$  between DM and DE in units of  $\text{eV}^5$ . Furthermore, notice that the function

$$M = 10^9 \text{eV}, m = 1.567 \times 10^{-54} \text{eV}, \xi = 0.176, g = 0.1 \text{eV}. \quad (11)$$

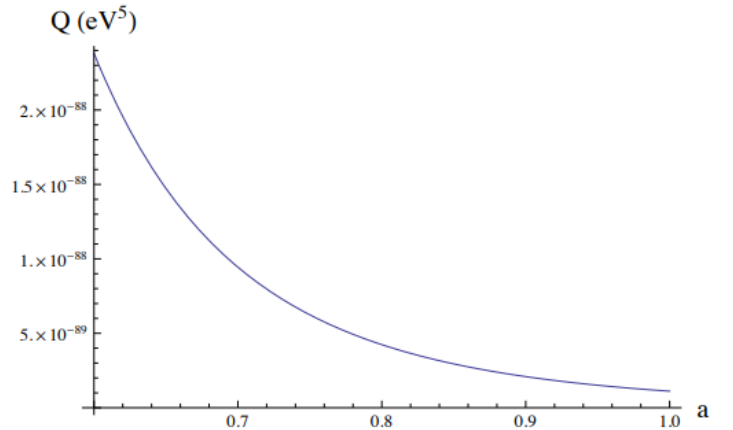


Figure 1: Q versus a.

continually decreases in value as it approaches present time and that  $Q$  has a low interaction value. For this plot, we have set our parameters to ones in agreement with observational constraints:

In our analysis, we let  $g$  range from 0 eV to 1 eV. Also,  $m$  is constrained from observable data in [3], and we use a reasonable range for  $M$ , from  $10^9$  eV to  $10^{12}$  eV. For these parameter ranges, the order of magnitude of  $Q$  can be anywhere

from  $10^{-100} \text{eV}^5$  to  $10^{-80} \text{eV}^5$ . For comparison, a typical value for a parameterization of  $Q$  that treats DM and DE as fluids is  $|Q| \sim 10^{-45} \text{eV}^5$  [3].

### Conclusion

We have demonstrated a novel method of calculating the interaction in the continuity equation,  $Q$ , between DE and DM involving the Boltzmann Transport equation. Treating DE and DM as fields is more fundamental compared to their typical treatment in the cosmological literature as fluids, and we applied our method to a standard Yukawa-type coupling

with 2-to-2 conversion between DE and DM. We found that the interaction strength  $Q$  from the continuity equation is relatively small for this coupling. The results show the viability of this method of calculating  $Q$ , and it can be applied to other kinds of field couplings as well.

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# The Expectations of Sex Education Curriculums from the Adult Population

Melanie D. Prater and Christi Hu, PhD

*Faculty Mentor: Christi Hu, PhD*  
Science, Psychological Science

## Abstract

Previous research has found that the majority of sexual education programs taught in the school system are abstinence-based. This project continues the line of research investigating the relationship between types of sexual education and sexual activity in college. While research has shown that teenagers' sexual education did not cover, or covered only briefly, important topics and focused on abstinence, very little research has been done from the perspective of adults. This study asked adults, what type of sexual education programs they received and what they thought was currently being taught in sexual education programs; it also asked them to rank the importance of several topics. Information on religion, politics, and location were also gathered. The level of importance on several topics, including LGBTQ issues and abstinence, were related to religiousness and political stance. While there were differing opinions in several areas, there was still a large portion of adults who focused on abstinence as an important topic.

## Background

Previous research in this laboratory has found that the majority of sexual education programs taught in the school system are abstinence-based (Prater, 2019), which supports other findings in the literature. In a study conducted by Gardner and colleagues (2015), the findings showed that only 1/3 of the schools in the US reported being an abstinence-only-based sexual education program. However, every student involved in the study reported that their sexual education program was abstinence-only and highly valued virginity even when the school reported otherwise (Gardner, 2015). In another study, only 5-10% of students reported that they were enrolled in a comprehensive sexual education program (Constantine, Jerman, Petra, Huang, & Alice, 2007).

Gardner also found that students' sexual education program did not cover, or covered only briefly, topics that they thought were important. These students stated that their ideal sexual education program would include a neutral orientation to sexuality that assumes that young people will be sexually active, full and specific information on contraception and safe sex options, and information on accessing sexual health services (Gardner, 2015).

However, it is not just the students who believe that there is much lacking in their sexual education. Parents also believe that certain topics are lacking in sexual education programs. Parents have reported that they wanted the topics of puberty, healthy relationships, abstinence, sexually transmitted

diseases, and birth control taught in their child's sexual education program (Kantor & Levitz, 2017). In a study done in California, 89% of parents were in support of comprehensive-based programs, while 11% of parents were in support of abstinence-only-based programs (Constantine, Jerman, Petra, Huang, & Alice, 2007).

No conclusions have been drawn pertaining to what influences parents' perception of sexual education programs. A study conducted on the different views of sexual education between Democrats and Republicans showed no significant difference between the expectations of Democratic and Republican parents (Kantor & Levitz, 2017). There is also a lack of research in more conservative areas of the country. This project aimed to fill some of these gaps by asking adults specific questions about their expectations of sexual education programs, along with demographic, religious, and political affiliation questions.

## Method

### Participants and Recruitment

Participants were recruited through social media by the sharing of the survey and a request for joining the study. At the end of the survey, we also asked if they would share the survey on their social media page, using snowball sampling. Participants were eliminated if they were 1) under 18 years of age or older or 2) currently enrolled in college courses. This

ensures that we were gathering data from adults not in any type of school system.

### Materials

Participants completed an online survey with 35 questions in total.

*Participants' own sexual education program.* The survey included the choice of 5 different sexual education programs, with instructions to select the one option that best describes the program that they experienced in high school. Definitions of the programs were obtained from the Sexuality Information and Education Council of the United States (summarized in Connecticut State Department of Education's Overview of Sexual Health Education; CSDoE, 2020).

*Current sexual education programs in community.* The participants were asked to indicate which topics they believed were offered in the current sex education programs at local schools, based on a list of topics provided to them. They were then asked to rank the importance of each topic individually. The participants were also asked if they believed that a sex education program should be co-ed and who they believed should teach a sex education course.

*Demographic questions.* The survey included questions regarding age, race, and level of education. The participants were asked which state they lived in and to rate their religious and political views.

### Data Collection

Data was collected using social media. The survey was shared on a social media platform, and at the end of the survey, the participants were asked to share the survey on their accounts in order to spread access to the survey. The project was approved by LaGrange College's IRB.

### Results

145 adults participated in this study. 4 participants were removed from the study due to nonsensical answers. Therefore, our sample was 141 (114 females, 26 males, 1 nonbinary). The participants ages ranged from 18 to 79 years. The participants were white (123), African American or black (7), Asian (2), Indian (1), multiracial (4), and 4 failed to respond.

The majority of all participants (66.79%) thought that an outside source should be brought in to teach sexual education programs (See Figure 1).

Participants who identified as very religious found the topic of abstinence more important in sexual education programs compared to non-religious participants ( $\chi^2=59.43$ ,  $p<0.00$ ). Participants who identified as non-religious found the topic of LGBTQ issues more important in sexual education programs compared to very religious participants ( $\chi^2=59.43$ ,  $p<0.00$ ). Participants who identified as politically conservative found the topics of abstinence ( $\chi^2=70.34$ ,  $p<0.00$ ) and morality ( $\chi^2=46.82$ ,  $p<0.00$ ) more important in sexual education

Figure 1.

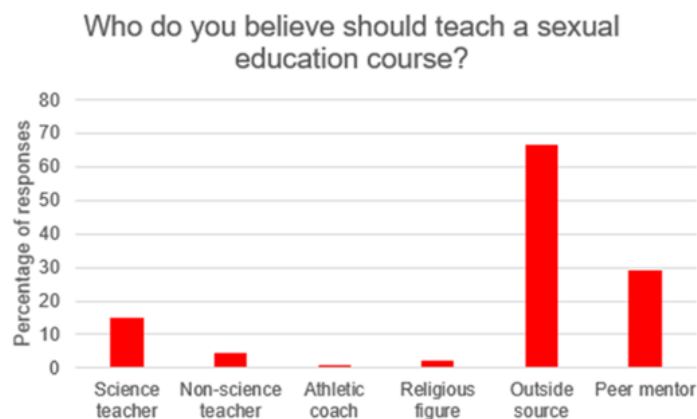
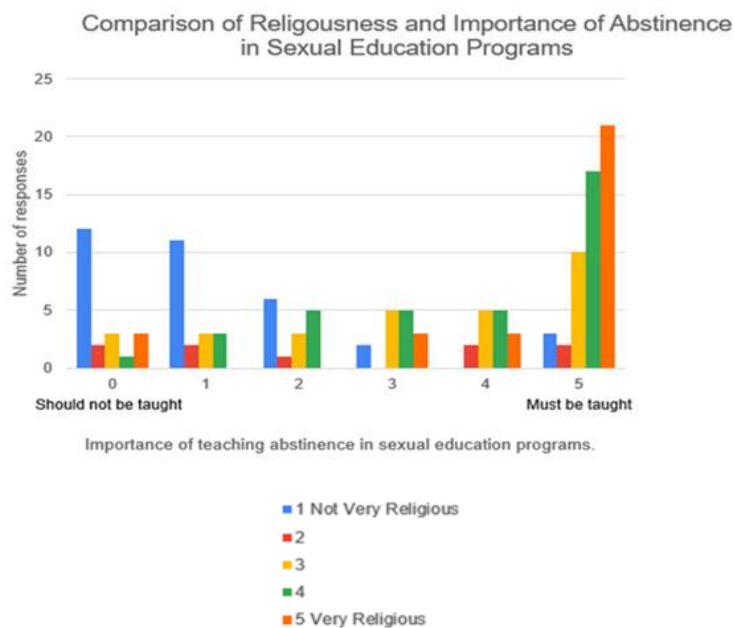


Figure 2.



programs compared to liberal-leaning participants. Participants who identified as politically liberal found the topic of LGBTQ issues more important in sexual education programs compared to conservative-leaning participants ( $\chi^2=59.33$ ,  $p<0.00$ ). Participants who ranked the topic of LGBTQ issues as more important also ranked topics of abstinence as less important ( $\chi^2=45.36$ ,  $p<0.00$ ). However, even in groups of participants that encouraged the inclusion of LGBTQ topics, there is still a large number of adults who rank abstinence as important. The participants who ranked LGBTQ issues as very important (n=56), 17 also ranked abstinence as very important (See Figure 2).

Levels of education did not predict the participants' rank of importance in LGBTQ issues ( $\chi^2=11.35$ ,  $p=0.33$ ); however, a quantitative trend shows that participants of higher education showed a large amount of support to the inclusion of LGBTQ topics.

Participants who identified as very religious also thought that sexual education programs should not be coed, while participants who identified as non-religious thought that they should be coed. ( $\chi^2=13.31$ ,  $p = 0.01$ )

### Discussion

The support of the topics of abstinence, LGBTQ issues, and morality are correlated with religious and political stance. This could support that the opinions of sex education are influenced by political and religious agendas.

The majority of the adults sampled supported an outside source being the teacher of sex education programs. Seeing as the majority of current sex educators are not outside sources, this is valuable information moving forward in the understanding and improvement of sex education programs.

There was surprising support of abstinence topics, even in the non-religious and liberal-leaning participants. This highlights the adult view that teenagers should not be having sex and that sexual education programs should teach this lesson. However, previous research shows that over half of college students are sexually active, regardless of the type of sexual education program (Prater, 2019). We need to move away from this focus and start educating students in ways to live a sexually healthy life.

The limitation to this study is the lack of diversity in the sample. The overwhelming majority of the sample were white women from the South. We would have a better understanding of the population if our sample was more

diverse. Future studies should collect data from the groups that are lacking, which would show a better understanding of the current situation of the mind set about sex education.

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