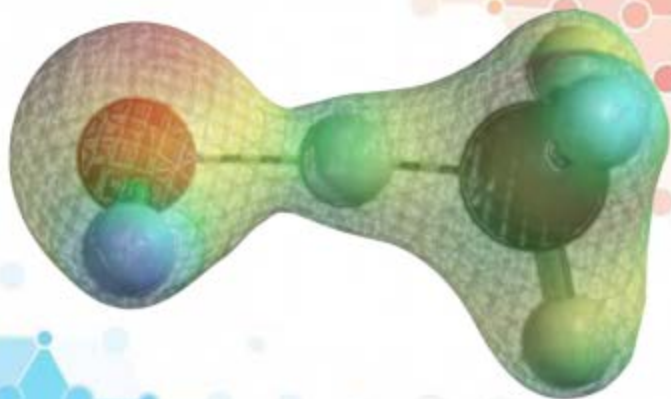


TURNINGS

The University Honors
Program



2018-2019

California State University Stanislaus

Turnings

Volume 16, Spring 2019

A Journal of Exploratory Research and Analysis

The articles published here reflect the Capstone Research efforts of graduating seniors in the Stanislaus State University Honors Program. They present projects conceived from personal academic interests and mentored by faculty members familiar with the research and scholarship driving these efforts of discovery.

As this research is born of the intersection of personal interests and scholarly preparation, each student's work reflects the undulation of intellectually inquiry, tracing the peaks and troughs along which the wave of their interests travels toward the culmination of their investigation. In some cases topics coalesce into an energetic harmony that amplifies the urgency of the problem at hand. In others, diverging results create a dynamic tension that resonates far beyond the original scope of the research. In the course of their research, students are confronted by a world of data, questions, critiques, and alternate visions that often take them by surprise. They come to realize that scholarly inquiry acts not as a perfectly polished mirror that reflects a hypothesis back virtually unchanged, but rather as a prism that shatters their current thinking into constituent parts that travel in their own directions before coming back together in unanticipated ways.

When they rise to the challenge, students reflect on these altered visions and use them to bring their hypotheses into greater alignment with the world beyond the looking-glass. Sound research emerges

from *growth* in perspective, not stasis, and the goal of good mentoring is to cultivate an openness to the topsy-turvy, dizzyingly disorienting results their work may bring. We thank our faculty mentors (more than 100 so far), who have worked with our Capstone students during the past eighteen years to help them frame, conduct, and enthusiastically embrace the results of effective research projects.

The 2018-2019 academic year marks our largest crop of Honors Capstone Projects to date, with 38 seniors presenting research at our 18th Annual Honors Capstone Conference and 33 of those presenters publishing their investigations in this journal. Students pursued their work multiple sections of our Honors courses, reshuffling as class times and schedules shifted each semester to discover new colleagues and connections in each iteration. In spite of the large numbers and the dynamic cohorts, this year's projects coalesced around several important themes, ranging from zoological studies, topics related to learning styles and higher education consumerism, technologically driven efforts to identify and model everything from faces to fake news on-line, philosophical inquiry, literary criticism and censorship, and the biological and social dimensions of autism spectrum disorders. All of these themes are explored in the pages that follow. We thank our students for the journey on which they have taken us and look forward to future installments as their work progresses.

The Honors Capstone Project

Seniors in the Honors Program are encouraged to tackle complex problems using methods, insights and knowledge drawn from relevant disciplines. Honors Program faculty and capstone research mentors offer critical feedback and guidance along the way. The main objective is for students to explore, gather, and analyze information effectively, and to share their reflections on the implications of what they have discovered. Group discussions help to promote thoughtful questioning and critical analysis. The primary goal is to communicate knowledge, judgments, and original perspectives cultivated on the basis of careful inquiry, exploration and analysis.

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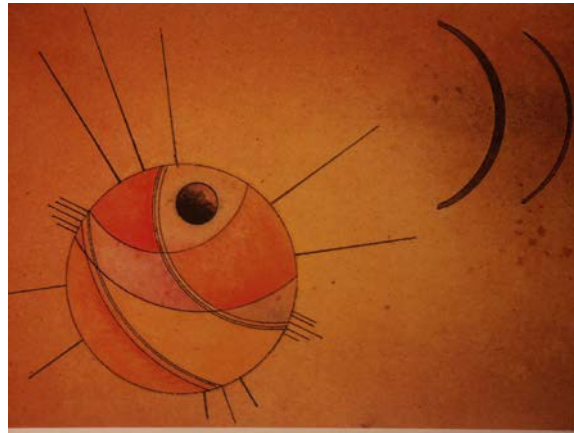
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HONORS PROGRAM COMMUNITY STATEMENT

The Honors Program at CSU Stanislaus is a community of scholars bound together by vital principles of academic openness, integrity, and respect. Through focused study and practice involving exploration and discovery across a variety of disciplines, the Honors Program upholds these principles of scholarly engagement and provides students with the necessary foundations for further research and inquiry.



Our interdisciplinary curriculum is integral to this work and is intended to facilitate creative understanding of the irreducible complexities of contemporary life and knowledge. Personal and intellectual honesty and curiosity are essential to this process. So, too, is critical openness to difficult topics and respect for different perspectives, values and disciplines. The Honors Program aims to uphold these virtues in practice, in principle, and in community with one another.

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Potential Mutagenic Properties of Hookah Smoke vs Cigarette Smoke

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Abstract

Hookah has recently been popularized in the United States as alternative to smoking tobacco using cigarettes. Since consuming hookah involves pulling smoke through water before inhaling it, there is a preconception that the potentially dangerous water-soluble tar components are trapped in the water, thus making the vapors safer. We performed a DNA nicking assay to test mutagenic properties of hookah smoke to compare them to cigarette smoke. The DNA nicking assay involves incubating various concentrations of hookah smoke solutions with bacterial DNA to measure the level of cuts in the sugar backbone of the bacterial DNA. The amount of DNA nicking by hookah solutions was orders of magnitude less than the nicking that has been detected with cigarette smoke. Additionally, UV spectroscopy revealed that some of the smoke components did remain trapped in the water. Though more research remains to be conducted, the results of this and similar studies could be used to explain differences in the rates of cancer and other tobacco-related diseases between countries or regions in which one delivery method is preferred or more prevalent/dominant than the other.

Keywords: hookah, cigarettes, mutagenic, smoking, DNA nicking

Introduction

The act of smoking tobacco has been performed by people of all cultures and backgrounds for about 2,000 years now (A Brief History of Smoking, 2013). There are many ways to smoke, be it through pipes, cigarettes, cigars, or bongs that are more modern, e-cigarettes, vaping pens, or hookahs. Hookahs are not exactly new, as they have been in use in the Middle East for the last 400 years, but the use of hookahs to smoke tobacco is an emerging trend here in the United States, especially among adolescents and young adults (Barnett and Livingston, 2017). Part of the reason for this could be that smoking tobacco using a hookah is seen as a safer alternative to smoking tobacco through a traditional cigarette. A hookah is a water pipe designed for the use of smoking tobacco in a different way than usual. With a hookah water pipe, the tobacco is heated via burning of charcoal that sits on top of the tobacco. This occurs in a bowl positioned at the top of the apparatus. Perforated aluminum foil separates them, and the charcoal and tobacco are never in direct contact. Then, the smoke released from the tobacco due to the heat from the charcoal is passed through the long shaft into the vase at the base of the hookah that contains water. The water cools the smoke before the smoker inhales it through a hose attached to the top of the base of the hookah. It was thought that passing the tobacco smoke through the water before inhaling it would eliminate the health hazards of tobacco, and this is

one of the reasons hookah is believed to have been invented. This perception, however, is false (Hookah smoking and its risks 2018)

Many years of research and data accumulation has provided proof that regular exposure to first and secondhand cigarette smoke leads to a multitude of respiratory diseases and more than a dozen different types of cancer (U.S. Department of Health and Services 2014). Smokers also have an increased risk for strokes, blindness, amputations, and reproductive problems. The toxins in cigarette smoke cause damage through mechanisms such as DNA nicking and DNA methylation, which either change our genes or changes how they are expressed, respectively (Lee and Pasouva, 2013). DNA nicking occurs when the integrity of the double stranded DNA is compromised, prompting our body's natural repair mechanisms to try to fix the problem. However, the repair is not always successful, and can easily lead to mutations in our DNA, meaning that the instructions that code for the proper, functioning proteins in our bodies now contain errors. The mutations, consequently, lead to all the aforementioned diseases and health problems. DNA nicking has previously been confirmed to occur as a result of cigarette smoke (Stone et al., 1995). This study aims to both positively detect DNA nicking from hookah smoke and to quantitatively compare the levels of nicking between the two different tobacco delivery methods.

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Methods

Smoke Sample Acquisition. Acquisition of hookah smoke residue was done in a controlled laboratory setting at California State University, Stanislaus. In a fume hood, I set up a traditional hookah apparatus and connected the end of the hose to a cellulose filter. I used small traditional charcoal briquettes to heat a common brand of mint-flavored hookah tobacco. Every thirty seconds, 30 mL of air was pulled through the hookah and then through the filter before being vented into the fume hood. This represents what a smoker inhales. Then, the smoke trappings on the cellulose filters were removed by soaking the filter in a small jar of water for 24 hours. Next, the filters were removed from the jar and the smoke components were dried down using a Centrivap vacuum, and then suspended in a small amount of water again (to get a more concentrated solution) to be tested for absorbance using a UV-Vis spectrophotometer. Additionally, the water in the hookah base after the smoke acquisition session was also tested for absorbance.

DNA Nicking Assay. A DNA nicking assay with PUC-18 (supercoiled DNA plasmid) was performed. A supercoiled plasmid, which is simply a plasmid twisted around itself multiple times, is incubated with an agent which is suspected to damage DNA. If DNA damage does occur, the plasmid will become much more flexible. This freedom to twist will allow the plasmid to uncoil into a more relaxed form. By using a supercoiled plasmid, even a single nick in the sugar backbone of the DNA will cause a significant change in the surface area of the plasmid that is available to interact with an agarose gel.

Various solutions were created for this assay. Each gel included two control solutions. The first control solution was DNA that was not incubated, and the second was DNA which was incubated only with TE buffer. PUC-18 was also incubated with glucosamine, which is known to nick DNA, to provide a standard solution. The experimental solutions were composed of DNA incubated with varying concentrations of the tar solutions. Once the solutions were created, they were incubated at 37 °C for four hours, before being loaded onto a 0.8% agarose gel. The electrophoresis took place over two hours at a potential of 80 volts and 0.04 amps of current. Then, using ImageJ software, the bands on the gel were digitized and related to concentration to determine the response to increasing concentration of the tar solutions.

Results

Hookah smoke solution samples obtained from the filters show absorbance at around 280 nanometers (Fig. 1), as did the aqueous solutions taken directly from the hookah base after the smoke acquisition session (Fig. 2).

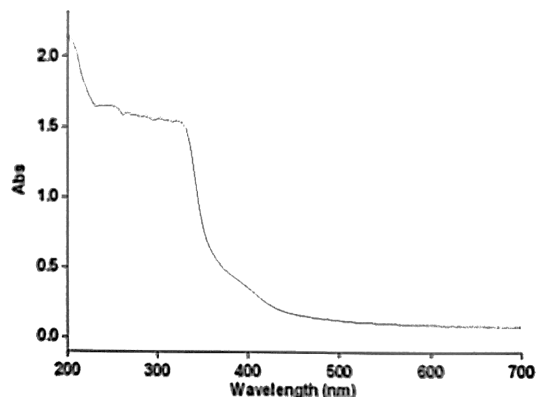


Figure 1. UV spectra of an aqueous hookah sample obtained from mainstream smoke.

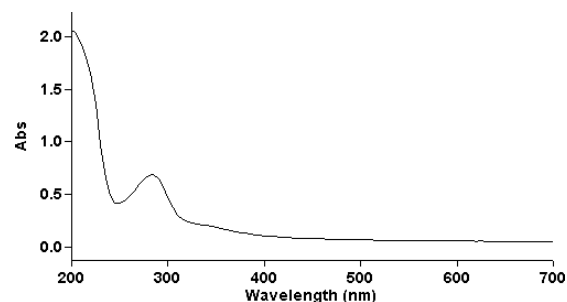


Figure 2. UV spectra of an aqueous sample from the water in the hookah vase, obtained after a session of smoke acquisition.

The DNA nicking assay showed that PUC-18 DNA was nicked by the compounds contained in the hookah smoke solutions, as evident by the presence of two separate bands visible on the gel for the lanes, which were loaded with the hookah smoke solutions incubated with the PUC-18 DNA (Fig. 3).

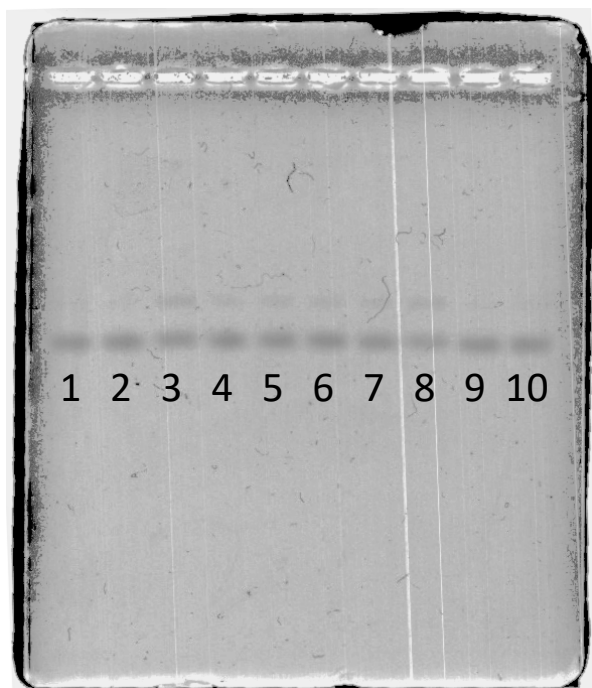


Figure 3. Agarose gel from DNA nicking assay showing two distinct bands of pUC18 in lanes 2-8. The pUC18 DNA was incubated with aqueous solutions of mainstream hookah smoke.

Quantification of nicking caused by the compounds in the hookah smoke, obtained using ImageJ software, shows that the amount of nicking by hookah solutions is orders of magnitude less than the nicking that has been detected with first-hand cigarette smoke in previous studies. However, we have no definitive evidence yet, as more trials need to be conducted to obtain consistent data that support the initial results of this study.

Discussion

Having obtained absorbance at 280 nm for the hookah smoke solutions means that one or more chemical compounds other than pure, deionized water were present in the solutions. Such a high absorbance value would not have been obtained if nothing transferred from the filters into the water when they were placed in a jar for 24 hours. These chemical compounds, which likely are responsible for the DNA nicking, observed in the nicking assay, need to be further characterized by mass spectrometry. The absorbance obtained when aqueous solutions from the hookah base were analyzed with UV spectrophotometry indicate that some of the chemical compounds responsible for nicking were trapped in the water would not ever reach the smoker's lungs. Though this may translate into a decreased exposure to DNA nicking compounds when smoking tobacco using a hookah water pipe versus a traditional cigarette, it does not definitively mean that

smoking hookah is overwhelmingly less dangerous than smoking cigarettes.

The positive detection of DNA nicking by hookah smoke implies that regular smoking of tobacco, using a hookah water pipe could lead to mutations in the smoker's DNA that might result in cancer and other diseases later in life. For people who are classified as "light" cigarette smokers, smoking under a pack per day, the risk of developing malignant cancer is anywhere from double to quadruple that of non-smokers (Schane et al., 2010). One cigarette, on average, takes only 20 puffs of smoke to finish, while the average hookah smoking session exposes a person to about 200 puffs of smoke (Hookahs 2018). Therefore, the average hookah session is roughly the equivalent of smoking 10 cigarettes. Even though some of the cancer-causing toxicants are trapped in the water of the hookah vase, smoking tobacco through a hookah water pipe can potentially increase a smoker's risk of cancer by similar magnitudes as smoking tobacco through cigarettes does.

This could lead to a public health issue in our society, especially if hookah continues to increase in popularity. Surveys conducted in recent years across the US that gauge high school and college students' perceptions of cigarettes versus hookah show that most people have more favorable outlooks toward hookah than they do towards cigarettes. For example, a survey done in 2015 assessed the cognitions of a random sample of middle and high school students in Florida. The study found that these adolescents had far more positive cognitions towards hookah use than cigarette use. About 87% of them answered that they would smoke hookah if their best friend offered them some, while only about 40% would do the same if offered a cigarette. In addition, about twice as many answered that hookah does make young people look cool than answered that smoking cigarettes does. Additionally, about 68% thought that quitting hookah would be easy, while only about 32% thought that quitting cigarettes would be easy (Barnett and Livingston, 2017).

In the end, the individual behavior of the smoker determines to what extent the effects of this habit will have on his or her health. If a cigarette smoker goes through a pack a day, he or she will be inhaling more toxins than a hookah smoker who has one hookah session every weekend. Still, research that aims to quantify and qualify the health risks associated with the inhalation of tobacco smoke through the many different smoking apparatuses available in our society today is as important and valid as ever. Furthermore, once concrete knowledge is obtained, it is necessary to find effective and efficient ways to disseminate this knowledge throughout the general public, so that they can make informed decisions about the act of smoking tobacco.

Future Work

Potential next steps to take further include characterization of the chemical components of hookah by mass spectrometry, as well as exploring methods to detect radicals in the hookah smoke.

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Trauma and the Emotional Stroop Task: Differences between Gender and Ethnicity

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Abstract

Individuals that have experienced a deeply distressing or disturbing event are considered to have faced trauma. Although previous studies have assessed trauma, relatively little is known about the cognitive processes that occur across ethnic variations. When assessing trauma, different genders are often exposed to different types of trauma, as well as differences in exposure to certain types of trauma. These variations are examined in the color-naming interference on an Emotional Stroop Task. This was measured to assess attentional bias on individuals who have faced a traumatic event. Fifty-four participants were recruited and used for analysis. Findings are discussed in the context of differences among gender, ethnicity, and trauma groups.

Keywords: trauma, Emotional Stroop Task, women

Introduction

The American Psychological Association (2018) defines trauma as a person's emotional response to an extremely negative event. More specifically, the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013) has defined traumatic event as being exposed to death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence. Examples of trauma include sexual abuse, physical abuse, exposure to warfare, disasters, serious accidents, and sudden deaths of loved ones. The Sidran Institute of Traumatic Stress Education and Advocacy (2019) reports that an estimated 70% of adults in the United States have experienced a traumatic event at least once in their lives.

Groups that have experienced a deeply distressing or disturbing experience such as war veterans (Ashley, Honzel, Larsen, Justus, & Swick, 2013) and those with childhood trauma (Wingenfeld et al., 2011) have been studied to better understand the underlying mechanisms that occur when these events occur. Despite the plethora of studies examining the links between trauma and the general population, few studies have examined the role that ethnicity may play. By taking a multi-ethnic approach, we can begin understand how experiences specific to members of different ethnic group that may be directly affected by that risk. Given that the minority trauma experience differs from the Caucasian trauma experience, various researchers have commented on the need for cross-cultural assessment of trauma (Williams & Mohammad, 2009). Some of these experiences include experiencing racism, micro-aggressions, and

perceived discrimination that may further enhance trauma symptoms (Coleman, 2016). Trauma reaction can be further emphasized in minority groups when factors such as racial discrimination and micro-aggressions are accounted for (Williams, Metzger, Leins, & DeLapp, 2018).

While trauma affects many individuals, certain groups are more susceptible to witness trauma. For example, lifetime prevalence of exposure to trauma varies by ethnic group: White/non-Hispanic (83.66%), African-Americans (76.37%), Asian/Hawaiian/Pacific Islanders (66.38%), and Hispanics (68.17%; Roberts, Gilman, Breslau, & Koenen, 2011). Whites were more likely than the other groups to have any trauma this includes, to learn of a trauma to someone close, and learn of an unexpected death (Roberts, Gilman, Breslau, & Koenen, 2011).

With these figures in mind, the risk developing PTSD was significantly higher for Blacks, statistically equivalent for Hispanics, and lower for Asians compared with Whites (Roberts, Gilman, Breslau, & Koenen, 2011). However, the risk of child maltreatment was higher for Blacks and Hispanics, specifically as children and witnessing domestic violence. Blacks had a higher risk of active combat, and Asians had a higher risk of having been a civilian in a war zone than Whites, (Roberts, Gilman, Breslau, & Koenen, 2011).

The difference in the exposure to different types of trauma may be due to factors such as minority status, which has been significantly associated with negative mental health outcomes, (Meyer & Cooper, 2003). Members of certain ethnic groups are also at a disadvantage when it comes accessing certain

resources (e.g., education, occupation) that have a direct impact on health. (Coleman, 2016).

While certain groups are more likely to come into contact with trauma, there are cultural factors that influence the post-trauma experience. Marshal, Schnell, and Miles (2009) found that in comparison to non-Hispanic Caucasians, Hispanics have reported higher levels of overall posttraumatic distress. When comparing a group of officers who experienced similar traumas, Hispanic officers were found to experience more severe PTSD symptoms, (Marshal, Schnell, & Miles, 2009). Factors that may contribute to these symptoms include a reaction to trauma such as depersonalization and derealization, post trauma coping (e.g., wishful thinking and self-blame coping), and post-trauma social context (e.g., receiving less social support; Pole, Best, Metzler, & Marmar, 2005).

Beyond ethnicity, there are also differences in the types of traumatic events that each gender is exposed to (Silove et al., 2017). Previous studies have found PTSD to be more prevalent in women than in men (Tolin & Foa, 2006). When assessing trauma, different genders are often exposed to different types of trauma, as well as differences in exposure to certain types of trauma. Men's traumatic experiences are often related to interpersonal assault and violence, exposure to war, and accidents (Silove et al., 2017). These gender differences were further analyzed when assessing trauma in veterans, results indicated that males obtained trauma by war exposure in comparison to women who reported physical and sexual victimization (Freedy et al., 2010).

Upon looking at the traumatic experiences that women face, it is often related to gender-based violence (e.g., rape, general assault, stalking, beaten up by spouse or partner) and network trauma (e.g., unexpected death of loved one, child with serious illness, traumatic event to loved one; (Silove et al., 2017). When assessing sexual abuse, an estimated 43.9% of women and 23.4% of men had experienced other forms of sexual violence that included forced penetration, sexual coercion, unwanted sexual contact, and noncontact unwanted sexual experience (Breiding, 2015). Along with those statistics, PTSD has been found to be more prevalent in women than men (Khoury, Tang, Bradley, Cubells, & Ressler, 2010).

It is noted that men have reported more traumatic events whereas women have noted a higher lifetime prevalence of PTSD (Silove et al., 2017).

One of the byproducts of exposure to trauma is the effect it has on cognitive processing. Attentional bias is one of these cognitive processes that is altered

in the short-term. There is already a general attentional bias towards threat that allows us to prioritize incoming threatening information (Notebaert, Crombez, Van Damme, Houwer, & Theeuwes, 2011), but trauma can enhance attentional bias. Previous studies have found signs of hyper-vigilance manifest as attentional bias toward threatening cues (Bar-Haim, Lamy, Pergamin, & Barkermans-Kranenberg, 2007) and greater interference of negative emotional stimuli on attention (Pineles, Shipherd, Welch, & Yovel, 2007). Attentional bias has been implicated in the possible cause and maintenance of prevalent mental disorders (Van Bockstaele et al., 2013).

Due to its ability to detect attentional bias to trauma related words, the Emotional Stroop Task has been suggested to be used as a pre- and post-task with intervention studies of PTSD patients (Ashley, Honzel, Larsen, Justus, & Swick 2013). The Emotional Stroop Task has been used on several types of trauma including war veterans. Veterans with PTSD were unequally slower in responding to combat-related words when compared to control groups (Ashley, Honzel, Larsen, Justus, and Swick 2013). For trauma- exposed individuals, those who experienced more severe abuse/trauma showed greater interference (Carpos & Blanchette 2014). By assessing the concept of greater interference, we can assess that trauma has had an effect of attention span of an individual. These slower reaction times provoke a cycle in which the person becomes hyper-vigilant to all stimuli related to the persons' worries, thus evoking an emotional response which creates an emotional disturbance for the individual, (Williams, Mathews, MacLeod, & Steinberg, 1996).

Previous studies have focused on individuals who have faced traumas using the Emotional Stroop Task and have completely disregarded the concept of ethnic variations. As we begin to shift toward assessing mental health through the psychological, biological, and sociological lens, we must begin to assess many of the standards that have been set in place. By incorporating ethnic variations, we can better understand the interactions among trauma and attentional bias in different groups.

Upon analyzing these different groups, we can begin to get a holistic view of the role that attentional bias may play in these disorders. The purpose of this study is to examine how attentional bias may vary in women who are minorities and have faced trauma using the Emotional Stroop Task. It is hypothesized that women who have faced trauma will have a longer reaction time and increased errors in trauma related words as compared to men who have faced trauma. It is also hypothesized that minorities

with trauma will have a longer reaction time to trauma related words as compared to Caucasian/Whites with trauma. Finally, it is hypothesized that individuals with trauma will have a longer reaction time and more errors than those without trauma.

Method

Participants

Participants included 54 (7 males and 46 females) with the following ethnic breakdown: 10 White, 33 Hispanic or Latino, 1 Native Hawaiian or Pacific Islander, and 9 other. Given the low sample of different ethnic groups, minority groups were categorized together while the Whites were categorized in a group of their own. Our sample consisted of 40 individuals who had experienced trauma in some way and 14 who did not. Those who had trauma were asked to state what type of trauma they had encountered. The average age of participants was 21.85 years ($SD=4.80$) Consent was obtained from each participant prior to beginning the questionnaire. Participants were recruited by flyers that were placed on CSU Stanislaus bulletin boards. This same flyer was posted on Facebook in trauma-related groups. Undergraduate and graduate students from CSU Stanislaus were recruited using the Psychology and Child Development department's online subject pool, Sona. Participants signed up for a timeslot that was convenient for them. Flyers were also promoted via Facebook groups, and fliers placed on campus on the boards. Every individual who participated in the study was placed in a raffle to win a Kindle Fire.

Measures

The Emotional Stroop task (EST) is a modified version of the Stroop task. In the Stroop Task, subjects were presented with a list of words written in different colors and are asked to name the colors that words are printed as quickly as possible while ignoring the content of the word. For example, the word printed is yellow, but the inside of the word is red, participants are asked to name the word as quickly as possible while ignoring the content of the word.

While the task may seem similar, the Emotional Stroop task focuses on engaging an emotional response that interferes with the task demand of color naming rather than creating a cognitive conflict in the incongruent word presented. This is accomplished by including emotionally triggering words (e.g., death, cancer, war, etc.) in the list. Demonstrating that there is an attentional bias in coloring naming bias across various disorders is the most common use of the task (Williams & Mathews, 1996).

A modified version of the Life Event Checklist (LEC) for DSM-5 was used to determine if the individual has faced trauma. The list consists of a number of difficult or stressful things that may occur in the lives of others. For each category to the participants has the option to indicate whether the event happened to them, witnessed it, learned about it, part of their job, not sure, and doesn't apply. Those who indicated that a traumatic event happened to them or witnessed it were placed in the trauma group.

The questionnaire was completed on Qualtrics. After completing the questionnaire, the participant was redirected to the millisecond program where the Emotional Stroop Task was performed. Data on the Emotional Stroop Task was recorded on the millisecond website. Word stimuli was presented on a computer screen that was accessible to participant. The color identification response for each stimulus was detected by means of a keyboard. During the task, subjects were asked to press the key on which the color was represented by.

Procedure

Participants were asked to press the associated color key to identify the target word. A practice trial containing six words was administered to ensure that the participants understood the task. A fixation cross was present in the center of the screen (500ms) followed by a target stimulus. The task contained five different categories each containing 20 words: neutral (center, shapes), death (suicide, homicide), sexual abuse (consent, penetrate), physical abuse (slap, damage) and combat-related (warlord, gunman). The colors consisted of green, yellow, blue, and red. After the response was recorded the subject was told if their answer was correct or incorrect.

Results

An independent samples t-test was conducted to examine the differences between males and females using the scores of an Emotional Stroop Task reaction time for neutral, death, sexual abuse, physical assault, and combat categories. Results indicated a significant difference for physical trauma between males ($M = 1253.22$, $SD = 404.25$) and females ($M = 896.03$, $SD = 241.52$), $t(37) = 2.62$, $p = .01$. See Table 1 for other categories.

Table 1

<i>Mean Scores of Gender Reaction Time in ms</i>					
Gender Group	Mean (SD)	RT	t-value	df	p-value

Male	1097.25 (477.94)	Death	1.54	37	.13
Female	885.22 (232.96)				
Male	1014.20 (289.63)	Sex	1.08	37	.28
Female	886.95 (216.18)				
Male	1116.59 (567.95)	Combat	1.28	37	.21
Female	908.62 (273.48)				

An independent samples t-test was conducted to examine the differences between males and females using the scores of an Emotional Stroop Task percentage correct for neutral, death, sex, physical, and combat categories. Results indicated a significant difference for combat trauma between males ($M = 87.66$, $SD = 11.65$) and females ($M = 96.15$, $SD = 5.75$), $t(51) = 3.11$, $p = .03$. See Table 2 for other categories.

Table 2

Gender Group	Mean (SD)	RT	t-value	df	p-value
Male	92.86 (9.77)	Death	1.07	51	.28
Female	95.55 (5.54)				
Male	92.86 (7.81)	Sex	.90	51	.37
Female	95.16 (6.09)				
Male	94.80 (11.86)	Physical	.39	51	.70
Female	95.75 (4.63)				

Bias scores were calculated by subtracting the mean reaction time neutral word presentation from each of the means reaction to stimulus word conditions (death, combat, sexual abuse, and physical). A positive bias score indicated a slowed response latency to identify the color of the word when compared to the time take to identify the color of the word in the neutral condition (explaining why there are negative means). An independent samples t-test was conducted to examine the differences between males and females using the scores of an Emotional Stroop Task bias for death, sex, physical, and combat categories. An independent samples t-test was conducted to examine the differences between males and females using the scores of an Emotional Stroop Task bias reaction for death, sex,

physical, and combat categories. See table 3 for reaction time

Table 3

Gender Group	Mean (SD)	RT	t-value	df	p-value
Male	44.98 (189.38)	Death	.72	51	.47
Female	-15.92 (210.76)				
Male	-4.84 (80.77)	Sex	.03	51	.97
Female	-8.14 (275.57)				
Male	136.96 (175.59)	Physical	1.11	51	.26
Female	-9.37 (337.58)				
Male	39.76 (236.36)	Combat	-.17	51	.87
Female	53.03 (185.67)				

An independent samples t-test was conducted to examine the differences between Non-Hispanic Whites and Non-Whites for using an Emotional Stroop Task reaction time for neutral, death, sex, physical, and combat categories. Results indicated a significant difference for sexual abuse trauma between whites ($M = 1043.5833$, $SD = 232.92$) and minorities ($M = 865.15$, $SD = 207.08$), $t(38) = 2.21$, $p = .03$. See Table 4 for other categories.

Table 4

Ethnicity Group	Mean (SD)	RT	t-value	df	p-value
White	983.84 (254.66)	Death	.97	38	.34
Minorities	887.27 (265.48)				
White	1002.37 (239.21)	Physical	.86	38	.40
Minorities	913.18 (283.95)				
White	1031.08 (299.61)	Combat	1.10	38	.28
Minorities	903.78 (307.91)				

An independent samples t-test was conducted to examine the differences between Whites and minorities using an Emotional Stroop Task for the percent correct for neutral, death, sex, physical, and combat categories. Results indicated a significant difference for death related trauma between Whites ($M = 90.45$, $SD = 9.20$) and minorities ($M = 96.28$, $SD = 4.73$), $t(52) = 2.89$, $p = .01$. Results also indicated a difference for physical abuse trauma between Whites ($M = 91.82$, $SD = 9.77$) and minorities ($M = 95.59$, $SD = 4.29$), $t(52) = 2.42$, $p = .02$. See Table 5 for other categories.

Table 5

<i>Mean Scores of Ethnicity Percent Correct</i>					
Ethnicity Group	Mean (SD)	RT	t-value	df	p-value
White	95.00 (5.44)	Death	.03	52	.98
Minorities	94.94 (6.52)				
White	91.82 (11.89)	Combat	1.60	52	.11
Minorities	95.87 (5.61)				

Bias scores were calculated by subtracting the mean reaction time neutral word presentation from each of the means reaction to stimulus word conditions (death, combat, sexual abuse, and physical). A positive bias score indicated a slowed response latency to identify the color of the word when compared to the time take to identify the color of the word in the neutral condition (explaining why there are negative means). An independent samples t-test was conducted to examine the differences between Whites and minorities using an Emotional Stroop Task for the bias reaction for death, sex, physical, and combat categories. See Table 6 for bias scores.

Table 6

<i>Mean Scores of Ethnicity Bias Reactions</i>					
Ethnicity Group	Mean (SD)	RT	t-value	df	p-value
White	-26.90 (178.57)	Death	-.28	52	.78
Minorities	-6.23 (213.48)				
White	40.53 (102.73)	Sex	.65	52	.51

White	21.06 (349.25)	Combat	-.51	52	.61
Minorities	55.06 (137.11)				
	(200.41)				

An independent samples t-test was conducted to examine the differences between non-trauma groups and trauma using an Emotional Stroop Task for the reaction time for neutral, death, sex, physical, and combat categories. Results indicated there was no significant difference between trauma versus non-trauma groups in terms of reaction time. See Table 7 for reaction time.

Table 7

<i>Mean Scores of Trauma & Non-Trauma Groups Reaction Time in ms</i>					
Group	Mean (SD)	RT	t-value	df	p-value
Non-Trauma	1020.46 (461.45)	Death	1.11	52	.27
Trauma	909.00 (265.03)				
Non-Trauma	1040.53 (414.39)	Sex	1.54	52	.13
Trauma	905.30 (223.18)				
Non-Trauma	1016.41 (337.21)	Physical	.92	52	.36
Trauma	933.25 (274.19)				
Non-Trauma	1180.41 (852.25)	Combat	1.60	52	.12
Trauma	932.42 (306.99)				

An independent samples t-test was conducted to examine the differences between Non-Trauma and Trauma groups using an Emotional Stroop Task for the percent correct for neutral, death, sex, physical, and combat categories. Results indicated a significant difference for sexual assault related trauma between Non-Trauma ($M = 91.88$, $SD = 7.60$) and Trauma ($M = 96.02$, $SD = 5.46$), $t(52) = 2.20$, $p = .03$. See Table 8 for other categories.

Table 8

*Mean Scores of Trauma and Non-Trauma Groups
Percent Correct*

Ethnicity Group	Mean (SD)	RT	t-value	df	p-value
Minorities	-18.53 (278.41)				
White	-9.78 (157.20)	Physical	-.18	52	.86
Non-Trauma	95.78 (7.23)	Death	.40	52	.69
Trauma	95.00 (5.80)				
Non-Trauma	94.48 (8.95)	Physical	.90	52	.37
Trauma	96.14 (4.43)				
Non-Trauma	92.86 (10.04)	Combat	1.40	52	.18
Trauma	95.91 (5.90)				

Bias scores were calculated by subtracting the mean reaction time neutral word presentation from each of the means reaction to stimulus word conditions (death, combat, sexual abuse, and physical). A positive bias score indicated a slowed response latency to identify the color of the word when compared to the time take to identify the color of the word in the neutral condition (explaining why there are negative means). An independent samples t-test was conducted to examine the differences between Non-Trauma and Trauma groups using an Emotional Stroop Task for bias reactions in death, sex, physical, and combat categories. Results indicated a significant difference for death related trauma between Non-Trauma ($M = -105.26$, $SD = 282.49$) and Trauma ($M = 23.26$, $SD = 163.41$), $t(52) = -2.07$, $p = .04$. See Table 9 for other

categories. Table 9

*Mean Scores of Trauma & Non-Trauma Groups
Bias Reaction*

Group	Mean (SD)	RT	t-value	df	p-value
Non-Trauma	-85.19 (463.80)	Sex	-1.33	52	.19
Trauma	19.56 (118.34)				
Non-Trauma	-109.31 (547.09)	Physical	-1.60	52	.18
Trauma	47.51 (184.29)				
Non-Trauma	54.69 (238.31)	Combat	.13	52	.89
Trauma	46.69				

Discussion

The aim of this study was to investigate whether there were gender differences, trauma and non-trauma differences, and/or ethnic differences in the individuals performing the Emotional Stroop Task. This was done by measuring attention (reaction time) and percentage correct on an Emotional Stroop Task. Our results indicated that males reported a longer reaction time in comparison to females in terms of physical assault. These results are consistent with aforementioned research about gender differences in trauma exposure, i.e., males are often exposed to more non-sexual assault (Silove, 2017).

When comparing gender differences and percentage correct, there was a significant difference between males and females in terms of combat with words correct, with males did not getting as many correct as females. This may be due in part because males who are involved in war are found to report war-related trauma in comparison to women who are found to report sexual trauma or physical assault (Freedy et al., 2010).

When comparing reaction time, a significant difference was also found when comparing Non-Hispanic Whites and Minority groups who had trauma in the category of sexual abuse. Whites as a group had the tendency to get the words incorrect. This may be attributed to White women having more sexual assault as adults in comparison non-white participants, (Littleton, Grills-Taquechel, Buck, Rosman, & Dodd, 2013).

When comparing percentage correct, a significant difference was found between Whites and minorities in the category of death related trauma. Indicating that Whites did not get as many words correct as minorities. This concept is consistent with previous studies as Whites are more likely than other groups to experience or witness a death related trauma. As mentioned in Roberts, Gilman, Breslau, and Koenen (2011), this includes seeing someone killed, witnessing a dead body, and unexpected death.

When comparing percentage correct, a significant difference was found between physical abuse trauma between Whites and minorities. These results indicate that Whites obtained less words correct in comparison to minorities in this category. As mentioned in Roberts, Gilman, Breslau, and Koenen (2011), Whites had reported having more incidences of being attacked or beaten up.

Upon assessing percent correct between trauma and non-trauma groups, the non-trauma group reported a getting more words incorrect in the category of sexual assault. This was not expected as previous studies have indicated that trauma exposed individuals would have performed with more errors (Carpos & Blanchette 2014).

When comparing bias reaction time, there was a latency response indicating that the trauma group had a longer time responding to the category of death related trauma. This indicates that there was a greater interference in this category. By comparing bias scores, there was the ability to compare mean scores solely on emotional context. This latency may be attributed to a large portion of our sample size to have faced a life threatening illness or injury given that the effect of the Emotional Stroop Task is believed to show the behavioral response of failing to filter out experience-relevant emotional content, (Williams, Mathews, MacLeod, & Steinberg, 1996).

Limitations

While the results do show some evidence of group differences, there were some limitations to this study. There were originally 137 participants, but due a large portion not downloading the plug-in for the Emotional Stroop Task, the participant pool was reduced to 54. Concerning the results, unequal groups limited the statistical analyses that could be performed.

When analyzing cognition in future studies, it would be valuable to determine when the trauma may have taken place and how the individual feels about the trauma itself. Although individuals have their own timeline for healing, a potential time line can be investigated. The emotional state of the individual in terms of the trauma would be beneficial information also.

Future research can begin to assess resilience in spite of traumatic incidences. Despite culture, income, and socio-economic status, what are some essential characteristics that allow individuals to be resilience in spite of debilitating circumstances? Although we found some significant results for traumatic interference, there was also a trend for certain groups who had faced trauma to perform better on the Emotional Stroop Task. This information can be beneficial for those who have psychiatric illnesses, as we can further understand coping mechanisms as well as personal stories.

Other areas of cognition be further examined in respect to trauma is allowing individuals to express their trauma narratives and its relation to their emotional state. Trauma narratives can directly assess the behavioral responses of individuals by analyzing the content of their personal story as well access self- schemas and the individuals overall cognitive paradigm in relation to self.

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Dice Mathematics: A Hypothetical Study into Rationalizations of Bias

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Abstract

The design of two-player chance games is traditionally based in symmetry. That is, both players operate under identical rulesets in determining who wins and who loses. The goal of such designs is to make position arbitrary. Whoever takes on the role of Player 1 or Player 2 is irrelevant to the odds of either player winning, to such an extent that these labels are usually never mentioned. However, through elementary probability theory, the theory of chance and outcome, games can be constructed where the two players use different rules, but do not have any advantage over the other. Research in how humans understand probability theory suggests that complexity within a chance system inevitably leads to errors on the human end. What this research lacks are the specific types of complexities that are conducive to this error, as they pertain to game design. This hypothetical study seeks to answer how one might design a mathematically balanced, two-player game of chance that participants will still believe to be fair. The two rulesets of the game will be differentiated by the number of outcomes, the playing pieces, or the mechanics that generate outcomes. Participants will be presented with five different games and will be asked to determine whether or not these designs favor one player over another. Once completed, this study would reveal the kinds of complexities in game design that cause players to sense bias, and how asymmetry may be introduced into mainstream game design without arousing suspicions of foul play.

Keywords: probability theory, heuristics, fairness in game design

Introduction

Many researchers have found a certain level of intuition regarding a layman's understanding of probability reasoning, though that intuition can take interesting shapes. Biehl and Halpern-Felsher (2001) conducted a questionnaire on 153 students, anywhere from fifth grade to college. They found an alarming lack of consistency when participants were asked to assign percentage values to common probability phrases such as "likely," "less than likely," and "probable." Biehl and Halpern-Felsher concluded that the use of implicative phrases was detrimental to an individual's ability to visualize likelihoods, and percentage values were preferable. This work was furthered by Goldstein and Rothschild (2014), who ran an experiment testing participants' abilities to gauge preconceived probability distributions, using a variety of methods. These methods were classified under "graphical methods" and "standard methods."² The results showed that participants who employed the

graphical method of generating histograms were significantly more successful than those using any other method. 49% of graphical responses were exactly correct, compared to 26% from standard responses. Additionally, mean absolute errors fell from 20% in standard responses to a mere 5% in graphical responses, meaning that visualized data was far more reliable than numerical data.

However, biases within percentage probabilities are still possible. Consider the work of Costello and Watts (2014), who have constructed a model to better shape our discussion on this phenomenon, called the Probability Theory Model with Noise. The model assumes that certain concepts in probability theory, such as negations³, are, to an extent, inherent in human understanding. However, in the case of more complex probabilistic statements, mistakes can be caused by random error, or "noise." To test this model, Costello, Watts, and Fisher (2018) had students from the School of Computer Science and Informatics in the United Kingdom assign percentage probabilities to patterns of

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² In this experiment, "graphical methods" involves the construction of charts such as histograms, where "standard methods" is a blanket term applied to the construction of confidence intervals, mean and median averages, and expected values.

³ Negations are referred to as "NOT" statements, as they flip the truth. As an example, the negation of "This apple is red." is "This apple is *not* red."

weather. The Probability Theory Model with Noise predicted and demonstrated that students would succumb to the conjunction fallacy⁴ more frequently in instances when the probability of two weather patterns (i.e. “cloudy,” “raining,” “windy,” etc.) were far apart in mathematical likelihood.

It is necessary to note that the Probability Theory Model with Noise, while substantiated to an extent, is still incomplete. In an article directly addressing this model, Crupi and Tentori (2016) argue that the Probability Theory Model with Noise fails to explain conjunction fallacies in conditional statements. That is, the model cannot account for events that rely on one another to occur.⁵ A model presented by Trueblood and Busemeyer (2012) could potentially correct these issues. Their Quantum Inference Model sees human rationalizations of probability systems through the lens of quantum mechanics. Essentially, biases and fallacies in human perspectives occurs when compared events are deemed “incompatible.” That is, when the chance of event A does not in any obvious way influence the chance of event B, fallacies will occur. This model benefits from accounting for a subject’s prior knowledge on the events described, a type of heuristic, or self-taught, data collection that influences further encounters with probability theory.

To see how these concepts relate to game theory, Grimalday, Karz, and Proto (2012) tested the effect that explicit biases play on strategies in games of chance. The researchers collected 426 Warwick undergraduate students and pitted them together in an Ultimatum Game, where a “proposer” offers a percentage of a prize to a recipient. The recipient, in turn, can accept the offer and take their share, or deny it, leaving both empty-handed. The variable is the asymmetry by which one player is disproportionately selected as the proposer. The results found that in game structures where the position of advantage is assigned at random, referred to as “Variable Games,” players are far more likely to both propose lower offers and accept whatever offers they are given. The conclusion, in the researchers’ minds, was that players expected the unevenness of the game to level off as time went on, and, so, it was worthwhile to play aggressively.

The current research does well to highlight understandings of probability in many conventional environments where probability and probability theory are prevalent, but such studies have yet to be conducted strictly in the realm of chance games. To expand upon this research, it will be necessary to look for biases and suspicions of bias in somewhat controlled, but ultimately randomized games of chance. In searching for the

specific methods of complicating chance games that produce error, one will come closer to determining how human beings approach games of chance and rationalize fairness.

This study aims to test the potential applications of the Probability Theory Model with Noise. The model posits that biases in probability rationalization are caused by randomized error in the system. Thus, as the systems grow further apart in complexity, the number of opportunities for random error to generate will increase.

Methods

It is necessary to clarify fairness and complexity in the context of this study. Fairness is, in essence, the truthfulness of the game’s design. Imagine that this two-player game of chance is run by a facilitator who explains the rules and keeps track of points, prizes, and the like. This facilitator is also tasked with informing the players on the odds of success and failure. These states of success and failure operate on a binary, in that any given round results in a success for one player and a failure for the other. Fairness is an absolute question, in which an individual must decide if the odds they are told are the true mathematical odds of the design of the game. If someone is told by the facilitator that they have a 50% chance of success, and the math agrees with this claim, then the game is fair. If a player is told that their chance of success is 15%, but the math shows that the chance is actually 40%, the game is unfair, especially when the reverse of this statement demonstrates that the other player was promised an 85% chance of success which, mathematically speaking, was actually a 60% chance.

Complexity, for the purpose of this study, is the obvious differentiation between the probability systems in a game of chance, assuming that the generators of these systems are perfectly designed. For an example of complexity, consider one player rolling a blue 6-sided die versus another player with a red 6-sided die. It is assumed that the dice are not rigged, and perfectly represent their theoretical distributions. The complexity is the difference in color in this example, though it does not require much thought to conclude that this complexity is trivial and does not truly affect the outcome of the game.

There are more engaging forms of complexity that are harder to discount, however. Consider a game of chance in which one player rolls a 20-sided die versus a player rolling three 6-sided dice, adding these values together. One cannot so easily determine the fairness or

⁴ An example of the conjunction fallacy is someone believing the chance of rain to be higher than the chance of rain or thunder, which is mathematically impossible.

⁵ As an example, consider the odds of rain in a given area. The odds of rain is restricted by the odds of cloudy weather; the former is not possible without the latter occurring first.

unfairness of such a design, but, luckily, there are two simple conditions that are sufficient for the game to be fair in its purest mathematical sense. If one is able to assign numerical values to the system, as with a set of dice, then one should be able to calculate a mean average across an infinite set of outputs, called the Expected Value. Condition 1 for fairness is that the Expected Values of the two systems be equal. Condition 2 is that the probability distribution of both systems be symmetric about the Expected Value. That is, there is an equal chance of procuring a value below or above the Expected Value. Using these sufficient conditions, one sees that the game above is indeed fair, as their systems share an Expected value of $E[x]=10.5$, and have probability distributions symmetric about this $E[x]$.

One may refer to this game as a difference of cardinality. One system maps two sets of equal cardinality in a one-to-one correspondence, while the other maps over two hundred inputs to only sixteen outputs. Another take on this difference in cardinality is comparing a 20-sided die to a simple coin flip. If one assigns 10 to a flip of tails and 11 to a flip of heads, then the sufficient conditions are met and the game is shown to be fair. This presents the difference in cardinality through an alternative lens, in which both systems operate within one-to-one correspondences. This can also be called a difference of materials.

An additional form of complexity is that of mechanics. When comparing systems of dice and coins, one can argue that the physical mechanics behind generating numbers with these systems are far too similar. Both a die and a coin are “rolled” to produce values, where the time spent tumbling is used to abstract a true random number generator. However, there are other commonplace systems that can be used in comparison. A deck of cards, for instance, uses shuffling and drawing with replacement to abstract a similar probability distribution to a single die. Thus, an additional fair game can be one 20-sided die rolled in comparison to a deck of 20 cards, each with a unique number one through twenty written on the face. The deck is shuffled well before every draw, and the card is always replaced in the deck after it is drawn.

Which of these differences are the most likely to produce errors in rationalization amongst those that are not informed of their nature beforehand? How could one design a fair game of chance such that players tend to believe the game to give the advantage to one player or another, even though it truly does not?

In regards to the rationalizations of bias by participants in this study, it will be necessary to categorize these rationalizations, for the sake of condensed data and anonymity. Should an individual believe a dice game of chance to be unfair, this feeling can be rationalized by the following:

- Rationalization of Number - in which the individual cites the number of individual playing pieces in one or both systems as the cause of bias
- Rationalization of Type - in which the individual cites the face-value of the dice in the system (i.e. 6-sided, 8-sided, 12-sided, etc.)
- Rationalization of Design - in which the design of the particular dice given are a source of bias, including weighted dice, imperfect dice, and chipped dice
- Rationalization of Data - in which the individual uses a sample set of rolls to determine the nature of the game
- Rationalization of Environment - examples include a poor surface for rolling dice, and vibrations in the grounds affecting rolls
- Rationalization of Mechanics - in which the physical acts necessary to procure values are cause for bias
- Rationalization of Superstition - in which the individual believes that one side or the other is destined to win or lose. An example would be an individual saying, “I always roll less than a four!”
- Other - in the event that a rationalization cannot be obviously categorized into one or more of the above

200 CSU Stanislaus students shall be selected, split evenly by sex, with members from all academic departments, paying close attention to those who have taken probability theory courses and those who have not. They will also be asked about their history and familiarity with games of chance.

Before the proper experiment is conducted, participants will be asked to answer preliminary questions on their questionnaire on their experience with probability theory and games of chance. In particular, the questionnaire shall ask:

- At any point in your high school and/or college education, have you taken a mathematics course in probability theory, or statistics?
- Do you consider yourself familiar with any of the following game pieces? If so, which ones?
 - A deck of 52 playing cards
 - 6-sided dice
 - Common tabletop gaming dice (6-sided, 8-sided, 10-sided, etc.)
- How would you define a “fair” game of chance?

This experiment will begin with a brief presentation on the nature of games of chance and how we may define the concept of fairness. For the purposes of this experiment, a fair game is one in which either player has a 50% chance of success, and a 50% chance of failure in any given round. That is, their role in the game

is entirely arbitrary. Then, the rules of the game shall be presented, in which one player is given a single, resin-cast 20-sided die, and the other is given a probability system that changes from game to game. The game has these players perform the physical operations required, comparing the procured values acquired, and granting the round to whomever procures the higher amount. A game is played until one player wins five rounds.

Some terminology will be used to more easily discuss the tools at play. For instance, when one rolls a 20-sided die to determine a numerical outcome, this can be short-handed to 1d20. Similarly, the roll of a six-sided die can be shortened to 1d6. Rolls can be combined by changing the coefficient (i.e. three 6-sided dice, added together, is 3d6). The four games, which have already been described above, are as follows:

1. 1d20 (blue) vs. 1d20 (red)
2. 1d20 vs. 3d6
3. 1d20 vs. a coin flip
4. 1d20 vs. 20-card deck

Once the game has been presented on the projector screen, participants will be asked to fill out the appropriate space on their questionnaire about the fairness of the game without any actual play. Participants must offer an absolute statement on the fairness of the game for their response to be valid. In addition, participants that spot bias shall select the side of the game they believe to have an advantage, and attempt to justify their claim, by any means necessary. Responses of “no bias” will be recorded as precisely that, with no regard for the participants’ reasoning. Responses of “bias” will be categorized using the rationalizations above. If an individual’s response satisfies multiple categories, this compound rationalization shall be counted separately in each category.

Discussion

Since this study has yet to be conducted, the results can only be speculated. The most likely rationalizations are expected to be those of mechanics. These games are designed without taking into account the potential for deliberately skewing the results. Consider the game in which one player is able to flip a coin to procure values. If one is skilled enough, they might purposefully flip the coin in such a way to procure heads, and thus a value of 11, far more often than expected. A player with a deck of cards might not sufficiently shuffle their deck, and, in these cases, the games cannot be considered fair. Fairness comes into question when it fails to account for the human element of the game. The rules can require that the players flip, roll and shuffle sufficiently to prevent control over the outputs, but such a rule is not easily moderated. Thus, it is likely that the

fourth game, comparing a die roll to a deck shuffle, is the most likely to be deemed unfair, using a Rationalization of Mechanics. Of course, this perceived unfairness is still not technically the case, since the game will only exist in the abstract, but the rationalization is still understandable and substantiated.

For this reason, this study can begin the discussion on fairness in game theory, but will require far more iterations and considerations to be conclusive. When working in the world of game design, one must always recall the unpredictability of the innumerable factors that both imitate true random generation and produce outlying strings that betray the expected nature of said systems.

Still, with enough data, one will be able to ascertain the kinds of similarities and differences in game design players value. It informs on how one engages with systems of probability on an everyday basis, and asks what kinds of complexities individuals are able to easily clear away and those that are considered unacceptable. It will hopefully reveal how formal education in probability theory shifts one’s perspective on simple games of chance, as well as inform game designers of the kinds of complexities they might introduce into an asymmetric game and not raise alarm. Game design has been an important aspect of human society for centuries. The amount of work we put into designing our leisure time is extraordinary, and fair play is integral to that leisure. A clearer understanding of fair play is a clearer understanding of what drives us to craft these games in the first place.

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The Interdependency of Environment and Human Existence

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Abstract

This paper explores various ways in which the environment and man are interconnected. This topic is more important now than ever as recent environmental regulations and policies have been rolled back leading to a less than optimistic view of our species' future. As this issue continues to snowball into something much more ominous, it has the very real potential to quickly become uncontrollable not just for us, but for future generations. There currently seems to be a disconnect between ourselves, and how we tend to view the environment. This has led to a societal apathy which is dangerous if all current available data concerning our effects on environment are true. This problem ultimately, is what the paper addresses: why the environment matters, not as a current events issue, but as a matter of the highest importance in terms of survival of ourselves and our world. Research for this project has been conducted in a multidisciplinary way with fields such as biology, chemistry, economic policy, politics, sociology, environmental ethics and anthropology consulted. The paper attempts to answer the question, "why is our natural world important." The results of this have of course been varied depending on various perspectives but ultimately, the answer has been that it indeed is. It is hoped that this paper will serve as a call to action both personal and societal as to why and how to personalize this concern and push for a more aware society.

Key ideas: stability, society, effects

Introduction

The world today is more concerned with environmental issues than ever in modern history. In attempting to even try and flesh out major issues, it becomes clear that there are many conflicting opinions between peoples of the same populations and, most glaringly, between those populations and what their governing bodies decide for them in terms of that environment. This paper will make clear the reasoning behind historical difference of thought between peoples and their governments and the methodologies such as actions, education and deceptions used by those same governments to obfuscate truths concerning environmental impacts on our lives. The paper will expand this idea while exploring how we individually take part in our own local ecology focusing specifically on our own countries' past and why it has seemed to be fairly easy to hide deeper truths about the fragility of our world for the sake of business or profit. Specific case studies are offered as support as well as evidence of disasters. The case studies focus on reasons leading to environmental disasters, immediate responses in regards to them, policy changes that have been driven by them, noticeable changes that have resulted from these positive regulations, and what the government did in those times in reaction to them.

Because of the importance, relevancy, and gravity of this issue, I have taken measures to introduce into this

paper the facts of each case specifically by using articles written and scientific data taken at the time of each modern issue and tracing each to their immediate and long-term impacts. While this paper will be concerned specifically on the negative impacts of governmental notions of what is or should be allowed in terms of environmental use and humanity's direct impact of it. This paper will also cover positive changes and why some of these positive changes have recently been threatened or altogether rolled back due to political and societal threats. These threats to present-day regulation, while currently being tempered down, are some of the most important to understand as they have the ability to nullify all positive effects that our society has taken to make our country safer for ourselves and generations to come. This paper will look closely at these regulatory concerns with an eye toward what people have been able to accomplish through individual research leading to a greater understanding of the biological and chemical aspects of nature as well as societies role in the changes of them and what can be done now to address them.

Methods

Scientific data has been used as corroboration to all other topics in the paper with the most recent available government data on resource usage and personal pollutant output to again personalize this information (EPA and

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various others). This will include a breakdown of carbon emissions, pollutants, and the same of the waste production of the population as well as the individual. Data taken from climatologists will be utilized to see how our impacts have had an effect on our world as well, leading to predictions of further global warming and the dangers it will cause. This will be explored in current models of likely changes in farming production, sea level rise, and the security issues that stem from these results.

Another area for research is the economic aspect of environmental protection. Our economic system is invariably tied together with our environment. Everything from the roof overhead to the silicon enabling me to write this research paper via a computer, to the paper it will be printed on has come from our environment. As such, the protections of the environment have traditionally been seen as a hamper to progress and industry and have been lobbied against for years by corporate and governmental bodies.. But with so many requiring so much for their daily comforts, ours have not only taken a toll on our own countries resources, but we have been taking a large share of other countries' resources as well. With resource depletion comes a spike in prices for not only consumers, but producers as well. This research paper will explore the impacts of resource depletion world-wide, but will focus on the central valley specifically pertaining to farming communities and what scarce resources means to agricultural communities.

Case studies will be used heavily as well to see what immediate negative impact may occur when our efforts to change the environment can go wrong. This will be seen through historical environmental disasters such as the Cuyahoga River fires (Jonathan Adler, "Fables of the Cuyahoga: Reconstructing a History of Environmental Protection) and the middle ages river pollution that contributed to the loss of many lives. Also, the various oil spills focusing on the more recent such as the Exxon Valdez oil spill and the Deepwater Horizon disaster. Furthermore, there will heavy research on deforestation and ocean acidification and its effects on the global environment, including the ability to change world-wide carbon and oxygen levels. Moreover, there will be historical research concerning such subjects as the mass migration and destruction of American plains grasslands to make way for American agriculture leading to the great Dust Bowl .

Climate change will also be a major focus, not only in terms of what is causing it but the effects it will have on our future, both locally and in humanity as a whole.

This will include issues such as mass migration and land usage.

Early American Environmental Concerns

Humanity has been aware of its ability to affect nature around them for longer than recorded history. This ability to manipulate our environment to our advantage is one of the few characteristics of Man that makes us what we are. Yet, because of a lack of deeper understanding of that same nature, this has not come without a cost. Now, due to the levels of ability which previously may not have been available through research, physics, and chemistry we are able to understand why that cost exists and how we as a people all contribute to that cost. During the 19th century the major ramifications of these costs were not yet understood in any specific way. The American concept of manifest destiny—or the divine right to expand from one coast of North America to the next—was in full frenzy. This was a strategic and economically profitable understanding of the land as America encouraged farmers to expand west, not only for the farmers' benefit but also to use those less settled areas as a buffer between the more developed East and the Mexican and British territories of the west. These farmers were encouraged to develop the land with an understanding that if one could develop and protect an area, that area would be considered theirs. This led to extraordinary migration to the west and the cutting and clearing of massive swaths of forest land that continued to be cleared through the rest of the 1800's as well as further West as America continued its expansion to the Pacific. These behaviors led to a tipping point in the Midwest during the 1930's which manifested in the form of what is now called the Dust Bowl.

Due to new farming technologies, and a process known as "deep ploughing" used to reach the more organically rich soils found below the topsoil which displaces the deep-rooted grasses that help to preserve soil integrity, the soil became much less stable. This in turn made the natural process of erosion by wind (the Aeolian process) increase exponentially culminating to a degree not seen in the area in modernity. The lack of any real form of wind protection or soil stabilizing material allowed the strong winds of the Midwest to blow massive amounts of dry topsoil into the air. This led to the drying out of topsoil exposed and in turn to continually release more dry soil into the air. Without precision instruments to measure at the time, it is hard to say how much dirt and dust were displaced, nonetheless some of the more massive clouds were able to blow starting from the Midwest and reaching

all the way to New York City, en route dropping an estimated 12 million pounds of dust in Chicago alone.

This example of a lack of understanding or blatant disregard of natural processes for the short term benefit of few has been repeated to various degrees throughout history. Many times these areas are not fully understood by those who move to and live in these places due to lack of understanding of the area or simply not being told or being aware of the problem in the first place. These issues often affect those who have few options of where or how to live due to economic instability or other social dilemmas. Moreover, on finding out about an area's possibility of danger, these same people rarely have the ability to leave or the voice to speak out against the issues present due to their low priority to those who have the ability to change things. The economic short term is many times more attractive to those who have the ability to gain from it than to find another long term solution.

Case Studies: Adverse influence of Economics and Politics

A major issue for human kind has interestingly been one of the most basic issues for as long as we have been around—what do we do with our waste? As a species we produce massive amounts of waste that all needs to go somewhere. According to a 2013 EPA study, the average American creates 4.4 pounds of waste per day with 1.51 pounds of that waste being recycled. This leads to a daily amount of unrecycled waste of 2.89 pounds per person per day. Most of this all goes on without us even realizing it as it stems from sources generally not thought of in daily activities such as power and water consumption as well as waste that is made by the products we consume. Yet individually this all adds up to a staggering 1,055 pounds of unrecycled waste per person per year. With an estimated 323.1 million people living in the US today this number quickly adds up to approximately 341 billion pounds of waste each year in the US alone. While there are major issues at play today in the world in terms of where this all ends up—areas such as the Great Pacific Garbage Patch—these concerns would not be so major if it wasn't for incorrect or risky disposal of waste here at home.

The industrial revolution was a major part of not just American, but world history. It allowed us to create amazing things in astounding quantities for people everywhere. Yet, due to a lack of regulation of what to do with the waste products created by the new and increased manufacturing techniques, this amazing time was also one of the most costly to the environment as it introduced

massive amounts of chemicals and toxins into the air and waterways. The effects of this were felt everywhere as water became less drinkable and air less clear. In areas such as Ohio's Cuyahoga River there were major warning signs, as less and less animal and plant life was found downstream from these major centers of operation. The people living in these areas had asked for years for something to be done about issues clearly stemming from these places. Yet, due to many of the areas politicians and societal leaders having a hand in these large productions their cries fell on deaf ears. The continued production and lack of care peaked when the Cuyahoga River itself caught fire for the first time in 1868. Yet, again, this incredible sign of environmental health (of lack thereof) went unheeded as factories continued to dump their waste into the river. Local residents began seriously taking note of this after this astounding event, but it was passed off by those who had clout in the area as a freak incident and eventually forgotten. Yet, as waste continued to accumulate and grow, the Cuyahoga River caught fire time and time again—thirteen times in total from 1868 to 1969 including one where 5 people lost their lives.

The majority of incidents were covered as quietly as possible and as happenstance of modernity, but the voices of the people were growing louder and louder and the reliance on industrial processes was waning (and thus a waning of the power they wielded). By the early 1960's the unhealthy signs of nature in America were being seen and spoken of largely due to the independent study of those willing to do the uninfluenced work. As their voices grew from rising concerns due to these types of events so too did the pressure for regulations on those who would continue to pollute necessary natural resources. Largely due to the 1969 Cuyahoga River fire there was finally enough of an effort to stop this kind of blatant disregard for the world around us. Tellingly, no one lost their life in this fire, nor was it the most costly, but it was the most covered in news media up to that time. On January 1, 1970 congress passed the National Environmental Policy Act, enacted to: "declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality. Sec. 2 [42 U.S. Code § 4321]. It was approved and signed by Richard Nixon shortly after. This was a major step a very long time coming that would eventually give

rise to the organization of the Environmental Protection Agency.

One of the more overtly visible effects on our environment from human consumption is our usage of traditional energy technologies such as coal and petroleum. There was even a kind of instant recognition in media such as in scenes overlooking Los Angeles with a cloud of brownish haze covering the city.. While this constant haze may not be as prevalent now as it used to be, it is most definitely still there. This cloud of chemicals is clearly detrimental to human health and safety as there is a correlation between cities that have major smog issues and various problems such as asthma and cancer seen most readily in the larger industrial metropolis' such as Beijing. Yet, an even more easily seen and understood damage comes from failures in systems already in place and considered necessary to the transportation of these substances.

The Deepwater Horizon oil spill disaster occurred on April 20, 2010 in the Gulf of Mexico when there was an explosion at the Deepwater Horizon offshore drilling rig. This disaster is considered massive in scale and the largest oil spill ever recorded. Unfortunately, there is no shortage of oil spills as they are fairly common, yet this incident remains a sensitive one for many involved. Energy is one of the top grossing import export businesses worldwide and is instrumental to daily life in the modern world. Yet the Deepwater Horizon spill is one of the greatest glaring examples as to why other forms of energy must be on the forefront of our thought unless we want to repeat these same occurrences time and time again. While the oil leaks in the past two years have been disheartening with an accumulation of about 2000 tons being spilled worldwide, the Deepwater Horizon stands out in history with an estimated minimum spillage of 492,000 tons with a possible high of 627,000 or more tons. This caused massive amounts of damage to not only the health of the Gulf's animals and plant life, but also to the economy of those who used the waters of the Gulf for their economic interests. Fishermen on the Gulf coast of America are today still hurting from the effects of this spill in production due to the death of fish in the area. This key economic factor tellingly seems to be the line we as a nation refuse to cross, as after this incident, serious talk began as to how and why this incident occurred.

During this time, the BP Oil Company—the proprietor of the drilling rig—was questioned as to the safety measures involved with a drilling operation of this magnitude. While in recent years leading up to this incident

there tended to be more regulations concerning offshore drilling operations, there has traditionally been little to no oversight on the operations themselves. The blame for this incident was placed mostly on the BP Oil Company itself as well as contractor to the oil platform Halliburton. The lack of sufficient quality in this case leading to tragedy of both environmental casualties and human lives has been chalked up to trying to save money in building the platform.

Ten days after the initial explosion of Deepwater Horizon President Barack Obama temporarily ordered the inspection of most major drilling operations taking place in the Gulf of Mexico and banned new offshore drilling leases. Shortly thereafter President Barack Obama issued a moratorium on drilling operations that regularly worked more than 500 feet down effectively shutting down 33 drilling platforms after the inspections. This moratorium lasted until October of that same year and was viewed as a threat to the industry. Later in December a group called the Back to Work Coalition was formed in response to this specifically in fear that the moratorium would continue and to try and prevent further governmental regulation on the industry. This group was formed by twelve offshore oil and gas drilling stakeholders as well as trade organizations which together hold many billions of dollars per year in capital. Although this organization did make a justification that three billion dollars per year go into the Gulf Coast area because of them, and eight billion more go into the production of crude oil, the losses have been even more staggering. The tourism industry by itself is estimated to have lost more than 22 billion in the two years following this incident, with the fisheries losing billions more, spill related clean-up costs already in the tens of billions, and a loss of jobs estimated to be more than 20,000 by the year 2020. Yet, this Back to Work Coalition was championed by six of the Louisiana Senate and Congress becoming a powerful and very successful campaign against regulation. By early 2011 the majority of the offshore oil drilling industry had gone back to work as usual.

To say there have not been victories along the way would be false but the issue in terms of these victories, is that victories many times come at a great cost. Frequently this cost is overlooked as the well-being and convenience of people is seen as priority over those of flora and fauna. But, when the viability of the American Bald Eagle was threatened along with other great birds, America did respond. But, not until an individual did the work for the rest of us.

Concluding Remarks on Importance and Individual Action

In 1962, Rachel Carson published what is considered to be the major great work that inspired the modern environmental movement. In this masterwork of research, logic, criticism, and powerful persuasion Carson outlines the reasoning behind why pesticides specifically used at the time were incredibly harmful to not only humans but devastating to the environment itself. She reasons through why these various pesticides are harmful to human health dedicating four chapters of the book to the effects of pesticides on humans. Moreover, Carson fingers the pesticide DDT specifically as detrimental to the environment and the main cause as to why specific bird populations were rapidly declining such as the American Bald Eagle. She presents the findings both objectively with scientific explanations as to the chemical makeup of the DDT molecule and the effects this has on the eggshells of bird species, as well as empirically with the proofs of why certain birds were affected more than others. The evidence against companies which create pesticides was also damning as she lays out accusations as to why and how these companies were intentionally manipulating truths with the main goal of selling their product and with disregard to the lives of those it effects. These accusations led to a national conversation as to the truth behind her book leading to law suits and Carson being thrust into international view. This all ultimately culminated in the banning of certain pesticides in the US including any that contained the DDT chemical. Since the ban of pesticides using DDT, the American Bald Eagle population has rebounded phenomenally from an “endangered species” to a species of “least concern” showing how the efforts of a single person can indeed bring to fruition an unquantifiable achievement.

Throughout our history, the American people have been told to follow along and not to challenge the status quo. This did not work even in the age of King George and this sentiment has persisted until modern day. Yet, it does seem that in certain areas we as a people have become hopeless, or worse apathetic to the world around us. Environmental disasters are somehow still looked at as necessary evils for the betterment of humanity. Regulation on corporate behaviors are viewed as threatening to our capitalist economy. Our current administration believes that we have gone too far regarding how much we have come to protect our environment—the only one we have—and have pulled out of the Paris Climate Agreement which is an historic agreement created to try and prevent further

environmental damage causing global warming that all other traditionally extreme conservative countries around the world have signed on to. With the October 2017 inclusion of Nicaragua and the November 2017 inclusion of Syria into this group of countries, it leaves The United States of America the only country to not be signed onto this agreement—a rarified achievement indeed. The justification for this is a claim is that this deal will at the least hurt the American economy and at the most is intentionally designed to do so. And yet, many of these other countries’ economies are expanding at a far more rapid pace than our own. Their middle class is also expanding, as is their ability to rely less on fossil fuels with an eye toward the future of “clean” energy. If there is one, this is the true threat, as the more America is left behind in the technological race to develop these energies, the more reliant we will have to be on others for that technology in the future. Yet, the information currently being disseminated by our government and those who have a less than positive interest in this issue would have the people believe otherwise. The true tragedy is, that this willful ‘turning away’ from the reality that we live as a species is working.

The need to prevent, or at the very least mitigate, the possibility of environmental disasters are not a question of when. The time for this is now. While governments try to protect the corporate systems’ rights, the right to life itself is at stake for the rest of us. We have seen the incredible damage humanity has afflicted on our own environment but, more importantly, we have seen the great successes we have achieved by understanding how we do so and in changing our behaviors accordingly. We have helped rebuild multiple species on the brink of extinction by understanding the effects of a single molecule. The great ozone hole has been shrinking since our decline of use and eventual ban of CFC’s. If we allowed those in power to tell us what is possible neither of these would have occurred. The true question then is, when they say it is impossible, will we listen?

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E-cigarettes: Safe Nicotine Delivery System?

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Abstract

E-cigarettes have become increasingly popular with people throughout the United States. Unlike regular cigarettes, e-cigarettes do not produce a heavy smoke, but nicotine is still present. However, there has been a lack of research done on the substances found within liquids that make the e-cigarettes so popular, so more needs to be done. This is a problem because middle and high school aged children are using them without knowing their composition. Therefore, this subject needs to be explored, so we can educate our young people about the possible effects. The present study hypothesizes that there are aldehydes contained in e-cigarettes from nicotine being present, and that the substances will have properties that nick DNA. In order to demystify the youths misunderstanding of their use with vaping products, laboratory experiments were designed specifically to detect aldehydes and the effect that the product could have on DNA. Specifically, a DNA nicking assay was designed to see if DNA would damage from fractionations of e-cigarette solutions, as well as a Purpald solution to detect if any aldehydes were present, and a spectrometer to observe the absorbance. Aldehydes were detected using the Purpald solution procedure, but further research must be done to show conclusive evidence the e-cigarette products do damage DNA.

Introduction

Smoking cigarettes are becoming a thing of the past. Nowadays, people are turning to vape pens or e-cigarettes to fulfill a need or to socialize with their peers. Specifically, to vape means to inhale and exhale the vapor produced by an electronic cigarette or similar device. According to a 2018 report from the CDC on e-cigarette use, 20.8% of high school students and 4.5% of middle school students used e-cigarettes before. Though these small devices are commonly embraced as a healthier alternative than smoking regular cigarettes, they still pose health problems for us. Little do people know that these devices contain toxic chemicals that are detrimental to the body. People think that “vaping” is harmless and pose no potential threats. However, according to Andrey Khlystov and Vera Samburova (2016), “several studies have demonstrated formation of toxic aldehydes in the vapor during vaping.” Still people are hooked on the flavorful vapors that are emitted from e-cigarette pens and believe that the liquid within the vapor is harmless. Also, the amount of information available on the flavoring of the liquid in vape pens is scarce, so there is a need to determine whether the flavors that the manufacturers such as: Fairwinds, Alibaba, and DHgate are deemed suffice and safe for users across the board.

The defining mechanisms of this research are important because vape pens have infiltrated elementary schools. With that, the children ranging from 6th grade to 12th grade who have started at an early age not knowing the true side effects of vaping. Without the proper information, and the right message to the younger generations, vaping will only be the start to their smoking journey, and could potentially lead them to experiencing narcotics, and other fatal drugs. Testing the liquids associated in the drugs will determine what is exactly within the drugs and determine which vaping liquids are detrimental to the human body. Thus, the “vaping” phenomena must be deemed as unhealthy until further research has been carried out.

The perception of vaping is something that needs to be justified. No longer should people view vaping as harmless with no side effect. The purpose of this research is to discover the underlying chemicals contained within vaping products that may pose detrimental health concerns on our health.

Background/Literature:

Vaping has roots dating back to the fifth century in a place that is known today as Afghanistan. However, it is known as a modern trend that is continuously taking new strides in the consumption of nicotine. Most recently, E-

cigarettes were introduced in the market and have led to the what we now know to be vape pens that are battery powered electronic devices that deliver nicotine or nicotine-free “vapors” to smokers in aerosol form (Khlystov and Samburova). It is closely related to devices such as hookahs, bonds, but in this modern day in age, people enjoy products that are sleek and small enough to accompany with them along their day-to-day activities. They are operated by a single battery that has atomizers attached to it. In turn, when turned on, the atomizers then heat up the liquid that is within the cartridge creating a vapor that sends the nicotine or flavor of choice to the consumer. The flavoring compounds associated with vaping, and the process that allows the liquid to heat up, decomposes the compounds within the liquid, and in turn leads to the production of aldehydes (Khlystov and Samburova). To clarify, aldehydes are organic compounds formed via the oxidation of alcohols and include formaldehyde (methanol) and acetaldehyde (ethanol). Through the formation of aldehydes, triglycerides are formed, and if high concentrations of triglycerides are found within the bloodstream, the risk of strokes are increased. Therefore, the perspective that vaping is very safe and does not have adverse side effects must be dealt with and addressed to keep our youth and adult populations healthy.

Teens across America, somehow and someday, are purchasing vape pens like they are candy even though the Food and Drug Administration (FDA) has regulated the sale of vape products by banning the sale of people under the age of eighteen years old (Klager, et. al). These teens are obtaining fake identification cards and have easy access to the newfound trend. The ignorance is substantial, and even though children are generally healthy individuals due to age, vaping initiates the decline in one’s health if one habitually uses the products. In fact, the American Chemical society believes that, “Smoking is the second leading risk factor for early death and disability in the world.” (Korzun, et. al.) This is also a problem for the youth, more so than adults because their brains are not fully developed yet. The prefrontal cortex (PFC) which is responsible for the executive functions and attention functions, has not fully developed in adolescents, so consuming nicotine during that time is a precursor for cognitive impairment later on in life (Goriounova & Mansvelter, 2012). Comparing smoking behavior of adolescents to that of adults may point to an enhanced sensitivity of the adolescent brain to addictive properties of nicotine. According to Colby et al. (2000), “adolescents report symptoms of dependence even at low levels of cigarette consumption.” The most susceptible youth lose autonomy over tobacco intake already within 1 or 2 days of first inhaling from a cigarette. Among adolescents the appearance of tobacco withdrawal symptoms and failed attempts to stop smoking can precede daily smoking dependence and appear even before consumption reaches

two cigarettes per day (DiFranza et al., 2007). The popularity vape pens have gained since their arrival to the mass smoking markets proved may be strong indicators for addictions in young adults and teenagers who start vaping at an early age.

Research Question (Thesis) and Rationale:

My research question is “Are aldehyde levels present in e-cigarettes and how do e-cigarettes affect PUC-18 Plasma DNA?” This is important to delineate because adolescent children are being exposed to the potentially harmful toxins, and they might not be aware of the hidden dangers.

Methods/ Research Design:

The purpose of this lab experiment is to test the compounds found in the e-liquids that go into the chambers that are decomposed to produce a vapor, and the amount of DNA nicking that those compounds may pose. To do that a Purpald solution was used to detect the for aldehydes within the e-liquid. Aldehydes are known to be toxic, primarily by their facile reaction with primary amines and thus their ability to wreak havoc with protein structure. This will be done by adding a drop of the e-liquid to a solution called Purpald, which will then be dissolved in a 2 mL of 1 N solution of sodium chloride. If, detected, the reagent, Purpald, 4-Amino-3-hydrazino-5-mercapto-1,2,4-triazole, will then produce purple colored solutions. Depending on the amount of time the solution takes to turn purple, the aldehyde will be defined. We then analyzed the purple solutions by UV/VIS. Based on the UV spectra, we have detected acetaldehyde in both vaping and hookah solutions.

A smoking apparatus was used to mimic the action of inhaling the vapor from the e-cigarette to collect residue. To do this, a 50 mL syringe was used to produce the smoker’s action of inhalation and then the contents of that will be collected onto cellulose filters. Then the residue collected will be removed from the filter using acetone or water and then dried down by a Centrivap vacuum. Then the filter will be suspended in water once again and fractionated with a sephadex.

Furthermore, a DNA nicking assay was used to determine the possible DNA damage from the use of e-cigarettes. That assay uses the properties of supercoiled PUC-18 DNA which will be assorted with different amounts of e-liquid, and accompanying controls. Then those mixtures were loaded into the wells of agarose gel containing either the e-liquid and PUC-18 DNA, PUC-18 DNA itself or the glucosamine control. Determinately, if the DNA has been nicked, the nicked DNA will be much lower on the agarose gel than DNA that was intact. The glucosamine is used juxtaposed to the PUC-18 because it is known to have DNA nicking properties. Finally, ImageJ was used to show the exact amount of nicking that has taken place in clearer view.

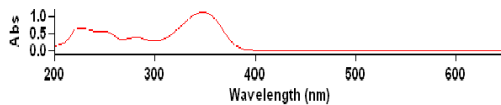
The brand of the e-cigarette unit was chosen upon availability and popularity. The e-cigarette used was a Blow One T2 2.4 mL blow tank. Instead of rebuilding an atomizer, the stock atomizer will be used for this experiment. Below is a diagram of the apparatus used to contain and collect hookah and vape smoke residue. Every thirty seconds, 30 mL of air is pulled through the Blow One T2 2.4 E-cigarette into a syringe, before being vented to the atmosphere. The smoke is then collected on a cellulose filter, and this first-hand smoke exposure. The apparatus used can be seen in the following image.



- A. E-Cigarette
- B. Cellulose Filter
- C. Airway
- D. Syringe

Results/Conclusions:

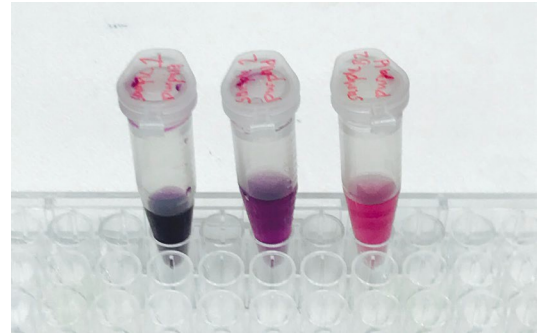
The mainstream vapors from the e-cigarette were collected on Cambridge filters; the filters were soaked in water and then the aqueous solutions were dried via vacuum centrifugation. After weighing the dried mass, the samples were reconstituted with water and then analyzed by UV spectroscopy; the e-cigarette had an absorbance of (200 Nm). The vaping samples had a peak wavelength of 345.0 nm and an absorbance of 1.130 nm.



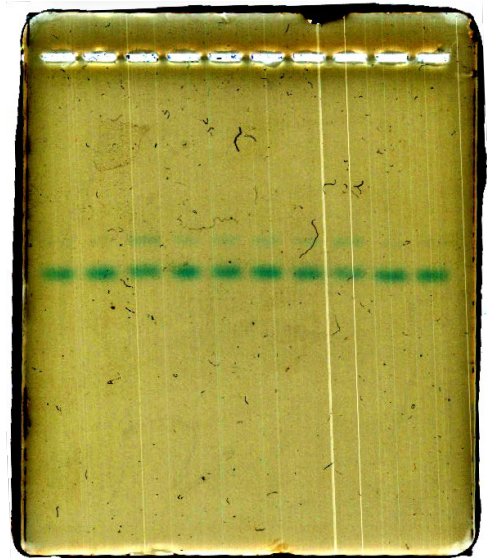
Peak Table	
Peak Style	Peaks
Peak Threshold	0.0100
Range	650.0nm to 200.0nm
Wavelength (nm)	Abs
345.0	1.130
280.1	0.388
250.0	0.568
230.0	0.668

We did, however, detect aldehydes in the e-cigarette samples using the Purpald Assay. Aldehydes are highly reactive with DNA, and therefore are mutagenic and carcinogenic. After many years of smoking, the damage

caused by aldehydes could accumulate in lung tissue and cause serious illness.



The amount of nicking by the e-cigarette solution is orders of magnitude less that the nicking we have detected with cigarette smoke. However, we have no definitive evidence yet. We had hypothesized that the e-cigarette samples would cause DNA nicking like the gel shown below in wells three and eight of a regular cigarette tar.



Alexander Skochko (2018)

Future work

More work needs to be done on this matter. More products and flavors should be examined as well, so that, our youth would know what exactly are in the products. The CDC has started to express their concern for the use of e-cigarettes and the various marketing strategies that are being produced, so their concern will more than likely spark deep interest on the subject at hand.

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The Relationship between Fiction Genres and Empathy

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Abstract

The current research regarding the relationship between empathy and reading has established many positive correlations that show an established link between empathy and reading. The research has shown a positive link with empathy and literary fiction, reading over time, short term reading effect, and others. However, this area of research has not looked at specific genres to determine if there are genres that have a more positive impact on empathy, or even if there are genres that may negatively influence a person's empathy. This research focused on the relationship between fiction genres and empathy. In this study, romance fiction and horror fiction were researched in order to determine if one had a greater impact on empathy. It was hypothesized that readers in the romance group would have higher levels of empathy than those in the horror group. Participants were randomly assigned to either the romance fiction group or the horror fiction group and read a short story from that genre. Empathy was measured by an established scale that contains 30 items. The study found that there was a significant difference in empathy between the groups, with the romance fiction group scoring higher than the horror group on the empathy measure. There were no significant differences found based on gender or enjoyment of the story.

Keywords: empathy, romance, horror, fiction

Introduction

Empathy is an important part of the human experience. Empathy can be defined as actually feeling what another person is feeling. This goes beyond sympathy, which can be described as feeling sorry for someone, and this doesn't include actually experiencing the other person's sorrow or hurt. When a person experiences empathy, it shows true understanding of what another person is going through and the emotions that they are experiencing. This ability is an important part of growing up, in order for children to understand their peers and those around them. One way to potentially promote empathy in children, and everyone else, is through reading, which allows connecting to characters of different backgrounds and realities. However, little is known about the impacts of different genres on developing empathy, which could reveal important information about what literature should be promoted to students.

The present research has looked into the impacts of reading over time on empathy. Research shows that life time exposure to reading increases a person's cognitive empathy, which is understanding the world from another person's point of view. A short-term experience of reading will impact affective empathy, which is the capacity to share another's feelings (Stansfield & Bunce, 2014). Previous studies suggest that the long-term exposure to literature is important to developing empathy, but could

those results vary based on genre? If research could focus on genres, it would be possible to know the stories that could help benefit the growth of empathy.

One prevalent genre nowadays is young adult fiction, which could be more relevant to college students in particular. Current popular young adult fiction includes *The Fault in Our Stars* by John Green or *The Hunger Games* by Suzanne Collins. Sherr and Beise (2015) discovered that when using young adult literature as part of the classroom in a graduate social work program, the students who read young adult literature as a required text scored higher on empathy measures than those who did not. This has potential implications for educational purposes, extending past K-12 education into college education.

Could some areas of fiction negatively impact a person's empathy skills? Soman and Parameshwaran (2017) found that viewing horror films compulsively can lead to the onset of psychopathology, including psychosis. Their findings suggest that parental guidance is necessary to particularly vulnerable populations that are underage. Even though the study relates to film, I expect that these findings could be similar in fiction stories that share similar themes and images.

Another study evaluated the response to different forms of fright media. The study asked college students about previous experiences with fright media. They were asked questions such as asking if they had ever watched a

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show or movie that was so disturbing that the emotional effects continued after it was over. The results found that ninety percent of participants had some kind of fright reaction (Harrison & Cantor, 2009). The study also found that more than half of the participants had disturbances in sleep and eating patterns as a result of the horror media. It also caused many participants to avoid the kind of event that was depicted. These negative reactions suggest that empathy may not be involved when consuming this kind of media because of the experience of fright.

Much of the current research focuses on literary fiction alongside genre fiction. Barras (2013) compared literary and genre fiction and found that literary fiction was more likely to develop empathy. Leading researchers, Kidd and Castano (2017) researched that literary fiction is more likely to develop empathy than genre fiction. Research lacks on focusing on genres together, but based on previous research studies looking at specific genres individually, I believe there could be significance in empathy between genres such as romance and horror.

In this present study, it is proposed that there will be significant differences in levels of empathy between horror readers and readers of romance fiction. It is predicted that those who are exposed to horror fiction will not have higher levels of empathy. Those who are exposed to romance fiction, in contrast, will have higher levels of empathy. The findings in this study could lead to implications in the educational field, such as being able to tailor lesson plans around building empathy. If significance is found, this field of research would also be able to see the significance of genre in promoting empathy and be able to continue research with other genres.

Methods

Participants. For this online study, 17 students from California State University, Stanislaus were recruited to participate. Participants were 4 males and 13 females with an age range from 20 to 50 ($M = 26$, $SD = 8.52$). They were recruited through SONA, the Psychology Department's online subject pool, and by sending emails regarding the study to classes with faculty permission. Students who participated through SONA received one point of participation credit for the participation, and at their instructor's discretion may have been offered extra credit. All participants were at least 18 years old or older. All of the participants were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (American Psychological Association, 2002).

Research Design. This research study was a between-groups design. The independent variable was genre, with two levels being romance fiction and horror fiction. Participants were randomly assigned to read the romance or the horror fiction short story. There was no control group in this study. The dependent variable was empathy after reading the story, which was tested through an empathy

measure. Participants were also asked demographic information about their age, sex, and class standing.

Materials and Procedure. Students were recruited to participate using SONA and email. The participants were directed, either through email or SONA, to the survey through Qualtrics. In order to begin the study, participants had to agree to the terms of the informed consent. After participants agreed to the terms of the informed consent, they were given the demographic questions. The participants were then randomly assigned to read either the romance short story or the horror short story. The romance short story was "Widow" By Julia Lemyre-Cossette, and the horror short story was "Click-Clack the Rattlebag" by Neil Gaiman. Following the story, participants took part in an empathy measure. The empathy measure was developed by Caruso and Mayer (1998). It asked participants to select how strongly they agree or disagree with statements relating to empathy. The final questions participants were asked consisted of finding out if any characters in the story reminded them of anyone and to what degree they enjoyed the story. To finish the study, there was a debriefing form to allow students to understand the research they participated in.

Results

An independent samples t-test was conducted to analyze the empathy differences in the romance and horror fiction groups. Romance readers ($M = 3.78$, $SD = 0.52$) had significantly higher empathy levels than horror readers ($M = 3.65$, $SD = 0.22$), $t(15) = 0.64$, $p = .049$. Figure 1 shows the empathy levels of the participants by condition.

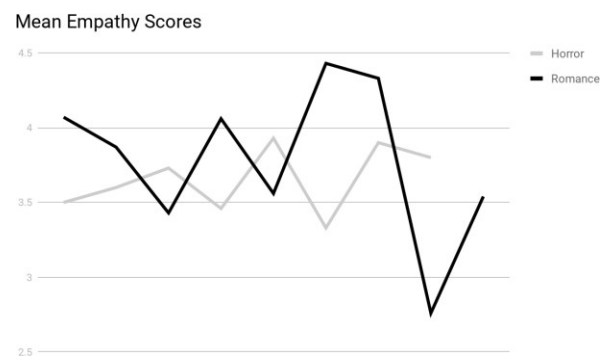


Figure 1. Mean empathy scores by group. (Eckerdt, 2019).

A one-way ANOVA was also conducted to determine if there were differences in empathy based on how much each participant rated their enjoyment of the story. Empathy levels did not significantly differ in those who enjoyed the story a little ($M = 3.67$, $SD = 0.20$), a lot ($M = 3.76$, $SD = 0.14$), a moderate amount ($M = 3.75$, $SD = 0.43$), a great deal ($M = 3.98$, $SD = 0.51$), and none at all ($M = 3.33$, $SD = 0.81$), $F(4, 12) = 0.76$, $p = .57$.

The final analysis was an independent samples t-test was also conducted to test the gender differences in empathy. Females ($M = 4.74$, $SD = 0.45$) did not significantly differ from males ($M = 3.67$, $SD = 0.18$), $t(15) = 0.28$, $p = .129$.

Discussion

Although previous research has overlooked analyzing empathy based on different genres, this research has shown that it is a topic worth pursuing. The results show a significant difference in the empathy levels of romance readers and horror readers. These results aligned with the hypothesis that readers in the romance fiction group would have higher levels of empathy after reading the story. Enjoyment of the story and gender were also analyzed to test for an effect, but these results were not significant.

This study may contrast with the research conducted by Kidd and Castano (2017). Their research indicated that literary fiction was more likely to promote empathy than genre fiction. Although their research looked at genre fiction by the basis of its characteristics instead of specific genres, this research shows that genre fiction may have an impact on empathy that was not previously thought out.

This research was not without limitations, which may account for the significant results. The sample size was small, with less than 10 participants per condition. Efforts were made to attract more sign-ups through email, but a large number of studies were available at the same time on SONA. Another limitation is causation of empathy. Empathy is affected by many factors, and the empathy measure does not account for any external factors to the study itself. Even with these limitations, this research still adds to the current field of study and shows a potential relationship with different genres and empathy.

The significant relationship found in this study has implications for this field of research. This field of research that has examined different relationships with reading and empathy has not examined genre closely until now. After finding significant results, this research area is now worth pursuing to attempt to find other genres that may promote empathy above others. This research also has implications for educational purposes. The findings have already indicated a reason to consider increasing the readings of romance fiction stories over horror in order to promote empathy more. With previous research done by Sherr and Beise (2015), this information could be used at the college level in order to promote empathy in adult students as well.

Future work

The survey used for this study will continue to run for a few more weeks in an attempt to gain a more significant sample size. Significant results were found with a small

sample size, so research should continue in this area with larger samples in order to have more meaningful results. Research should also look at more genres to potentially discover the genres that may promote empathy the best. In order to examine the educational implications in the K-12 setting, future research should also focus on the empathy effects at different age levels, rather than having only college-aged participants. This area of research has growing potential if the relationship between different genres and empathy is continually examined.

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The Link: Estrogen Therapy and its Role in the Prevention and Treatment of Alzheimer's Disease

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Abstract

Alzheimer's, a neurodegenerative disease that destroys memory and other cognitive functions most common in people over the age of 65, affects 35.5 million people worldwide, two thirds of which are women. The most notorious aging process that occurs in women around ages 45-50 is menopause, in which menstruation no longer occurs and 17β -estradiol, the primary circulating form of estrogen in the body, decreases significantly. Symptoms of menopause that are often overlooked are mood swings and decreased cognition/memory just prior to and after menopause. Studies have also suggested that estrogen has many functions beyond the reproductive system, including aiding in memory, learning, and mood. Meta-analysis was utilized in order to answer a question that has yet to be definitively answered; is estrogen depletion in women related to their increased statistical risk of getting Alzheimer's. This will ultimately allow us to determine whether or not estrogen therapies are useful in the prevention and treatment of Alzheimer's disease. Data reviewed including ovariectomies with hormone replenishment and cognitive testing showed that estrogen therapy may help with memory with the caveat that there is an optimal time and dosage for menopausal hormone therapy. Overall, findings were not significant enough to suggest a promising future in their use to prevent or treat Alzheimer's disease.

Keywords: *Alzheimer's disease, estrogen, hormone therapy, menopause*

Introduction

When the word estrogen is brought up, several connotations come along with it including, women, ovaries, hormones, emotions, etc. However, estrogen plays a role in many different functions throughout the body that are completely separate from the ovaries and reproductive system. While it is true that it is produced primarily in the ovaries, men also produce and utilize estrogen. There has also been research to suggest that hypothalamus-derived estrogen exists. While researching estrogen, it was noted throughout several articles that estrogen also plays a role in cognition, which led me to a neurodegenerative disease known as Alzheimer's. Alzheimer's is a neurodegenerative disease that destroys memory and other mental functions most common in people over the age of 65 and affects 35.5 million people worldwide (**figure 1**). It is also important to note that women have a 1 in 6 chance of getting Alzheimer's whereas the odds for men are 1 in 11. ("Why Is Alzheimer's More Likely in Women?")

I am particularly interested in hormones and the various roles that they have beyond their conventional functions. I am also interested in working on research that is still developing and has aspects that are still not well understood, such as Alzheimer's.

Although there are some thoughts as to what causes Alzheimer's, there is not a definitive answer, and therefore there is no known way to effectively treat it. This began to make me think about the aging process and what this could mean in terms of hormonal changes. The 50 is menopause,

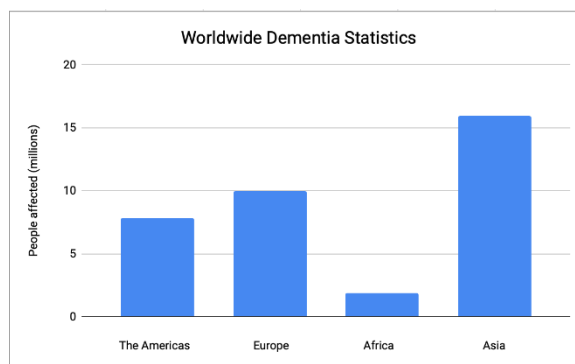


Figure 1. Worldwide Dementia Statistics based on research conducted by WHO (Worldwide Health Organization)

in which menstruation no longer occurs and there is a significant decrease in 17β -estradiol, the primary circulating form of estrogen in the body. There are various effects that menopause has on the female body, and in terms of the brain, it is observed that women can experience mood swings and decreased cognition/memory main aging that occurs in women around ages 45- just prior to and after menopause. Although both men and women produce estrogen, women produce it at much higher levels, and since estrogen is known to have an effect on cognition, the drastic depletion after women enter menopause could be related to why women are more susceptible to the disease.

Methods

My research is a meta-analysis (figure 2) which focuses on determining if estrogen therapy is a proper tool in the prevention and treatment of Alzheimer's disease.

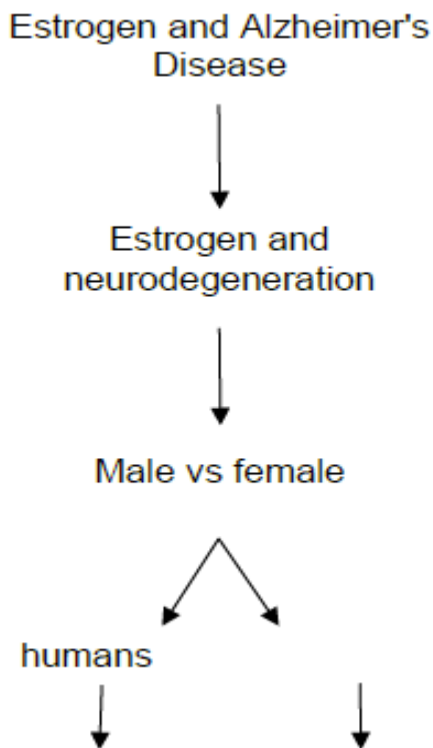


Figure 2. Data was obtained by conducting the following search using the California State University Library Database.

Meta-Analysis

It is important to understand the key differences between the male and female brain that range from processing, chemistry, structure, and activity. From the time of development, males and females are noted to have several differences in brain development, one of the most notable being the inability of estrogen to enter the brain. In females, estradiol is bound to fetal neonatal estrogen-binding protein which is unable to cross the blood brain barrier and therefore unable to enter the brain. In males however, testosterone is carried to the brain and able to enter to later be aromatized to estradiol. During development, females also develop verbal centers in both hemispheres as opposed to men, who only have verbal centers on one side. After development, it is noted that men use 7X more grey matter and females use 10X more white matter. This is significant as white matter helps to connect grey matter with other processing centers. This is believed to be the main reason that females are able to transition between tasks more readily. Females also have a larger hippocampus than males meaning that there is a higher density of neural connections there, which may be affected with decreased estrogen production, since we now know it is derived from the hypothalamus.

It is currently understood that Alzheimer's patients have a buildup of amyloid plaques, which are essentially

clumps of beta-amyloids that are detrimental to the brain as they aid in the destruction of connections between nerve cells. Throughout numerous studies, it is seen that there is oxidative stress in patients with Alzheimer's Dementia and that there might be mitochondrial involvement in the generation of oxidative stress that is associated with Alzheimer's. There have been reports from research conducted as early as 1988 which suggest that mitochondrial function was impaired by amyloid plaques (Pereira) with the data showing that cells lacking mitochondria were protected against the toxicity of amyloid plaques. Interestingly, it was also observed that mitochondria from young females generate less reactive oxygen species in the presence of β -amyloid peptide than older females.

The idea that hormone replacement therapy (HRT) may be beneficial to women for reasons beyond cognition has been around for quite some time. Previously, as some women went through menopause they would undergo these HRT's, however this was discontinued after findings from a 2002 study published by the Women's Health Initiative (WHI) surfaced. The findings showed that synthetic estrogen and progesterone injection increased the risk for cancer, stroke, and even potentially Alzheimer's. For a long time this study was the reason hormone therapies were not recommended. After further research into this study, it was evident that there were some flaws such as the specific participants used and the severity of the symptoms of the menopausal women in the study. These design flaws were addressed and in an experiment performed on middle-aged female mice that were close to the age of female deprivation and treated with estrogen, it was observed that the mice had improvement in memory for several cognitive tasks. (Bimonte-Nelson) In contrast, there was no enhancement in memory after prolonged periods of hormone deprivation. It was observed that there is a "window of opportunity" around the premenopausal period for estrogens to protect the brain against declines in cognition. (Daniel JM) It was also shown that depending on the task, estrogen can enhance, degrade, or have no effect on cognition, meaning that estrogen modulation is not uniform. It is also important to note that in previous hormone therapies, estradiol was not used, but rather a cocktail of estrogenic compounds purified from the urine of pregnant horses, which was used in order to increase estrogen and decrease β -estradiol metabolites. (Bhavani) Further testing that was done to compare estradiol and equine therapies showed that there were less mixed results in patients that were treated solely with estradiol.

Although the study released by WHI (Women's Health Initiative) deterred physicians from recommending hormone therapy, this did not deter studies from continuing, as we have seen. In the past, menopausal hormone therapies were used to prevent coronary heart disease (CHD) and osteoporosis as it is known that estrogen plays a protective role in terms of bone and heart preservation. However, this was discontinued after a study performed on 27,000 postmenopausal women showed adverse outcomes including excessive risk for CHD, stroke, VTE, and breast cancer. Currently, the Endocrine Society recommends women be screened for cardiovascular issues and breast cancer prior to hormone treatments. According to Up to Date, a software system that is a point-of-care medical

resource, the current standing on MHT is that it is appropriate for managing symptoms associated with menopause however; it should not be used as a prevention tool for cardiovascular, osteoporosis, or dementia and should only be used for a maximum of 5 years. (Martin, MD, Kathryn)

There were many methods used throughout the experiments that I researched however I found that those that were most common included hormone replacement therapies, because as we discussed previously, hormone therapies had been done on humans in the past and were thought to have adverse effects, so I believe in order to disprove this generalization, many scientists used this method to put an end to the stigma, should their results support their hypotheses. Many maze tests were also used in order to test cognition as this is a way to see not only how an organism can learn, meaning what techniques they use to acquire a task, but how well they are able to remember how to get through the maze. Most importantly, ovariectomies and castrations were performed in order to inhibit the release of the primary hormone produced by the male or female, respectively. Of note, all of the previously mentioned methods were performed on mice. Human testing is much less commonly seen as the test subjects cannot be manipulated to the extent that rodents can and therefore, the only tests performed on humans were simple cognitive tests.

Because brain-derived estrogen comes primarily from the hypothalamus, most studies conducted are targeted towards testing hypothalamic-specific tasks in mice as the results can be paralleled to humans. In the brain, 17β -estradiol (E2), which is primarily produced in the hippocampus, is thought to influence memory through receptors in the membrane that can rapidly activate cascades involved in synaptic plasticity, which allows junctions between neurons to communicate, allowing the brain to change or adapt new information, which is required for learning and memory. At the University of Florida, neuroscientists have tested the importance of E2 and its various receptors including $ER\alpha$, $ER\beta$, and a more recently recognized G-protein coupled ER. It was shown that E2 enhanced memory when young mice were treated at the time of “training”, but not when treatment was delayed by two hours. Some mice exhibited long-term effects of memory facilitation several days after treatment and were thought to be able to do so as a result of the transcription of genes that maintain cognitive function, thus proving that cyclic E2 treatment improved memory in mice 48- 72 hours after treatment.

Because $ER\alpha$ was thought to act as a transcription factor for E2, young and middle-aged ovariectomized mice were tested and had $ER\alpha$ knocked out ($ER\alpha$ KO). These mice were also not treated with E2. The results showed that these mice had impaired memory, and more specifically that when E2 is low, cognitive deficits are observed when $ER\alpha$ is also not present. These findings are in agreement with growing literature that suggests that memory function is positively correlated with hippocampal $ER\alpha$ levels. (Foster 2012) These knockout mice also show us that before menopause, elevated levels of E2 may be able to compensate for impaired $ER\alpha$ function which is believed to be a possibility

due to the fact that $ER\beta$ can also be engaged by E2. (Fugger) Interestingly, it is known that $ER\alpha$ polymorphisms exist in women and are associated with increased susceptibility to Alzheimer’s as E2 levels decline during middle-age. (Corbo 2006)

It can also be concluded that circulating estradiol regulates brain-derived estradiol via actions of GnRH receptors. This is also important to note because although we have seen that hippocampus- derived estrogen is important for cognition, circulating estrogen is what is most greatly depleted at the time of menopause. Once again, ovariectomized female mice were tested by first being injected with letrozole, a medication commonly used in women who have had breast cancer, which blocks $ER\alpha$. The use of letrozole allowed scientists to block peripheral estradiol administration which in turn enhanced hippocampal- dependent memory in various maze tasks the mice were subjected to. In the second round of testing, antide, a long lasting GnRH receptor antagonist was administered into the hippocampus which again blocked peripheral estradiol and showed the same results as previously observed. Lastly, the mice had their hippocampi infused with GnRH which showed enhanced hippocampus-dependent memory. All three trials of testing were important in demonstrating that peripheral estradiol-induced enhancement of cognition is mediated by brain-derived estradiol via hippocampal GnRH receptor activity.

While most testing is done on females, I believe it is also important to observe the differences, if any, in sexes when it comes to hormone therapy. Both male and female mice were gonadectomized

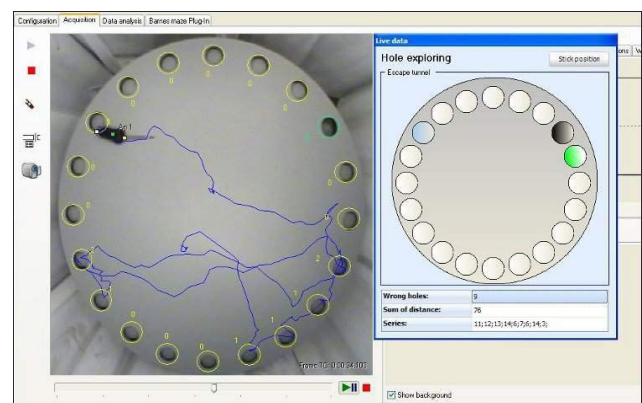


Figure 3. Barnes Maze Test example

and the males were supplemented with either 17β -estradiol (E2) or testosterone propionate (TP), and then underwent a series of Barnes maze tests (**figure 3**), shown in the figure, to assess spatial working memory, reference memory, and learning strategy. The mice initially underwent an acquisition trial which was the first stage of learning, when a response is established. 24 hours later they underwent four more maze tests, and one week later they underwent the test one more time. The data shows that gonadectomized mice took longer to acquire the task, and showed retention deficits after one week. There was also a shift in search patterns used by the mice. In males, they went from random to spatially focused

and interestingly, the transition was faster in males treated with TP as opposed to those treated with estradiol. The females were observed to maintain thigmotactic serial searches throughout. The conclusion was that because of the multiple strategies that are able to be used, there is limiting ability to resolve major differences across sexes.

As previously mentioned, the duration between which estrogen has depleted and been reintroduced plays a role in the effects that its administration will have. A study was designed to examine the effects of long vs. short-term estradiol (E2) replacement. Three aspects were considered; cognition, anxiety, and depression. In order to test cognition, mice were subjected to object placement tasks. To test anxiety, they were placed in mirror mazes and subjected to light/dark transition tasks. Lastly, to test depression, they were subjected to forced swim tasks. The mice, either 14 or 19 months old were ovariectomized (OVX) and either implanted with estrogen releasing implants immediately after surgery, 5 months after surgery, or given a placebo. The mice were then tested once they had reached 20 months of age. The results are as follows; in the object placement test, OVX mice showed improvement in cognition when compared to those given the placebo. In the open field and forced swim tests, there was observed to be anti-anxiety and anti-depression behavior in those treated with E2 immediately when compared to those that had delayed injection or no placebo. The findings were consistent in showing that E2 replacement reduced anxiety and depression behavior as well as showed improved cognition however, delayed E2 influenced whether the use of estrogen treatments were effective (Walf).

Conclusion

In conclusion, opposing effects of estrogen can be attributed to the different types of cognition and the theory that there are multiple memory systems throughout the brain that are each responsible and optimized for processing specific memory tasks (White and McDonald). Since studies suggest there is an optimal time for menopausal hormone therapy, this could be used as a preventative measure in order to inhibit millions of people from suffering and families that must watch their loved ones suffer. Further research will need to be conducted as there seem to be specific factors that make hormone replacement therapy a useful tool to preserve loss of cognition such as the age at which one is treated, the dose given, and the duration of estrogen loss prior to initiation of treatment. Although great advancements are being made each year, there is still so much to be understood about Alzheimer's and the various physiological and endocrinological functions that are involved. This work means a great deal to me as any advancement that may be made will help better the lives of millions. In the future, I hope to be in a position where I am able to do hands on research to further delve into the effects that estrogen, or any other processes, may have on preventing and/or curing Alzheimer's.

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What is the Most Used Learning Style in the Elementary School Classroom; The Impacts of Teaching Different Learning Styles in the Classroom?

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Abstract

As most teachers know, students learn the material taught to them most effectively by using multiple strategies presented in class. The many strategies are displayed by the four main learning styles in education that include visual, auditory, reading/writing, and kinesthetic. Hence, teachers must address this diversity to enable their students to succeed in learning in the classroom. Students also come from different backgrounds at home, such as the English language learner, the foster child, the intelligent student, and a special needs student. Therefore, knowing the most commonly used learning style in the elementary school classroom allows teachers to utilize the most appropriate strategy to push their students forward to learn the next California Common Core Content Standard to be covered. This is exemplified, especially, for a teacher that needs to move on quickly with a concept in class. If a teacher can reach the golden rule in teaching of 80 percent (Olivant, 2017) of the population of students in their classroom to understand a concept by using one learning style, then this can be an efficient way for a teacher to move onto to the next material that needs to be covered. The remaining 20 percent of students that do not fall under this learning style can be pulled aside later in the day for additional assistance. The reasoning for this approach is that there is a large quantity of California Common Core Content Standards that elementary school teachers need to meet, and there is only so much time in the school day/school year to cover all standards. As a result, there were methods used in this research project that include recruiting participants using a snowball sample, beginning with teachers at Crowell Elementary School that I met, while undertaking observations for my Liberal Studies classes. All participants were teachers currently teaching in kindergarten through sixth grade classes. Interviews conducted were conducted in their classrooms. Thus, after completing the above procedure, I learned that most teachers try to incorporate all four learning styles of visual, auditory, kinesthetic, and reading/writing in their teaching. However, according to the data collected, visual is the prevalent learning style utilized in the elementary school classroom after conducting five snowball sample interviews from teachers at Crowell Elementary School and Earl Elementary School. Further, most students needed to see visual aids in the classroom in order for them to best understand the material. As follows, teachers who may be struggling in the classroom to reach all of their students learning curves can utilize this learning style of visual and combining with others in order to have the great majority of their class understand the abstract concepts at hand to then move on to the next lesson.

Keywords: Learning Styles, English Language Learner, California Common Core Content Standards, Kinesthetic

Introduction

There are many learning styles being used in the elementary school classroom each day. Most teachers utilize a variety of learning styles to teach their students throughout the school day. This would be tedious for the students and their learning if teachers failed to use different styles. Recently, teachers have tried to use more creativity in the classroom to make learning more comprehensible as well as entertaining. Without creativity, teachers cannot consider the myriad of ways to teach their students the material to keep them both engaged and entertained throughout their lessons.

There tends to be about 20-35 students in a class, and every student has a different learning style or

comes from a different background. Some may be better at listening to a teacher to understand the material. Some may be better at visualizing something in front of them to learn, like me. Some may need to move their body to learn. Some may need to write down the concept to understand the abstract material being presented. Each student is different and is entitled to learn by the best means possible to understand the material being taught. Thus, it is beneficial to know your students thoroughly in order to teach them in the manner that is best for their learning.

Background

Learning styles have different ways a teacher may use to teach material to their students. All students

think differently and come from diverse backgrounds of learning. The learning styles include kinesthetic of using the body, visual of seeing, auditory of hearing, and reading/writing on paper. In the field of Liberal Studies (Olivant, 2017), visual activities include writing directions on a board, using resources that require reading and seeing, having students take notes on concepts, and using videos. Reading/writing includes having students draw pictures/make models or write things out on paper. Auditory includes using lectures to listen to, using music related to the themes, and using oral reports. Kinesthetic is having students use computers or calculators, providing movement in class, and playing by role imitation.



Figure 1. Four Learning Styles
(Photograph from Metropolitan)

According to a journal article by Cassidy and Eachus, the authors both evaluate the efficacy of teaching and learning in higher education by investigating the relationships between assessment of their learning styles, academic beliefs, self-report student agency, and academic achievement. The authors after conducting research of the first- and second-year undergraduates used the Research methods proficiency (RPM) to measure the students before and after completing modules in research studies. “From this it may be reasonably concluded that high academic self-efficacy, internal academic LOC and high academic self-confidence are likely to be associated with the adoption of deep or strategic learning approaches; while low academic self-efficacy, external academic LOC beliefs and low academic self-confidence will be associated with surface or apathetic learning approaches” (Cassidy, 2000). Therefore,

proving that students who have good approaches to studying and focusing in class tend to have higher achievement in school because they are using the best teaching strategy/learning style for them to learn from their teacher. If the teacher can keep utilizing the best strategies from students that have higher academics, they just need to know the best strategy/learning styles to implement for other lower academic students. This proves knowing the most used learning styles/teaching strategy in the class is important because this can be implemented to teach to the student’s interest in order to keep them both engaged in the material and understanding it in their best form. Overall, the data above proves the better teaching strategies (learning styles) used that best fit with the student, the higher academic achievement is correlated.

According to John Yerxa, an education officer, who states that simply being aware that there can be different ways to approach teaching and learning can make a difference. This difference can be the small portion between a student understanding the concept when delivered in the student’s best interest or being far from understanding the concept at hand. Furthermore, learning styles are where “individuals characteristically approach different learning tasks.” (Cassidy, 2004) All student’s minds think differently when given an assignment. This is then presented below in Gardner’s multiple intelligences where Gardner portrays the different ways a person may think when given a task.

Learning styles are also diverse from Gardner’s Multiple Intelligences theory (Gardner, 1983), which are the many different ways our brains intellectually think. The main point on Gardner’s Multiple Intelligences theory is students are not in one specific intelligence category of learning. Students are able to embrace all the multiple intelligences, just one intelligence may be more favorable for a student over the others. Each of these intelligences apply to the many different learning styles of visual, auditory, kinesthetic, and writing/reading. According to my worksheet that I used to observe in the classroom for my liberal studies classes. The different multiple intelligences include the following below.

First, linguistic intelligence is where one facilitates well with their words and language. Second, logical-mathematical intelligence is where one is able to use abstract thinking of numbers and reasoning to solve problems. Third, spatial intelligence is when one thinks best by drawing or seeing pictures. Fourth, bodily-kinesthetic intelligence is when one thinks and learns best when using their body to move around. Fifth, musical intelligence tends to involve people thinking best when listening to the sounds of music. Sixth,

interpersonal intelligence is when someone is both smart and understands others feelings well. Seventh, intrapersonal intelligence is when you are self-smart and can reflect well. Finally, naturalist intelligence is when one can think best and learn when among the nature of the world (Armstrong, 1994). All students come in different packages of intelligences from multiple backgrounds, thus causing them to learn in many different ways.

The multiple intelligences help in diversifying the types of learning styles above by explaining the different ways a student may think. Therefore, the teacher can ascertain what is the best type of activity or activities they may integrate into the classroom by knowing how their students think for themselves to learn the material. An example would be a teacher teaching the student a mathematics problem, but the student is having trouble with multiplication. The teacher can tap into the student's intelligence of logical-mathematical and kinesthetic to teach them through the learning style of kinesthetic by having the student move their body to learn. Thus, I will have them do 2 sets of 3 jumping jacks. This will teach them that $3 \times 2 = 6$. This teaches the student the material in a way that works better for them to learn. Then, the teacher can reinforce that style more often if it works for that student. Gardener states we must tap into their multiple intelligences to use their best way of thinking to ascertain what learning style to use depending on the student's strengths and weaknesses.



Figure 2. Multiple Intelligences

(Photograph in Hastac)

Further, the teacher should get to know their students and personalities as well. Knowing your

student better allows the teacher to be more open to inputting creativity into their lesson plan on the multiple teaching strategies they must encompass (Olivant, 2009). The teacher must know their student's interests and abilities so they can build around to spark creativity in their lesson plan. This is exemplified where the student is an athlete and having trouble in counting 1-100 in a mathematics problem. It is better to have the student kinesthetically jump in the air to practice their counting, instead of tediously say it out loud. This is creative by the teacher, keeps students engaged in the lesson by jumping, and encompasses the learning style the teacher should use for that student more often.

In a study below, an English teacher describes her experiences in the classroom where she accommodated multiple intelligences. Someone discovered her students had a higher grasp of knowledge of the material taught when they could express what they learned in different strategies that best worked with them. An instance in the text describes the teacher having her class play a game of "Chalkboard Pictionary" as she calls it in her English classroom. This is also one of her favorite kinesthetic language arts activities too she stated. The students would be doing a review on African proverbs and get into two teams. Each student on a team would go head-to-head up to the chalkboard drawing what they thought was the best picture to demonstrate their learning of the African or American proverb presented to them. Translating these proverbs and symbols into pictures takes concrete thinking.

The teacher lastly stated after playing the game that "I am always struck by the talent of some of my students who often are the least talented with paper, pen, and word but are outstanding with picture conceptualizations. This realization has led me to offer more picture alternatives" (Simeone, 1995). Her study proves that certain students in class may struggle with demonstrating their learning of using just pen and paper. Some students may need to get up and draw what they learn in order to demonstrate their knowledge that was presented to them. Every student learns in a different way and may need to express themselves in different ways as well. These students here used the learning styles of kinesthetic to move their body to draw and multiple intelligences of visual-spatial to draw artistically what they learned. The author seems to imply that not all students are like this, so it is beneficial to use multiple learning styles in the classroom, even in English, to get the material across to the students in the best way. This study proves not all learning needs to be with writing in pencil on paper. There are other avenues for different types of learners.

A study below exemplifies “an experiment that someone did for nursing students on their best learning styles when teaching them in the classroom. Results of this experiment include that the predominant learning styles were: sensing – 82.7%, visual – 78.7%, sequential – 65.8%, and active - 59.9%” (Gonzalez, 2017). This is interesting to me; these are not the usual learning styles I will use. Even though my project is based on learning styles most commonly used, this teaches me that learning styles are applied at all ages and in many ways. Even nursing students do not think the same way as each other proving that all students no matter what you are learning will be different.

Like the students in the nursing school, we are all different. The nursing students must be able to observe and touch their patients with their senses to learn their material the best for them. Hopefully, their teacher will apply this research into their future lesson plans more often. This helps me as well, because I know if a student wants to be a nurse in the future, they need me to see/teach using the learning style of visual more often for them to best understand the material in the classroom.

Description of Research

The purpose of my research is to identify the learning styles used most commonly by teachers in the elementary school classroom. This is important because every student learns in a different way and teachers must address this diversity to enable their students to succeed.

It is beneficial to know the most commonly used learning styles in the elementary school classroom so that not only myself, but also other future teachers may benefit from this information. In standard practice, teachers cannot move onto another lesson until 80 percent of the class understands the current concept they are learning. Thus, knowing the most commonly used learning style will help teachers reach as many students as possible. That is because not all students learn the same way and will understand the lesson every time it is taught. This will then make both the teacher’s and the student’s jobs easier for them.

I predict the teachers will say they use multiple different learning styles in the classroom. However, more specifically, my hypothesis is the most commonly used learning style in the elementary school classroom is visual learning. This is because most students need to be able to observe a problem being performed in front of them in order for them to understand the problem. For example, when I observed the classrooms, most teachers tended to model most of the problems on their

smartboards for the students to see, touch, read, and copy down.

Methods

I will recruit my participants using a snowball sampling method, beginning with the teachers at Crowell Elementary School that I met while conducting observations for my Liberal Studies classes. All participants will be teachers currently teaching in kindergarten through sixth grade classes. All interviews will be conducted in a public facility of the teacher’s choosing at a time convenient for the teacher. Possible places include the teacher’s classroom, Stanislaus State Honors building, and coffee shops. The letter of support for my research that I received from the principal of Crowell Elementary School also allows me to conduct an interview with the teachers on her school campus. I will start each interview by getting an informed consent. I will then start the audio recording and ask the interview questions. Lastly, I will thank them when the interview is over and invite them to my Honors Capstone Conference to hear my results.

Data will be collected through in-person, semi-structured interviews with multiple elementary school classroom teachers from different grade levels. I will ask them basic questions on their teaching background in one set of questions. In another set of questions, I will ask them about the learning style the teachers think they use most often and why they use it. I will listen to what they say and write down brief notes during the interview. I will also record the interview on the Voice Memos app on my iPhone to ensure I do not miss any important information. I will make sure that I have the teacher’s permission to record and will only record with the teacher’s permission. I will then use the recording along with my notes to identify learning styles and themes emphasized by participants when analyzing my results.

Results

In late November, I was approved by Stanislaus State University Institutional Review Board (UIRB) to start my research by interviewing teachers. I then contacted 4 past teachers I observed before at Crowell Elementary School and an additional one from a current teaching credential class I was taking at Stanislaus State to do the semi-structured interview to gather some results.

The first teacher interviewed was a Hispanic, male, sixth grade teacher at Crowell Elementary School. This teacher stated that out of all 4 learning styles of visual, auditory, kinesthetic, and writing/reading, in general, he utilized auditory and kinesthetic the most in his classroom. For auditory, he believed his students learn the material best when they are able to talk to each

other when moving around the classroom. The learning style he stated he used most often into his classroom is kinesthetic. The teacher stated that after reading many teaching books as research, he learned when his students are more exhausted than he is at the end of the day by both learning and moving around at same time. He then knows his students were both engaged and learning in class which leads to them being more tired than him. In addition, for using the kinesthetic learning style, the teacher does not prefer for his students to sit down for a long period of time because they can get “chatty” or bored from not moving as they learn to get their blood flowing. The teacher stated that he encompassed the kinesthetic learning styles as well by having his students get out of their seats to write on whiteboards to discuss in small groups what are their answers to math problems presented on the smartboard. The teacher added that he would utilize the other learning styles more if they were more exciting to him and at the moment, they did not fit the needs of the students he currently has in his class.

The second teacher interviewed was a white, female, third grade teacher at Crowell Elementary School. The teacher asserted that she tried to use all 4 learning styles in every lesson that she creates. However, she encompassed the learning style of visual the most in her classroom because that is the way she learned when she was in school and this is an easy way to teach if that is how she learned previously. An example of how she utilized visuals in the elementary school classroom was by asking her students to have “1,2,3 all eyes on me, mouths off.” If the students looked at her, it was easier for them to understand the material as she presented the directions on the document camera for all to see. At the same time, the students would point to each word on their paper in front of them to follow along. The learning styles this teacher used the least is kinesthetic. In her opinion, it is more difficult for her to incorporate this learning style, especially in her bungalow portable classroom that shakes as students walk in the classroom.

The third teacher interviewed was a white, female, fifth grade teacher at Earl Elementary School. The teacher said she used all 4 learning styles in her classroom. However, the learning style she incorporated the most in her classroom is visual. She believes it reaches all learners. Also, if a student is struggling on learning the class material, then looking at a visual image helps that student make a connection to assist better in understanding the confusing concepts at hand. This teacher also uses her technology in the classroom as visual aids for her class as another angle in learning an abstract concept. This teacher stated she does not use the learning styles of auditory as much because most, young students do not process by hearing

in her opinion. This is due to their speaking/listening skills that need to be improved.

The fourth teacher interviewed was a white, female, special education autism specific classroom teacher with grades third through sixth at Crowell Elementary School. This teacher stated in general she tends to use all the learning styles listed above. Nevertheless, the learning styles the teacher employs the most in her autism specific classroom is visual. This teacher asserted that her students do well when a visual is supported to help make a connection, which is huge for autistic students. An example of this visual representation is a tangible item, such as a cotton ball or a rock, where the students can actually touch the object. Even though visual is the best learning style for the teacher, it is also best paired with another learning style of auditory, specifically when giving instructions in her classroom. She also encompassed the kinesthetic learning style in her classroom additionally because autistic students have a sensory issue where they move their arms when they are more anxious. Therefore, she gave ample opportunity to her autistic students to get out of their seats to move the anxiousness out of their bodies. In addition, the learning style the teacher incorporated the least was writing/reading because not all her students can use this style well to learn. Thus, this learning style can be frustrating for students. Therefore, the teacher will modify or limit this learning style of reading/writing to ensure that her students keep learning and improving. An important point the teacher brought up in this interview is to remain cautious of who needs what for each student. This is because all students are unique and not all 9/10 will know or be able to complete the 4 learning styles.

The fifth teacher interviewed was a Latin, female, first grade teacher at Crowell Elementary School. In general, she stated that she uses all 4 learning styles in her classroom. However, she added visual is used the most in lower grades. The materials this teacher employs in her classroom included pictures, graphs, videos, photos, objects. The teacher also stated that if she could give her students something to look at and focus on, then this would help make something abstract be understandable to learn. The learning styles the teacher incorporated least was reading/writing because some students at this age can surpass their grade level or some are very behind.

Conclusion

After obtaining results from data collected in interviews of the elementary school teachers above, the most commonly, used learning styles appear to be visual. My hypothesis was supported by the data above on visual as the most commonly used learning style in the

elementary school classroom. This is because most students need to be able to see what they are doing in order to focus their attention on or actually touch to help make an abstract concept easier to comprehend.

However, overall, it was interesting to learn after doing this research that most teachers in general try to incorporate all 4 learning styles of visual, auditory, kinesthetic, and reading/writing into all their lessons. This way, the teachers can attempt to reach each student in their classroom. Nonetheless, teachers use visual the most to reach most of their students in their classes. However, they should strike to encompass all the different learning styles to reach all the students in their classroom. Every student is important and is entitled to understand the lesson concepts at hand in whatever way it takes to do so.

Another note after conducting this research is that half of the teachers stated that sometimes they combine the learning styles in their lessons to reach those students who learn more effectively when the styles are combined. Such an example would be the special education class where the teacher likes to pair an auditory with a visual aid because autistic students are more apt to learn when they can touch or see things when being told directions out loud. This goes the same for general education students that are told to put their fingers on a text as they read the material as a class as suggested by the third-grade teacher.

An additional note after conducting this research is that most of the teachers imparted in their interview that they were beginning to use the learning style of kinesthetic in their classes. These teachers stated that they are finding many of their students to be restless while in class. This is somewhat like how some college students struggle to be able to sit still in class for long periods of time. Thus, teachers are slowly finding more ways to have their reckless students learn better by having the students incorporate their body more often in the classroom when learning a new concept.

This research was important to me. Now, I can share my learning styles findings with future teachers and let them know that yes, visual is the most commonly used learning style in the elementary school classroom. Now, teachers knowing the most utilized learning style may use this learning style in the classroom to reach the great majority of students, when the teacher has to move on from topic to topic to cover in class. Teachers are charged with teaching the California Common Core Content Standards during the school year. Most of the time, there appears to be insufficient time in the class day or year to cover every standard. Therefore, future teachers should utilize the learning style or styles that allows students to learn the best and to allow the class

to move quickly to cover the standards. The teachers can always pull aside those students not in the visual learning style radar, for extra assistance after the lesson or infuse two learning styles in one lesson to reach all the students in the class. This should enable the class to learn faster and proceed efficiently so that the class will learn all the required standards.

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LGBTQ: Not a Censor, but a Value

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Abstract

For as long as there has been literature, there has also been censorship. When considering the reasons why books may be censored, no theme is safe. Yet some censors are more controversial than others, especially those of a more sexual nature. Particularly, there is a lot of controversy concerning the LGBTQ censor, or the censorship of literature depicting Lesbians, Gay men, Bisexuals, Transgenders, and the Queer/Questioning. Although this censor is a fairly recent one, it is one that includes several sectors within the United States. For it not only concerns the academic effects on the learning community within a public school; it also pertains to the extent of one's freedom of speech and information as well as creates many other challenges within the United States. Therefore, through the reading, analysis, and writing about select literature censored due to its portrayal of the LGBTQ, I will be arguing how the censorship of books depicting LGBTQ content within the public education system is more detrimental than beneficial for its learning community. Therefore, the inclusion of these books and others similar to them is needed. For it will improve not only the academic, but also the political, social, and legal sectors within the United States in regards to the existence, validation, complexity and acceptance of all of those who make the LGBTQ community.

Keywords: LGBTQ, censorship, banning, inclusion, exclusion

Introduction

As long as there has been literature, there has also been censorship of literature. When it comes to the reasons why books are censored, no theme is safe; whether they are serious themes like violence, or relatively harmless ones like fantasy. However, some censors are more controversial than others, especially those of a more sexual nature. Specifically, there is a significant amount of debate concerning the LGBTQ censor, or the censoring of all literature depicting Lesbians, Gay men, Bisexuals, Transgenders, and the Queer/Questioning.

Although censoring literature has been occurring for a long time, censoring literature portraying LGBTQ content is a fairly recent one. At first, it seems to be like any other censor used by various authority figures to prevent select literature from being read for "the sake of the readers," yet the act of banning LGBTQ literature has much more profound consequences on the learning community than any other censor. This brings to mind the act of censorship in general, and how it is still a constant occurrence today, especially within public education. It also brings to mind how it may be a violation of freedom of speech and information, both important Constitutional rights and very strong parts of both the political and social ideology of the United States.

Thus, the censorship of literature for LGBTQ content in public schools becomes an issue of political, social, and academic importance. It creates debate concerning the

extent of one's freedom of speech, the academic effects this censorship may have on the learning community within the public school, and how it may create more challenges both inside and outside the social scene in the near future: specifically, the LGBTQ scene.

Background

Censorship of literature has been around since the creation of literature itself, whether it be seen in the burning of books at the command of Qin Shi Huang from 213 BCE-206 BCE to the more contemporary 1930 Nazi book burnings. So, there has always been great discussion concerning it, especially when done in public education. This can especially be seen within the LGBTQ censor, which in this context I define as the prevention of reading literature due to its depiction of non-heterosexual relationships/attractions instead of or alongside heterosexual ones. My findings of discussions concerning this censor essentially depict one view: the censorship of literature conveying LGBTQ content is harmful for the learning community within public schools in how it censors both those that are a part of the LGBTQ community, as well as the exposure of said community to those outside of it.

The censorship of books will never stop as long as there are books in circulation. For the public education system, this means that as long as books are being created

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and made available to those part of the public education system (the students), not all individuals (particularly, the student's parents or legal guardians) will be accepting of these books; whether it be nudity, masturbation, and especially sexuality. However, in this context, the most recent and perhaps most controversial censor is not just sexuality, but any sexuality that is outside the "normal" heterosexual, cisgender one; for as Pat Scales claims, "novels and picture books featuring gays and lesbians are now the biggest targets of censors" (534). This is because compared to other censors, the LGBTQ censor disrupts social norms more profoundly, as it portrays "alternatives" to the "normal" lifestyle that other censors do not. For example, the censor of violence exists, but violence is seen as a relatively normal aspect of life, while the LGBTQ censor exists as it disrupts the "normal" aspect of life in being romantically/sexually attracted to the sex/gender opposite of oneself. So, books that challenge this aspect are then open to being challenged and possibly removed from the school (and thus its readers), depending on the severity and quantity of complaints placed by those in charge of these readers.

Censorship then directly correlates to its impact on young readers and their freedom to information as well as their freedom of speech. For as observed by Scott DiMarco "In the library world, access to information is a human right, not to be tampered with, not to be controlled in any way" (369). This statement then brings to mind how censoring literature on LGBTQ grounds may be a direct violation of our freedom to access information, a right granted to us by the First Amendment in the U.S Constitution. So, it should be rendered unconstitutional or prohibited from occurring at all. However, as explained by the American Library Association, "The First Amendment's constitutional right of free speech, which is also applied to the states, only prevents government restrictions on speech, not restrictions imposed by private individuals or businesses" ("Intellectual Freedom: Issues and Resources"). In other words, as long as it is not imposed by the government (with a few exceptions), it is not a violation of free speech for private individuals (in this context, the parents or legal guardians of the readers within a public school) to censor LGBTQ literature, just as much as it is not a violation of free speech for these same private individuals to support said literature, as both sides are merely exercising their rights of free speech and information. However, this does not mean we should let the censorship of any literature occur without fuss, especially LGBTQ literature. Rather, we need to challenge this attempted banning, for both those represented by it, as well as those not represented by it. This academic calling to action is further advocated by Mahesh Rao et al, as he brings to mind how many more works are still being censored each day, "making the initiative just as relevant today as 35 years ago" (69). So because the act of censoring LGBTQ literature in schools is only growing stronger as time progresses, so should the

means of challenging and overturning this censorship on the grounds of freedom of speech and information.

Thus, the exclusion of LGBTQ literature proves to be more harmful than helpful to the learning community within public education. This is due to how it causes the loss of an asset that education itself is supposed to provide to its students. Meanwhile, the inclusion of it shows to be more helpful than harmful in that it enhances the education of those within the learning community. This can be seen when Megan Roberts discusses how including LGBTQ literature within a library "helps [LGBTQ students] create connections with literature and develop positive self-esteem. In addition, [non LGBTQ students] who hear stories about people who are different from them—those who have two mommies or are from another part of the world, for example—develop empathy and an understanding about themselves and others" (88). These observations then prove the notion of censoring LGBTQ literature "in fear of corrupting the readers" as invalid.

In fact, this censoring of LGBTQ literature brings to light harmful ideologies within public schools. These ideologies, as observed by Malcolm Beemer-MacDonald, have been shown "to create an unwelcome learning environment for LGBTQ students through the perpetuation of heteronormativity" (2). Heteronormativity is the belief that heterosexuality is the only valid or "normal" form of sexuality within a given environment. This then extends into a similar belief prominent in public schools: heterosexism, which is the belief that heterosexual people are inherently superior to non-heterosexual people. Thus, the censorship and exclusion of LGBTQ literature in public schools not only uphold these beliefs, but also make it possible to "perpetuate stigma of LGBTQ identities and relationships and the idea that such identities and relationships are not appropriate subjects for [students] to learn about or to even acknowledge... More problematic is that students are taught that LGBTQ representations, in any context, are morally wrong" (102-103). This effect is further proven by Elisabeth Rauch when she argues how due to this exclusion, "perhaps even more than other patron groups, GLBTQ [students] are at risk when they are without materials to help them feel included in their community. Suicide rates among this group are alarmingly high, perhaps a result of the bullying" (13). Therefore, the inclusion of LGBTQ literature is all the more a must for librarians and schools nationwide, in order to help combat both the censor itself as well as its "prisoners:" both the LGBTQ minority within the United States population, as well as the heterosexual, cisgender majority.

Thus, the focus of this paper is how the censorship of books depicting LGBTQ content within public education is more detrimental than beneficial for the learning community. Therefore, the inclusion of these books and others similar to them will improve not only the academic sector but also the political, social, and legal

sectors within the United States in regards to the existence, validation, and acceptance of all those who make the LGBTQ community. In order to figure out the reasoning behind the censorship of these books, I have examined select LGBTQ literature from the perspective of both a reader and a scholar.

Literature

In order to examine the censorship of LGBTQ literature from a reader's perspective, I read the following books: Stephen Chbosky's *The Perks of Being a Wallflower*, Alice Walker's *The Color Purple*, and Susan Kuklin's *Beyond Magenta: Transgender Teens Speak Out*. These books were selected due to their status as being some of the most popularly banned books due to LGBTQ content across various public schools (grades ranging from lower middle school to the upper high school level) since their initial publications: male homosexuality, female homosexuality, and transgender people respectively.

Analysis

In order to examine the reasoning behind the censorship of LGBTQ literature from a scholar's perspective, I analyzed each text by taking note of the LGBTQ content that earned its censorship in the first place. Once this analysis was completed, I wrote an interpretive essay on the books to disprove the means of them being banned, as well as provide perspective on how exposure to these works are beneficial to readers across public schools.

Results: Interpretive Essay

Thesis

In accordance with my reading and analyzing the previously-mentioned books, my interpretive essay portrays the idea that the "controversial" aspects of each book that caused their being censored are not as controversial as initially thought. As depicted in Figure 1, the essay opens with the thesis that although these works may be censored on several grounds, they should nonetheless be included and exposed to readers, as both the LGBTQ content and other values within each text make them more beneficial than detrimental to the readers of public learning communities nationwide.

Book #1: *The Perks of Being a Wallflower*.

Stephen Chbosky's *The Perks of Being a Wallflower* is a well known novel that has also possessed a cult following since its 1999 publication. However, despite this novel's popularity, it has been cited for censorship in several public schools nationwide, according to research done at Marshall University. The grounds for censorship of this novel include its portrayal of drug use, profanity, and masturbation; yet one of the most cited reasons for its censorship is due to its portrayal of male homosexuality, as depicted in the relationship between two

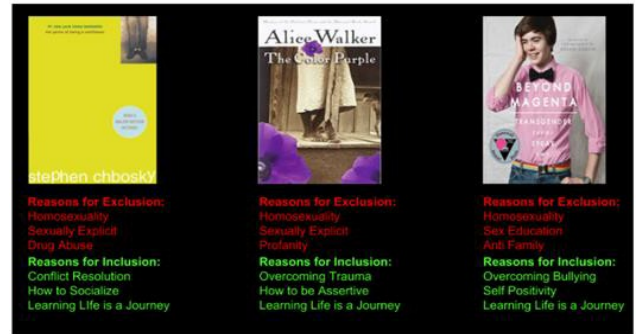


Figure 1: The Censorship of Select Books due to LGBTQ content across the United States Public Education system. States include Florida, Connecticut, Illinois, Ohio, New York, Indiana, Wisconsin, Texas, North Carolina, and Virginia.

supporting characters, Patrick and Brad ("Banned Books"). Nevertheless, it is through this relationship that Chbosky is able to portray the challenges, decisions, and experiences that homosexual men must face that non-homosexual men don't in terms of coping with their sexual orientation. One of these challenges is the fear of admitting one's sexuality to themselves as well as others (also known as "staying in or coming out of the closet"). This is shown in the book when Patrick tells Charlie not to tell anyone that Brad is gay "Because he's scared" (Chbosky 36). The book also displays the ignorance of what homosexuality is, as displayed by the mainstream, heterosexual ideals of modern society. This can be seen in Charlie's reaction when Patrick tells him he's gay: "I went to the library... I did some research because I honestly didn't know much about it" (64). However, this portrayal is beneficial, for if exposed to readers within public schools, it will widen their world perspective; whether they are in the position of closeted Brad, openly gay Patrick, or even the heterosexual narrator Charlie.

In addition, this relationship is not the main plot of the novel, but rather a small part of it. There are many other messages within the novel that readers can learn from besides the message that one needs to accept or at least tolerate those different from themselves, especially in terms of sexuality. One can also learn how to socialize with other people, how to handle conflict and overcome trauma with both family and friends. Yet most important of all, one learns that life is a journey and so the best thing that one can do is enjoy the ride.

Book #2: *The Color Purple*

Similarly, Alice Walker's *The Color Purple* has been cited in public schools for censorship despite its earning a Pulitzer Prize for Fiction a year after its 1982 publication. According to Marshall University, the reasons for censoring this novel also includes profanity as well as sexually explicit and unsuited for age group; yet one of the main reasons for censorship was due to its depiction of female homosexuality through the relationship between the

main character, a child bride Celie, and supporting character, singer Shug Avery (“Banned Books”). Yet, when compared to the male homosexuality in *The Perks of Being a Wallflower*, there are differences seen in female homosexuality through this relationship, such as how it is shown as being more sensual (rather than sexual), as well as being “tolerated” more for going against the “normal” ideals of sexual attraction.

Within *The Color Purple*, it is through this relationship that readers can see the challenges, decisions and experiences that lesbians experience that non-lesbians don’t in terms of their sexuality. For instance, the novel does not initially convey the element of fear but rather infatuation, such as Celie’s reaction upon looking at Shug’s photograph: “The most beautiful woman I ever saw... An all night long I stare at [the photograph]. An now when I dream, I dream of Shug Avery. She be dress to kill, whirling and laughing” (Walker 6). Yet later on in the novel, it does show fear along with confusion, when Celie starts to question her feelings for Shug when she sees her husband fawn over Shug and vice versa, for “that the way it spose to be. I know that, but if that so, why my heart hurt me so?” (73). In addition, the novel also shows ignorance in relation to homosexuality by making it seem that female homosexuality is not legitimate when compared to heterosexuality. This is seen in how Celie is constantly being set up for dates by her stepson and his wife, even though “They know I love Shug but they think womens love just by accident, anybody handy likely to do” (260). Therefore, although Celie did not face the same obstacles in her relationship that Brad had, she also experiences fear, confusion, and ignorance in terms of coping with and eventually accepting her sexuality.

However, just like male homosexuality in *The Perks of Being a Wallflower*, female homosexuality in *The Color Purple* is only a subplot. If it is to be included within public schools, there are many other valuable lessons that are communicated to readers in addition to the idea that female homosexuality is okay through the portrayal of Celie’s relationship with Shug. One can also learn how to overcome childhood trauma, how to stand up for oneself, and how to strengthen one’s bond with their family. Overall, though, the reader learns that no matter how hard life may be, one can still have the hope and strength to persevere until the very end, as long as they try.

Thus, the comparison of these two novels and their respective LGBTQ content shows that although they may be similar, not all homosexual relationships are the same. Although the LGBTQ community and their relationships may differ in several ways, they are nonetheless united in the fact that they are not seen as “normal” and should be “fixed” in order to fit into the ideals of modern society.

Book #3: *Beyond Magenta: Transgender Teens Speak Out*

Finally, Susan Kuklin’s *Beyond Magenta: Transgender Teens Speak Out* is a unique book compared to both *The Perks of Being a Wallflower* and *The Color Purple* in its format (pictures and interview rather than just text), relatively recent publication (2014), and the reasons behind its censorship as shown by Marshall University. The reasons behind the censorship of this particular work include anti family, political viewpoint, and religious viewpoint in addition to homosexuality (“Banned Books”). For not only do transgender people interrupt the “normal” sexual orientation of heterosexuality, but also the “normal” gender norms of identifying as either female or male.

However, as portrayed in this book, transgender people still share the same elements of fear, ignorance, and complications with their identity that both male and female homosexuals experience, but have their own respective differences as well. For instance, transgender people feel the same initial fear that both male and female homosexuals feel in “coming out” to their friends and family. This similarity is told by one interviewee in the book, Luke when he explains how “Coming out as trans is very exposing. It opens you up to a lot of mockery” (Kuklin 152). Yet in addition to this, transgender people also have to “come out” to their dating partner in hopes of not being rejected, something neither gay men or lesbians experience. On a different note, there is arguably more ignorance concerning transgender people than there is concerning homosexuals in both their relation to those outside the LGBTQ community as well as within. As explained by another interviewee Cameron: “the straight, non-trans population seems to think that trans people automatically have allies in gay people. Moreover, that gay people automatically have allies in the trans community. And they do Not, capital N” (Kuklin 118). Thus, like both *The Perks of Being a Wallflower* and *The Color Purple*, this book also shows how transgender people are both similar and different from other members of the LGBTQ community.

However, despite the fact of identifying as transgender and all that pertains to it being the main message of this book, there are still messages conveyed that are relatable to anyone, regardless of their identifying as transgender or not. The messages that can relate to any student if the book is to be included in public schools include overcoming student bullying, self-love and positive body image. Yet most importantly of all, the reader learns that life is a journey and that as long as one is learning from it and handling it the best that they can, nothing is unattainable.

Final Words

Thus, the essay concludes with the idea that although initially banned for the portrayal of their respective LGBTQ content, these three books provide significant benefits for the public education sector if included within their libraries and exposed to readers

across the United States. Although they portray content different from non-LGBTQ literature (as well as each other) in terms of their respective characters, experiences, challenges, and environments, these books and their content are not as controversial and wrong as they have been thought to be. Therefore, they should all the more be included within public schools in order to improve the United States as a whole; not only within the academic sector, but also the political, legal, and social sectors as well.

Significance

Through this research project, I have emphasized the importance of the inclusion (rather than exclusion) of LGBTQ literature within the United States' public education system. Considering the visibility of the LGBTQ community within the United States and how it rises each day outside the classroom, it is not rising within the classroom, where it should be most implemented. With the emerging prominence of acknowledgement, tolerance, and representation of LGBTQ members and allies alike within the social, economical, legal, and political sectors within the United States, the academic sector should then also follow suit. This will prove beneficial for not only those part of the LGBTQ community, but also those outside of it in terms of tolerance, empathy, and overall acceptance of being equal to one another. For no matter how different we may be in terms of sex, gender, and sexuality, we are all ultimately united in being human.

Discussion

Throughout the United States, the censorship of LGBTQ literature has been an ongoing issue within the public education system in how it is creating the exact opposite effect that those who censor the literature intended. Rather than implement a love of learning and curiosity of topics and ideas that they may not be exposed to otherwise, they are "protected" from said topics and so left ignorant and uninspired to learn. In addition, this censorship of LGBTQ literature also leaves those both in and out of the LGBTQ community at a major disadvantage. So instead of excluding these works for the protection of the readers, they should be included for the sake of the readers. By doing this, as observed by Pat Scales, one is still doing what the public education system wishes to implement, which is cultivate a love for learning and exploring by "modeling the principles of intellectual freedom" (18). Therefore, the inclusion of LGBTQ literature for the benefit of the learning community within public education becomes all the more apparent.

However, there are limitations within this study of how the censorship of LGBTQ literature is more harmful than beneficial to the learning community within public education. Particularly, these limitations lie in the members of the LGBTQ community being analyzed. For within this paper, only 3 members of the community (Lesbians, Gay

men, and Transgender people) are considered here, putting the Bisexual and Queer/Questioning members aside. In addition, this study can also be seen as taking an incorrect "all encompassing" approach to the issues of sex, gender, and sexual orientation, when each issue can be (and arguably should be) analyzed and studied separately rather than together. Nonetheless, this study still brings to mind the visibility of the LGBTQ community and how the inclusion of books depicting all of its members within public schools is more beneficial than what many authority figures may say otherwise.

Another interpretation of this project can be how the censorship of any work within a public school may work in favor of the students under select circumstances. On one hand, the censorship of any work limits the readers' ability to develop a love for learning, discourages their wanting to explore various topics and other harmful effects if it is not challenged and eventually overturned. Yet on the other hand, censorship can sometimes be a good tool to use for readers within the learning community of public schools depending on the reasoning behind the censorship. This proves to be true in the cases of hate speech or age appropriateness. In addition, censorship of literature may also work differently depending on the school system, such as private schools, boarding schools, or religious schools. However, by incorporating often banned literature within public schools, the public education system is only being used as it should: to create both a curiosity and love of learning for its students.

Conclusion

So, the censorship of literature overall is still an ongoing issue, even in modern United States society. Particularly, the censorship of LGBTQ literature proves to be one of the most recent censors as well as one of the most harmful censors, as it extends to sectors of the United States not seen in other censors, like violence or fantasy. With this paper, I explored LGBTQ themes as a recently active literary censor and how it is detrimental to the education (and society alike) of the United States to exclude LGBTQ literature. Thus, we should challenge and eventually overturn this censor by including LGBTQ literature within public schools. For the inclusion of LGBTQ literature within public schools would not only benefit the LGBTQ community, but also those outside of it, as it will only add to the overall understanding and well-being of all citizens throughout the United States, no matter how they may identify.

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Parenting stress and Child Behavior Problems: Examining Whether Marital Satisfaction Plays a Moderating Role

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Abstract

Parenting stress can have an important influence on parents' marital satisfaction, as well as child behavior problems. Parenting stress can impact marital satisfaction, which in turn may serve as a moderator for other family variables. The present study examines whether marital satisfaction moderates the relation between parenting stress and child behavior problems. It was hypothesized that parents experiencing high levels of stress and also lower marital satisfaction would report higher child behavior problems in comparison to parents who experience higher marital satisfaction. Fifty-three families were recruited from Stanislaus County, California. Data were collected as part of a larger study on family interactions in families of preschoolers with and without developmental delay. Parents of children aged 3-5 years completed 3 questionnaires: the Child Behavior Checklist Ages 1.5-5, the Quality of Marriage Index, and the Parenting Daily Hassles Scale.

Keywords: marital satisfaction, child behavioural problems, parenting stress

Introduction

Studies show that having a supportive social network can reduce parental stress, and in the case of a married couple, having a reliable or happy marital relationship can reduce parental stress. (Hostetler 2011). A study in 2015 found that marital satisfaction was significantly related to both parenting stress and child behavioral problems; parents who reported lower marital satisfaction had higher parenting stress and reported more child behavior problems (Robinson & Neece 2015). Child behavioral problems have been associated with affecting school performance and children repeating grades (Kim, Mazza, Zwanziger & Henry 2014). A study by State and Kern (2017) also found that teenagers who had less behavioral problems in high school had reported higher life satisfaction. It was also found that parental stress had also been linked to child abuse in a study conducted by Crum and Moreland (2017).

Methods

Participants

53 Families residing in Stanislaus County, California were recruited, with children ranging between the ages of 3 and 5 years.

Procedure

Data have been collected as part of a larger study on family interactions in families of preschoolers with

and without developmental risk. The larger study has recruited children with developmental risk, as well as typically developing children. All children were administered intelligence tests as a part of the larger study, using the Wechsler Preschool and Primary Scales of Intelligence, 4th Edition (WPPSI-IV).

After recruitment, families were contacted by the laboratory coordinator to schedule each visit to the university. The research assistant or principal investigator obtained an informed consent form from the parents, then gave each parents a packet of questionnaires to complete. Each parent was instructed to complete questionnaires separately and to avoid discussing their responses. Parents were encouraged to return their questionnaires at their following visit. After the parent signed the consent form, informal assent was obtained from the child, then testing with the WPPSI-IV commenced. Testing with the WPPSI-IV was performed either by the principal investigator (a licensed clinical psychologist), or by trained research assistants (masters-level graduate students in either behavior analysis or counseling, trained and supervised by the principal investigator). Parents completed a packet of several questionnaires, of which 3 were used in the current study. When parents returned with their completed questionnaires at the second family visit, questionnaires were checked for completion by trained research assistants. Any incomplete items, or items for which the response was unclear, were addressed immediately with the parent. If items were left incomplete after the visit, the principal investigator

made attempts to collect any remaining questionnaire data by phone. Questionnaire data will be scored and entered by trained and supervised research assistants, with regular checks for reliability and accuracy.

Families received 3 forms of incentives to encourage participation in the study. Families received gift cards for participation in each phase of the study: \$40 for participation in the initial intellectual assessment, \$20 for completion of parent questionnaires, and \$40 for participation in the family visit. In addition to monetary incentives, a brief written summary of the child's intellectual functioning (written by supervised and trained research assistants) was provided, and focal children and their siblings were allowed to pick from a "prize bin" of small toys or stickers (each with a value of less than \$1) each time they visited the university.

Measures

The current study used 3 parent-completed questionnaires from the larger packet of questionnaires parents complete for the study.

Child Behavior Checklist

Child Behavior Checklist (CBCL; Achenbach & Rescorla 2001) Ages 1.5-5 is a standardized form used for parents to measure the behavioral and emotional problems of their children aged 1.5 to 5 years old. The CBCL contains ratings of 99 forced-choice items and one open-ended item, which requests that the parent to add any additional problems not already listed. The items ask parents to rate frequency of various behavior problems as observed in their children, including emotionally reactivity, anxiety/depression, somatic complaints, withdrawal, attention problems, aggressive behavior, and sleep problems. The form also includes three open-ended questions for parents to describe physical and mental disabilities, and possible concerns about the child (Achenbach & Rescorla 2001). For each of the 99 scale questions, parents are able to respond 0 (Not True), 1 (Somewhat or Sometimes True) or 2 (Very True or Often True). High scores on the CBCL indicate greater emotional and behavioral problems.

A study conducted by Dutra and Campbell (2004) tested the reliability and validity of the CBCL by having over 200 psychologists and psychiatrists test it, and found it to be have both adequate internal reliability, as well as good convergent and discriminant validity.

Quality of Marriage Index

The Quality of Marriage Index (QMI) is a six-item, unidimensional index of marital quality (Norton 1983). Respondents answer the first five items on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The sixth item is answered on a 10 point scale ranging from 1 (extremely low) to 10 (extremely high). Higher scores on the QMI reflect a

happy and content marriage, whereas low scores reflect an unhappy marriage. QMI has strong evidence for reliability, allowing clinicians to efficiently monitor couples' relationship status' and progress over time (Woods 2013), and has been named as an accurate global assessment of marital satisfaction (Bradbury, Fincham & Beach 2000). The QMI's validity was supported as it correlated with the Kansas Marital Satisfaction Scale (Schumm, Paff-Bergen, Hatch, Obiorah, Copeland, Meens & Bugaighis 1986).

Parenting Daily Hassles Questionnaire

The Parental Daily Hassles Questionnaire (PDH; Crnic & Greenberg 1990) is a 20-item measure of typical everyday events in parenting and parent-child interactions. For each question, a parent rates the frequency of occurrence of daily hassles on a 4-point scale ranging from 1 (rarely), to 4 (constantly). The parent also rates the intensity of the hassle on a 5-point scale from 1 (no hassle) to 5 (big hassle).

The PDH's reliability has been affirmed as it has been used in various other studies to test for parental stress. In one particular study conducted by Lutz et al. (2012), they chose the PDH specifically because the intensity and frequency of the PDH are highly correlated with one another ($r = .78$). Regarding validity, Crnic and Greenberg (1990) have demonstrated evidence for strong discriminant validity of the hassles measure.

Analysis

Data was analyzed for relevant covariates, which were included in all analyses (yearly family income, parental total years of education, and child race). Child level of developmental risk (typically developing or developmentally at-risk) was included as a covariate, with children in "at-risk" category having either an IQ below 85, or parent-reported diagnosis of a developmental disability. Mothers and fathers' results were run separately, then compared using qualitative comparisons. To test if marital satisfaction moderated the relation between parenting stress and child behavioral problems, a moderation analysis was conducted using a multiple linear regression. The independent variables of the regression are parental stress (as measured by the PDH) and marital satisfaction (as measured by the QMI), as well as a calculated variable representing the interaction between these two predictors, which is created by multiplying the independent variable and moderator together after each variable has been centered to have a mean of 0. The dependent variable of the regression is child behavior problems (as measured by the CBCL). If the interaction was significant, moderation is supported. If found, the direction of the interaction will be interpreted from

plotting the interaction and from an analysis of the simple slopes.

Results

Results did not support the hypothesis that marital satisfaction acts as a moderator for the relationship between parenting stress and child behavioral problems. However, other interesting results were found from both mothers' and fathers' data.

Mothers

Results indicated that maternal parenting predicted child internalizing behaviors (i.e., clinginess, withdrawal, and sadness) with a trend of significance in predicting child externalizing behavior problems (i.e., physical aggression) as well as child total problem behaviors (i.e., anxiety, being prone to nightmares, and refusing to eat). Mothers with higher stress also reported having children with more behavior problems.

Maternal data also revealed a statistically significant relationship between developmental group and internalizing child behavioral problems, along with a trend toward significance for developmental group predicting externalizing behaviors. Overall, children in the developmental risk group showed higher behavior problems.

Fathers

Father parenting stress showed a trend toward significance in predicting child internalizing and externalizing behaviors. It was also shown that higher parenting stress was associated with higher behavior problems. Fathers of children of color reported their children as having more internalizing child behavioral problems in comparison to fathers of white children.

Developmental group significantly predicted fathers' ratings of internalizing, externalizing, and total child behavioral problems. Children in the developmental risk group showed higher behavior problems.

Discussion

Results from the present study did not support the hypothesis that marital satisfaction acts as a moderator for the relationship between parenting stress and child behavioral problems. One possibility on why we did not find moderation is that parenting stress and child behavioral problems might have been the incorrect variables to look at. Marital satisfaction could still be a moderator, but for other variables such as perceived family social support and child behavioral problems. High marital satisfaction could be an influencer to perceived family social support and as a result could affect child behavioral problems. And although moderation was not found, maternal findings are

consistent with past research showing that mothers' stress and marital satisfaction predicts child behavioral problems (Marchland, 1998; Query, 2001).

Despite the paternal results not showing a relationship between the main variables of interest, child race was associated with fathers' ratings of child internalizing problems. These results are somewhat consistent with past research showing that children of color have more externalizing behavioral problems than Caucasian children ("Children of color," 1998; Hoffman, 2018). Because this research is observational and not experimental, the relationship between child race and child behavioral problems is based solely on parents' perception; this research does not imply that a child's race is a cause for more behavioral problems. Our findings also support past research in that there is a relationship between developmental group and child behavioral problems (Neece, 2014).

Suggestions for Future work

The paternal results might be giving an accurate picture of how fathers perceive their families, but future studies should also consider observational data collection to enrich our understanding of how both mothers and fathers perceive their children's behavior. Those wishing to conduct similar studies such as this should consider parenting stress and marital satisfaction as targets of intervention for families who have children experiencing behavioral problems and also continue to research marital satisfaction as a moderator for other variables.

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Computational Study of the Oxidation of Volatile Organic Compounds by the OH Radical: An Exploration into the Molecular Realm

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Abstract

Volatile organic compounds (VOCs) present in the atmosphere are regulated by chemical processes and agents called ‘sinks’. These processes are poorly understood and most modeling of atmospheric reactions congregate and often ignore different individual reactions. These studies often ignore the behavior at the molecular level. This study attempts to understand the intermolecular and electrostatic interactions between the hydroxyl radical, the most important sink, and five VOCs. The study was performed *in silico* using Spartan '16, a computational chemistry software. Møller-Plesset and density functional models were used along two different basis sets, 6-311+G** and 6-31+G*, to generate the transition state geometry and thus the vibrational frequency of the transition state. These methods were used to generate a potential energy surface with the approaching distance and hydroxyl radical rotation as the parameters. The results suggest that as reaction reaches its transition state, electrostatic and intermolecular interactions become important in shaping the reaction's path. This behavior was rationalized by the interactions between the singly occupied molecular orbitals (SOMOs) of the hydroxyl radical and the highest occupied molecular orbitals (HOMOs) of the VOCs. This demonstrates that the often-ignored electrostatic interactions between neutral species influence reaction paths and therefore kinetics. This new understanding provides useful information for modeling of atmospheric chemical processes.

Keywords: VOCs, OH radical, atmospheric reactions

Introduction

The Earth's atmosphere is a complex mixture of different substances like nitrogen, oxygen, argon, and other trace gases. Some of these trace gases make about 1.92 % of dry air and are known as volatile organic compounds (VOCs).¹ A VOC is a carbon-based compound that is present in the atmosphere in its gaseous form. These VOCs consist of carbonyls, alcohols, alkanes, esters, aromatics, ethers, amides, etc. Some examples of these compounds are methane, acetone, chloroform, among others. Some of these compounds are shown in Figure 1.

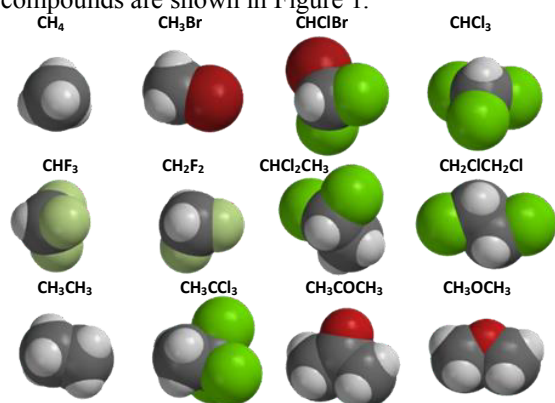


Figure 1. Common VOCs found in the atmosphere. Color legend: white H, dark red Br, gray C, green Cl, red O, light green F).

These organic gases have varied sources but being mainly produced by fossil fuel usage, biomass burning, terrestrial plants, oceans, anthropogenic and biogenic emissions.² These organic compounds have been found to be harmful to humans and the environment.³ In fact, these pollutants are not only found outdoors, but they are common indoors.⁴ However, the existence of these VOCs are regulated by chemical processes in the atmosphere. The agents and processes that reduce the concentration of these gases are called “sinks”.² The most important sink is the hydroxyl radical, $\cdot\text{OH}$.⁵ Other sinks such as ozone (O_3), the nitrate radical, $\cdot\text{NO}_3$, halogen radicals, photolytic fragmentation, and simple deposition also contribute to the reduction of VOCs levels.^{2,6} These sinks are shown in Figure 2.

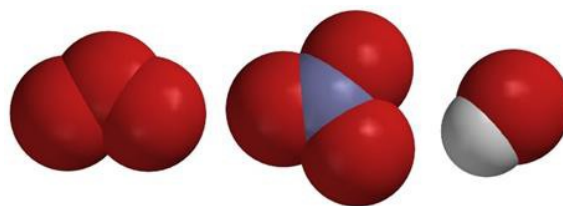
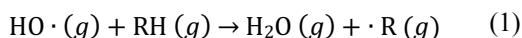


Figure 2. Common atmospheric sinks. From the left, ozone, nitrate radical, and hydroxyl radical. (Color legend: blue N, red O, white H).

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The hydroxyl radical is mainly generated by the photolysis of ozone by UV light in the presence of water vapor.⁷ This radical is the main initiator of the radical oxidation of VOCs in the atmosphere, turning them into different compounds that will either keep reacting and decomposing or will form final products like carbon dioxide and water.⁶ In VOCs, this radical oxidation is started by the hydroxyl radical in a process called hydrogen abstraction.² In this process, represented by equation 1, the radical approaches the VOC and a bond between the oxygen atom and the hydrogen from the VOC forms. The products of this process are water and a radical VOC.



Nevertheless, the chemistry of this or many other sinks is neither simple nor understood with the level of detail necessary to solve the problems caused by VOCs. In fact, the reactions that will occur depend significantly on the VOC reagent. In many cases, the intermediate species have physical and chemical properties that will affect adversely the removal process of the starting organic species.⁵ For example, the oxidation of VOCs with NO_x can produce O_3 , which is toxic to humans.² The multitude of factors such as concentration, temperature, location, climate change, among others increase the difficulty when attempting to understand atmospheric chemistry. Climate change is becoming an increasing concern for researchers trying to study the atmospheric chemistry because as the symptoms of climate change begin to change the behavior of the atmosphere, this will have a large effect on the regulatory processes of VOCs.²

The importance of the hydroxyl radical and the aspects that affect the way it is regulated in the atmosphere make it a suitable target for study. In this study, hydrogen abstraction reactions between the hydroxyl radical and five VOCs are investigated. The purpose of this project is to explore the molecular behavior of these reactions. This behavior refers to the interactions between neutral species and the effects their mechanisms will have on kinetics. This work will consist of the study of structure, thermodynamics, and possible application to kinetics. The study will bring insight into the often-ignored molecular interactions in the microscopic world and their possible effects in the macroscopic level.

Background and literature review

Research on the kinetics of the hydrogen abstraction reactions by the hydroxyl radical is varied but is mainly focused on the experimental determination of reaction rates and the modeling of the reaction rates of these species in the atmosphere. However, the study

of these processes through computational methods is less common. The few studies that have in silico methods involve gas phase calculations used to determine the reaction rates for common reactions between the sink and a varied range of VOCs.

A good example of such research comes from the study by Petit et al., where computational calculations were performed on a list of different organic compounds to determine the rate coefficients for the hydrogen abstraction reactions.⁶ However, Petit's study focuses on the kinetics and computational methods to determine the rates exclusively and does not inquire in any other direction to further explain the results.

A possible direction in which to investigate is the more in-depth chemistry of the sinks, not only their respective reactions with VOCs but also their origins. Monks discussed the typical reaction rates for common sinks (among them the hydroxyl radical), the origin of these sinks, interactions with other sinks, and the factors that affect the presence of these sinks.⁷ However, this work is short and broad and it does not address some of the problems that were discussed earlier, such as intermediate chemistry and the new factors that affect kinetics such as climate change.

Climate change is becoming a concerning factor, especially with the conclusions from the Intergovernmental Panel on Climate Change, IPCC, in which it was declared that the last three decades to be the warmest in the last 800 years and possibly 1400 years.⁸ Therefore, the climate change factor must be an important aspect to be considered in the new research, since the atmosphere is a dynamic system and models are often static.

Another example of the research done in the hydroxyl radical chemistry is the work by Wang et al. In their work, computational methods were used to understand a significant source of the hydroxyl radical. They focused their work around the formation of the hydroxyl radical from the $\text{O}_3\text{-H}_2\text{O}$ complex.⁹ The aspect to notice from this work is the use of visualization that allows the reader to understand the meaning of the numeric information using 3D molecular modeling.

Although the sample studies hereby presented are strong in their own specific areas, they do not consider all the aspects that provide a more profound understanding of the problem of modeling the molecular behavior of atmospheric reactions. In fact, most studies ignore the molecular factors when they model atmospheric processes. Some cluster all the important aspects of a system and ignore the complexities in order to simplify the problem.² To truly obtain a complete understanding of the problem produced by VOCs and their effects in our health and environment, one must look farther. One must investigate the molecular realm. In this new world, hints are hiding everywhere. Therefore, the purpose of this study is to explore this

microscopic universe in order to understand the system in place.

This project will focus on studying five systems consisting of hydrogen abstraction by the hydroxyl radical from five VOCs, mainly organic compounds with halogens such as fluorine, chlorine, and bromine. The method is based on those used by Tzima, Chandra, Korchowiec, and Jursic, that computationally studied the hydrogen abstraction by the OH radical of different VOCs in the atmosphere.¹⁰⁻¹³ In this project, transition state geometry optimizations were used to determine the structure of the transition state. The transition state structure was used to generate potential energy surfaces that provided insights into the interactions at the transition state. Behaviors observed in the potential energy surfaces were rationalized using electrostatics and frontier molecular orbital theory.

This study has the purpose of revealing the interactions between the target species that are ignored by the fact the species are neutral. Furthermore, this project has the purpose of revealing the origins of molecular behavior as observed in potential energy surfaces.

Computational methodology

This project was carried *in silico* using the software Spartan '16.¹⁴ This software was used to carry out the geometry optimizations, transition state geometry optimizations, hydrogen abstractions simulations, among other calculations.

The first part of the experiment consisted of the collection of structural and energetic data for the unreacted VOCs. The geometry optimizations were carried using the following models: MP2/6-31G* and 6-311+G**, B3LYP/6-31G* and 6-311+G**, and EDF2/6-31G* and 6-311+G**. MP2 stands for second-order Møller-Plesset model, which provides great values in geometry calculations.¹⁵ B3LYP, which stands for Becke, 3-parameter, Lee-Yang-Parr, is a "hybrid" of density functional models and provides similar structural results to those of MP2.¹⁵ Finally, EDF2 stands for 'Empirical Density Functional 2', which is another density functional model that has a similar performance to MP2 and B3LYP.^{15,16} These models were chosen because of their performance in producing accurate structural values in geometry optimizations compared to other models. 6-31G* and 6-311+G** represent the basis sets of each model, these are functions that represent the overall state of a system.¹⁵

Data obtained from the geometry optimization consisted of infrared spectra, molecular orbitals, and their corresponding energies, thermodynamic values, vibrational frequencies, charges, bond orders, electrostatic potential maps, and images of the molecules and their highest occupied molecular orbitals

(HOMOs) and lowest unoccupied molecular orbitals (LUMOs).

The second part of the study consisted of constructing and calculating the transition states for the five hydrogen abstraction reactions. This was done by running transition state geometry calculations on all the guessed transition state complexes. The vibrational imaginary frequency was chosen for each transition state to represent the approaching radical to the hydrogen that will be abstracted. Using this vibrational mode for the transition state, a 2D potential energy surface was generated by selecting the 360° rotation of the hydroxyl radical with respect to the C-H (abstracted hydrogen) bond. Using the same vibrational mode, a similar 2D potential energy surface was generated for the distance between the oxygen in the radical and the hydrogen in the VOC.

The last of these experiments consisted of studying the LUMOs and HOMOs of each VOC and the sink to understand the structure of the transition state and provide further information about the sink-VOC interactions. In this part of the experiment, the degree of overlap between lobes of equal phase was taken as a source to rationalize the behavior observed in the potential energy surfaces.

Results and Discussion

Methane

Methane, CH₄, is a common VOC and the first target of this study. Its structure is shown in Figure 3. Methane has little to none electrostatic interactions with any other molecules. This is more clearly shown in its electrostatic potential map (EPM) in Figure 3. In blue are the areas of low electron density, that is the least negatively charged areas, and in red are shown areas with high electron density, which are the most negatively charged areas.

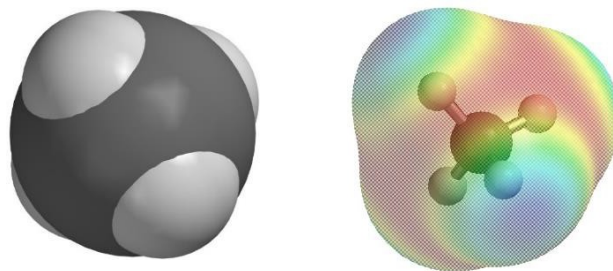
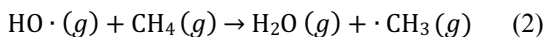


Figure 1. Space filling of CH₄ and EPM of methane. Model: B3LYP 6-311+G**.

The reaction of methane with the hydroxyl radical is shown below in equation 2.



To physically represent this reaction, the transition state was built by placing the OH radical at roughly 100° angle from the hydrogen that will be abstracted. The transition state for this reaction is shown in Figure 4. This image represents the transition state with a combination of electron density and EPM surfaces (mesh and color, respectively). Structural information about the transition state models for methane is summarized in Table 1. The different models show some structural similarities, but with some differences due to the model itself. This structural data showed great agreement with literature data with only a few deviations.^{12,13} However, the largest difference comes from the imaginary frequencies that represent the transition state.

Unfortunately, a single image of the transition state does not represent the full behavior of the reaction. For a better representation, is necessary to depict the energy of the system as a function of the approaching distance

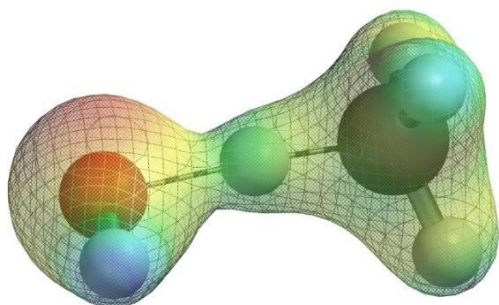


Figure 2. $\text{CH}_4\text{-OH}$ transition state represented by an EPM surface and an electron density gray mesh. Model: B3LYP 6-311+G**.

between the radical and methane and the energy of the system. This plot is shown in Figure 5 and is accompanied by snapshots of the reaction complex. This image shows the beginning of the hydrogen abstraction as the hydroxyl radical approaches hydrogen in methane. In the transition state, the electron density is observed in between the radical and methane. Finally, at the lowest point, water is formed along with the methyl radical.

To further understand this reaction, it is necessary to bring the 3D potential energy surface. However, to understand its meaning it is necessary to view the behavior of the reaction complex. The 3D potential

energy surface for the hydrogen abstraction of methane is shown in Figure 6. The axis perpendicular to the energy of the system corresponds to the distance between the oxygen atom in the hydroxyl radical and the hydrogen that will be abstracted from methane. The second axis that is perpendicular to the energy corresponds to the rotation of the hydroxyl radical with respect to the C-H bond. The meaning of a potential energy surface is that it reveals the paths that a reaction can follow. This is done by following the valleys of lowest energy as one move from the reagents towards the products passing through the transition state.

The 3D potential energy surface represents the hydrogen abstraction of methane by the hydroxyl radical. To understand the plot, one starts at the region indicated by the blue arrow, this corresponds to the state where the reagents exist. The next important region is that indicated by the orange arrow, this is the transition state. Finally, the black arrow indicates the region where the products exist.

Given the information above, it is possible to discuss the most important aspects of this plot. The first aspect to notice in the small hump that characterizes the transition state. This hump only occurs in the angle of OH rotation between 100-200°. This means that as the OH radical rotates with respect to methane, at 100-200°, unfavorable electrostatic interactions between the radical and methane increase. Although the difference in energy is of a few kJ mol^{-1} , it is still significant. This small hump is also observed in the product region. This confirms that as the OH passes through that angle, unfavorable interactions increase. A possible rationale for this effect is that as the OH rotates, charges in the radical and/or methane interact unfavorably to increase the energy. To prove this rationale is necessary to monitor charges, distances, and the energy of the system as the OH rotates.

To rationalize the behavior observed in Figure 7, the system between the hydrogen atom in the radical and carbon is chosen. The reason for this choice is that as seen in Figure 5, the abstracted H has the highest positive electrostatic charge and C the most negative. Therefore, the interactions between two opposite-charged atoms will decrease the energy as they approach each other and vice versa. In Figure 7, as the

Model	O-H _{abs} /Å	C-H _{abs} /Å	∠CHO	Imaginary Frequency / cm^{-1}
B3LYP 6-311+G**	1.339	1.203	173.5°	-870
EDF2 6-311+G**	1.371	1.190	172.2°	-416
MP2 6-311+G**	1.337	1.176	170.8°	-1793

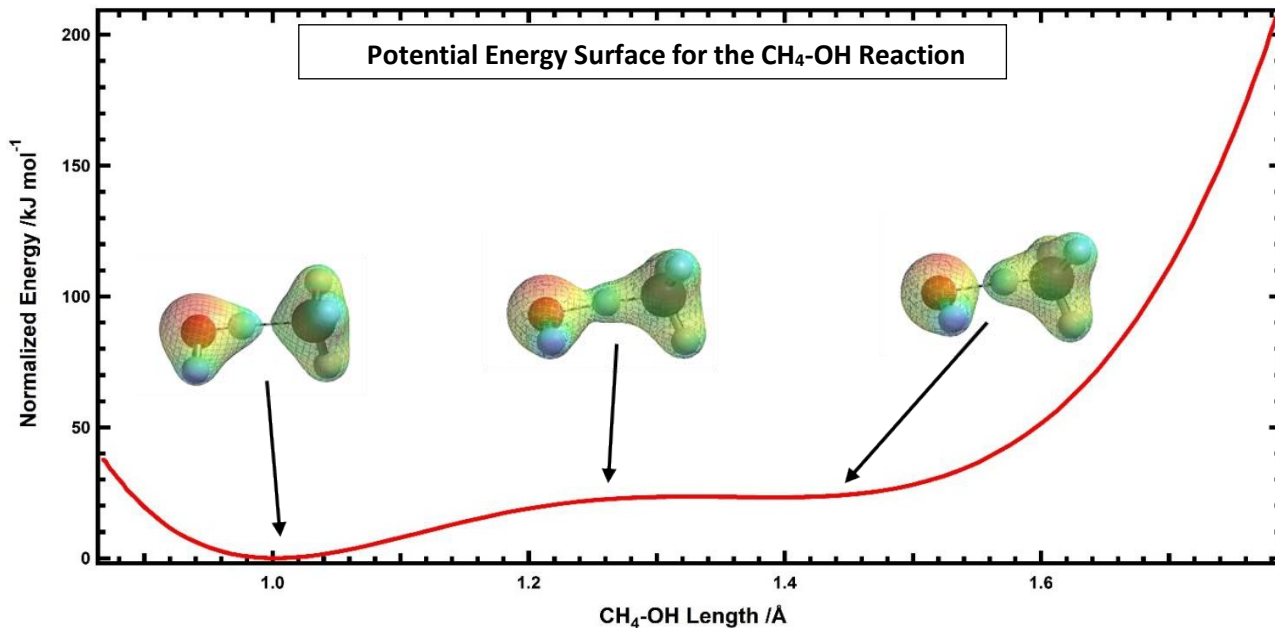


Figure 3. 2D potential energy surface for the reaction between methane and the hydroxyl radical. This plot has snapshots of the reaction that shows the formation and breaking of bonds. Model: EDF2 6-311+G**.

radical passes through the 100-200° angle, the distance between H and C increase rapidly. Therefore, as expected the energy will increase since C and H cannot interact favorably to decrease the energy of the system. The interactions between the inversely charged regions in the complex provides evidence on how electrostatic interactions, even in neutral species, affect the path of a reaction. However, to further understand the reaction pathway, it is necessary to introduce the interactions between molecular orbitals.

Frontier molecular orbital theory refers to the model that explain chemical behavior based on the interactions between molecular orbitals (MOs) in different molecules. Frontier MOs interact based on their geometry and their energy. The energy gap between them must be relatively small for bonding interactions to take place. Geometry is important to allow an adequate overlap between the lobes of a molecular orbital. When a good overlap occurs between

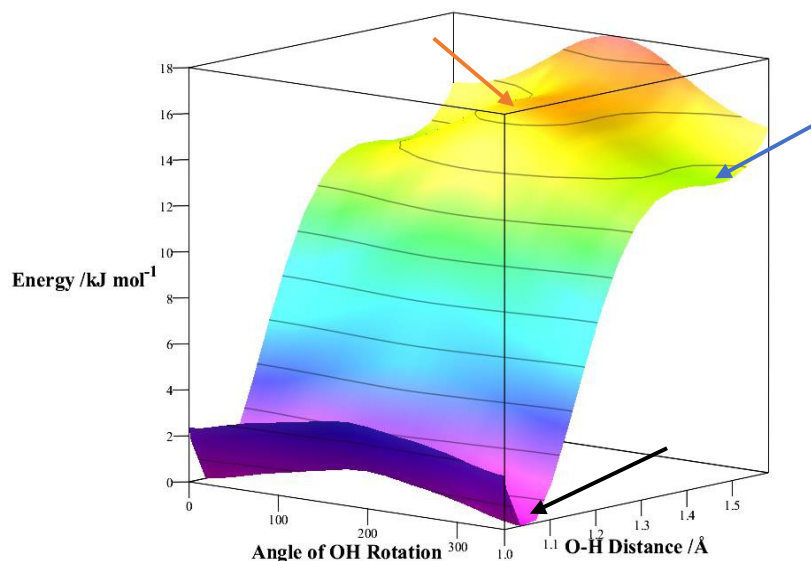


Figure 4. 3D potential energy surface for the hydrogen abstraction of methane. Model: EDF2 6-311+G**.

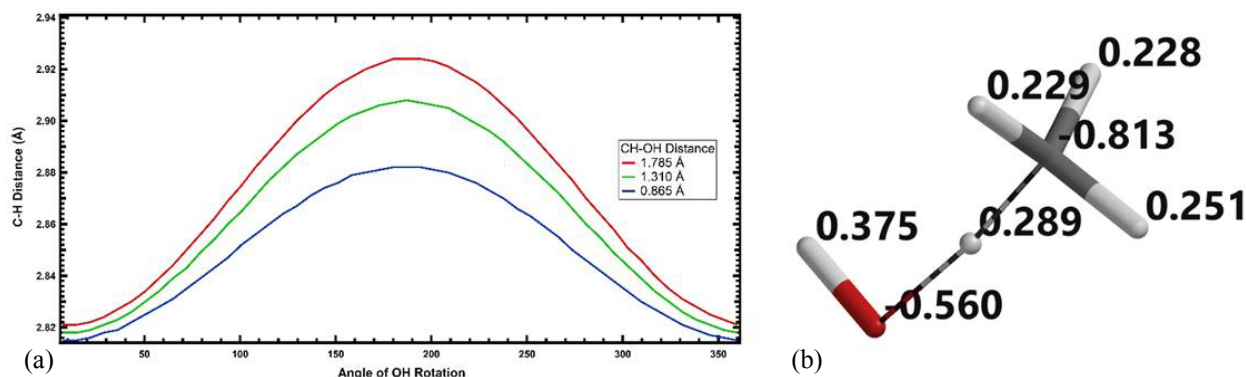


Figure 5. (a) As the OH radical rotates through 100-200°, the distance between the hydrogen in the radical and carbon in the VOC increases. (b) Carbon has the most negative atoms in the CH₄-OH complex and hydrogen is the most positive.

two lobes of the same phase (same color in diagrams) the energy of the system will decrease. However, when two lobes of different phases overlap or two lobes with the same phase do not overlap well the energy of the system increases.

In the CH₄-OH system, two MOs play an important role in shaping the transition state geometry and the path of the reaction. The electron of methane that will be part of the new O-H bond is in the HOMO. The electron of the OH radical that reacts with methane is located at the Singly Occupied Molecular Orbital, SOMO. A diagram

showing these MOs, their energies, and their interactions are shown in Figure 8.

The two SOMOs of OH with different energies correspond to the MOs with different electron spin. For methane, there are three degenerate HOMOs with different structures. The red lobe of the SOMO is not symmetrical under rotation with respect to the C-H bond. Additionally, only the red lobe of HOMO 2 is symmetrical under the rotation mentioned before. Therefore, when the OH radical approaches methane, the SOMO and HOMO will interact as shown in Figure

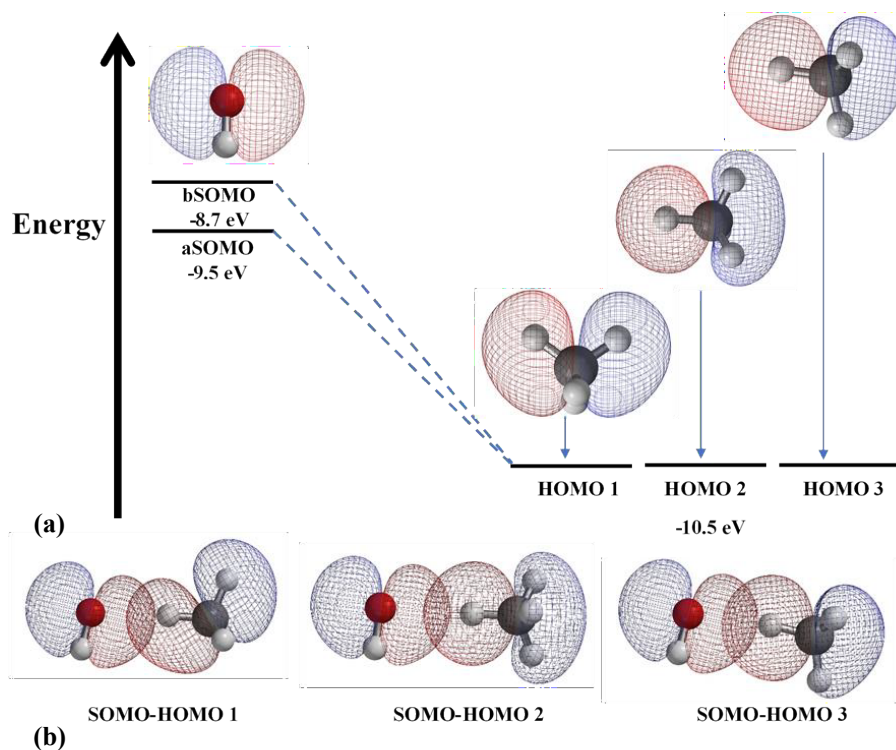


Figure 6. (a) Energy diagram representing the energy interactions between the SOMOs of the OH radical and the HOMOs of methane. The different shapes of the HOMOs of methane produce different degrees of overlap. (b) Interactions between the different HOMOs and SOMO.

8 (b). Figure 8 (b) shows the different degrees of overlap between the HOMOs and the SOMO. The rotation of OH produces fluctuations in the overlapping between the SOMO and the HOMO. These fluctuations in the overlapping will produce situations in which both MOs will constructively interfere well and thus reduce the energy of the system. Since the MOs are asymmetrical, there are angles in which the overlapping is reduced and thus increases the energy of the system. Therefore, the origin of the energy hump observed in the potential energy surface is caused by the change in the level of overlap of the MOs as the hydroxyl radical rotates with respect to methane.

Methyl bromide

Methyl bromide is the second molecule of interest in this project. Its structure is shown in Figure 9. In contrast to methane, methyl bromide is a polar molecule, as it is seen in its EPM in Figure 9, thus it is expected to have stronger molecular interaction produced by dipole-dipole interactions. Like methane, upon abstraction methyl bromide becomes a radical and the hydroxyl radical becomes water.

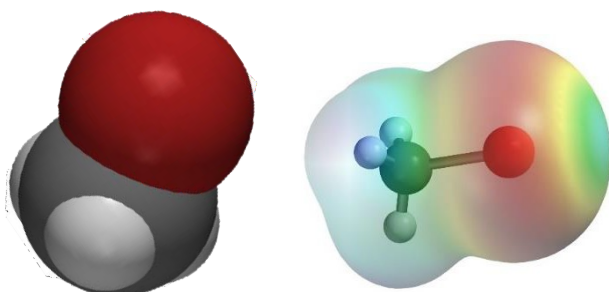


Figure 9. Space filling of CH_3Br and EPM of methyl bromide. Model: B3LYP 6-311+G**.

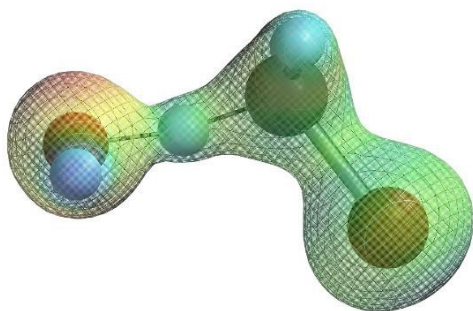


Figure 10. $\text{CH}_3\text{Br-OH}$ transition state represented by an EPM surface and an electron density gray mesh. Model: B3LYP 6-31G*.

The transition state of this reaction is shown in Figure 10. The transition state structure of methyl bromide has similar structural characteristics to those of the transition state of methane. Details on the transition

state are summarized in Table 2. The main difference is the CHO angle. Like methane, the values obtained between different models differ by small fractions, except for the imaginary frequency that is drastically different as it was observed in methane. These structural values agree well with literature values.¹⁰

Given the structural changes of the methyl bromide system compared to that of methane, it is expected that the 3D potential energy surface is quite different from that of methane. The potential energy surface is presented in Figure 12. In this potential energy surface, the most particular aspect is the presence of two humps rather than one as in the case of methane. The two humps are produced by electrostatic interactions between different atoms in the reaction complex. These interactions are observed in Figure 11. The first plot shows that as positively charged atoms (solid lines) decrease their distance from the hydrogen in the radical (positively charged) the energy will increase. This effect occurs in the angles 100-250°, the approximate regions where the humps are observed in the potential energy surface. The second plot indicates that positively charged atoms reach their lowest charge between 140-260° and the negatively charged atoms reach their least negative charge. Therefore, an increase in energy is expected to occur in these angles because the charges are not interacting favorably. For those reasons, two humps with a region of high energy between them is observed in the transition state.

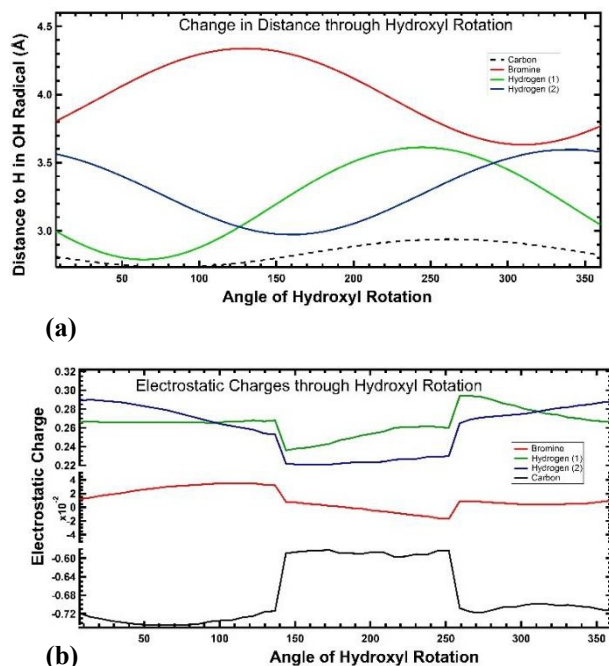


Figure 11. (a) Describes the distances between the H in the OH radical and different atoms as the radical rotates. (b) Describes changes in electrostatic charges as the OH radical rotates.

Table 2. Structural Analysis of CH ₃ Br-OH Transition State.				
Model	O-H _{abs} /Å	C-H _{abs} /Å	∠CHO	Imaginary Frequency /cm ⁻¹ ₁
B3LYP 6-31G*	1.296	1.225	165.7°	-1268
EDF2 6-31G*	1.335	1.198	161.8°	-801
MP2 6-31G*	1.280	1.209	170.0°	-2482

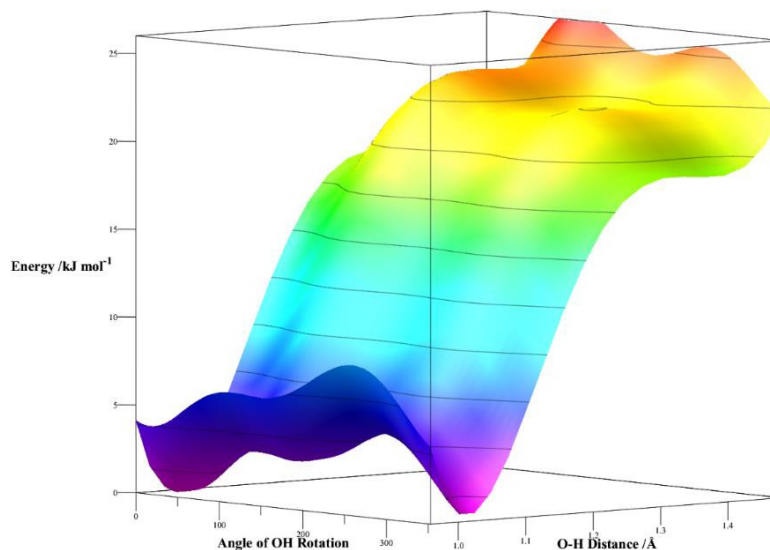


Figure 12. 3D potential energy surface for the hydrogen abstraction of methyl bromide. Model: EDF2 6-31G*.

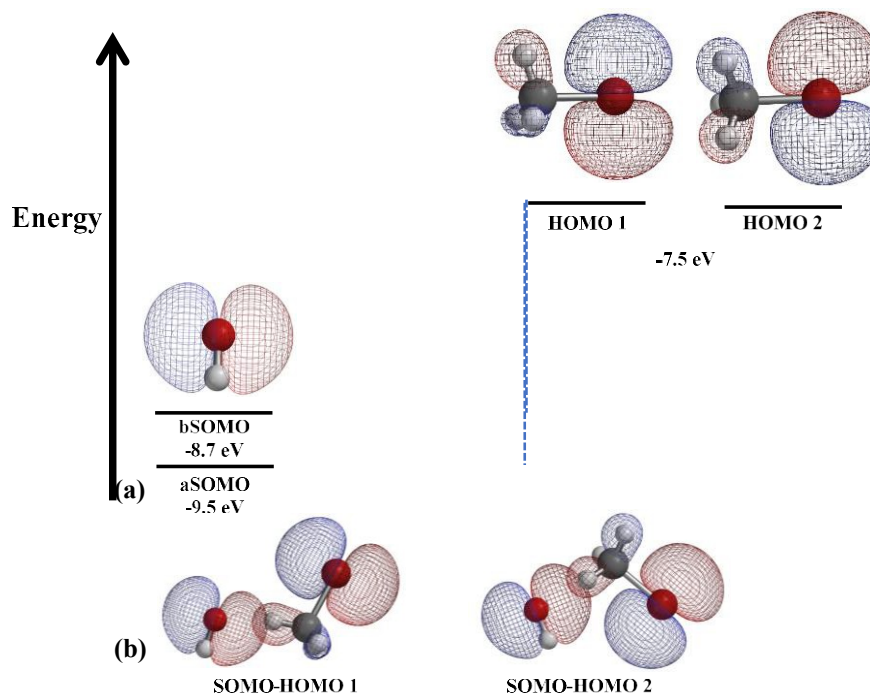


Figure 13. (a) Energy diagram representing the energy interactions between the SOMOs of the OH radical and the HOMOs of methyl bromide. The different shapes of the HOMOs of methyl bromide produce different degrees of overlap. (b) Interactions between the different HOMOs and SOMO.

A similar effect is observed in the regions where the products exist. However, this area is not of interest to this project. Nonetheless, the shape of the potential energy surface for the products and reagents have the same origins.

Having observed the molecular behavior of the potential energy surface, it is time to rationalize it using frontier molecular orbital theory. A diagram like Figure 8 is shown in Figure 13. The MOs diagram shows a different energy behavior to the MO diagram of methane. In the case of methyl bromide, the energy of the HOMOs is higher than those of the SOMOs. Nevertheless, the energy gap between the two different MOs is small which is necessary for the MOs to interact.

The most important aspect of the MOs diagram is the shape of the lobes in the different MOs. In contrast to methane, the lobes for bromine are larger than those of the hydrogen atoms. This represents a source for new interactions between the OH radical and methyl bromide. As the radical approaches, the distance decreases between the lobes of different phase that surround bromine. Since the two lobes have different phases, there will be antibonding interactions caused by destructive interference. These interactions are unfavorable because as the wavefunctions destroy a node (a region with a 0% probability of finding an electron) is created, this reduces the volume of where the electrons can move thus increasing the energy of the system. Furthermore, these types of unfavorable interactions will occur between the other hydrogens (not abstracted) since the phase of their lobe is the opposite to that of the hydrogen that will be abstracted. Therefore, as the OH radical rotates it will encounter two lobes with opposite phases. The level of interaction is different between the two lobes (non-abstracted hydrogen and bromine) because of the relative size of the lobes. Therefore, the increase in energy due to these interactions will be different. The unequal interaction between the lobes of the MOs explains the presence of two unequally-sized humps in the transition state found in the potential energy surface.

Fluoroform

Fluoroform, CHF_3 , has the most halogen atoms compared to the previous two cases. Its structure is shown in Figure 14. Since fluorine is the most electronegative atom, it is expected that the hydrogen atom is highly electron deficient. This is confirmed based on the electrostatic potential map shown in Figure 14. Therefore, stronger interactions with other molecules are expected during a reaction.

The hydrogen abstraction of fluoroform by the hydroxyl radical occurs through the same process as the two previous molecules, thus there is not a drastic difference between the three transition state structures. The transition state structure is shown in Figure 15 along with its structural data in Table 3. These values agree well with literature.¹² The structural measurements of the transition state of fluoroform do not differ from the structures previously observed. Nevertheless, in order to understand the reaction better, the potential energy surface is required. The potential energy surface is shown in Figure 16.

The potential energy surface of fluoroform shows an identical behavior to that of methane. It will make sense given that, like methane, fluoroform has three identical atoms with which the hydroxyl radical may interact. Nonetheless, it has been observed that the major cause of the shape of the transition state energy profile is the MO interaction. In order to understand the

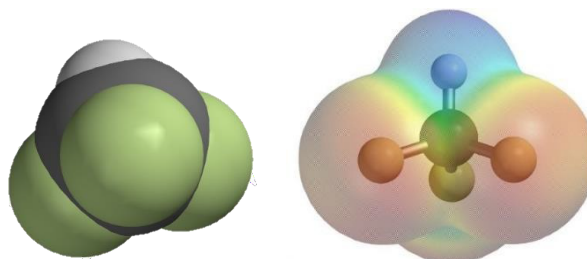


Figure 14. Space filling of CHF_3 and EPM of difluoromethane. Model: B3LYP 6-31G*.

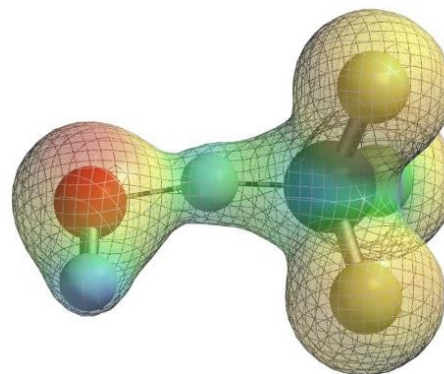


Figure 15. CHF_3 -OH transition state represented by an EPM surface and an electron density gray mesh. Model: B3LYP 6-31G*.

Table 3. Structural Analysis of CHF_3 -OH Transition State.

Model	O-H _{abs} / Å	C-H _{abs} / Å	∠CHO	Imaginary Frequency / cm ⁻¹
B3LYP 6-31G*	1.252	1.249	167.7°	-1455
EDF2 6-31G*	1.283	1.220	166.9°	-1061
MP2 6-31G*	1.244	1.229	162.3°	-2750

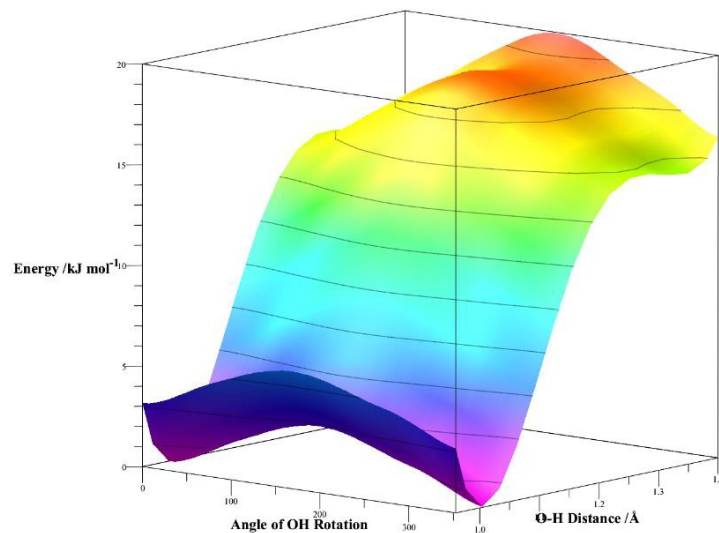


Figure 16. 3D potential energy surface for the hydrogen abstraction of fluoroform. Model: EDF2 6-31G*.

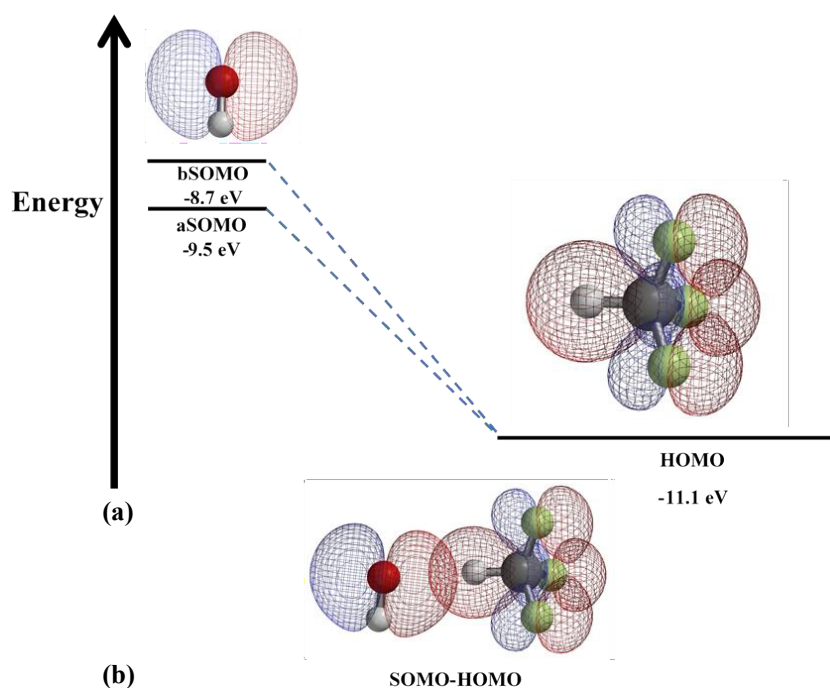


Figure 17. (a) Energy diagram representing the energy interactions between the SOMOs of the OH radical and the HOMO of fluoroform. The shape of the HOMO of fluoroform produce different degrees of overlap. (b) Interactions between the HOMO and SOMO.

reaction of fluoroform and the hydroxyl radical, the MO interactions are required. The diagram shown in Figure 18 represents the HOMOs and SOMOs of the reagents and their energy and interactions.

In the case of fluoroform, it is possible to observe a relatively complex HOMO compared to the other molecules that have been previously discussed. In fact,

the first aspect that may be noticed is the presence of three lobes with a different phase below the lobe that will react with the SOMO. Previous experience may suggest that the three lobes will provide for three increases in energy (or more) due to destructive interference. However, what is observed in the potential energy surface is one hump only. This is caused by

simple structural factors. First, the lobe of the HOMO that will be interacting with the SOMO is much larger, thus covering the space where the hydroxyl radical is rotating. This will reduce or not allow for any interactions between the opposite-phased lobes of the HOMO. Second, the distance between the abstracted hydrogen from the carbon atom is the largest in fluoroform when compared to the previous molecules. This increase in length suggests that the transition state occurs far away from the carbon center and thus from the opposite-phased lobes. The increase in energy is caused by the asymmetry of the lobes that will produce different degrees of overlap. This was the same behavior that was previously observed in methane.

Methyl chloride and difluoromethane

Having discussed methane, methyl bromide, and fluoroform, it is time to draw qualitative conclusions about the observed behavior. This section will serve the purpose of laying out the results for the rest of the molecules to compare with the molecules that have been discussed. The molecules that will be discussed in this section are methyl chloride and difluoromethane, shown in Figure 18.

The transition states shown in Figure 19 show similar patterns to those observed in previous transition state complexes. The structural information is presented in Tables 4 and 5. This data showed good agreement with literature values.^{11,12}

Methyl chloride and methyl bromide are structurally similar. Therefore, it is expected their potential energy surfaces are similar. Like in methyl bromide, methyl chloride showed two humps produced by the HOMO-SOMO interaction.

The potential energy surface of difluoromethane shows a different behavior from what has been previously observed. There is only one hump, but it appears to be deformed by the presence of more than one hump being combined/overlapped over each other. This combination of humps is because fluorine is the smallest halogen used in this experiment, therefore the bond angle between the atoms (and therefore the lobes)

is the smallest. Therefore, it is expected that the increases in energy occur closer to each other since the lobes are relatively close.

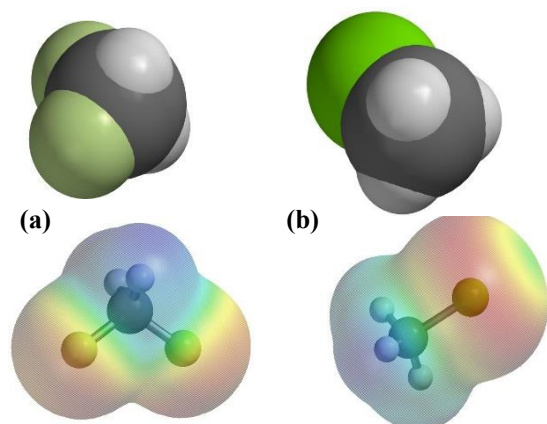


Figure 18. Space filling model and EPM of CH₂F₂ (a) and methyl chloride (b). Model: B3LYP 6-31G*.

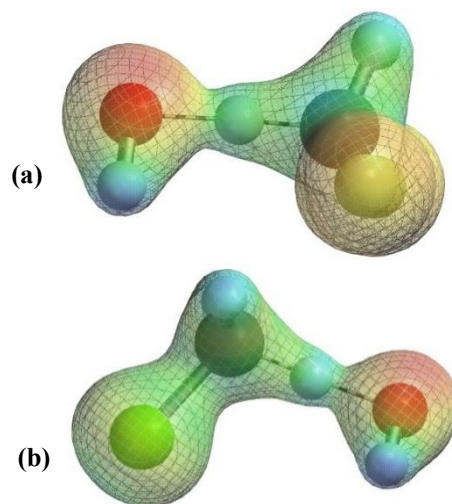


Figure 19. CH₂F₂-OH (a) and CH₃Cl (b) transition states represented by an EPM surface and an electron density gray mesh. Model: B3LYP 6-31G*.

Table 4. Structural Analysis of CH ₃ Cl-OH Transition State.				
Model	O-H _{abs} /Å	C-H _{abs} /Å	∠CHO	Imaginary Frequency /cm ⁻¹
B3LYP 6-31G*	1.323	1.212	166.1°	-1033
EDF2 6-31G*	1.355	1.197	163.5°	-427
MP2 6-31G*	1.285	1.209	159.2°	-2501

Table 5. Structural Analysis of CH ₂ F ₂ -OH Transition State.				
Model	O-H _{abs} /Å	C-H _{abs} /Å	∠CHO	Imaginary Frequency /cm ⁻¹
B3LYP 6-31G*	1.299	1.225	163.0°	-1269
EDF2 6-31G*	1.346	1.195	161.7°	-717
MP2 6-31G*	1.287	1.207	170.5°	-2459

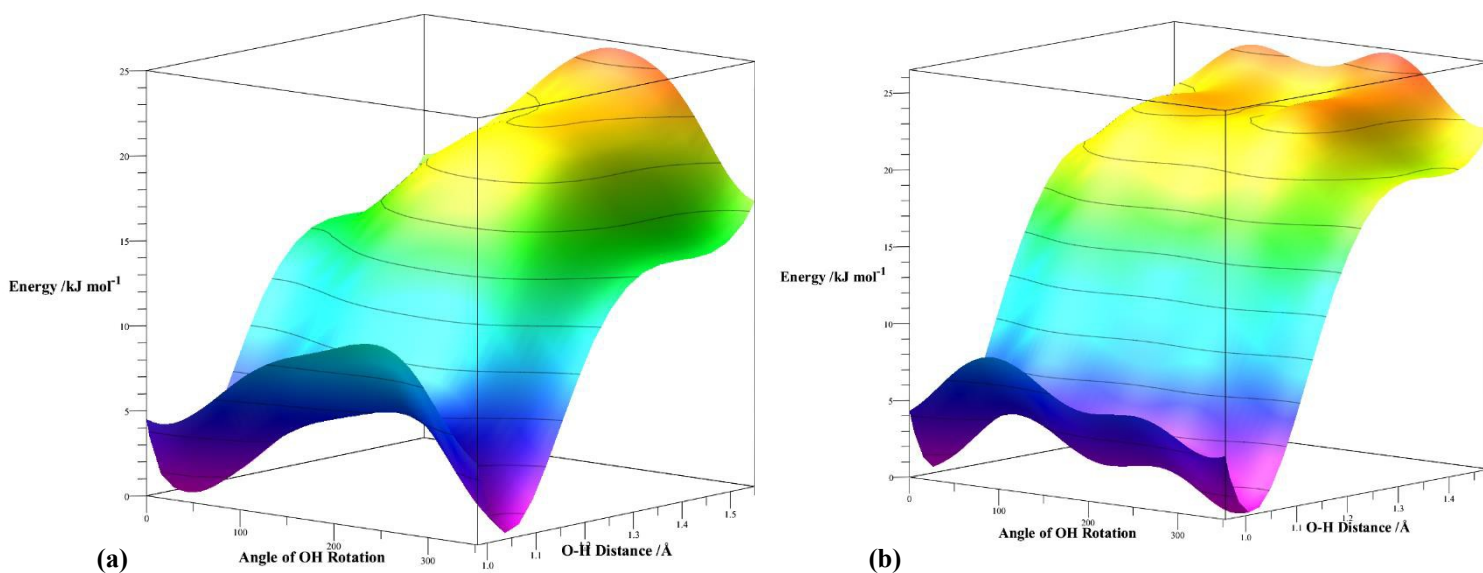


Figure 20. 3D potential energy surface for the hydrogen abstraction of difluoromethane (a) and methyl chloride (b). Model: EDF2 6-31G*.

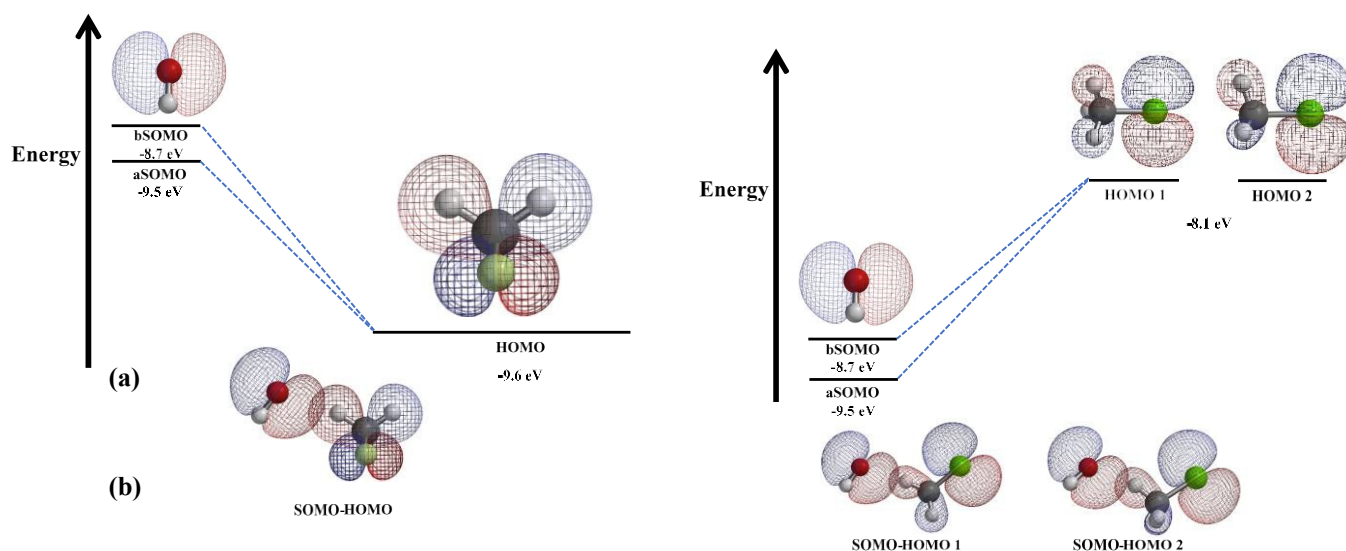


Figure 21. (a) Energy diagram representing the energy interactions between the SOMOs of the OH radical and the HOMO of difluoromethane (left) and methyl chloride (right). The shape of the HOMO(s) produces different degrees of overlap. (b) Interactions between the HOMO(s) and SOMO.

Summary and conclusions

The purpose of this project was to explore a set of different radical reactions in the atmosphere to better understand the aspects that affect them. The reactions covered discussed in this project occur between VOCs and the hydroxyl radical. Understanding what molecular factors affect these reactions is crucial to model and understand the presence and regulation of these VOCs in the atmosphere. These reactions are important processes that must be understood from a microscopic level. The VOCs discussed in this project are methane, methyl bromide, fluoroform, methyl chloride, and difluoromethane. When these molecules react with the hydroxyl radical the reaction will yield water and a radical derivative of the VOC.

The computational approach that was taken in this project had the main goal of generating potential energy surfaces for the reactions. These potential energy surfaces brought insight into how a reaction may proceed through one or several energy paths from reagents to products. The energy behavior observed in the potential energy surfaces was supported through the use of electrostatic molecular interactions between different atoms in the transition state complex. HOMO-SOMO interactions were used to rationalize the origin of these interactions and behavior.

It was observed that as the hydroxyl radical rotates with respect to the O-H(abstracted) bond, the energy increased in several regions represented as humps in the potential energy surfaces. These humps were caused when atoms with opposite or equal charge signs interacted unfavorably. However, the shape of these humps originated from the HOMO-SOMO interactions. It was observed that as lobes with opposite phases interacted closely there was an increase in energy due to the destructive interference between the HOMO and SOMO. This indicated that the degree of overlap played an important role in shaping the potential energy surface. The degree of overlap depended on the shape of the interacting lobes and the distances between them. Therefore, there is a direct qualitative relationship between the shape of a potential energy surface and the shape of the HOMO lobes in the VOC.

From the evidence presented in this project, it is possible to conclude that the MO interactions and electrostatic interactions play a crucial role in shaping the path of a chemical reaction and therefore the reactions rates that are observed through experimental measurements. However, it is important to mention that the potential energy surfaces only represent a very particular set of conditions and do not fully represent all the possibilities through which the same process can occur. The method that was used to generate the data limited the degrees of freedom of movement of the molecule. In fact, there is no reason for which the

molecules would not be allowed to approach in another direction other than the ones presented in this project. Nonetheless, the potential energy surfaces presented here represent the lowest energy interactions in a system of multiple possible energy paths. Therefore, although the results do not represent every possible process, they do represent an excellent sample of behavior to understand these chemical reactions.

Implications

The purpose of this project was to explore the aspects that influence chemical reactions at the microscopic level. This understanding is crucial in making accurate predictions of chemical processes at the macroscopic level. These predictions are useful tools in creating modeling that provides information about the presence and regulation of VOCs by sinks. This knowledge is central to understanding the complex chemistry that occurs in the atmosphere. The atmosphere is essential for humans and life in general. Therefore, obtaining new tools and understanding of processes that endanger the stability of the atmosphere must be a priority to scientists.

Future Work

There is still several questions and system that provide intriguing topics of investigation in this field. As it may be noticed from this project, all the molecules contained only three halogens F, Cl, and Br. It would be interesting to study molecules that contain other atoms. Additionally, all the molecules were limited to 5 atoms due to calculation costs. Larger molecules could provide interesting results as the molecule becomes more dynamic upon the addition of more carbon atoms or groups. Finally, the project that may provide the most interesting results will be one in which the behavior observed for the transition states is a mathematical model to then be introduced into a mathematical equation for the reaction rates of a specific reaction.

Acknowledgments

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Effects of animal-assisted therapy on different ages and patients

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Abstract

Animal-Assisted Therapy (AAT) is when an animal is used to work with a patient or patient with a therapeutic goal. In this study, different medical backgrounds were compared within an age group to see how effective AAT is as a therapy. The factors used to determine effectiveness were anxiety reduction, stress reduction, physical improvement, social improvement, self-care improvement, cardiovascular improvement, increase attention, control of emotions, decrease pain, increase motivation, blood pressure and heart rate improvement, and decrease in salivatory cortisol. Each study does not include all these factors. Some studies find a negative or no significant changes to the patients which are also recorded. AAT has been studied in children for various condition and seems to be very effective. AAT helps with mental disabilities in adult and can have short term improvement for pain and chronic illness. Most studies that have been done for elderly patients is for dementia and Alzheimer's disease and mostly improves factors associated with social behaviors.

Keywords: therapy, animal-assisted therapy

Background

Animal-Assisted Therapy is a category of Pet Therapy. Animal-Assisted Therapy (AAT) uses animals in a clinical setting to help a patient while having a therapeutic goal in mind. Animal-Assisted Activity (AAA) is in a casual setting where a group interacts with the animals with no therapeutic goal in mind. This study will focus on Animal-Assisted Therapy. The term "Pet Therapy" was first use in the 1960's by Dr. Boris Levinson, American Child Psychiatrist.. He is accredited with being the first to do scientific research on the effects of Pet Therapy on patients, but animals being used to help people can be traced back to the 1700's. In 1961, he started documenting his observations on how a dog's presence affects a child and how it can be used to initiate communication. The dog's presence seems to calm the child (Hooker et al. 2002). In this relaxed environment, the child can open up and therapy can then be more affective. Later studies looked at how the animal's presence can affect mental, emotional, and physical recovery.

Methods

Three age groups were used to analysis results, children and adolescents, adults, and elderly. Children range in age from 3 to 18. Adults range in age from 18 to 60, though most are middle-aged. Elderly range in age from 58 to 99. Within these groups, different conditions were looked some in a clinical setting. Some of the conditions were mental disabilities, chronic illness, chronic pain, and post-surgery. In each study, certain factors were looked at to see how affective AAT was for the patient or patients. These factors were taken to be complied in comparable tables within each age group. The factors recorded for the studies: anxiety reduction, stress reduction, physical improvement, social improvement, self-care improvement, cardiovascular improvement, increase attention, control of emotions, decrease pain, increase motivation, blood pressure and heart rate improvement, and decrease in salivatory cortisol. Each study does not include all these factors. Some studies found a negative or no significant changes to the patients which are also recorded.

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Results

Children and Adolescents

Table 1. Results of 10 experimental studies with children and adolescents using animal-assisted therapy. There is a range in the child's condition from student mental health, mental disorders, individual therapy, chronic conditions, cancer, post-surgery and pain relief. The studies shown in Table 1 did not test for all factors, shown in the last column. All except for 2 showed positives in each that they tested for.

	Found	Opposite was found	Factor was not Studied
Anxiety reduction	4	-	6
Stress reduction	6	-	4
Physical improvement	1	-	9
Social improvement	3	-	7
Self-care improvement	1	-	9
Cardiovascular improvement	1	-	9
Increase attention	4	-	6
Control Emotions	3	-	7
Decrease pain	2	-	8
Increase motivation	1	-	9
Blood pressure and/or Heart Rate	1	1	8
Decrease Salivary Cortisol	-	1	9

A study using AAT to help post-surgery children found that it increases in beta waves which correlates to an increase in attention (Calcaterra et al, 2015). Also showed improvement in motivation, pain tolerance, and aid in fast recovery. Another study worked with kids with leukemia with solid tumors (Silva et al. 2018). Both the children and their caregivers reported improvement in pain tolerance, communication, motivation, and overall psychological health. Physical factors, like oxytocin, cortisol levels, serotonin, increased after AAT in support of the reports (Braun et al. 2009). A study that just focused on the reduction of pain with children in acute hospital setting showed that the children showed pain reduction 15 minutes after being visited. They compared it to adults using oral acetaminophen for pain management.

Animal Assisted Therapy can also help outside of the hospital. A case study with a 14-year-old boy who showed severely low self-esteem because he was scarred on his face used the dog to create a rapport and build confidence (Lubbe and Scholtz 2013). The

therapist was able to connect to the boy who showed improvement in communication by initiating conversation by the end of therapy. A study done in 2015 looked at the benefits on first-year female undergraduates (Crump et al. 2015). In the final study the students were split into two groups. One would be with the trained dogs for 15 minutes in groups of 3 or 4 with two dogs in the middle and the other would spend 15 minutes coloring or drawing. These groups would then switch. Before and after measurements on Cortisol levels were taken using saliva, Perceived Stress Scale, and Stress-Arousal Checklist were taken during both sessions after 20 minutes of resting. Both groups saw an improvement in mental arousal and a decrease in stress levels, but there was three times more increase in arousal and a 63% greater loss in stress when the patients after the participates were with the animals. Cortisol level showed no change. In the classroom setting it was showed to help students have better attitudes towards school (Beetz 2013, Fedor 2018). One study that compared an AAT classroom with a controlled classroom and found that even through they showed the same depression score, the AAT classroom scored higher in socioemotional school experiences.

Adults

Table 2. Results of 7 studies done using AAT with adults of different backgrounds including patients with intellectual disabilities, physical disabilities and intellectual disabilities, long stay psychiatry, inpatient, brain injury, and heart failure. The studies shown in Table 2 did not test for all factors, shown in the last column.

	Found	Opposite was found	Factor was not studied
Anxiety reduction	4	-	3
Stress reduction	2	-	5
Physical improvement	1	-	6
Social improvement	1	-	6
Cardiovascular improvement	1	-	6
Increase attention	1	1	5
Control Emotions	1	-	6
Increase motivation	2	-	5
Blood pressure and/or Heart Rate	1	1	5

When working with patients having brain injuries, it was found that there was no positive improvement after the session but there were also no negative effects (Gocheva et al. 2018). The patients were distracted

during the therapy session which may have influenced how affective the session was for the patient. Another study done on inpatients of multiple hospitals (Phung et al. 2017). Before the AAT session, 84% thought that it would be beneficial to them. After, 94% thought that it would be. The patients said they felt more energized and helped their mental health. Studies were also done on patient without intelligent disabilities but have other medical conditions. AAT showed short-term improvement in patients with heart failure (Cole et al. 2007). Neurohormone levels and anxiety lowered while epinephrine levels increase. With anxiety lowered it relieves stress from the heart while epinephrine promotes increased heart rate.

Elderly

Table 3. Results of 4 studies using AAT with elderly patients. Most studies done on elderly patients are on Alzheimer’s Disease and dementia. The studies shown in Table 3 did not test for all factors, shown in the last column.

	Found	Opposite was found	Factor was not studied
Physical improvement	1	-	3
Social improvement	3	-	1
Self-care improvement	1	-	3
Increase attention	2	-	2
Control Emotions	1	-	3
Decrease Salivary Cortisol	2	-	2

A case study done on a 84-year-old women with dementia found long-term improvements (Nordgren and Engstrom 2012). Many improvements were seen even after 3 months from using AAT including physical improvements , less distorted , and though there were relapses, overall had better behavior. Another looked at how it can improve the lives of elderly patients with illnesses like Alzheimer’s, Dementia, mood disorder and psychotic disorder (Moretti et al. 2011). The patients filled out a questionnaire on their self-perceived quality of life, mini mental state examination, and a geriatric depression scale. The research found that all patients in the study saw improvement even in the control, but the ones that were able to interact with the dogs for 90 minutes a week for 6 weeks had higher improved scores that the patients that were not able to interact with the animals directly. Women with

dementia have no significant improvement using the multidimensional observation scale for elderly subjects (MOSES) but had increased apathy, improved irritable behavior, and increase social interaction (Motomura et al. 2004). There was a greater improvement in apathy than in irritable behavior and there was a significant increase in social behaviors. Seventy-five percent of patient said that they enjoyed the therapy and sixty-three percent said they liked dogs better after using AAT.

Discussion

Reviewing the studies, in the case of a hospitalized setting. Hospitalization can cause unintentional stress. Animal-assisted therapy helps with temporary pain relief and stress relief which therefore indirectly helps with recovery. This temporary pain relief and stress relief comes from the emotional response the patient feels when working the animal also from the social connection a person feels with the animal. This is seen in the studies mentioned earlier with children post- surgery and with leukemia (Calcaterra et al. 2015, Silva et al. 2018). It also promotes recovery by affecting biological factors like increasing cardiac parameters and hormone release (Cole et al. 2007). Stress can amplify symptoms in a hospital setting. Using this therapy can help patient recover faster. As seen in Table 1 and 2, both children and adults both have had many cases where anxiety and stress were decreased whether it was measured or the patient reported it through a survey. In the case of the children who were hospitalized after surgery, the cardiovascular response while being visited by the animal helped with this aspect of recovery (Calcaterra et al, 2015). Also seen in adults with heart failure, using AAT short term affects were seen to help with heart health (Cole et al.2007). It also helps with the mental state of the patients. Interacting and having to help take care of the dog cause the patient to be involved and physically active. In a case study of a man in long- stay psychiatry, his confidence built while working with the dog, he started taking the dog to be walked and throwing her treats to catch (Hall and Malpus 2000). When working with inpatients, many believing that AAT helped them mentally (Phung et al. 2017). Many felt as though they felt more energized after their session.

In the case of patient with mental illness, it helps promote social interactions, self-care, and behavior management. In Table 3, elderly patients saw improvement in social interactions and increased attention in many of the studies. Working and caring for the dogs help to promote confidence in caring and the animal promotes a non-judgmental environment for the individual to express themselves. Improvement in social interaction also usually came with improvement physical movement. The patients usually started to be

more active after their session, as is the case with the 84-year-old women with dementia (Nordgren and Engstrom 2012). Also helped with focus, though many of the effects are only seen for three months. More long-term studies need to be done. The pattern seems to be that the session needs to be repeated to help make the effects more permanent.

Using AAT on children and adolescents have been studied across many different background and medical conditions. The therapy is very effective at decreasing anxiety and stressed. It helps children relax, whether it is in a hospital setting or in a classroom. For adults, it is very effective with patient with mental disabilities. It helps reduce anxiety, stress, and improve motivation. In elderly patients, the main condition studied was dementia and Alzheimer's disease. AAT helps individuals with building confidence in social interactions and promoting self-care. This type of therapy is more effective with populations with mental and physical conditions, but can also help the everyday person with stress and anxiety as seen when working with students.

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Kate Chopin and Feminism: the Significance of Water

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Abstract

Late nineteenth century writer Kate Chopin in her time was commonly recognized as a regionalist or realist author, focusing on the lifestyle and setting of the Louisiana region. An author's intentions are extremely important. The way a writer crafts a story is telling of how that person views the world they are in. Because of this, although she did not directly advocate for it, she should be considered a feminist writer as well. Chopin's writing tells the story of women claiming their own independence in the only ways they can in patriarchal society. Within that, she uses water in many of her stories as a representation of independence and baptism into a new way of life. Most of the female characters who have an experience with water, also act in a way that goes against the societal norm for each situation. Even though Chopin made her career through the use of regionalism and realism (Chopin and Levine et al. 441), it does not take away from the fact that she was representing women in her stories as fighting for their independence in their own ways. While regionalism and realism are very important parts to understanding Chopin as a writer, the fact that she, in her own way, advocates for women to have their own agency is also a huge part of her writing. Water is used as a tool to represent the independence of the characters, and can be used to show how Chopin can be considered a feminist writer.

Keywords: Kate Chopin, feminism, water, symbolism

Introduction

Kate Chopin was a late nineteenth century American author who wrote three novels and over a hundred short stories in her lifetime. Her writing is commonly considered to be regionalistic in nature, which focused on the culture, characters, setting and dialect of the Louisiana region; she was also considered to be a realist writer as well, for her depiction of what everyday life was like in each particular setting. In her writings, regionalism focuses more on setting while realism looks more at how the situations in the story are realistic. While Chopin's writing does fulfil aspects of both regionalism and realism, her writing also possess' a lot of feminist aspects. Her writing contains situations and instances that examine women's independence in a way that was unusual and unaccepted by men in that time period. Lois Tyson in chapter six of her book *Using Critical Theory* explains feminist theory as "examin[ing] the ways in which our personal identity is formed by our culture's definition of what it means to be a man or a woman" (139). This can be done through looking at the way patriarchy can be seen in society, what gender roles are expected to be fulfilled, sexism, etc. Chopin's stories mostly contain aspects of feminist theory in them in one form or another. Because of this, Kate Chopin should also

be considered a feminist writer as well as a regionalist and realist. Placing the sole focus on the two forms takes away from the fact that Chopin was representing women in her stories as fighting for their independence in their own ways. While regionalism and realism are very important parts to understanding Chopin as a writer, the fact that she advocates for women to have their own agency is also a huge part of her writing. An author's intentions are extremely important. The way a writer crafts a story is telling of how that person views the world they are in. For Kate Chopin, her writing tells the story of women claiming their own independence in the only ways they can in patriarchal society.

Symbolism and imagery are very important to delve into the deeper meanings of a story, and Kate Chopin utilizes water to do so. Water symbolism is littered throughout her stories as a representation of both the characters feelings, as well as a rebirth aspect into the female characters and their transitions into their independence. Stories that have a female character having direct agency in their lives apart from the norms of society also have water symbolism. Motherhood and maternal instincts also play a large part in Chopin's writing, and for the stories used in this research, where there was not symbolism with water, there was symbolism with motherhood. Looking at the way Chopin

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represents water further explains her role as a feminist writer.

Background Information

Kate Chopin was born in St. Louis Missouri in 1850, and lived until 1904. With her father having passed away in a railroad accident when she was about five, Chopin was raised primarily by her mother and grandmother. She also went to school at St. Louis Academy of the Sacred Heart, where she received most of her education by the nuns there who helped to shape her education. Because of the way she was raised, and who she was raised by, Chopin had a lot of influence from independent woman in her life. In her biography *Unveiling Kate Chopin*, Emily Toth mentions that, “She was a bit too smart, or too forthright, for high society. Although she was ‘one of the acknowledged belles,’ known for beauty and ‘amiability of character,’ she was also noted for ‘cleverness’ – which, for women, is not always praise. Often it means that a young woman is unwilling to hide her intelligence. She has a voice and she wants it to be known that she has brains” (45). Chopin had a habit of not conforming to what society asked of her. She did not want to pretend to be someone she was not in order to appease the patriarchal standards of her time.

Once Chopin was older, she married and moved to New Orleans, Louisiana where most of her writing is set. Kate Chopin was her own person, she did not conform to what society expected of her, and she was lucky enough to have a husband who loved that about her. In her biography, Toth mentions that, “Oscar was a rare man who preferred an original woman, one who was neither quiet nor stay-at-home” (67). He did not mind that Chopin was her own person, and did things independently, like go for walks alone or even smoking cigarettes. Oscar Chopin’s extended family, however “regarded her with great suspicion and disapproval” (67). They would often tell him that he needed to put her in her place, but he would just wave them off and laugh about their comments with his wife. Chopin’s own personality can be seen in her writing, as many of her characters act in this way.

Kelly A. Ryan in her article “Women and Patriarchy in Early America, 1600–1800” discusses the roles that women held in the time period from 1600-1800. Ryan notes that “Laws and religious practices demanded women’s subordination to men, and governmental and extralegal controls on women’s sexual and familial lives buttressed patriarchal ideals and practices by enforcing their dependence on white men” (par. 1). Women were meant to be completely dependent on men, and were seen as little more than property.

The Awakening

The Awakening tells the story of wife and mother Edna Pontellier as she struggles with understanding who she is and what she wants to do with her life. The story is set in both Grand Isle, an island off the coast of New Orleans, and the city itself. The novel starts with Edna’s husband reading the newspaper, and when his wife and companion Robert come back from the ocean, he notices that his wife has been sunburnt. He tells her so and is “looking at his wife as one looks at a valuable piece of personal property which has suffered some damage” (Chopin and Culley 4). Right away we see a disconnect between Mr. and Mrs. Pontellier, and the fact that he views her as property shows the patriarchal stance of her husband. During their stay there over the summer, the couple constantly are at odds with one another, and Edna is happier when he is away doing other things. During one such fight, where Mr. Pontellier accuses Edna of being a bad mother, she sits outside and it is noted that “There was no sound abroad except the hooting of an old owl in the top of a water-oak, and the everlasting voice of the sea” (7). The ocean is constantly referenced and Edna thinks of it longingly as if it was calling to her. The moment that Edna begins her awakening, or realization that there is more to life than just being an obedient wife and mother occurs while she is at the ocean:

The voice of the sea is seductive; never ceasing, whispering, clamoring, murmuring, inviting the soul to wander for a spell in abysses of solitude; to lose itself in mazes of inward contemplation.

The voice of the sea speaks to the soul. The touch of the sea is sensuous, enfolding the body in its soft, close embrace (14).

The ocean to Edna is an escape from her life with her family. She loves her children, but they are a drain, and her husband’s constant judgement of her capability to be a good wife and mother causes her to seek independence from that even more. Edna reflects on the summer before, when her kids had gone to their grandmothers house. “Their absence was a sort of relief, though she did not admit this, even to herself. It seemed to free her of a responsibility, which she had blindly assumed, and for which Fate had not fitted her” (19). She does not feel she has what it takes to be a perfect mother, as she is called to do by society.

Nearing the end of their vacation, Edna was laying outside on their porch one night. Her husband finds her, and tells her to come in; when she refuses, he gets angry and tells her that he “can’t permit you to stay out there all night. You must come in the house instantly” (31). This causes her to insist on staying out even more. “She wondered if her husband had ever spoken to her like that before, and if she had submitted to his command. Of

course she had; she remembered that she had. But she could not realize why or how she should have yielded, feeling as she then did" (31). She no longer feels like it is her duty to follow her husband's every wish. She has begun to be her own person, and she does not want to follow anyone else's desires but her own. Upon reflection one evening, Edna thought about everything that had happened this summer, attempting to figure out what had happened that changed her. "She could only realize that she herself—her present self—was in some way different from the other self" (39). She has become more aware of the change beginning to occur within her.

On another day, Edna is talking with one of her friends Madame Adele Ratignolle at the beach, and she attempts to explain the feelings that she is beginning to have. Previously she had told her that she was not willing to sacrifice herself for her children, and Adele had taken offense to that, telling her that nothing should matter more to her than her children. During another conversation, Edna tried again to explain what she meant by that: "I would give up the unessential; I would give my money, I would give my life for my children; but I wouldn't give myself. I can't make it more clear; it's only something which I am beginning to comprehend, which is revealing itself to me" (46). She loves her children deeply, but is not willing to sacrifice her being and desires in order to be the devoted mother that society is asking her to be. Madame Ratignolle is an example of what Edna should be; a devoted wife and mother who would give up everything in order to please her family. She cannot comprehend the independence that Edna seeks, and feels that she is selfish for entertaining the idea. This comparison between the two women is brought up many times in order to show that Edna is not fulfilling the role she is meant to.

The rest of the novel occurs in New Orleans. The Pontellier's have gone home, and must go back to their everyday routine, although Edna continues to reflect about the ocean. She is still becoming her own independent person outside of what society is asking of her. One such instance of this occurs when Edna misses her Tuesday appointments. For Edna, every Tuesday she was to remain home to receive any callers that wanted to come and visit. When her husband asks her that evening how many had come, she replies "There were a good many...I found their cards when I got home; I was out" (49). Her husband is dumbfounded by this, and asks if she had at least left an excuse, saying that she was ill or something to make it seem unintentional. To this she replies that she had them say that she was out. Her husband begins to get upset by this and says "Why, my dear, I should think you'd understand by this time that people don't do such things" (49). Her husband is upset that she is neglecting her duties as a wife, and is more worried what others will think if they see that he is not able to control his wife. Edna, however, is beginning to

not care what society demands for her to do as a woman, and is instead only doing things that she wants to do.

Shortly after this encounter, Edna resolves to completely forego her Tuesday visits and do only what she feels like doing, which in her case is painting. This completely shocks her husband, and he compares her to Mrs. Adele Ratignolle, who despite her love of music "does not let everything else go to chaos" (55). It is at this time that Mr. Pontellier begins to feel that his wife is becoming mentally unstable. He notes that she does not act like herself anymore, to which the narrator responds with "That is, he could not see that she was becoming herself and daily casting aside that fictitious self which we assume like a garment with which to appear before the world" (55). Edna is rejecting the role she had been assigned as a woman, and is being mistaken for someone who has lost their mind when not conforming to what society asks of her.

Not long after, Mr. Pontellier was called away on business and would be gone for a few months. Her mother-in-law comes to take the children back to her home while he is away. Edna finds herself alone, and when she expects to miss her family and wish to be with them, she instead finds peace in her solitude. She takes this opportunity to solidify her independence and move out of her big house into a small apartment on her own. When talking to one of her friends, Mademoiselle Reisz, she explains her plan to move into her own place and states that "'I know I shall like it, like the feeling of freedom and independence'...whatever came, she had resolved never again to belong to another than herself" (76). When her husband learns of this, he has the house remodeled so that appearances can be kept up, and no one would think that she moved out just because she wanted to. This again shows his concern with not being able to control his wife, and worrying what others will think. By the end of the novel, Edna knows that she does not want to go back to the way things are. She is happy with her independent life, and does not want to go back to being nothing more than a wife and mother. She refuses to be stripped of her own identity and forced to assume the role of someone she no longer feels she is. She decides to go back to Grand Isle and the ocean, where she first realized she had the ability to have her freedom, and decides to swim out to the ocean farther than she had ever gone before. This is symbolic of the lengths that she herself has gone in deciding her own fate within the society she lives in. The last few paragraphs of the novel state

She felt like some new-born creature, opening its eyes in a familiar world that it had never known. The foamy wavelets curled up to her white feet, and coiled like serpents about her ankles. She walked out. The water was chill, but she walked on. The water was deep, but she lifted her white body and reached out with long, sweeping stroke. The touch of the sea is sensuous,

enfolding the body in its soft, close embrace (109).

The water in this story is a representation of independence. In this section specifically, it details the struggle that Edna has faced in trying to become her own person while everyone around her discouraged her and pushed her to remain the way she was. Taking her own independence was difficult, just as the water is difficult; but the end result was worth the struggle. As she is swimming further and further, she goes back to a time in the beginning of the novel where she had gone a little too far and was terrified that she would drown. The fear sparks itself again as she swimming farther out than she has before, but it goes away in an instant. This shows the growth that she has experienced in the time that occurs in the novel. The novel ends with an implication that Edna drowns. In this way she secures her independence indefinitely through death, and does not conform to what society asks of her any longer.

This novel is arguably one of Kate Chopin's most popular works today, although in its time it was met with a lot of criticism and disapproval. In *Kate Chopin's Private Papers*, Emily Toth talks about how Chopin was a part of group called Wednesday Club that "remained loyal to her" after she left. She also mentions that "In late 1899, after *The Awakening* had been condemned by most male reviewers, the Wednesday Club invited Chopin to give a reading, and over 300 women turned out to applaud and praise her" (131). While patriarchal society rejected Chopin's novel and noted that it was "a decidedly unpleasant study of a temperament," for many women it was a breath of fresh air in a world that forced them into roles that many did not want to fulfill any longer (Chopin and Culley 166).

In his introduction to the novel *Kate Chopin: Modern Critical Views*, Harold Bloom argues that *The Awakening* is not a feminist novel, but instead is a story inspired by the poetry of American poet Walt Whitman. Bloom notes that it written in "Whitman's true mode" (1). Whitman's poetry was erotic in nature and very narcissistic, and Bloom argues that that is exactly where Chopin got the idea and style for the novel. While the similarity between the two writers is undoubtable, the meaning behind Chopin's novel is undeniable in its anti-patriarchal stance. The irony in her life and the life of her friend Adele, who is a true representation of what a woman is supposed to be like in that time, is constantly being compared. While *The Awakening* has similarity in style with the poetry of Walt Whitman, it does not take away from the anti-patriarchal message that Chopin placed in the novel.

Others were a lot more accepting of viewing Chopin's novel as feminist. One such article is "The Re-understanding of Edna Pontellier's Death" by Limin Bai, which looks at Edna's death at the end of *The Awakening*

not as a suicide or escape from a life she no longer wanted, but instead considers it a triumph in choosing a fate that she was passionate in exploring, a newfound independence that no one will be able to take away from her.

"The Story of an Hour"

"The Story of an Hour" paints the picture of Mrs. Mallard, a devoted wife who is told the news of her husband's death. It is noted in the story that Mrs. Mallard does not react the same way most women would; rather than being in shock and paralyzed, she immediately starts weeping "with sudden, wild abandonment" (Chopin and Solomon 217). After this, "When the storm of grief had spent itself she went away to her room alone" (217). It is important to note that she looks out her window and notices that "The delicious breath of rain was in the air" (217). The timing of the rain lines up with Mrs. Mallard's own reaction to the news of her husband's death. Her weeping could be occurring at the same time as the rain, and the "storm of grief" subsides as the actual storm outside does. The word delicious also gives a romantic view of the rain, which also explains Mrs. Mallard's next realization:

There was something coming to her and she was waiting for it, fearfully. What was it? She did not know; it was too subtle and elusive to name. But she felt it, creeping out of the sky, reaching toward her through the sound, the scents, the color that filled the air...When she abandoned herself a little whispered word escaped her slightly parted lips. She said it over and over under her breath: "free, free, free!" (218).

The parting rain is a symbol of Mrs. Mallard's own parting grief. She realizes that while she is sad that her husband is gone, this is the opportunity for her to live for herself, and not for anyone else. She now has the freedom to live her own life independently. Nearing the end of the story there is a quote that states "she was drinking in a very elixir of life through that open window" (219). The rain, and the aftermath of rain, is a huge symbol of Mrs. Mallard's own feelings. There is a rebirth effect that the water causes for the protagonist, an acceptance and excitement for a new way of life—a new independent life. When she comes back downstairs, her husband walks in, very much alive. Mrs. Mallard then dies and "When the doctors came they said she had died of heart disease—of joy that kills" (219). In this way, even after finding out that her husband is not dead, she still finds her independence from him in death.

It is important to note that in the beginning of the story the reader is told that Mrs. Mallard has a heart condition. This causes her appear to be weak and fragile in the view of her closest friends and to the reader as well.

This is significant, because her reaction to the news of her husband is not the reaction that they were expecting. By portraying her as weak and then showing how she is strong, Chopin negates the negative stereotype of women being weak and fragile creatures. Mrs. Mallard also experiences her awakening to this new independence after she witnesses the aftermath of rain outside her window. This story can be looked at as feminist because the main character is looking forward to living the rest of her life independently from patriarchal society. The most important part though, is that this realization comes after the protagonist's experience with water.

“At the ‘Cadian Ball” and “The Storm”

While the two stories are separately published, they can be read together as one piece, as the former does a good job of setting the scene and background for “The Storm.” Chopin did not publish “The Storm” herself, most likely because of its erotic content, it was instead published in 1969, with her completed works. Both work together to express the independence of Calixta.

“At the ‘Cadian Ball” is told from two separate points of view. The first is through Bobinôt, who is hopelessly in love with Calixta, the Spanish girl who is desired by almost all the men in the area. The second is through Clarisse, who is in love with Alcée Laballiere, the wealthy man who is known to have a bad reputation with women. Calixta and Alcée have feelings for each other, but Alcée knows that he would never marry Calixta because of their difference in station. He is wealthy and comes from a good background, and she does not. Her mother was an immigrant from Cuba “Calixta’s slender foot had never touched Cuban soil; but her mother’s had, and the Spanish was in her blood all the same” (Chopin and Koloski 142). Despite this, the attraction remains; Bobinôt, upon learning that Alcée will be attending the upcoming ball, decides to go as well, to make sure that Alcée does not try anything with Calixta. Clarisse, too, upon learning that Alcée has left home to go to this ball, resolves to go after him to proclaim her love and stop him from trying to be with anyone else.

At the ball, Alcée and Calixta find each other and go off to a room to talk. He asks her to come with him to the city. Calixta knows that he does not mean to marry her, but is tempted to go all the same. They are interrupted by Clarisse, who tells him there is an emergency back home. Alcée gets up and starts to leave without even a second glance to Calixta, and only turns to say goodbye when Clarisse says something about it. When Alcée asks about the emergency, she tells him that she loves him and does not want him to be with anyone else. Calixta calls Bobinôt over and asks him if he still wants to marry her. When he replies that he does, she agrees to it, making him extremely happy.

“The Storm” occurs some years after this event. Calixta and Bobinôt have been married for five years and have a son named Bibi. While Bobinôt and Bibi were out to get some things for Calixta, a storm is fast approaching, and the two were forced to wait it out in the safety of the store. Meanwhile, Calixta is noted to be oblivious to the fast approaching storm until it started to get dark. She hurries to close all the windows and grab the clothes hanging on the line when Alcée rides up and asks to take shelter in their home. Inside, Calixta begins to worry about her husband and son and staring out the window a bolt of lightning strikes a nearby tree, causing her to stagger back into Alcée’s arms. Chopin writes that “The contact of her warm, palpitating body when he had unthinkingly drawn her into his arms, had aroused all the old-time infatuation and desire for her flesh...As she glanced up at him the fear in her liquid blue eyes had given place to a drowsy gleam that unconsciously betrayed a sensuous desire” (Chopin and Levine et al. 457). The sexual tension between the two is undeniable at this point, and the growing storm is almost a parallel to their growing desires.

While the storm is occurring Alcée notes that “Now—well, now—her lips seemed in a manner free to be tasted, as well as her round, white throat and her whiter breasts” (457). The storm is serving as an opportunity for Calixta to be her own independent person, free to be with Alcée in a way that society refused to allow. The storm represents the chaos of the feelings that she has had for Alcée for many years, and allows her to take her own agency in exploring the relationship that society would not allow her, due to their difference in station. Chopin notes that “She was a revelation in that dim, mysterious chamber; as white as the couch she lay upon. Her firm elastic flesh that was knowing for the first time its birthright, was like a creamy lily that the sun invites to contribute its breath and perfume to the undying life of the world” (457).

“The rain was over...Calixta, on the gallery, watched Alcée ride away” (458). Their affair lasts as long as the storm does, and with its passing, the build up of feelings between the two since the ball seems to dissipate as well. It is also important to note that Bobinôt is almost taken aback at the happiness of his wife when he returns. “Bobinôt’s explanations and apologies which he had been composing all along the way, died on his lips as Calixta felt him to see if he were dry, and seemed to express nothing but satisfaction at their safe return” (458). He had expected her to be upset and angry that they had been gone, but instead she is just happy to have them home. She makes dinner for them and “when the three seated themselves at table they laughed much and so loud that anyone might have heard them as far away as Laballiere’s” (458). Calixta has taken her independence and experienced the life that she felt that she lost, but she

is also happy with the life that she has now with her husband and son. Her happiness is noted to be heard from as far as Alcée's own home, which shows that she does not need Alcée to be happy, he has not saved her from a terrible life. The story ends by stating "So the storm passed and every one was happy" (459). Calixta explored what could have been had she gone against what society asked of her when she married Bobinôt, and though she ends up being more content with the life she has with her husband, it is by her own choice, as she could have done things much differently. The storm represents a rebirth for Calixta, a chance for her to choose Bobinôt, not because he was the choice that patriarchal society gave to her, but because she was happy with him.

"Azélie"

"Azélie" is a little different than the other stories, in that it follows the thoughts of 'Polyte, the male lead who is trying to win the affections of Azélie, whose family has the tendency to mooch off of others without working for it in exchange. Most people in their town do not take this family seriously, and are often annoyed with their inability to contribute.

The story starts out with Azélie walking to the town store from her home. She lives with her father, grandmother and little brother in a cabin that "was removed some distance from the plantation house, and only its pointed roof could be discerned like a speck far away across the field of cotton" (Chopin and Koloski 279). She is noted to be wearing "a faded calico dress that had been made the summer before, and was now too small for her in every way" (276). Azélie comes from a poor family. They live on land with crops, but they are unworked and so they are unable to make a profit from them, and rely on the grace of the shopkeeper to just give them the things that they need. 'Polyte does not like Azélie, and is annoyed that his boss is okay with just giving them the things they need free of charge. Azélie at first is only there to get some meat, but after 'Polyte sarcastically asks her if she needs anything else, she leans on the counter and lists more things. He notes that "There was no trace of any intention of coquetry in her manner. He resented this as a token of indifference toward his sex, and thought it inexcusable" (278). She is not flirtatious like other women would be in this situation, and 'Polyte feels like he is entitled to that kind of consideration because of the things he is giving her. This story focuses on the ways in which Azélie is not portraying the role she is supposed to, and shows the ways in which 'Polyte feels he is entitled to the treatment he thinks he deserves. In this way, this story is very patriarchal in nature.

After 'Polyte refuses to give her tobacco and whiskey to bring back to her father, she comes back in the middle of the night and breaks into the store to get it for

herself. This is also telling of the lengths she is willing to go to bring her father the things he desires. When 'Polyte catches her, she is not apologetic in any way, denies she was stealing and claims that "I was jus' takin' a few li'le things you all too mean to gi' me" (281). Instead of turning her in, he lets her go and instead tells her never to step foot in the store, but to come to him directly if she ever needed anything and he would just give it to her.

"After that night 'Polyte loved Azélie desperately...he was almost ashamed to acknowledge to himself" (282). 'Polyte hates that he has come to love someone "so wholly devoid of moral sense" (282). He feels he deserves better than to love this girl, who is everything but the perfect woman. Despite this however, he loves her anyways, and looks forward to every opportunity to see her. In a moment of weakness he proclaims his love to her and kisses her, and she wants absolutely nothing to do with it. He knew that her father would have to go back to Little River, and wanted to ask Azélie to marry him when he left. He "believed he would be able to awaken Azélie to finer, better impulses when he should have her apart to himself" (283). He believes that once she is married to him and is his to mold, he can turn her into the woman she should be. Instead however, Azélie refuses him and goes to Little River with her family, but even still "her reserve led him to believe, since he hoped it, that he had prevailed with her and that she had determined to stay with him and be his wife" (284). When he realizes that she has indeed gone, he quits his job in hopes to follow her there and win her over.

While this story is not exactly in the same format as the others, it still follows some of the same ideas. Water isn't used specifically, but the idea is still represented through a place with water in the title. Azélie going to Little River instead of marrying 'Polyte is her way of being her own person, despite what patriarchal society asked of her. The River represents a passage or journey, and in this case expresses Azélie's desire to be with her family, even though it means leaving her home. Azélie is also a mother type figure for her family. She is constantly the one that is coming to town to get things for her father and will leave for Little River to continue to do so.

"A Sentimental Soul"

"A Sentimental Soul" follows the everyday life of Mamzelle Fleurette as she runs a little shop in her town. Against her better judgement, she has fallen in love with the locksmith Lacodie. He is married, and Mamzelle Fleurette knows that nothing can come of her affection for him, and that she should not have the feelings at all. She goes to confession to tell Father Fochelle about it, and he tells her that she needs to do everything in her power not to entertain the feelings any longer. She starts to work on

pushing him from her mind, when he suddenly stops coming in to get the paper, as he did every day before. His wife comes instead one day and tells her that Lacodie has fallen ill. More and more days pass and Lacodie continues to get worse and worse until eventually on a “chill and misty” evening Mamzelle Fleurette is up all night praying for Lacodie, who dies the next morning (Chopin and Koloski 300). The misty evening is the only reference to water that this story has, which makes it unlike all the other stories that have water directly relate to the independence of the character. However, she does spend the entire night praying and thinking about Lacodie, which she had been told specifically not to do by Father Fochelle.

Formerly, Mamzelle Fleurette had enjoyed going to confession; but after Lacodie’s death she did not enjoy it any longer. “Her heart went on loving Lacodie and her soul went on struggling; for she made this delicate and puzzling distinction between heart and soul, and pictured the two as set in a very death struggle against each other” (300). She continued to pray for him despite her best attempts not to, and she continued to feel bad for the feelings that she still had for Lacodie. However, once she finds out that his wife has gotten married to another shortly after his passing, she is furious and “was preparing for the first time in her life to take her conscience into her own keeping” (302). Instead of going to confession to where she usually does, she takes a car to a church much farther away, to confess to a priest there. She does, without any mention whatsoever of Lacodie. Afterwards, “Mamzelle Fleurette did not ride back to her home; she walked. The sensation of walking on air was altogether delicious; she had never experienced it before” (302). Walking was a very uncommon thing for women to do alone, especially with as much distance as Fleurette had from her home. By walking home and not confessing to being in love with the dead husband of another woman, Mamzelle Fleurette owns her own independence in the matter. Upon returning home as well she takes a picture frame and “neatly and deftly pasted Lacodie’s picture. Then she re-entered her room and deliberately hung it upon the wall...and she did not care if the Gascon’s wife ever saw it or not” (303). The environment surrounding her on her walk home fills her with the strength she needs in order to take her consciousness into her own hands. She no longer feels she needs to do whatever Father Fochelle tells her to in order to save her soul. She decides to not push away her feelings for Lacodie, and live her life with his presence always near her.

While it isn’t water that helps Mamzelle Fleurette come to this conclusion, her walk provides the clarity that she needs to finally act in the way that she has been wanting to since the beginning. In this way, the setting is still a representation of her independence, even if it is not through water specifically.

Conclusion

In conclusion, most of the stories analyzed had symbolism with water that helped to provide the ability for the female characters to have agency in their own lives apart from what patriarchal society was asking of them. Water is used as a baptism or rebirth into a new life, and mirrored the emotions that the women were feeling in their situations. Because of the way that water was used in these stories and novel, Kate Chopin should be considered a feminist writer. She worked hard to show what life was like for an American woman in the nineteenth century, as well as the struggle that women faced with being accepted and able to determine their own destinies. While Kate Chopin did a lot of work with regionalism and depicting the lifestyle of Louisiana, she also had a big part to play in showing the lives of women who were beginning to break out of the patriarchal bubble they were forced into. She uses her skill as a regionalist writer to uses aspects of that setting to influence these women into accepting their own agency and independence. By viewing Chopin as a feminist writer, as well as a regionalist and realist writer, we can begin to have a more accurate view of history.

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Assessing the Role of Social Skills as a Moderator in the Relationship between Socioeconomic Status and Child Behavioral Problems

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Abstract

This study examines the role social skills play as a moderator in the relationship between socioeconomic status (SES) and behavioral problems in children. It was hypothesized that social skills would buffer the effect of SES on behavior problems. Data were collected as part of a larger study on family interactions in families of preschoolers with and without developmental disabilities. Participants consisted of 47 families, with a focal child aged 3-5 years, residing in Stanislaus County. Parents completed questionnaires assessing their SES, as well as the focal child's social skills and behavior problems. Results indicated that, though SES did not significantly predict child behavior problems, the link between SES and behavior problems was moderated by child social skills when mothers were rating children's externalizing behaviors. Moderation was not found for fathers' ratings of child behavior problems. For both mothers and fathers, child social skills were found to significantly predict most types of behavior problems. Findings from this study indicate that targeting child social skills in therapeutic interventions may help reduce childhood behavioral problems.

Keywords: socioeconomic status, child behaviour problems, social skills

Introduction

The influence of socioeconomic status (SES) permeates throughout an individual's lifespan. SES has been found to affect the overall functioning of an individual, including physical and mental health. (DeCarlo Santiago, Wadsworth, & Stump, 2011). Low SES has been widely accepted to significantly impact the development of children, including the manifestation of internalizing and externalizing problem behaviors (Letourneau, Duffett-Leger, Levac, Watson, & Young-Morris, 2011). Research has shown that poverty-related stress exacerbated anxiety and depression symptoms for children, which can be a detriment during development (DeCarlo Santiago et al., 2011). Furthermore, children with SES disadvantages have been found to be three times more likely to have mental health problems compared to children with a more privileged background (McGrath & Elgar, 2015).

The American Psychological Association (n.d.) defines SES as the social position an individual has in

society. SES is typically measured by combining an individual's education, income, occupation, and employment status (American Psychological Association, n.d.). Research has shown that the degree to which a child's surrounding environment affects their developmental potential is largely determined by the combination of variables that encompass SES measures (Letourneau et al., 2011). The socioeconomic position in terms of family economics and educational aspects as SES indicators have been shown to have a strong influence on a child's health and well-being (Hosokawa et al., 2018).

Many potential mechanisms by which SES might influence the occurrence of behavioral problems have been found throughout the years. Developmental research has traced the influence of SES on behavior problems to early childhood experiences and prenatal exposure to maternal stress (Repetti, Taylor, & Seeman, 2002). Moreover, the absence of a maternal figure and indirect psychosocial consequences relating to the

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socioeconomic position of an individual have also been shown to underlie SES impact on behavior problems (McGrath & Elgar, 2015). Leijten, Raaijmakers, Orobio de Castro, and Matthys (2013) suggested that disruptive problem behaviors in children are more strongly associated with problematic parenting practices in disadvantaged families, which often have smaller social networks and less access to resources to provide them with parenting assistance and advice. Furthermore, maternal education has also been linked to a child's social and emotional competence (Hartas, 2011). Studies have found that socio-economic disadvantage and lack of maternal educational highly influence competencies in children (Hartas, 2011). Similarly, children living with families experiencing socioeconomic disadvantages were found to have lower cognitive skills and a higher risk for behavior problems (Hartas, 2011). There seems to be a persistent trend showing a relationship between family SES and children's social and behavioral skills.

Extensive research has been conducted that examines the negative effects of growing up in a disadvantaged environment, and the impact it has on child development. Singh and Ghandour (2012) stated that children living in the most disadvantaged neighborhoods, and with parents with less than a high school education, had higher odds of developing social behavioral problems than children living in a more advantaged environment (Singh and Ghandour, 2012). A longitudinal study conducted by Gilliam (2017) found that living in low-income communities, parenting, and other proximal family risk factors assessed in early childhood were predictors of conduct problems during middle childhood and more serious forms of anti-social behavior in adolescence and early adulthood. Furthermore, Rubio-Codina, Attanasio, and Grantham-McGregor (2016) findings stated that large developmental deficits associated with poverty from early ages were strongly mediated by parental education, especially maternal education, and the quality of the home environment. Quality of employment and number of work hours have also been associated with parental health, parent relationship with child, and child development (Nicholson, Strazdins, Brown & Bittman, 2012). Nicholson et al. (2012) findings suggested that job combinations that include extensive work hours and poorer quality jobs are associated with elevated rates of parental mental health problems, less time spent in

developmentally important activities with children, and socio-emotional developmental difficulties for children.

In addition to financial hardships and social disadvantages, social skills have also been found to play an important role in predicting behavior problems. A longitudinal study conducted by Izard, Fine, Schultz, Mostow, Ackerman, and Youngstrom (2001), found that the level of emotional intelligence and social skills of a child at age 3 had long term effects on social behavior at age 8. Specifically, children who had good emotional intelligence were able to make socially acceptable statements to their peers and emphasize with them, which led to prosocial behavior (Izard et al., 2001). Furthermore, poor social skills have been linked to depression, anxiety, and aggressive behaviors as children grow older (Baker, Blacher, Crnic, & Edelbrock, 2002). Other studies have also found low social and emotional skills to be associated with increased behavioral problems (Schell et al., 2015). Research has indicated that the total social skills of a child are significantly correlated with internalizing and externalizing problems behaviors (Koblinsky, Kovalanka, & Randolph, 2006).

Social skills and SES have both been associated with behavior problems, but research has rarely examined the interaction within these variables. The purpose of this study is to further expand the existing research on connections between SES and child development by analyzing the relation between family SES, children's social skills, and their behavior problems. This study examined the role social skills plays as a moderator in the relationship between socio-economic status and behavior problems in children. It is hypothesized that social skills serve the role of influencing the strength between socio-economic status and behavior problems. In other words, analyses will test whether having strong social skills can weaken the impact of low SES on child behavior problems. Findings from this study could help identify points of intervention to improve child behavior problems before they worsen, limiting the negative impact of behavior problems on the rest of a child's life.

Methods

Participants

Participants consisted of 47 children aged 3 to 5 and their families from Turlock and Modesto areas. The participant families consisted of a "focal child"

(preschool child aged 3-5), parents, siblings, and other family members who are part of the household.

Procedure

Data were collected as part of a larger study on family interactions in families of preschoolers with and without developmental risk. The larger study recruited children with developmental risk, as well as typically developing children. For the current study, typically-developing and children at developmental risk were included, and developmental risk was treated as a covariate in data analyses. All children were administered intelligence tests as a part of the larger study, using the Wechsler Preschool and Primary Scales of Intelligence, 4th Edition (WPPSI-IV). Children who scored less than 85 (below average) on the WPPSI-IV, or whose parents reported that they had been diagnosed with a developmental disability, were placed in the “developmental risk” group.

After recruitment, families were contacted by the laboratory coordinator to schedule each visit to the university. The research assistant or principal investigator obtained an informed consent form from the parents, and then gave each parent a pack of questionnaires to complete. Each parent was instructed to complete questionnaires separately to avoid discussing their responses. Parents were encouraged to return their questionnaires at their following visit. After the parent signed the consent form, informal assent was obtained from the child, then testing with the WPPSI-IV commenced. Testing with the WPPSI-IV was performed either by the principal investigator (a licensed clinical psychologist), or by trained research assistants (masters-level graduate students in either behavior analysis or counseling, trained and supervised by the principal investigator). Parents completed a packet of several questionnaires, of which 3 were used in the current study. Parents were encouraged to return their completed questionnaires when they arrived for their second university visit. Questionnaires were then checked for completion by trained research assistants. Any incomplete items, or items for which the response was unclear, were addressed immediately with the parent at their second visit. If items were left incomplete after the visit, the principal investigator made attempts to collect any remaining questionnaire data by phone. Questionnaire data were scored and entered by trained and supervised research assistants, with regular checks for reliability and accuracy.

Families received 3 forms of incentives to encourage participation in the study. Families received gift cards for participation in each phase of the study: \$40 for participation in the initial intellectual assessment, \$20 for completion of parent questionnaires, and \$40 for participation in the family visit. In addition to monetary incentives, a brief written summary of the child’s intellectual functioning (written by supervised and trained research assistants) was provided, and focal children and their siblings were allowed to pick from a “prize bin” of small toys or stickers (each with a value of less than \$1) each time they visited the university.

Measures

This study used 3 parent-completed questionnaires from the larger packet of questionnaires parents completed as part of the larger study. *Family Information Form*: This was used to measure the parents income and SES. The form was broken down into 3 parts: questions regarding the mother, father, and focal child. It consisted of primarily demographical questions, formatted as multiple choice questions. Income was measured by asking parents to self-report their yearly income. *Child Behavior Checklist*: Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1991) Ages 1.5-5 is a standardized parent-completed form that measures the behavioral and emotional problems of children aged 1.5 to 5 years old. The CBCL contains ratings of 99 forced-choice items and one open-ended item, which requests that the parent add any additional problems not already listed. The items ask parents to rate frequency of various behavior problems as observed in their children, including emotional reactivity, anxiety/depression, somatic complaints, withdrawal, attention problems, aggressive behavior, and sleep problems. The form also includes three open-ended questions for parents to describe physical and mental disabilities, and possible concerns about the child (Achenbach & Edelbrock, 1991). For each of the 99 scale questions, parents are able to respond 0 (Not True), 1 (Somewhat or Sometimes True) or 2 (Very True or Often True). Three index scores can be calculated from the CBCL: Internalizing problems (such as anxiety and depression symptoms), externalizing problems (such as aggression and rule-breaking), and total problems (a summary score that includes all behavior problems in the measure). High scores on the CBCL indicate greater emotional and behavioral problems.

Preschool and Kindergarten Behavior Scales-2: Social skills were assessed using the Preschool and Kindergarten Behavior Scales–Second Edition (PKBS-2, Najarian et al., 2010). This is a norm-referenced, standardized instrument designed to evaluate the social skills and problem behaviors of children aged 3 to 6 years. The PKBS-2 has been recognized as a strong measure of prosocial skills and also contains many items that address other constructs of interest, such as problem behaviors and emotional knowledge (Najarian et al., 2010). The social skills scale, used in the current study, includes items that describe positive social skills that are characteristic of well-adjusted children aged 3-6 years. Items are scored using a 4-point rating scale (0= never, 1= rarely, 2= sometimes, 3= often). High scores indicate well-developed social skills.

Results

Zero-order correlations were initially run between all variables to identify relevant covariates to include in the study. Variables were included as covariates in the study if they were found to significantly correlate with the outcome variable (either internalizing, externalizing, or total CBCL ratings). Developmental group was included as a covariate for mother analyses, as this variable was significantly associated with CBCL ratings (See Table 1). For fathers, child gender, child race, and developmental group were found to be significant covariates when correlation analyses were run (See Table 2).

Table 1
Results of Correlation Analyses for Mothers' CBCL Ratings

	1	2	3	4	5	6
1. Mother Years of Education	1					
2. Mother PKBS	.305*	1				
3. Mother CBCL Internalizing	-.135	-.621**	1			
4. Mother CBCL Externalizing	-.096	-.520**	.810*	1		
5. Mother CBCL Total Problems	-.183	-.632**	.928*	.929*	1	
6. Developmental Group	-.375*	-.570**	.430*	.292*	.432*	1

Note. ** $p < 0.01$
* $p < 0.05$

Table 2
Results of Correlation Analyses for Fathers' CBCL Ratings

	1	2	3	4	5	6	7	8
1. Father Years of Education	1							
2. Father PKBS	.275	1						
3. Father CBCL Internalizing	-.309	-.761	1					
4. Father CBCL Externalizing	-.386	-.629	.786*	1				
5. Father CBCL Total Problems	-.332	-.771	.922*	.893*	1			
6. Developmental Group	-.248	-.572	.605*	.481*	.539*	1		
7. Child Gender	.097	.331*	-.260	-.259	-.314	-.356	1	
8. Recoded Child Race	-.276	-.266	.355*	.298	.305	.292*	-.024	1

Note. ** $p < 0.01$
* $p < 0.05$

Then, linear regression analyses were conducted via the PROCESS macro for SPSS (Hayes, 2013) to test whether social skills would moderate the relationship between socioeconomic status and child behavioral problems. First, predictor variables (SES and PKBS) were mean-centered to control for multi-collinearity. To test the moderating role of social skills on socioeconomic status in relation to child behavioral problems, an interaction variable was created by multiplying the years of education by the PKBS ratings for both mothers and fathers.

Data for mothers and fathers was run separately, with SES and PKBS scores being used as predictor variables, the interaction term, and relevant covariates all entered into the regression model. Results of the regression analyses for mothers are depicted in Tables 3-5 and in Tables 6-8 for fathers.

First, a PROCESS analysis was run to test whether mother PKBS scores moderated the relation between mother years of education and mother CBCL externalizing ratings. Results indicated that the interaction between mother years of education and PKBS was significant, providing support for the hypothesis that social skills moderated the relationship between SES and child externalizing behavior problems (See Table 3).

Table 3
Results of Linear Regression to Test That Mother Reported Social Skills Would Moderate the Relationship Between Socioeconomic Status and Child Behavioral Problems

Predictor	B	SE	β	t	p
Mother Years of Education	.48	.58	.11	.83	.41
Mother PKBS	-.191	.11	-.33	-1.81	.08
Interaction Mother Years of Education & PKBS	.06	.03	.34	2.14	.04*
Developmental Group	.78	4.05	.03	.19	.85

Note: Dependent Variable = Mom CBCL Externalizing Score
* Significant at the 0.05 level.

Next, a PROCESS analysis was run to test the moderation model with mother CBCL internalizing ratings as an outcome. Results indicated that moderation was not significant, but there was a trend towards significance. Moreover, PKBS was found to significantly predict mother CBCL internalizing ratings (See Table 4).

Table 4
Results of Linear Regression to Test That Mother Reported Social Skills Would Moderate the Relationship Between Socioeconomic Status and Child Behavioral Problems

Predictor	B	SE	β	t	p
Mother Years of Education	.31	.54	.07	.53	.60
Mother PKBS	-.26	.11	-.41	-2.44	.02*
Interaction Mothers Years of Education & PKBS	.05	.03	.27	1.86	.07
Developmental Group	3.64	4.10	.13	.89	.38

Note: Dependent Variable = Mom CBCL Total Problems Score
* Significant at the 0.05 level.

For mothers' CBCL internalizing ratings, moderation was not significant. However, analyses revealed PKBS to be a significant predictor of CBCL internalizing scores (See Table 5).

Table 5
Results of Linear Regression to Test that Mother Reported Social Skills Would Moderate the Relationship Between Socioeconomic Status and Child Behavioral Problems

Predictor	B	SE	β	t	p
Mother Years of Education	.472	.58	.10	.81	.42
Mother PKBS	-.29	.11	-.41	-2.76	.009*
Interaction Mother Years of Education & PKBS	.028	.03	.16	1.03	.307
Developmental Group	3.82	4.04	.14	.95	.350

Note: Dependent Variable = Mom CBCL Internalizing Score
* Significant at the 0.05 level.

PROCESS analysis was used to test the moderation model with fathers' CBCL internalizing and externalizing ratings as an outcome. Results showed no significant moderation. Yet, PKBS was shown to be a significant predictor in both outcomes (See Tables 6 & 7).

Table 6
Results of Linear Regression to Test That Father Reported Social Skills Would Moderate the Relationship Between Socioeconomic Status and Child Behavioral Problems

Predictor	B	SE	β	t	p
Father Years of Education	-.19	.44	-.05	-.43	.67
Father PKBS	-3.42	.08	-.61	-4.19	.000*
Interaction Father Years of Education & PKBS	-.01	.02	-.05	-.50	.62
Developmental Group	2.82	3.38	.12	.84	.41
Child Gender	-2.32	2.62	-.10	-.89	.38
Recoded Child Race	3.15	2.48	.14	1.27	.21

Note: Dependent Variable = Dad CBCL Internalizing Score
* Significant at the 0.05 level

Table 7
Results of Linear Regression to Test That Father Reported Social Skills Would Moderate the Relationship Between Socioeconomic Status and Child Behavioral Problems

Predictor	B	SE	β	t	p
Father Years of Education	-.62	.44	-.185	-1.40	.17
Father PKBS	-.23	.08	-.484	-2.88	.007*
Interaction Father Years of Education & PKBS	.02	.02	-.111	-.89	.38
Developmental Group	-.49	3.36	-.025	-.15	.89
Child Gender	-4.46	2.60	-.234	-1.71	.096
Recoded Child Race	1.70	2.47	.089	.688	.496

Note: Dependent Variable = Dad CBCL Externalizing Score
* Significant at the 0.05 level.

For fathers' CBCL total problem ratings, no significant moderation was found. However, results indicated that child gender and PKBS scores were significant predictors of father reported CBCL total problem scores. (See Table 8).

Table 8
Results of Linear Regression to Test That Father Reported Social Skills Would Moderate the Relationship Between Socioeconomic Status and Child Behavioral Problems

Predictor	B	SE	β	t	p
Father Years of Education	-.33	.41	-.09	-.81	.43
Father PKBS	-.38	.08	-.70	-5.04	.000*
Interaction Father Years of Education & PKBS	-.004	.02	-.02	-.20	.84
Developmental Group	-1.61	3.15	.07	-.513	.61
Child Gender	-5.28	2.44	-.24	-2.17	.04*
Recoded Child Race	1.47	2.31	.07	.64	.53

Note: Dependent Variable = Dad CBCL Total Problems Score
* Significant at the 0.05 level.

Results showed that when mothers had few years of education, whether or not their child's level of social skills made a significant impact on how mothers perceived their child's behavior problems (See Figures 1 & 2). Mothers with few years of education whose children also had low social skills reported significantly more child behavior problems than mothers with few years of education whose children had high social skills. When mothers had many years of education, their children's social skills had little impact on their perceptions of child behavior problems.

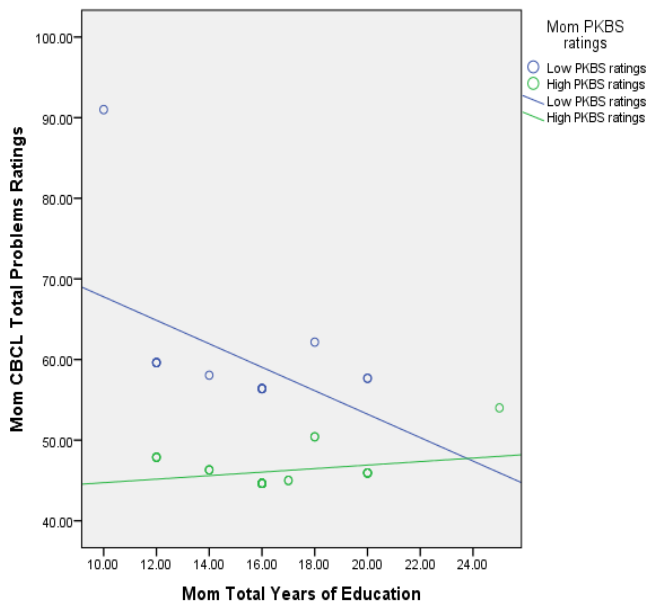


Figure 1. SES & Social Skills Interaction for Mother CBCL Externalizing Problems Ratings

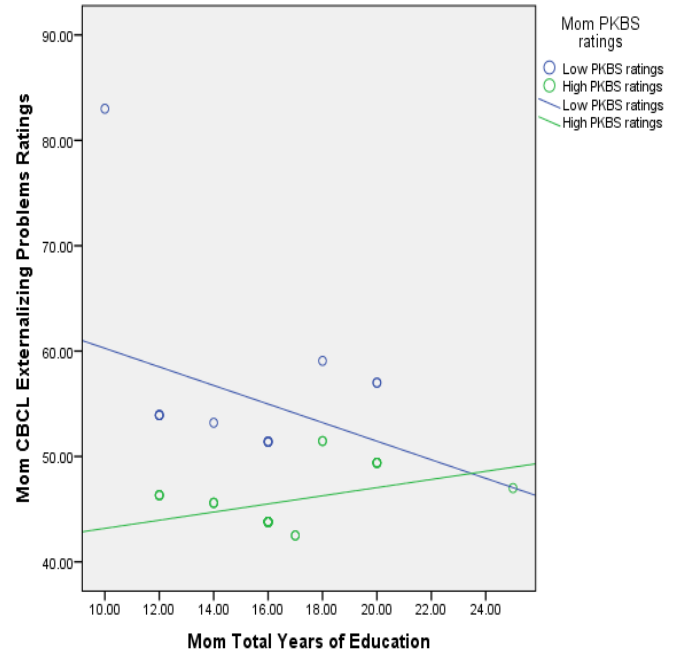


Figure 2. SES & Social Skills Interaction for Mother CBCL Total Problems Ratings

Discussion

The purpose of the present study was to examine whether social skills would serve to moderate the relationship between socio-economic status and child behavioral problems. The results of this study provided partial support for the proposed hypothesis. Specifically, for mothers, social skills buffered the effect of SES on externalizing and total behavior problems. Also, results indicated that social skills predicted child behavior problems for mothers' and fathers' ratings.

Contrary to expectations, SES did not predict behavior problems. This finding suggests that when considered on its own, SES had no significant effect on the child's behavior problems. These results might arise, in part, from the lack of variability in relation to the family's SES. It is important to recognize that although this study did not find SES to be a predictor of behavior problems, there is extensive research that provides important data that highlight the big impact SES can have on a child's overall well-being. For example, problem behaviors have been strongly associated with poor parenting practices in low SES households (Leijten et al., 2013). Similarly, a study done on alcoholic families found that most behavioral problems in children were predicted by family SES (Fitzgerald, Sullivan, Ham, Zucker, Bruckel, Schneider, & Noll, 1993).

Moreover, social skills were also found to be a significant predictor for most types of behavioral problems. Results from this study adds to the existent literature that addresses the role a child's social skills plays in predicting internalizing and externalizing problem behaviors (Koblinsky et al., 2006). Analyses indicated that when moderation was not found, social skills served as a strong predictor for most behavior problems reported by mothers and fathers. This finding is consistent to previous research that found a relationship between social skills and behavior problems in urban preschoolers (Koblinsky et al., 2006).

A child's developmental risk was found to be a significant predictor of behavior problems for both mothers' and fathers' ratings. This finding is parallel to previous research in which children with developmental delays were found to have a greater use of maladaptive strategies and a lower use of adaptive strategies than children who were typically developing (Gerstein, Pedersen y Arbona, Crnic, Ryu, Baker, & Blacher, 2011). Moreover, decreased risk for developmental delay and lower levels of maladaptive behavior have been linked to improved relationships between mothers and their child (Pedersen, Crnic, Baker, & Blacher, 2015). Furthermore, a study conducted by Bagwell, Molina, Pelham, and Hoza (2001) found that childhood ADHD predicted poor peer relations and an impairment to their social functioning. These findings provide support and are consistent to the findings of this study in which a child's developmental risk served as a significant predictor to behavioral problems.

Limitations

Even though partial evidence was found to support the hypothesis, there are important factors that should be taken into consideration which may have influenced the outcomes of this study. Sample size plays a crucial role in the ability to identify certain outcomes, such as main effects. Having a relatively small sample size may have not provided enough statistical power to detect a significant interaction between social skills and SES on child behavior problems. While there is evidence for the effect socioeconomic status has on behavior problems, the lack of representation of the general population in this study may have been a factor that affected the outcome. The mean income of the sample was relatively high, and did not fall under the federal poverty level. The underrepresentation of low SES may have slightly weakened the ability to predict significant outcomes.

Other limitations to note are the cross-sectional nature of this study, and the convenience sample. This study's cross-sectional design means that the results are correlational, which limits generalizability and reduces the ability to determine causation. Moreover, having a convenience sample could have added to the underrepresentation of the general population. Another important thing to note is the possibility of response bias. Since all data was parent self-reported, participants may not respond truthfully, either because they cannot remember or because they wish to present themselves in a socially acceptable manner.

Conclusion

The main finding of this study was that social skills moderated the effect SES has on child behavioral problems. It is crucial to target children's social skills in low-income families, in order to have the biggest impact on reducing behavior problems. Furthermore, social skills were found to be a significant predictor for behavior problems. Research has shown that targeting problem behaviors early on in a child's development can have a substantial positive impact on the rest of their lives (Gilliam, 2017). By applying effective and practical early prevention, we could make a significant contribution to the prosperity of children and the overall functioning of communities (McArdle et al., 2011). Moreover, developing these strengths may decrease or buffer problematic behaviors, and increase overall social and emotional health. (Marshall, 2015).

This study indicates that parents and professionals should be alerted to the importance of helping a child build strong prosocial skills. We should start targeting social skills in therapeutic interventions for children who come from a low SES background, to help reduce the impact behavioral problems may have later in life.

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The Relationship between Parents' Language Practices and Their Bilingual Children's Vocabulary Development

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Abstract

The purpose of this study was to examine the relationship between parents' practices and their bilingual child's vocabulary scores. Twenty-three parents and their bilingual children were recruited from a local Flea Market, in Central California, and were also recruited through social media. A Pearson correlation was conducted to find a relationship between the scores on the PPVT and TVIP, and their relation to telling stories, reading in English, and speaking in English. The results demonstrated a positive correlation between telling stories and PPVT, but not the TVIP. Another significant positive correlation was found between reading in English and the scores on TVIP, but not the PPVT. A final Pearson correlation was conducted, and found a significant positive correlation between speaking in English and the scores on PPVT, but not with the TVIP. These findings are discussed in the context of bilingual learning and parents' home practices.

Keywords: Bilingualism, parent practices, PPVT, TVIP

Introduction

From the day they are born, children begin to learn language based on their early environments. For some children, this means exposure to one language whereas other children learn two or more at once. Children are greatly influenced by their parents' native tongue. As a result, the child begins to acquire vocabulary through language experiences in home. Undoubtedly, supporting their child's bilingualism as monolingual or bilingual parent is an important factor in a child's proficiency in one or both language(s).

Bilingualism

A plethora of research has shown that children learn a second language faster when they are younger. There are differences in the way monolingual and bilingual children acquire and understand their language(s). Bialystok, Luk, and Yang (2010) found that bilingual children know less words compared to monolinguals. Furthermore, differences between monolingual and bilingual 2nd graders and 5th graders showed that 5th graders monolinguals performed better in a metalinguistic analysis (Hermanto, Moreno, &

Bialystok, 2012). Other research by Bialystok and Viswanathan (2009) demonstrated differences in bilingual children's inhibitory control, showing that bilinguals have to hold back a language when speaking to a monolingual.

For sequential language learners, these processes may differ. Umbel and Oller (1994) demonstrated that children need to be proficient in their first language to be successful in learning a second language. Research has found that children are more successful in learning a second language if the child has developed an understanding of their first language (Clifford, Rhodes, & Paxton, 2014).

These studies show some of the ways that language development differs among children. Of course, parents also place a role in their children's language learning.

Parents' Language Practices

Parents place different emphases on their child's language development. Satomi (2011) found that a child will speak more of a given language depending on the language spoken by the parent. It is common for parents to want their child to learn their native language. Lee,

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Shetgiri, Barina, Tillitski, and Flores (2015) found that parents prefer their bilingual children to practice their English at school because the parents feel like teaching the native language should be done at home. Parents may have the best intentions in wanting their children to be bilingual, but sometimes do not understand some of the language difficulties bilingual children may have (King & Fogle, 2006). For example, monolingual Spanish-speaking parents knew when their child was struggling in both languages. As a result, parents attempted to help their children any way they could by creating strategies such as asking the child to translate an English book verbally to Spanish to help their child practice their Spanish (Worthy & Rodríguez-Galindo, 2006).

However, knowing how to help one's child can be difficult, especially for immigrant parents who face challenges adapting to a new environment. Bilingual children's parents from a foreign country were less involved in their child's education (Turney & Kao, 2009). This was due to barriers that parents faced as minority immigrants (e.g., lack of child care, inconvenient meeting times, not speaking English, etc.). Other research supports the idea that the parent's ability to integrate themselves in a culture outside of their own helps their children excel in a school setting (Eunjung, 2002). Some schools support the development of both languages, which helps to remove the pressure of teaching both languages in the home. Still, the home environment plays an important role in language learning.

Mishina-Mori (2011) demonstrated that parents respond in a different language when considering the situation. Parents use their own language experiences of language to teach their children (Sawyer, Manz, & Martin, 2017). In fact, parents that knew both languages would use the language that they struggled with growing up as a way to support their child's learning of either language(s). Furthermore, bilingual parents play a role in what language their child will speak in the home (Hu, Torr & Whiteman, 2014). For example, parents tend to emphasize English at home, because they believe learning another language can hinder their child's success in English (Hu et al., 2014).

On the contrary, some parents want to teach their children their native language to be closer to the culture the child was born into. Farruggio (2010) found that parents place a special importance on making sure their child can speak their native language. Conversely, Dorner (2010) found that some parents placed their child in a two-way immersion program, because they found both languages to be valuable for their children in the future. Gerena (2011) demonstrated a difference in why parents want their children to learn another

language. For example, parents that spoke Spanish said that they wanted their child to learn Spanish so they can preserve their language and culture (Gerena, 2011). This is contrary to English-speaking parents that said the child would benefit from knowing another language for job opportunities and global connectedness (Gerena, 2011). Stritikus and Garcia (2005) compared Hispanic and non-Hispanic parents and the results showed that over 80% of the Hispanic parents wanted their children to be taught in a Spanish in the classroom. Alternatively, some parents preferred their children to be in dual programs because they liked how it valued their native language (Ramos, 2007).

Based on previous research, it is clear that parents approach language learning in the home differently, which plays a large role in children's outcomes. The current study explored similar aspects such as comparing parents' language practices and their child's vocabulary knowledge.

Present Study

The current study was conducted to understand children's vocabulary knowledge in both languages (e.g., English and Spanish), and how it relates to parents' language practices in the home. This research will specifically be adding to the literature by answering the following hypotheses: 1) amount of time telling stories will be correlated with higher English and Spanish vocabulary scores; 2) the amount of reading in English will be correlated with higher English and Spanish vocabulary scores; and 3) the amount of time speaking in English will be correlated with higher English and Spanish vocabulary scores.

Method

Participants

A sample of 23 participants was recruited at The Crows Landing Flea Market and through social media (e.g., Facebook & Instagram). The children age ranged from 2-5 years old ($M = 4.13$, $SD = 0.81$). There was an even split between parents were born in USA = 43.5% ($n = 10$) and Mexico = 43.5% ($n = 10$), with an addition few born in El Salvador = 8.7% ($n = 2$). Regarding language(s) spoken in the home, 34.8% reported speaking only Spanish while 56.5% reported speaking both languages.

Measures

English Vocabulary. The Peabody Picture Vocabulary Test (PPVT) consists of 19-sets and has 12 questions per set to assess an individual's vocabulary knowledge in the English language. The assessment begins at 2.5 years of age, and it goes on to 19 years of

age, and into adulthood. Scoring in the PPVT is done by using the basal and ceiling set rule. The basal set rule is one or zero errors in a set. The ceiling set rule is eight or more errors in a set. Once the child has eight errors in a set the assessment ends.

Spanish Vocabulary. Test de Vocabulario en Imagenes Peabody (TVIP) consists of 125 pictures to assess an individual's vocabulary knowledge in the Spanish language. The set begins at 2.5 years old, and it continues to 14 years and on. Basal and ceiling rules are used to measure the child's score. The basal is measured by using the highest eight consecutive correct responses. The ceiling is measured by using the eight consecutive responses that contain six errors. After the child reaches six consecutive errors within the eight consecutive the assessment ends.

Parent's Language Practices. The Parent Child Activities and Language and Culture Orientation (1998) questionnaire measures how much interaction the child and parent have during every day activities. For example, one of the questions that was asked was "Telling stories to the child." The scale for the question was 6= not at all and a 1= more than once a day.

Procedure

After the parent/guardian consented to participating in the study, the child was administered the PPVT and TVIP. While the child was taking the PPVT and the TVIP, the parent/guardian completed the Parent's Language Practices questionnaire. They had the right to end the study whenever the parent or child wanted. After the parent completed the questionnaire, and child the was tested in both the PPVT and the TVIP, the parent was debriefed. The parent was given a raffle ticket for the possibility of being randomly selected, and getting a goody basket. As an incentive the child was given a tub of Play-Doh.

Results

A Pearson correlation was conducted between PPVT ($M = 98.61$, $SD = 14.57$) and TVIP ($M = 89.26$, $SD = 16.13$) with telling stories ($M = 4.38$, $SD = 1.12$). A significant positive correlation was found between telling stories and the scores on the PPVT, $r = 0.55$, $p = 0.01$. In comparison to the TVIP, there was no significant positive correlation found between telling stories and the scores on the TVIP, $r = -0.13$, $p = 0.57$.

A second Pearson correlation was conducted between PPVT ($M = 98.61$, $SD = 14.57$) and TVIP ($M = 89.26$, $SD = 16.13$) with reading in English ($M = 2.70$, $SD = 1.38$). There was no significant positive correlation was found between reading in English and the scores on the PPVT, $r = 0.20$, $p = 0.39$. A significant

positive correlation was found between reading in English and scores on the TVIP, $r = 0.39$, $p = 0.09$.

A final Pearson correlation was conducted between PPVT ($M = 98.61$, $SD = 14.57$) and TVIP ($M = 89.26$, $SD = 16.13$) with speaking in English ($M = 2.67$, $SD = 1.11$). There was no significant positive correlation found between speaking in English and the scores on the PPVT, $r = 0.06$, $p = 0.81$. A significant positive correlation was found between speaking in English and the scores on the PPVT, $r = -0.42$, $p = 0.06$.

Discussion

This study looked at the relationship between parents' language practices, and bilingual children's vocabulary scores on the PPVT and the TVIP. The results partially supported the hypotheses. The results demonstrated a positive correlation between telling stories and PPVT, but not the TVIP. This might be due to most stories being told in English, thereby supporting English vocabulary development.

An additional significant positive correlation was found between reading in English and the TVIP, but not the PPVT. This finding was unexpected given the two languages involved. Perhaps the child is applying their vocabulary knowledge in English to Spanish.

A final Pearson correlation was conducted and found that a significant positive correlation between speaking in English and the PPVT, but not with the TVIP. This finding supports past research that shows speaking is related to vocabulary development (Hoff, 2006).

Limitations

Limitations in the study included missing parent data, the data collection environment, and sample size. First, there were no demographic questions for the parents. This did not allow the researchers to analyze the relationship between children's vocabulary scores and parent's age, income, and education level. Another limitation was the environment where the children were recruited. Some of the participants were recruited and tested at the local flea market whereas children recruited through social media were in their home. These children may have been able to focus more in comparison to the children that were in the louder flea market environment. In addition to the noise level distractions, some parents hovered over their child during the PPVT/TVIP administration. Lastly, the small sample size was not a good representation of bilingual children, nor did it allow for appropriate group comparisons.

Future Research

Future research could focus on comparing first-and second-generation parents, parent perceptions, and comparing monolingual and bilingual children to the parents' perceptions. By comparing first and second-generation parents, research can better understand how language practices differ in the home. A parent perceptions questionnaire can help with comprehending how parents practice language and value or prioritize language. Lastly, it would be interesting to compare bilingual and monolinguals, and how they differ in terms of their parents' practices and perceptions.

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Risk Aversion Behavior in a Mock Gambling Task

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Abstract

Humans consistently face risky decisions. Previous research suggests that people tend to favor lower risk options and that framing influences an individual's choices. The present study set out to discover whether reordering the level of risk of a gamble and the payout of that gamble changes an individual's decision when faced with multiple gambling options. The participants in the study were recruited through, an online survey platform ($n = 431$). Participants were shown 15 questions, each containing 5 gambles of which they were instructed to choose one. These gambling options presented participants with complete information, i.e. the exact percentage chance of winning and payout of the win. Participants, on average, played conservatively overall, choosing options with lower levels of risk. The hypothesis was that those individuals who were shown the level of risk first would choose their gambles more conservatively because they would be focused on the levels of risk. The results did not support the hypothesis, indicating that there is no statistically significant difference between the individuals that were shown the level of risk first compared to the payoff of a particular gamble. This suggests that the experimental manipulation did not have a significant impact on the behavior of the participants. The present study demonstrates that this low level of manipulation is not enough to sway an individual's choice.

Keywords: risk aversion, framing effects, gambling

Introduction

Individuals consistently face risky decisions. When we encounter these situations, we have to weigh the costs and benefits, considering if the risk we are taking is worth the potential gain. A large body of research is built around discovering what impact risk has on our behavior. Most individuals display a general aversion to risk, called risk aversion, meaning that they are more likely to choose an option with lower levels of risk, even if it is not the most statistically valuable. When proposed with two options of similar expected value (percent level of risk multiplied by payout), most individuals choose the option with a lower level of risk. These effects have been heavily examined in recent years in many different circumstances (e.g. Buchak, 2014, He & Hong, 2018). Due to its prevalence, risk aversion has become one of the foundational assumptions of modern behavioral economics.

Some popular explanations as to why humans are economically risk averse come from Expected Utility (EU) Theory (Neumann & Morgenstern, 1944) and later Prospect Theory (Kahneman & Tversky, 1977, 1990). EU Theory postulates that when a decision maker is faced with a risky situation, they will weigh the EU of each choice and make the decision best suited for their needs. This theory was first described by Bernoulli in

1738, who saw that individuals did not simply weigh the expected value (EV) of a scenario, they took many other variables into account. EV is a simple calculation of potential payout of a scenario multiplied by the likelihood of that scenario happening, most easily calculated in a gambling scenario (one ticket out of 20 in a raffle with a \$100 prize is worth $\$100/20 = \5). Bernoulli noticed that individuals do not always value things in terms of their EV, even if they are purely financial endeavors, because they take into account the relative usefulness (utility) they would get from it. For example, an impoverished individual finds a lottery ticket on the ground with 50% chance of winning \$100,000 and are offered \$49,999 for it. The expected value method would recommend that the individual refuse the offer, since the ticket is worth \$50,000. However, most people would gladly take the offer since the utility difference between \$0 (their current net worth) and \$49,999 is significantly more than the utility difference between \$49,999 and \$100,000. While the most obvious times that this sort of logic comes into play are decisions to gamble (e.g. play the lottery), but it also impacts our decisions on things such as potential career paths (e.g. weighing future pay vs. career satisfaction). This theory was further developed and brought into more modern economics by John von

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Neumann and Oskar Morgenstern (1947), who added axioms of rational behavior to the theory.

However, even the updated theory came under criticism, as some researchers try to develop the theory and accompanying models to better adapt them to the real world. For example, Buchak (2014) argues that EU theory inadequately addresses how different people react to risky situations. She proposes a risk-weighted expected utility theory, which more broadly considers risk in its calculations, essentially adding a third variable on top of utility and probability: risk-attitudes. She further argues that when individuals are faced with a risky situation, their attitudes towards risk and their current situations have a significant impact on the decision they will make. Because of this, she makes risk more of a centerpiece to how individuals behave, rather than as a small, individual difference in behavior. This view of risk-taking behavior does a better job of taking individual and cultural perceptions of risk into account on a situational basis, providing a more holistic view of human risk-taking behavior.

Prospect theory adds significant psychological complications to traditional views on risk-taking behaviors (Tversky & Kahneman, 1981). The authors of Prospect Theory argue that the framing of a situation has significant effects on the decisions made by individuals. By framing something in a positive light (e.g. saving lives), individuals are more inclined to choose that option over something framed in a negative light (e.g. losing lives). Their research provides quantitative evidence that individuals typically display some risk averse behavior. For example, the researchers gave participants the option to choose between two treatment options for a fatal disease that 600 patients contracted. Treatment "A" results in 400 deaths, treatment "B" gives a 33% chance that no one dies, but a 66% chance that all 600 participants die. Treatment "A" was augmented in different surveys, sometimes stating rather than 400 people dying, 200 people will live. When framed as 200 lives saved, 72% of participants chose treatment "A", but when framed as 400 lives lost, the number dropped drastically to 22%, despite the exact same outcome. This shows that the way a question is presented to participants has a substantial effect on their choices. Beyond this, the researchers asked 77 individuals if they would prefer a sure win of \$30 (78% of participants), or an 80% chance to win \$45 (22% of participants). This is despite the expected value of the latter bet being higher (\$36 compared to \$30), illustrating an apparent irrationality in human behavior, that most individuals display some kind of risk aversion behavior (Tversky & Kahneman, 1985). This is also partially explained from taking into account EU theory, in that the utility difference between \$0 and \$30 is much more significant than the difference from \$30 to \$45, so many individuals would be inclined to take the sure bet.

From this idea of risk aversion, we can assume that most individuals, on average, frame high levels of risk in a negative light. Thus, making the level of risk of a particular scenario more pronounced, individuals may have an aversion to it.

Risk aversion plays a large role in gambling decisions. The vast majority of researchers agree that some form of risk aversion takes place in gambling situations. While there are some individuals who are actively risk-loving (meaning they seek risky situations out for the potential rewards), most individuals are actively risk averse. Safra and Segal (2008), for example, argue that risk aversion is low when only small gambles are in questions, but when larger amounts of money come into play, the risk aversion displayed by individuals increases. This can help explain why individuals are willing to gamble small amounts of money in lotteries. Despite the incredibly small chance of winning, the small amount of money allows people to display substantially less risk averse behavior. The loss of that small amount of money may have no significant effect on the lifestyle of an individual, so there is no noticeable penalty through the loss.

With the existence of risk aversion behavior comes the need to measure how much risk taking an individual is likely to do. Numerous risk-taking questionnaires have been developed with the goal of predicting human risk-taking behavior. Established tests such as the Everyday Risk Inventory (Steketee & Frost, 1994) seek to gain insight into how much risk an individual is willing to take in specific areas such as finances. The Risk Propensity Scale is a newer scale, developed to be taken quickly which is advantageous in a brief, online study such as this (Meertens & Lion, 2008). The RPS has 7 questions, each of which use a Likert scale from 1 to 9. The Cronbach's alpha for the RPS was .77 and showed significant correlations with the longer Everyday Risk Inventory ($p = .01$, $r = .48$).

The present study examines the levels of risk individuals are willing to take depending on whether the participants are given the condition in which risk or reward is emphasized. The first hypothesis is that individuals will be more risk averse when level of risk is emphasized as opposed to an emphasis on the payout. The idea behind this is that individuals will pay more attention to the first thing that they see (the part of the gamble that is on top), which provides them with a foundation to compare and judge the proceeding gambles. Here, if an individual sees that there is a 90% chance at winning a small amount of money that may look significantly better to them than a 20% chance at winning a much larger amount of money, even if the expected value (EV) of the latter bet is greater.

The second hypothesis is that individuals will tend to choose gambles with a higher expected value, regardless of level of risk since the additional payout

will be enough to outweigh the additional risk. Essentially, this is a prediction that individuals will pay attention to the gambles. While they may show some risk aversion or risk loving behavior, individuals will pay attention to the EV of the gambles and take the bets that have a higher value. Individuals may make different decisions at this level, with some individuals that show extreme risk aversion choosing the safer bets consistently over more risky gambles, but on the whole participants should pick the bets with higher EV.

The final hypothesis is that individuals whose scores on the Risk Propensity Scale indicate that they will be more prone to take risk will take more risky gambles overall. This serves to show that the predictive value of the scale can be applied to this mock gambling task. Since the measure has been shown to have predictive value, a correlation here provides supporting evidence that people are taking the gambles seriously and playing in accordance to how they actually view risk taking.

Methods

Participants. Participants were recruited through Amazon Mechanical Turk (MTurk). Participants were paid \$0.50 for their participation in the survey. A total of 431 participants were recruited, all of whom completed the study in its entirety. The median age of the sample was 33 years old, ranging from 19 to 80. The majority of the sample was white (75.4%), heterosexual (87.5%), and male (58.9%). Data were collected on the participant’s level of education. All participants completed their high school education and 89.8% of the sample completed at least some college or trade school. *Materials and Procedure.* Participants were directed from Mturk to a Qualtrics survey. Participants were first given an informed consent form followed by a basic demographics questionnaire. Participants were then directed to an instruction block, which described the task and ensured participants that none of their own money was at risk, nor would they win any money from the task. Then participants were randomly assigned to one of two groups, the risk emphasis (RE) group or the payout emphasis (PE) group (see Figure 1).

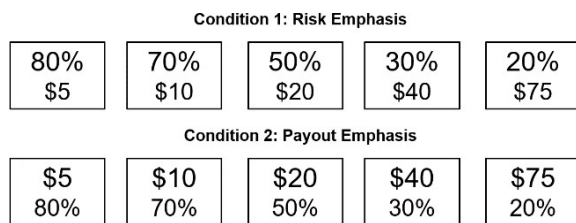


Figure 1. Example of Risk Emphasis and Payout Emphasis groups

The participants in these groups were given fifteen questions in total. In each question, the participants were able to choose one of five available options, depending on which gamble they would prefer. All of the gambles were entirely theoretical, meaning that there was no risk to participants. The RE group was shown the gamble with the level of risk on top and the payoff on bottom, and the PE group was shown the opposite. The gambles were separated into three separate groups, one group where expected value (EV) increases with increasing levels of risk, one where EV decreases with increasing levels of risk, and one where EV remains constant throughout levels of risk. The gambles were created somewhat arbitrarily so that it was not immediately obvious which bet had the highest EV, but preference was given to bets with numbers divisible by 5 for both the payout and level of risk. This was done mostly for easy processing of the bets by the participants, since the goal is not to “trick” them into picking the “wrong” bet. The bets with increasing EV with increasing levels of risk were chosen such that there was a consistent increase in EV. Similarly, the bets with decreasing EV with increasing levels of risk were chosen such that there was a consistent decrease in EV. The bets with constant EV were chosen so that there was very little (if any) variance between the EV of the different choices. Differences in EV were kept below 10 percent in this condition. Each of these gambles were rated on a scale of 1 to 5, 1 being the least risky option and 5 being the riskiest option. These were defined as such to determine how much participants were willing to take risks.

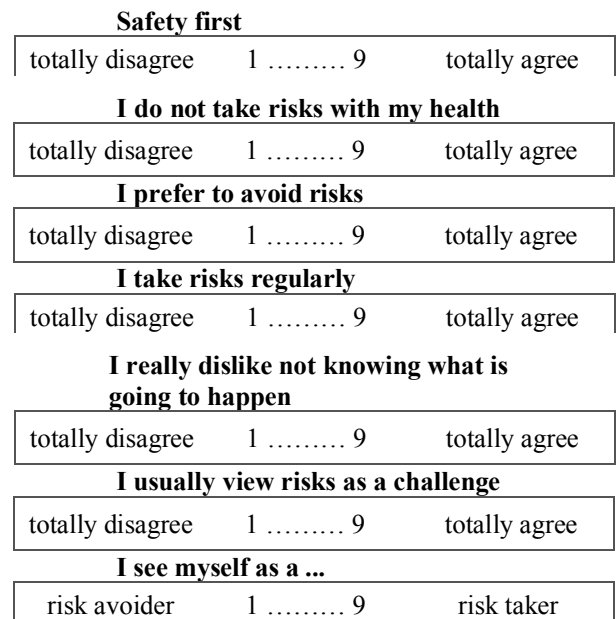


Figure 2. The Risk Propensity Scale (Meertens & Lion, 2008)

Participants were then given the Risk Propensity Scale (RPS) in order to correlate their general risk-taking behaviors with the options they choose (see Figure 2). The RPS consists of 7 questions, each scored on a Likert scale from 1 to 9, several of which are reverse coded. A high score means an individual is more prone to risk taking behavior and a low score means an individual is less prone to risk taking behavior. Finally, participants were given a debriefing form and thanked for their participation in the study.

Results

The participant's choices on the gambling tasks were rated from 1 to 5, with 1 being the least risky gamble and 5 being the most risky. This weighting is regardless of the EV of the gamble. The first hypothesis, that individuals will be more risk averse when level of risk is emphasized as opposed to an emphasis on the payout, was not supported. An independent samples *t*-test was used to determine if there was a difference between the PE ($M = 2.15, SD = 1.01$) and RE ($M = 2.13, SD = 1.05$) groups based on RPS scores ($t(428), p = .87, d = 0.02$), indicating no significant difference between the randomly assigned groups. In sum, this indicates that the order of the level of payoff and risk were not significant determinants of the participant's choices. For the second hypothesis, the means of participants' choices between the three groups of gambles (increasing, decreasing, and constant EV with increasing risk) were compared. Since the increasing EV questions should have influenced participants to choose gambles with higher risks, the decreasing EV questions should have influenced participants to choose gambles with lower risks, and the constant EV should have been somewhere in the middle. The mean responses followed the prediction with participants taking the most risky gambles in the increasing EV group ($M = 2.49, SD = 1.16$) followed by the constant EV group ($M = 2.08, SD = 1.12$), and the decreasing EV group ($M = 1.84, SD = 1.12$). The PE and RE groups were compared based on their gambling choices with a Repeated Measures ANOVA ($F(1, 429) = 0.03, p = .871$) with increasing, decreasing, and constant EV as factors. This indicated there was no significant difference between the groups from the experimental manipulation across the gambling options. While there was no difference between the PE and RE groups, there were differences in the increasing, decreasing, and constant conditions. The difference between increasing and decreasing EV was the largest ($t(429) = 15.608, p < .001, d = 0.75$), then the difference between increasing and constant EV ($t(429) = 11.99, p < .001, d = 0.56$), followed by the difference between constant and decreasing EV ($t(429) = 8.08, p < .001, d = 0.39$). This suggests that the

participants paid attention to the EV of each of the bet choices and chose, on average, bets with a higher EV. A bivariate correlational analysis was conducted to determine whether the individual's choices on the Risk Propensity Scale (RPS) correlated to their level of risk taking. The analysis showed that the individuals whose scores indicated that they were more prone to risk taking behavior correlated to more risky behavior in the gambling task; $r = -.13, p = .008, N = 431$. This supports the original hypothesis that those individuals that score higher on the RPS will take more risky gambles overall.

Discussion

The data did not support the first hypothesis. This suggests that the experimental manipulation may have not been significant enough. Past research has focused largely on framing the risk level as a potential for loss or in a significantly different way. The present study had a much subtler manipulation, which may have not been enough to sway the decisions of the participants. Future researchers should consider significantly increasing the font size of the group they wish to emphasize or find another way to further emphasize the group of interest. This study does, however, indicate more about what is necessary to manipulate the decisions of participants. The questions could also be phrased differently in two different groups which either emphasize the amount of money that will be lost if the gamble is not won or the amount of money that will be won if the gamble is won. This could be done in a similar way to Tversky and Kahneman (1981), who showed that participants will overwhelmingly choose an option framed as saving lives over an option framed as losing lives, even if the net outcome was identical. This addition could tell us more about individual differences and their interaction with risk. Alternatively, an example could have been given at the start that was framed in the opposite way of the participant's condition, or the framing could have been switched part way through the questionnaire for comparison purposes. This would have given a baseline for each individual, and a better indicator of the effect of the framing effects (Druckman, 2001).

Additionally, there may have been issues with the participants not taking the study seriously enough. The average participant completed the survey in just three minutes. While the survey itself was not particularly time intensive and actually could benefit from a "gut feeling" approach, 75 participants chose the first option for all of their gamble questions. While a risk averse individual may choose the most "sure thing", some of the gambles were quite obviously a better deal with the increased levels of risk. This suggests that these individuals may have simply chosen the option that completed the survey the quickest. Moreover, the gambles were presented to participants from lowest

level of risk to highest level of risk in every gambling option. Randomization of the options or randomly switching the order from increasing risk to decreasing risk would likely have made the phenomenon of individuals picking the left or right most options easy to identify. Given that the second hypothesis was supported, we can assume that participants, on average, gave some thought to their choices, by making a conscientious effort to change their decisions depending on the options available to them.

Even though there is, some indication that some of the participants may not have taken the study very seriously, the fact that the second hypothesis was supported indicates that the participants paid some attention, on average, to the gambles. Participants took significantly more risky gambles when the EV increased with increasing levels of risk compared to those gambles where EV decreased with increasing level of risk. This indicates that participants actually cared, to some extent, about how good of a “deal” they were getting with the gambles. They looked through their options and were more likely to choose those that had a higher EV. The fact that this hypothesis was supported may give an indication of how much reward is required for participants to take added levels of risk. It is interesting to note that the mean choice of the increasing EV group of questions (2.49) was still below the middle of the scale (2.5), indicating that individuals played conservatively overall. The final hypothesis aligns with previous research on the RPS, since individual differences in gambling choices were correlated with the test; this provides supporting evidence that it has predictive capabilities (Meertens & Lion, 2008). If future researchers are able to keep the attention of their participants for longer (perhaps through an in-person study), they should consider having longer-form risk taking questionnaires, perhaps including a financial risk-taking subtest, for a more sensitive measure. Alternatively, including multiple risk-taking tests would be beneficial so that the results of these tests could be correlated with one another.

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A Study on the Optimal Recovery Methods Following Anterior Cruciate Ligament Reconstruction Surgery

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Abstract

With the rapid increase in sports competitiveness, there has been an alarming increase in sports injuries as well. Preventative methods have been looked at and developed in depth, however, little studies have followed after injury in the recovery process. It is important to examine the recovery process following these injuries, not only for the client's return to activity but for a better quality of life following an injury. As the anterior cruciate ligament (ACL) is one of the most torn ligaments in the body and knee, especially in sports where quick changes in direction are required, the purpose of this study is to look at the recovery methods used following reconstructive surgery. This study pulled data from various sources, looking at recovery methods following ACL reconstructive surgery. The methods looked at are neuromuscular stimulation, creatine supplementation, eccentric exercises, and weight-bearing exercises. This study was designed to determine whether there is a single method or combination of methods that is the most optimal for a patient's recovery following reconstructive surgery. Examining the literature and comparing the studies done for each different method, I found that the combination of neuromuscular stimulation, eccentric exercises, and weight-bearing exercises are the most beneficial for the majority of patients following reconstructive surgery. Neuromuscular stimulation was used most often in the first weeks following the surgery, then moved onto eccentric exercises and weight-bearing exercises. Input from athletic trainers and physical therapists will be input into the study following in-person interviews. These findings are beneficial to athletic trainers and physical therapists for bettering the patients' recovery following the reconstruction surgery. Further studies will look at different methods in comparison to the examined methods.

Keywords: Anterior Cruciate Ligament, ACL, reconstruction, rehabilitation, recovery method, physical therapy

Introduction

One of the most common injuries in the more recent years, especially in women's field sports where pivoting is required, is the anterior cruciate ligament (ACL) tear. The anterior cruciate ligament is a ligament in the middle of the knee that controls the stability of the knee and influences some motor functions and range of motion of the knee. When torn, the ACL weakens the stability of the knee and leg, as well as causing a reduced reliance on the quadriceps, weakening the leg (Lepley et. al., 2014, p. 270). For athletes, a torn ACL causes an increase in ground reaction forces, increased time to stabilization and often means 6 months to a year in recovery (Webster & Gribble, 2010, p. 581). Even after surgical reconstruction, knee joint motion and proprioception can remain altered and may lead to a higher risk for articular cartilage degeneration and early onset

osteoporosis, in turn lowering quality of life (Hongsheng et. al., 2011, p. 170). Pre-operative and post-operative recovery methods are used to reduce the potential side effects of the reconstructed ligament. While surgical methods have continued to improve through the years, pre and post-operative recovery methods have yet to be looked at on a universal level to find the best way to improve post-reconstruction quality of life. Surgery plays a big part in the patient's return to his/her pre-injury quality of life, but the purpose of this study is to determine the optimal recovery method or combination of methods following reconstruction surgery are the most beneficial in long-term recovery. The methods examined in this study are preoperative conditions, physical therapy, neuromuscular stimulation, creatine supplementation, eccentric exercises, and weight-bearing exercises.

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Background

The anterior cruciate ligament plays an important role in leg stabilization, and damage to the ACL can lead to an asymmetry between legs that can impede full recovery and joint functionality (Krafft, 2017, p. 13). Most ACL tears are seen in sports requiring quick changes in direction such as soccer, volleyball, softball, football and alpine skiing (Tengman, 2014, p. 491). Depending on the type of tear and level of activity of the patient, surgery may be optional. Older subjects who live a more sedentary lifestyle may forego surgery in return for alternative training, while younger athletes more often opt for surgery to return to play and to maintain their more active lifestyle (Meuffels, 2012, p. 382). However, surgery is the best option for a possible return to pre-injury conditions, and the best possible quality of life. Anterior cruciate ligament surgery is most often done by a knee arthroscopy, through a tiny incision on the medial side of the knee. A camera is inserted for the surgeon to locate and inspect the injured and surrounding parts. The medical instruments are inserted along next to the arthroscope and will remove the remaining ACL with shavers and other instruments, then drill a tunnel in the bone where the graft will be placed. With the graft placed in the bone, they are secured using sutures, staples, and most commonly, screws (Taradaj, 2013, p. 2). With the ligament secured with the screws in the tunnel, the bone will regrow around the graft creating a new ligament. While specific surgical methods differ, a graft is always required to rebuild the torn ligament. The most common places grafts are harvested from include the hamstring tendon and kneecap (patellar) tendon and may either be an autograft, a graft from your own body, or an allograft, a graft from a donor (Gupta, 2017, pp. 2382-2383). Autografts can reduce the chance of post-surgery infections but can leave donor site morbidity and pain (scars), whereas allografts reduce pain and surgery time, but have a higher chance of infection (Mansson, 2011, p. 19).

Prior to reconstruction surgery, the process of diagnosing a ruptured ACL has improved in accuracy over time and is widely due to the following accepted procedures. The Lachman test for knee stability, the pivot test, the Knee Injury and Osteoarthritis Outcome Score (KOOS) alongside the International Knee Documentation Committee Subjective Knee Form (IKDC), both examine daily activity, pain, and quality of life on a scale, and the Tegner activity score is the

most widely used tests in diagnosing a ruptured ACL. The Lachman test looks at the manual anterior tibial displacement at during knee flexion and is used to diagnose, with accuracy, ruptures of the ACL and was validated in a study done by Martin C. Logan et. al in 2004 on how accurate the Lachman test was in predicting a ruptured ACL (p. 369). The pivot test is used alongside the Lachman test for diagnosing ruptures in the ACL using clinical measurements (Meuffels, 2012, p. 381) A study in 2012 by Luella Engelhar et. al. (2012) noted how the KOOS and the IKDC were able to separate the patient's symptoms, pain, quality of life, functionality, and activity level separately in order to provide the most individualized care possible (p. 2271). The examination of the knee prior to diagnosis is a factor that helps to determine functionality and limit post-operative complications (Krafft, 2017, p. 2). The Tegner activity score is most commonly used in the assessment of the quality of life and activity level of the patient following reconstructive surgery. It has also been used primarily to help study the quality of life and activity level many years after reconstructive surgery (Tengman, 2014, p. 493).

Literature

The main focus of rehabilitation protocols following reconstructive surgery is to return the patient back to the best quality of life possible. For athletes, that quality of life is the return to play at what their play level was prior to the ACL injury, which can be difficult to do. The significance of the pre-operative conditions and factors was studied by O. Mansson, J. Kartus, and N. Sernert in 2011. The study consisted of 73 participants, with a mean age of 24.6 years old and a range of age 14-40 underwent a pre-operative assessment that included range of motion, knee laxity measurements, a pivot shift test, a one-leg hop test, and a knee-walking test, while also evaluating activity level using the Tegner scoring and Lachman test with self-reported knee-patellar pain (Mansson, 2011, p. 16). Two different surgical techniques were used, the BPTB and the HT technique, and all patients received the same rehabilitation guidelines that allowed for weight-bearing and full range of motion and hyperextension movements. Following the study, Mansson, Kartus, and Sernert (2011) concluded that the pre-operative conditions that influenced a good quality of life the most following reconstructive surgery were the pivot shift test, the Lachman test and

the type of graft. While this study did not specifically look at recovery methods, it highlights how pre-operative conditions are influential in the quality of life post-reconstructive surgery as much as recovery methods are. In 2017, another study on the functionality of the knee pre and post reconstructive surgery was conducted by Fletcher C. Krafft, Bernd J. Stetter, and others. The study consisted of a total of 40 participants, 20 with a torn ACL, but no other ligament problems, and 20 control participants that had no history of previous leg injuries (Krafft, 2017, p. 3). The subjects were subjected to questionnaires, functional clinical tests, and functional performance tests. Two different questionnaires consisted of a self-evaluation of knee function and the influence of the ACL on general quality of life, while one was more surface evaluation, the second one, the Knee Injury and Osteoarthritis Outcome Score (KOOS) looked at the pain levels, daily activity, sport and recreation function and knee-related quality of daily life. The functional clinical tests consisted of leg circumference measurements in five places and passive range of motion of the knee joint measurements three times on each leg using a goniometer. The functional performance tests consisted of three separate types of jumps that examined the knee extension capabilities and knee extension musculature. The examination of what limits and determines the knee function pre and post ACL reconstruction concluded that the leg symmetry indices remained lower, indicating a greater difference in leg circumference between the reconstructed leg and the non-reconstructed leg, in the ACL tear and reconstruction group indicating a reduction in knee functionality post-tear and reconstruction surgery (Krafft, 2017, pp. 12-13). While functionality is not directly a form of rehabilitation, the study of how the knee reacts functionally to prior to and after reconstructive surgery plays an important role in how therapists can adapt recovery programs to meet individual functionality needs (Krafft, 2017, p. 15).

The standard of care differs by practice, but the general standard of care followed includes a criterion-based, rehabilitation program that emphasizes weight-bearing exercises, functional and resistance training, and early increase knee range of motion (Gerber, 2009, p. 52). The standard of care is what most studies are comparing to as the normal recovery process that they are trying to make better and safer. By

establishing a standard of care, more efficient examination and rehabilitation are capable, but the purpose of examining the standard of care next to the experimental recovery method is to determine which one has a more significant increase to the quality of life of the patient both in the short term and in the long term. If an experimental method is tested and proved significant improvements as compared to the standard of care, there will potentially be a change to the standards of care.

One of the most looked at recovery methods in recent years is neuromuscular electrical stimulation (NMES). Neuromuscular electrical stimulation is the process of stimulating the lower motor neuron to activate intact tissue subcutaneously (Lynne, 2007, p. 562). NMES is through stimulation of the peripheral nervous tissue, creating an action potential, the same way the body would naturally causing a muscle contraction (Lynne, 2007, p. 563). According to Lindsey Lepley (2014), quadriceps weakness following ACL reconstruction is one of the leading causes of decreased functionality of the knee and can be a cause of potential re-injury (p. 270). In 2017, I. Taradaj and others conducted a study that examined the effect of NMES on quadriceps strength and knee function in professional soccer players (p. 1). A total of 80 male soccer players participated in the study undergoing the same arthroscopic surgery and rehabilitation program in the six months following reconstruction surgery prior to NMES. The study conducted was a double-blind experiment, where conditions were randomly selected into groups (p. 3). While both conditions included hopping, aerobic exercises, and lower extremity strengthening, only one group received NMES on both legs. Taradaj's study measured the muscle strength, leg circumference, and range of motion and concluded that NMES significantly increased muscle power and mass with no significant difference in the range of motion, as compared to the control group (2017, p. 5). This study examined how NMES works in combination with traditional rehabilitation methods, however, a study conducted on older sedentary adults, concluded that NMES could increase muscle strength without having to combine it with physical movement (Banerjee, 2005, p. 2310). Lindsey Lepley et. al. (2014) also conducted a study on how a combination of eccentric exercises and NMES could improve quadriceps function following ACL reconstruction. With a total of

43 participants, Lepley examined four possible treatments over twelve weeks: NMES and eccentric exercises, NMES alone, eccentric exercises alone, and a “standard of care” (2014, p. 271). NMES began immediately post-operation while eccentric exercises were not administered until six weeks post surgery as to decrease risk for re-injury, and to allow time for adjustment by the patient (Lepley, 2014, p. 273). The conclusion made by Lepley, Wojiys, and Palmieri-Smith was that the combination of NMES and eccentric exercises, and eccentric exercises alone saw the greatest improvement in quadriceps strength following a twelve-week rehabilitation process. Another observation of the study is that a standard of the care recovery process was more effective than NMES, however, the note is made that the NMES machines could not have been powerful enough to provide a motor recruitment stimulus (Lepley, 2014, 275). In contrast to the previous study regarding the sedentary adults, the study from Lepley disagreed that NMES alone could increase quadriceps strength and activation, with the note that the machines used were of a different caliber and ability. Overall, NMES has been used both in combination with other recovery programs and examined by itself. Most studies point that NMES in combination with eccentric exercises and training gains more muscle strength and mass back than NMES alone in people with a more active quality of life, however, when the quality of activity is diminished in a patient, NMES can also offer a less vigorous course to build quadriceps strength and mass.

While neuromuscular electrical stimulation interacts directly with the muscles, other sources, such as supplementation have been suggested and studied in regards to how they affect strength following ACL reconstruction surgery. In 2004, a study was conducted examining the effects of creatine supplementation on muscle strength post-ACL reconstruction surgery (Tyler, 2004, p. 383.) By increasing total muscle creatine stores or phosphocreatine stores within the muscle, there is an increase in the processing of phosphocreatine allowing for greater ATP production and use. A total of sixty participants were randomized and administered creatine supplement or placebo, starting supplementation the day following reconstructive surgery. For seven days following surgery, subjects were given 20g per day of the supplement. Following the seven days, the supplement was reduced to 5g per

day for twelve weeks. Muscle loss, strength loss, and hip strength were examined at 11 days, 6 weeks, 12 weeks, and 6 months post operation. The examination of the possible effect of creatine on reducing muscle strength loss following reconstructive surgery was concluded to have no significant effect on the reduction of muscle loss following ACL reconstruction (Tyler, 2004, p.387).

Alternative supplements looked at to improve muscle mass following ACL reconstruction are Vitamin E and C. In 2011, a study examining the effects of Vitamin E and C on muscle inflammatory response and strength following ACL reconstruction surgery (Barker et. al., p. 114). The study explains the effects of Vitamin E and C on muscular dysfunction and atrophy in relation to the inflammatory cytokines and antioxidants in the blood (Barker et. al., 2011, p. 115). Following surgery, subjects were given either Vitamin E and C supplements or a placebo. The researchers observed a decrease in interleukin-8, an inflammatory enzyme, in the supplemented group as compared to the placebo group 90 minutes after surgery (Barker et. al., 2011, p. 118). The conclusion of this study found that Vitamin E and C supplementation reduced the effects of ascorbic acid concentrations in relation to the inflammatory response following surgery, as well as making the observation that there was a greater muscle strength in the reconstructed knee than the healthy knee. Although there is little data to support the claims and observations of this study, their conclusion suggests that by using Vitamin E and C supplementation prior to and following ACL-reconstruction surgery, one could predict a patient’s susceptibility to muscle weakness, and further postoperative complications while reducing the effects of the inflammatory response after surgery (Barker et. al., 2011, p.121).

Knee functionality is the most important outcome following ACL reconstruction and rehabilitation. Knee functionality plays a key role in the quality of life following anterior cruciate ligament injury and can be improved with the proper recovery techniques and processes. Physical therapy offers a multitude of recovery methods including neuromuscular electrical stimulation and weight-bearing exercise. Physical therapy is not a singular recovery method that can be isolated in a study but is looked at as a whole in regards to the benefits of attending physical therapy following ACL reconstruction surgery. According to Brian J.

Ekenroad et. al, (2017), physical therapy was previously based on biological tissue healing and their time frames but is now based on a criterion program that includes patient assessment using tools such as the I International Knee Documentation Committee Subjective Knee Form (p. 315). The study examined how rehabilitation protocols were managed and used to prevent postoperative complications. Physical therapy can be initiated as early as three days post-reconstruction surgery. The goal of early-onset physical therapy is to improve knee range of motion, which is key to knee functionality, and to reduce the chance of complications such as arthrofibrosis, an inflammatory response causing stiffness of the knee (Ekenroad, 2017, p.316). Following a criterion based physical therapy approach, there is an increased speed of recovery while not losing any quality of care or causing further complications or pain. After having met the standards for normal range of motion, physical therapy then progresses towards regaining strength in the knee and its surrounding muscles.

Physical therapy rehabilitation treatments have been studied in regards to the timing of the different treatments by Duncan E. Meuffels and others (2012). Their study was a collective questionnaire regarding which treatments are optimal following ACL reconstruction surgery. They concluded that neuromuscular stimulation provides more benefits to rehabilitation than strength training alone at the beginning of the rehabilitation period. As strength progresses, it is better to utilize closed-chain exercises early in the recovery process, rather than open-chain exercise to increase the stability of the graft. With the recovery process timing is important, however, patient safety and care are valued the most throughout the recovery process. Patient pain, daily activity, and sports are taken into account when determining the optimal time to reintegrate weight-bearing exercises into the rehabilitation process (Meuffels, 2012, pp. 383-384). In 2009, a secondary study that examined the effects of early onset eccentric exercises improved muscle volume, strength, and functionality 15 weeks post-ACL reconstruction surgery. One year following the original analysis, the same improvements were observed that subjects who received the eccentric exercises over the standard of care rehabilitation program showed a 50% greater improvement in knee functionality and quadriceps muscle mass (Gerber et. al., 2009). To provide additional support of the knee

during the recovery process, braces are utilized to ensure greater stabilization of the knee and surrounding muscles at the recommendation of physical therapists . However, this may lead to increased reliance on the supplemental support leading to an underdevelopment of the stabilizer muscles, making return to pre-injury conditions more difficult.

Conclusion

Each individual form of rehabilitation offers something different for the subject. While some are effective alone, such as weight-bearing exercises, others more often provide additional improvements together than they would alone, such as neuromuscular electrical stimulation. Based on the previous studies of neuromuscular electrical stimulation, there is significant data that NMES as a recovery method alone is beneficial in increasing muscle strength, but provides more strength and stability when paired with strength training exercises. When determining the standard of care rehabilitation programs, new literature on the effects of early onset eccentric exercises has been discussed as a more beneficial course of treatment than the standard weight-bearing exercises. The effects of supplementation have been promising and further research could provide an effective alternative or addition to standard rehabilitation procedures. Creatine supplementation could decrease the muscle deficits suffered from ACL reconstruction surgery, while Vitamin E and C supplementation reduce postoperative complications.

Discussion

The examination of multiple different recovery methods with the purpose of determining the most optimal rehabilitation process was inconclusive in whether or not there is a singular best recovery option. While each individual method offers some substantial benefit to recovery following ACL reconstruction surgery, patients needs and capabilities vary creating difficulties in standardizing a standard of care rehabilitation process that benefits all patients. However, based on the analysis of previous studies regarding the best way to improve quadriceps strength and mass, knee functionality, while reducing chance of post-operation complications, the standard of care recovery process this meta-analysis has determined is as followed: in regards to supplementation to reduce muscle atrophy and help maintain the most quadriceps strength following surgery, creatine supplementation has been shown to decrease the rate of muscle atrophy

following surgery, allowing for a quicker and safer increase in quadriceps strength. Along with supplementation, neuromuscular electrical stimulation in combination with eccentric exercises early after reconstruction surgery was shown to provide the greatest increases in knee functionality, strength and mass while limiting the potential for postoperative complications. While weight-bearing exercises are already standardized along with an immediate range of motion recovery, the addition of supplementation, NMES, and early-onset eccentric exercises could provide a greater standard of care for patients undergoing anterior cruciate ligament reconstruction surgery.

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Brainwave Entrainment to Improve Problem-solving skills in People with the Neurodevelopmental Disorder ADHD

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Abstract

The purpose of this study is to examine whether brainwave entrainment has an effect on problem-solving skills in people with an attention-deficit/hyperactivity disorder (ADHD). A predominant symptom of ADHD is inattention. ADHD is associated with symptoms such as difficulty sustaining attention during tasks, easily distracted, and seeming to avoid tasks that require sustained mental effort. The first-line treatment for ADHD is through the use of psychostimulant drugs, but some may experience negative side-effects. Therefore, there is a need for an alternative treatment that is less invasive. The present study hypothesizes that brainwave entrainment will put participants in a productive brainwave frequency that will allow them to perform better at problem-solving tasks. Binaural beats with a gamma-frequency (50HZ) were used to acquire brainwave entrainment. Four healthy subjects with ADHD participated in a single-subject ABA reversal research design study (three phases). In the first phase, participants listen to rain noise with no binaural beats for 5-minutes, then given 5-more-minutes to complete a puzzle (while still listening). In phase two, participants listened to rain noise with binaural beats for 5-minutes, then given 5-more-minutes to complete the puzzle. Lastly, in phase three, the first phase was repeated. The results suggest that brainwave entrainment had a moderate effect on the participant's problem-solving skills. Moreover, two participants performed very well while under brainwave entrainment, the other two showed some effect, but not significant enough. A future direction for this study is to control for daily mood, adding a fourth phase (ABAB), and a larger sample size.

Keywords: brainwave entrainment, problem-solving skills, attention-deficit/hyperactivity disorder (ADHD), neurodevelopmental disorders, inattention, psychostimulants, binaural beats, gamma frequency

Introduction

The purpose of this study is to examine whether brainwave entrainment has an effect on problem-solving skills in people with an attention-deficit/hyperactivity disorder (ADHD). ADHD is a commonly diagnosed mental disorder of the neurodevelopmental type. According to the Diagnostic and Statistical Manual of Mental Disorders – 5th edition (2013) (DSM-5) ADHD is a mental disorder that has three subtypes: inattentive, hyperactive-impulsive, or a combination of the two. In this present study, we focused on the inattentive subtype of ADHD. The DSM-5 describes ADHD (inattentive subtype) with characteristics such as lack of attention, regularly does not follow through on instructions, gets distracted very easily, and commonly forgets normal daily activities (Pettersson, Söderström, Edlund-Söderström, & Nilsson, 2017). In addition, the DSM-5TM has three further components that must be met in order to be diagnosed with ADHD. These components are: inattention that is interfering with normal functioning or development, and these symptoms must be observed in two or more settings, and lastly, they must be directly

impacting their social, academic, or their occupational functioning (Al-Moghamssi & Aljohani, 2018).

A predominant symptom of the inattentive subtype of ADHD is inattention. Some common behavior that is associated with this type of ADHD is difficulty sustaining attention during tasks and easily being distracted by extraneous stimuli in their environment. Most people with ADHD avoid tasks that require sustained mental effort and have problems completing problem-solving tasks such as homework, studying for an exam, or other problem-solving tasks that require full attention. Moreover, ADHD affects vital settings of their life (social, school, work, etc.) (Wiersema & Godefroid, 2018). A research study by Pila-Nemutandani & Meyer (2016) gathered a total of 90 children, half of them with ADHD, and provided a problem-solving task. Those with ADHD showed poor performance in the problem-solving task. The conclusion of the study noted that participants with ADHD had poor organizational and planning skills that explained their lack of problem-solving skills. Another reason the researcher believes people with ADHD lack problem-solving is because of their difficulties with executive functioning and complex reasoning (Elisa &

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Parris, 2015). One way that a researcher described ADHD, in regards to completing a specific task is by comparing them to a sleepy driver: ADHD is like driving while you're very sleepy and roll down the windows in hopes to get some fresh air and wake up, only to still be sleepy and unable to wake yourself up (Trejis, 2000). ADHD impacts the execute functions of a person's brain, including problem-solving skills, which is considered an executive function. (Pila-Nemutandani, & Meyer, 2016).

People with ADHD are notoriously known for "not paying attention" and being easily distracted while completing problem-solving tasks, this can lead them to poor problem-solving skills and low academic performance. A study that illustrates how students with ADHD are more susceptible to certain tasks than people without it was conducted by Weyandt, Oster, Gudmundsdottir, DuPaul, and Anastopoulos (2017), in which researcher recruited 436 first-year college students with ADHD and had them both perform working memory and performance tasks. Weyandt et al. (2017) concluded that students with ADHD had more academic difficulties compared to students that did not have ADHD in continuous problem performance tasks. Students with ADHD that were taking psychostimulants had a slight improvement over those that were not under medication; however, the improvement was not on all neuropsychological tasks (Weyandt, Oster, Gudmundsdottir, DuPaul, & Anastopoulos, 2017)

Although ADHD is vastly diagnosed in most children and adolescents, it also affects a great number of the adult population (Gould, Porter, Lyneham, & Hudson, 2018). About sixty-percent of adults continue to experience ADHD symptoms after childhood (Elisa & Parris 2015). ADHD has an epidemiological prevalence of about 5%, which makes it one of the most diagnosed mental disorders (Banaschewski et al., 2017). The most common first-line treatment for ADHD is through a psychostimulant intervention plan. Psychostimulants, such as Ritalin and Adderall, are among the most prescribed drugs that have shown to be effective in treating ADHD symptoms. Psychostimulants such as Ritalin and Adderall can be safe to use, but only when used as prescribed. Unfortunately, many of these prescription drugs are abused and even given or sold, by the patient, to other people that do not have ADHD (Prescription Stimulants, 2011). In contrast, in some cases, they have short term positive effects and/or severe side effects (Meppelink, de Bruin, & Bögels, 2016). Despite the great possibility of adverse side effects, most people diagnosed with ADHD are routinely prescribed psychostimulant drugs to ameliorate their symptoms. Taking psychostimulants can substantially increase their mortality rate – mortality rates are high for people taking psychostimulant medications for ADHD (Quinn, et.al., 2017).

Even though psychostimulant medication treatments are effective in treating the main symptoms of ADHD, these benefits might come at a high cost (Pettersson et al., 2017). On the one hand, most people taking these drugs have reported positive improvements, such as better; school/work performance, social interactions with peers, and control of their ADHD symptoms (Lynn, 2007). On the other hand, some have reported that the medication only ameliorated some of the symptoms but experienced severe unwanted negative side-effects. For instance, a well-known negative side-effect produced from taking psychostimulant drugs is a "zombie-like" feeling and/or adverse interaction with alcohol or other drugs, resulting in serious toxic side-effects (Barkla, McArdle, & Newbury-Birch, 2015). Other side effects include feeling constantly fatigued, not being able to sleep through the night, tremors, and depression. Despite this concerning information, according to Health Canada, psychostimulants like Ritalin have seen a dramatic 537 percent increase of use for people with ADHD (Trejis, 2000). Not only may they have negative side effects, but they are highly addictive. Ritalin, for example, is prescribed to millions of people with ADHD. Ritalin, like other prescription stimulants, makes most people feel energized and alert, just as what cocaine and methamphetamine (meth) does to people. The effects are similar because they are both (cocaine and Ritalin) in the same class of drugs. Ritalin (prescribed stimulant) has similar effects on the brain as cocaine does (see Figure 1). In figure 1, you are able to observe how cocaine (brain scan on top) lights up in similar areas as the brain scan below when people took methylphenidate (Ritalin), (Prescription Stimulants, 2011).

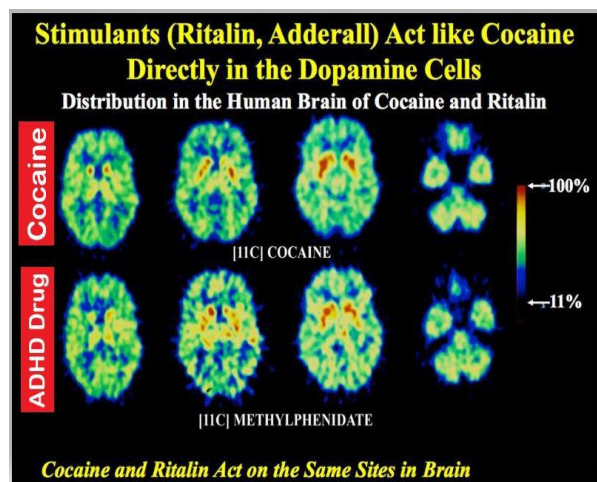


Figure 1. Brain scans: showing effects of cocaine on brain (upper brain scan) and effects of methylphenidate (Ritalin) on brain (lower scan) (after Volkow, et al. (BNL))

Other serious negative side-effects reported have been premature deaths and serious cardiovascular problems (Lynn, 2007). These negative side-effects may encourage people with ADHD to discontinue their prescribed medication treatment and instead suffer from their symptoms. If ADHD symptoms are left untreated, it may lead to low academic grades (children & adolescents), and problems at the workplace (adults) (Banaschewski, et. al., 2017).

Further research into alternative treatments is important. A possible alternative to ADHD medication is brainwave entrainment. Brainwave entrainment is a method that stimulates the brain into entering a desired specific brainwave frequency and state of mind (see Figure 2). Even though brainwave entrainment has been used since the late 1800s, many researchers are unaware of it (Huang & Charyton, 2008). Brainwave entrainment can be acquired through different methods, however, in the present study, we acquired brainwave entrainment with the use of binaural beats. Binaural beats are auditory sound waves, normally not consciously noticeable to the person hearing them, but easily captured by the brain. Binaural beats play a significant role in increasing neural synchronization (Colzato, Steenbergen, & Sellaro, 2017). See figure 2, for a visual description of how binaural beats are used to acquire brainwave entrainment. Binaural beats are administered through a set of headphones, two different frequencies are sent to each ear (150Hz left ear & 100Hz right ear), the difference between those two frequencies is then processed by the brain as a new frequency. The brain then tunes into this new frequency and in a way “takes-over,” at that point, the subject has entered into the desired mind state (one of the 5-types of brainwaves) thus, brainwave entrainment has been acquired (Wahbeh, Calabrese, Zwickel, & Zajdel, 2007).

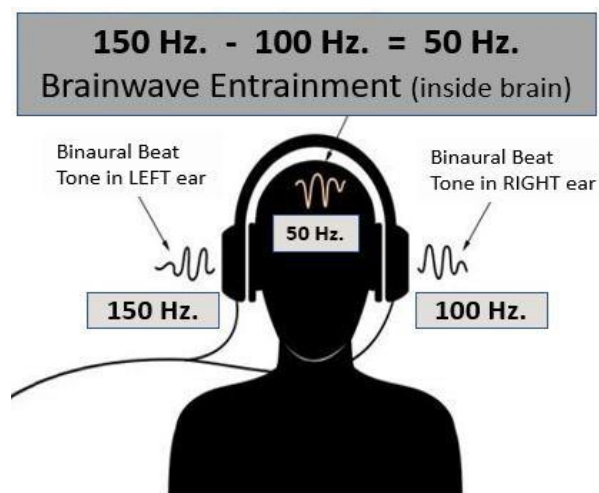


Figure 2. How brainwave entrainment is acquired through the use of binaural beats (after <https://wakeup-world.com>)

Past research has discovered that people with ADHD use theta brainwaves substantially more than those that do not have ADHD. As seen in Figure 3, “theta” brainwaves are associated with sleeping, which may lead people to feel drowsy resulting in feeling uninterested in completing any type of tasks (Trejls, 2000). A study into brainwaves by the Mission Psychological Consultants (1996) revealed that a treatment called Neurofeedback, where a person with ADHD learned how to manipulate certain brainwaves and control a computer game without the use of a keyboard or joystick, only by changing his brainwaves (measured with electrodes attached to the scalp), was successful at significantly reducing their inattentive behavior symptom (Trejls, 2000). This study is a good example of how brainwave patterns have a significant impact on people with ADHD.

When the brain goes into a specific wave pattern that has a specific targeted effect, like the gamma-frequency (high brain activity), it in a way “takes over” the brain. This will influence your brainwaves into a desired mind state: super focused mindset (gamma), normal alert consciousness (beta), relaxed (alpha), light sleep (theta), or deep sleep (delta) (Colzato, Steenbergen, & Sellaro, 2017). Figure 3 describes the various different brainwave frequencies and their effects once under brainwave entrainment. The gamma-frequency is the highest frequency in human brainwaves and can be achieved at 30Hz and above. This frequency has been used for centuries to get super focused and go into deep spiritual trances. The gamma-frequency is known to evoke peak brain performance, this high brain activity works very well while performing problem-solving tasks. At the other side of the brainwave’s spectrum is delta waves (1-3Hz), which are considered the lowest brainwaves to humans and good for deep sleep (Colzato, Steenbergen, & Sellaro, 2017).

Another study used to show the impact that binaural beats (brainwave entrainment) have on people with ADHD is a study by Nacim et al. (2008). Nacim et. al. (2008) recruited two groups of children: one group of children with ADHD, and the other group without ADHD. The researchers had the children take an IQ posttest while exposing them to musical binaural beats that resulted in brainwave entrainment. After analyzing the results of the IQ posttests, researchers discovered that both groups showed an improvement in their IQ performance while under brainwave entrainment. In Nacim et al. (2008) study, brainwave entrainment has shown promising results in treating some of the symptoms of ADHD. This is yet another great empirical study in which it demonstrates that brainwave entrainment can be of potential benefit to students with ADHD who are currently academically struggling.

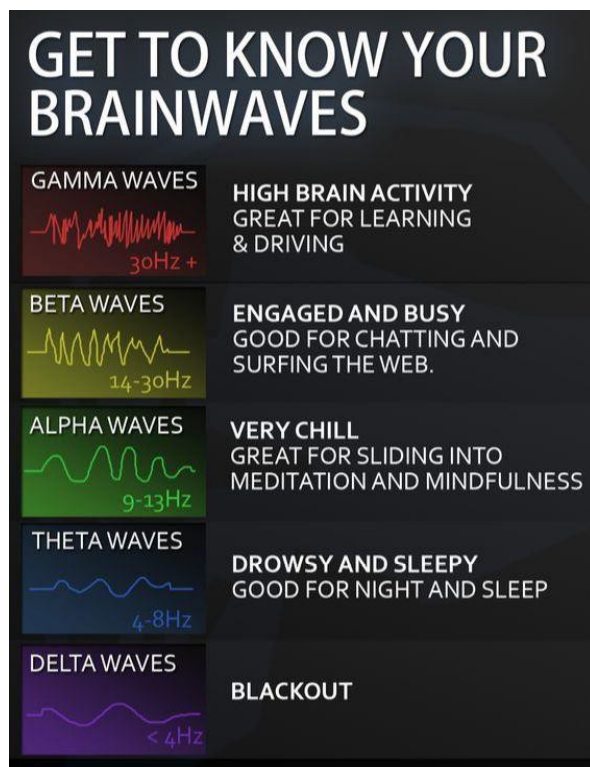


Figure 3. A description of the 5-types of brainwaves
(after <http://www.practicemindfulness.com>)

Another study, used in a slightly different way, used binaural beats (theta-frequency at 6Hz) to treat chronic pain in people (Zampi, Fore, Jerome, & Durham, 2015). A study by Zampi et al. (2015), recruited 36 subjects with different types of chronic pain and had them listen to theta binaural beats, while researchers measured any changes in the severity of pain the subjects perceived to be in. The results indicated that there was a large main effect for reducing the subject's perceived pain severity with the use of binaural beats (Zampi et al., 2015). Although the participants did not have ADHD, brainwave entrainment showed to be effective.

Each of these research studies demonstrates that brainwave entrainment is potentially effective at treating different symptoms in people with and without ADHD. Furthermore, these studies provide empirical evidence that people with ADHD lack problem-solving skills and show that brainwave entrainment can potentially be a treatment plan for such subjects.

Research Question/Significance

The present research aims to discover if brainwave entrainment has an effect on problem-solving skills in people with ADHD. Brainwave entrainment can either be used as an addition to an existing psychostimulant treatment or as a stand-alone alternative thus providing

ADHD subjects with treatment options. Brainwave entrainment may possibly be used at times when the extra focus is needed to successfully complete a difficult problem-solving task. For instance, while studying for an exam, doing homework, or performing any other problem-solving activity that is known to be particularly challenging to the individual. We are asking the question, "can brainwave entrainment improve problem-solving skills in people with ADHD?" We are hypothesizing that brainwave entrainment with a gamma-frequency of 50Hz. will improve problem-solving skills in people with ADHD. Positive findings of this research can provide a non-invasive treatment plan option for people with ADHD. In any case, if this study produces significant results, it may improve the overall quality of life of the individual.

Methods

Participants

A total of four participants with ADHD, two males and two females in the age range of 14-62 years old were recruited from Stanislaus County, a county with a medium sized population located in Northern California.

Design

A single-subject ABA reversal research design was used. The problem-solving task was generated using a one-hundred-piece puzzle task. Three different puzzles, of similar difficulty, were used for each phase. Brainwave entrainment was acquired with the use of binaural beats masked by rain noise, listened through a set of over-the-ear headphones. The independent variable was manipulated by the addition or removal of gamma-frequency (50Hz) binaural beats. The study consisted of three phases – no treatment (A), treatment (B), and no treatment (A). The dependent variable was the completion of the problem-solving task (puzzle), measured by the number of puzzle pieces the participant was able to connect in a five-minute time period.

Materials

Materials used in the study included: three one-hundred-piece puzzles (similar illustration & difficulty), a smartphone with a binaural beats app (Pure Binaural Beats), a timer, and over-the-ear headphones.

Procedure

Participants were administered a consent form, allowed time to read it, and asked to sign it. Once participants indicated consent, they were given instructions on how to proceed through the study and given a copy of the consent form for their records. Participants that continued with the study were requested to complete all three phases of the study. All four participants were tested individually. In the first

phase, the participant listened to rain noise for five minutes, without binaural beats. While listening to rain noise, participants were instructed to connect as many puzzle pieces as possible for an additional five minutes (see Figure 4). The number of puzzle pieces was recorded, but not told to the participant. In the second phase, the participant repeated the procedure as in Phase one, with the exception that this time the rain noise had binaural beats with a gamma-frequency of 50Hz., resulting in brainwave entrainment. In the last phase, the procedure was reversed to the same procedure as in phase one. In each of the three phases, the participant completed a different puzzle to avoid error through learned knowledge. At the end of the last session, participants were handed a debriefing form.



Figure 4. Visual model of a session
(taken by author)

Results

The results suggest that brainwave entrainment had a moderate effect on the participant's problem-solving skills. Moreover, two participants performed very well while under brainwave entrainment and showed significant results (see Figures 5, 6, 7, & 8). However, the other two participants showed very minimal effect, but not significant enough.

Discussion

The aim of this study was to investigate if brainwave entrainment could help people with ADHD perform better during problem-solving tasks. Further analysis of the results indicated that the participants that obtained positive results from brainwave entrainment reported feeling more focused. Although data suggests that there was an increase in the participant's problem-solving skills while exposed to brainwave entrainment, since it was only significant in fifty-percent of the subjects, it is not significant enough to reach a conclusion that brainwave entrainment was the direct cause. All four participants claimed to be able to hear

the binaural beats through the rain noise. To address that, an auditory inspection was performed by people without ADHD in which it was determined that the binaural beats sound was not able to be heard through the rain noise. It may be possible that people with ADHD are more susceptible to these audible waves and can hear the faint sound of the binaural beats. This is interesting because it shows some of the great differences that people with ADHD experience. A future direction that this study can possibly take is to be able to control for daily mood, add an extra treatment phase, and obtain a larger sample. The findings of the effects of brainwave entrainment on people with ADHD may be particularly of interest to clinicians that have patients with ADHD who have experienced severe negative side-effect to psychostimulants.

Future work

There are many potential works that could develop out of this study. For instance, it is possible to include subjects that do not have ADHD to the research study and analyze their effects on such brainwaves. In regards to the subjects with ADHD, the use of brainwave entrainment should be administered to both: subjects that are taking psychostimulants, and those that are not, and compare the results. Our study used a single subject ABA reversal design in order to use the same subject as their own control. However, follow-up studies should potentially use a single subject ABAB reversal design (extra treatment phase) to have more data and use a larger sample size. Additionally, there is the possibility of exploring other potential methods to acquire brainwave entrainment, including other frequencies. This would expand the current limits of only one frequency (gamma) and possibly discover benefits that the other brainwaves can offer. Each of these potential future studies would expand the capabilities and thus provide greater value and stronger research.

Acknowledgments

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Data Charts

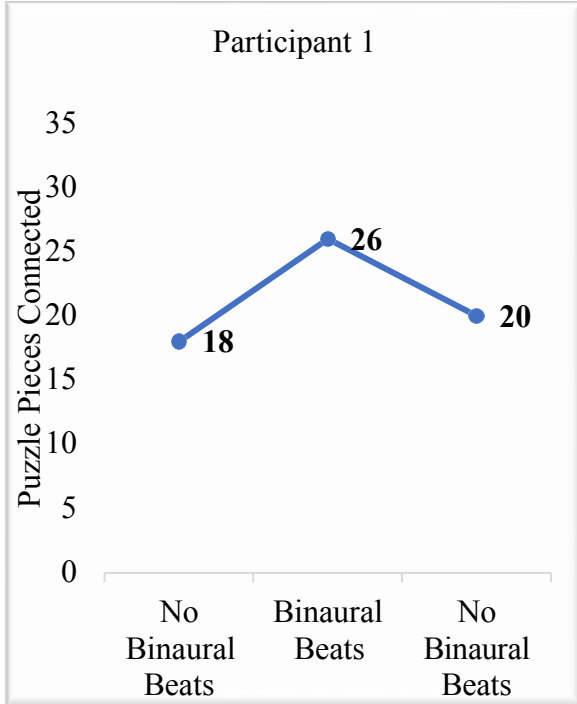


Figure 5. Data chart of older female participant

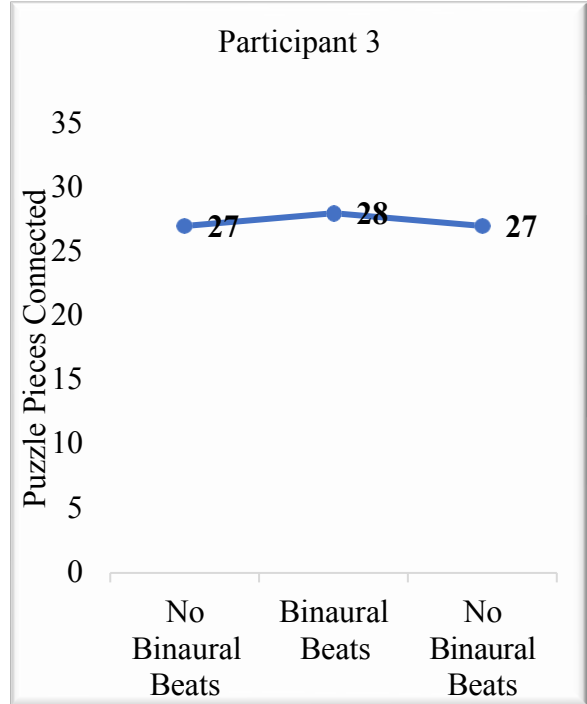


Figure 7. Data chart of younger female participant

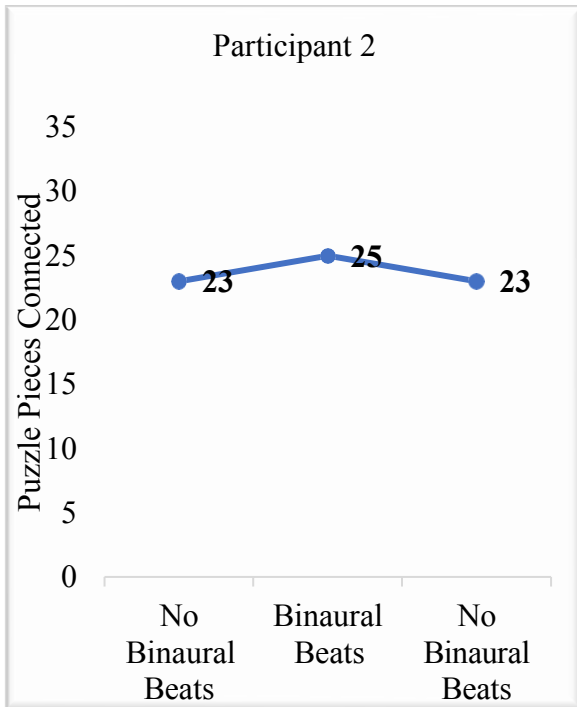


Figure 6. Data chart of older male participant

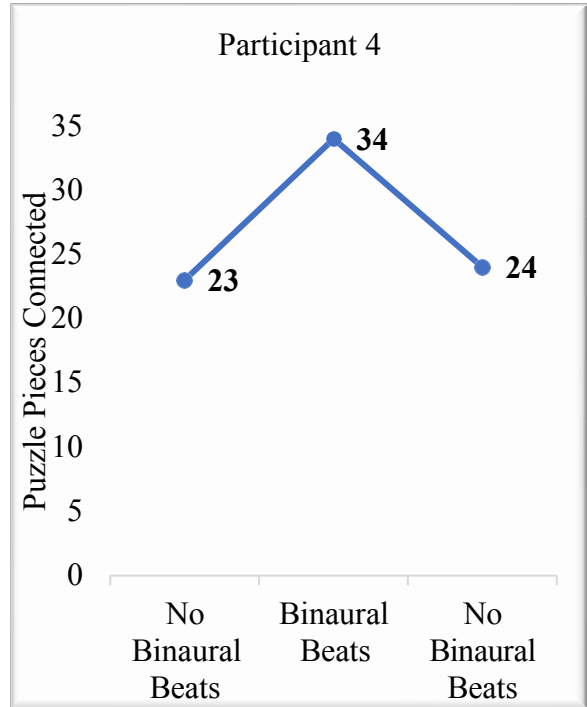


Figure 8. Data chart of younger male participant

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Analysis of Cellular ROS Regulatory Mechanisms in Patients Suffering from Small Fiber Neuropathy

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Abstract

Neuropathy refers to abnormal nerve conditions, which yield severe neurodegeneration and painful, episodic pain in the distal appendages. Small fiber neuropathy (SFN) is a disease in which patients suffer from intense pain and abnormal sensations related to touch in the extremities of the body. These symptoms are nonspecific, which makes diagnosis difficult and imprecise. Previous studies have examined the relevance of reactive oxygen species (ROS) in cell death and cell survival pathways, though no research has identified specific mechanisms. In order to craft a reliable method of diagnosis we examined the physiological changes in biopsied skin tissue of both diseased and healthy individuals. We focused on two potential proteins involved in ROS-induced pathways. Human tissue samples were probed for activation of Yes-Associated Protein (YAP) and 8-Oxo-2'-deoxyguanosine (8-Oxo-dG), which are known to be related to cellular stress pathways. YAP is responsible for promoting cell survival in the face of increased stress, whereas 8-Oxo-dG is involved in injury pathways that result in apoptosis. We successfully established a protocol, which gives accurate and precise diagnoses in 8-Oxo-dG trials. YAP trials showed no difference in staining between healthy and disease tissue. Extensive modulation of the protocol during this study revealed signs of potentially significant mechanisms, which could serve as novel diagnostic criteria and promote precision medicine. Thus, in addition to our original objective of establishing an effective staining protocol, we may have also found differential pathways.

Key Terms: (PNS) Peripheral Nervous System, (SFN) Small fiber neuropathy, (ROS) Reactive Oxygen Species, (YAP) Yes-Associated-Protein, (8-Oxo-dG) 8-Oxo-2'-deoxyguanosine, (ENFD) Epidermal Nerve Fiber Density, (IHC) Immunohistochemistry

Small Fiber Neuropathy and the Nervous System

The human nervous system can be defined by two broad subsets: the central nervous system (CNS), which connects the brain and spinal cord to the rest of the nervous system, and the peripheral nervous system (PNS), which joins the CNS to the PNS and allows us to feel sensory input such as touch and temperature. The PNS is more than 90% composed of mainly small, myelinated fibers and spans the whole body (Körei et al., 2015).

Small fiber neuropathy (SFN) is a disease in which small fiber neurons of the nervous system have higher levels of cellular stress, resulting in increased rates of programmed cell death, or apoptosis, thus giving the disease its name. This ultimately leads to lower nerve density (innervation) in the skin tissue.

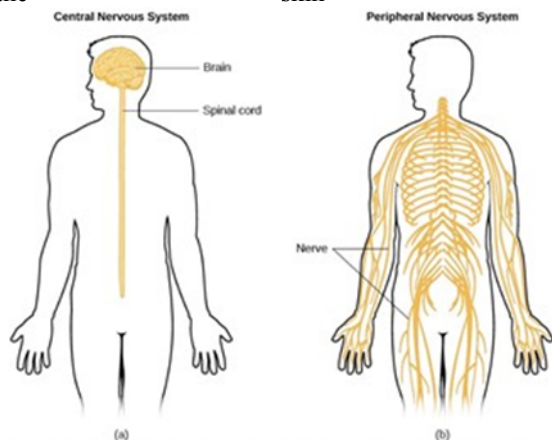


Figure 1: (a) central nervous system vs. (b) peripheral nervous system. (Figure by Rajiv Jhangiani, Ph.D.)

SFN is a condition that manifests in vague and hard

to diagnose symptoms. The disease commonly associated with over-sensitive and/or nonexistent reactions to cold or heat sensation, such as numbness or burning in distal appendages. Increased nerve responsivity can also arise, which is responsible for the characteristic allodynic, episodic pain that may be localized to one area or span the entire body. These symptoms are a direct result of increased levels of cellular and oxidative stress in neuronal cells of the peripheral nervous system. As apoptosis increases in frequency, there is lower innervation of the connective tissue (subdermal strata) of skin, resulting in nerve damage and impairment.

SFN has many originations, meaning the disease is often treated as a symptom of the overlying condition rather than a disease itself. Metabolic conditions are the most commonly determined, such as diabetes and hyperthyroidism. Other less common causes can also be observed. Neurotoxic exposure, whether natural or man-made, can also lead to the development of SFN. Examples include but are not limited to alcohol, antibiotics (IE ciprofloxacin), and the ingestion of Clostridium botulinum toxin (from the anaerobic bacterium responsible for botulism). SFN can be caused by certain infections such as Hepatitis C, HIV, and Lyme disease – even influenza. Immunological conditions can also be responsible, such as Celiac disease and Guillain-Barré syndrome. Least common, but still notable, are hereditary neuropathies such as Fabry's disease, which has seen some recent research (Terkelsen et al., 2017). The diversity of potential originations and lack of knowledge about the disease state of SFN results in an extensive diagnostic period without much treatment for the patients besides pain management. Existing research also shows that many neurodegenerative diseases

often result from dysregulation of molecular reactive oxygen species mechanisms, though no specific mechanism has been identified regarding SFN.

Reactive Oxygen Species

Molecular oxygen, O₂, plays a role in many crucial cellular pathways. In normal instances, oxygen is utilized as an electron carrier then reduced to a non-reactive state. However, when not reduced, chemically reactive, oxygen-containing species are formed – these are called reactive oxygen species (ROS). These include hydroxyl radicals (-OH), superoxide (O⁻), and singlet oxygen (1-O₂) (Geon, et al., 2015). ROS can be produced by endogenous reactions, arising within the cell, or exogenous sources, arising outside the cell. Endogenous ROS are produced by the incomplete reduction of oxygen during metabolic processes like glycolysis. Exogenous

ROS are caused by external stimuli, such as radiation exposure, certain drugs, pollutants, and smoke. Defects in cellular ROS mitigation result in oxidative stress and can induce nerve cell apoptosis (Loh et al, 2006). Studies have shown correlation of SFN to ROS dysfunction, with significant studies observing the susceptibility of neurites to ROS stressors, though a specific mechanism has not been identified (Fukui, 2016). Neural cell death disrupts normal nerve function and results in increased cellular stress.

8-Oxo-2'-deoxyguanosine and Yes-Associated Protein

Regulation of cellular levels of ROS, specifically in neurons, requires complex and highly interconnected sets of proteins, chemical modulation and signaling pathways that act as central regulators of cellular stresses and apoptosis.

Certain protein mechanisms have been found to be involved in ROS regulation, such as 8-Oxo-2'-deoxyguanosine (8-Oxo) and Yes-Associated Protein (YAP). 8-Oxo is a protein that acts as a pro-apoptotic protein, inducing cellular death. This protein is produced by oxidative damage and can over-accumulate within cellular DNA, resulting in DNA mutations such as guanine to thymine trans versions, and guanine to cytosine conversions due to reading error (Pengcheng et al., 2016).

The Yes-Associated Protein (YAP) promotes cell survival by binding to signaling regulators and transcription factors which are central to ROS pathways. Ultimately, it acts as a cell death inhibitor, resulting in a pro-survival mechanism (Campbell et al., 2013).

Small fiber neuropathy is far more prominent than it is portrayed and is often regarded as a symptom of other, often metabolic, conditions rather than being considered its own disorder, despite research indicating the relevance of reactive oxygen species in neurodegenerative diseases. Further understanding would promote the latter ideology. The purpose of this study was to further investigate the relationship between small fiber neuropathic tissue and the propagation of reactive oxygen species. Specific mechanisms of the pathogenesis of SFN have not yet been identified—our research seeks to identify them. This knowledge would provide a better understanding of the etiology and disease state of small fiber neuropathy and potentially expedite diagnosis and treatment. The current treatment options for small fiber neuropathy, mainly pain management, are inadequate or ineffective. This leads to a painful, frustrating existence for patients. Through this study we hope to contribute to the advancement of precision medicine as well as the knowledge of neurodegeneration, neuronal health, and the disease state of SFN.'

We investigated ROS signaling pathways in healthy and diseased patient tissue with specific focus on cellular mechanisms involved in the regulation of ROS. Based on the innervation observed in patients diagnosed with small fiber neuropathy, it can be deduced that SFN causes accelerated rates of apoptosis and nerve degeneration. Analysis of both cell death (8-Oxo) and cell survival (YAP) pathways allowed us a broader view of ROS prevalence in skin tissue. This study further establishes the connection of ROS and small fiber neuropathy while progressing towards the isolation of potential mechanisms of ROS behind SFN. Research examines whether cells in disease tissue are defective for ROS mitigation by probing human tissue samples for activation of YAP and 8-Oxo-dG. We expect to find an apparent connection between dysregulation of reactive oxygen species and denervation in small fiber neuropathy patients. Levels of the associated protein in diseased tissue will either be elevated in the case of 8-Oxo or decreased in the case of YAP depending on which one is resulting in decreased innervation.

Materials and Methods

Six trials were run in total, and for each trial six patients were selected. All patients had been previously diagnosed as being either normal or a degree of small fiber neuropathy, as diagnosed by a Nova Labs pathologist. Degrees are mild (MD), moderate (MT), and severe (SV). Each trial consisted of three normal patient samples and three diseased patient samples — one of each diagnosis — to provide visuals of various levels of neurodegeneration. Sex and age were not taken into consideration as selection was based exclusively on diagnostic reports. All samples were tissue samples taken from proximal thigh (PT) biopsies for the highest nerve densities.

Human skin biopsy samples were used for staining, with each biopsy having dimensions of 3x3x3 mm. Biopsy was utilized for tissue collection for its high accuracy and specificity when used in epidermal nerve fiber density (ENFD) testing. ENFD has 88.4% sensitivity in detection, versus 54.6% for clinical exams alone and a specificity of 98% (Devigili G. et al., 2008; Lauria G., Devigili, G., 2007),

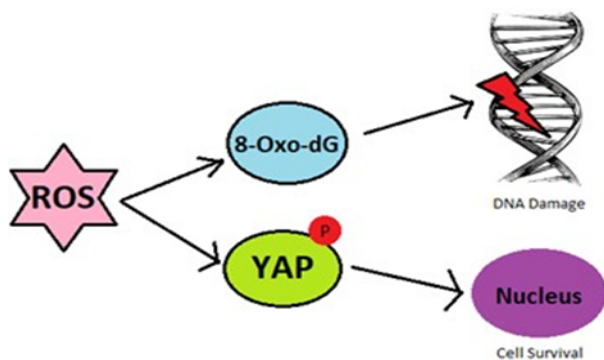


Figure 2: ROS-Initiated Pathways (Figure by author)

meaning this method can detect SFN even in asymptomatic patients. This test ignores nerve conductivity which may give positive readings despite extensive neurodegeneration.

Skin tissue was preserved in a modified Zamboni Solution based on a picric acid/formalin mixture designed to preserve nerve cells in tissue biopsies (Nova Labs Proprietary Chemical Formulation, Schmidt 2017). After fixation for a minimum of 8 hours, and not exceeding 3 days, the samples were flash frozen then sectioned via a tissue sectioning machine called a cryostat which can temperatures of -15°C to -20°C . Samples were directly placed into a 96-well plate with buffer for staining. Samples were stained and probed via advanced immunohistochemistry (IHC) methods to detect irregularities in both healthy and diseased epidermal skin tissue.

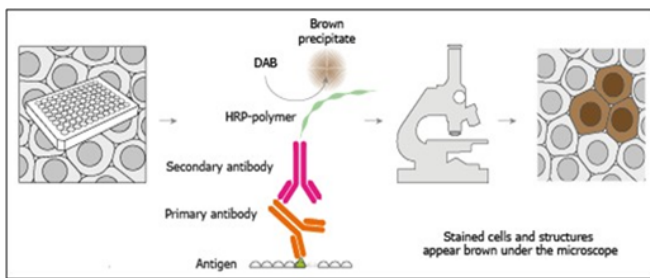


Figure 3: Immunohistochemistry staining in 96-well plate. (Figure from MetaGene, 2013)

IHC protocol allowed for antibody labeling and visualization. Two antibodies were probed for: Yes-Associated Protein and 8-Oxo-2'-deoxyguanosine with anti-rabbit and anti-mouse secondary antibody respectively. DAB substrate was utilized for peroxidase detection to observe oxidative plaques made evident by DAB's dark brown precipitate. Samples were developed and counterstained with nuclear fast red dye then mounted onto slides.

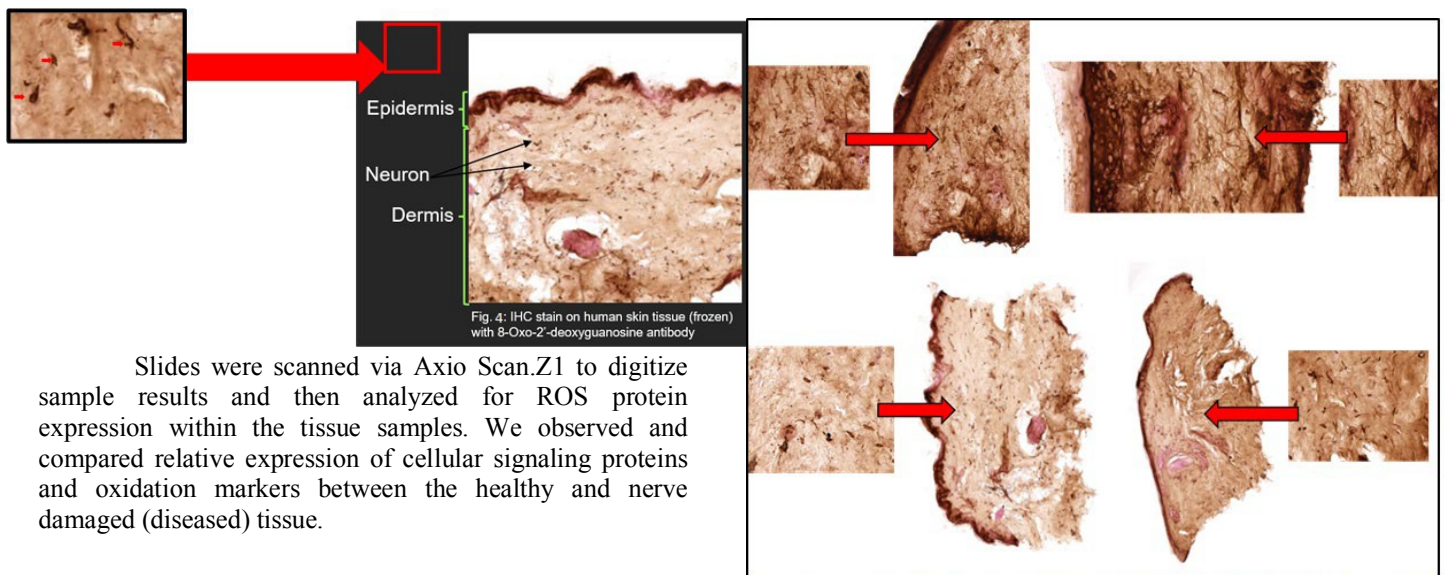


Fig. 4: IHC stain on human skin tissue (frozen) with 8-Oxo-2'-deoxyguanosine antibody

Figure 5: Tissue comparison of IHC stains on human skin tissue (frozen) with Phospho-YAP (top) and 8-Oxo-2'-deoxyguanosine (bottom) antibodies.

Slides were scanned via Axio Scan.Z1 to digitize sample results and then analyzed for ROS protein expression within the tissue samples. We observed and compared relative expression of cellular signaling proteins and oxidation markers between the healthy and nerve damaged (diseased) tissue.

Results

We began by selecting a panel of potential markers: BAX, Bid, Bim, YAP, and 8-Oxo-dG. We selected ROS-induced proteins because of their known relevance in other neurodegenerative diseases. We selected YAP and 8-

Oxo-dG for trials to allow for a broader examination of possible mechanisms. Decreased YAP staining signaled error in cell survival mechanisms, whereas increased 8-Oxo-dG staining is indicative of elevated DNA damage, cellular stress, and apoptosis. Immunohistochemical staining was modified over the course of three months, to ensure adequate and accurate staining in both 8-Oxo-dG and YAP proteins. This utilized primary and secondary antibodies, as well as protein block and counterstaining to avoid background staining. Optimal working dilutions and temperatures were established for all reagents and repeat validation was performed if new shipments arrived. Six trials were run on human biopsied skin tissue in total, three YAP, three 8-Oxo-dG. Each trial consisted of six patients, three normal, three diseased (N = 18). The same patients were utilized for the first two trials of both the YAP and 8-Oxo-dG (n = 2), with new patients for the last trials. All patients had been previously diagnosed as mild (MD), moderate (MT), and severe (SV) degrees of SFN.

We examined activation of the proteins by the presence of neuronal staining, indicated by dark brown precipitation. Any light brown artifact staining and background staining, due to melanin concentration, were disregarded. Over the course of protocol development, it was retrospectively noted that YAP showed no quantifiable differences in expression though stains typically had darker background staining than 8-Oxo-dG. Thus, we suspect that YAP is not a dysfunctional mechanism in ROS mitigation. 8-Oxo showed a distinct difference in expression with 90% more staining in diseased tissue on average. Staining varied minorly between trials, but results stayed consistent. This suggests SFN is resultant of increased neuronal apoptosis. An arbitrary scale of severity was established for initial, blind observation of protein expression levels to ensure no bias or preconceptions interfered (1 = Mild Stain – Probably Healthy, 2 = Moderate Staining, 3 = Severe Staining –

Probably Diseased). The scale was accurate in nearly all cases, apart from the YAP trials and allowed us to validate our findings. Any inaccuracy of this scale was due to the lack of quantifiable expression differences of YAP between

healthy and diseased patient tissue. Ultimately, our developed scale and protocol allowed us to produce accurate and consistent results.

Discussion

Increased staining of 8-Oxo suggests that this protein mechanism may be key in the neurodegeneration of small fiber neuropathy. Variation in staining results may be due to the progressive nature of this disease and brand of antibodies selected. 8-Oxo-dG may not be the primary mechanism, since ROS modulation is complex and interconnected. Thus, further work is needed to determine if 8-Oxo is indeed the mechanism to influence new treatment options for SFN. Immunohistochemistry procedures also vary in multiple processes, such as blocker selection, which may result in more non-specific staining and therefore inaccurate results.

Implications

This project has very high clinical significance, as this disease is an extremely debilitating condition. Normal actions, such as climbing the stairs or kneeling, become intolerably painful. Thus, research herein is relevant to patients, practitioners, and researchers alike. We hope to contribute to the advancement of precision medicine through better treatment of small fiber neuropathy as its own condition, rather than a symptom of overlying diseases. Potential better understanding of the disease state of small fiber neuropathy provides insight into further modulations of study as well as alternate routes of treatment.

Future Work

Future investigations should repeat this process with other potential proteins in order to identify any other underlying mechanisms. We believe that further exploration of treatment modalities should focus on 8-Oxo-2'-deoxyguanosine and its involvement in cell death pathways within epidermal skin tissue. Additional molecular studies are needed in order to justify mechanism relevance in order to provide expedited routes of treatment for sufferers of this disease. In depth molecular testing should be performed to investigate this and any other suspected mechanism(s)

relevance to SFN neurodegeneration.

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Data-informed, agent-based model of Information Dissemination within social media networks

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Abstract

This research will analyze how people communicate their self-identity within social networks. It will be evaluating how people present their concept of self through social media outlets and how they communicate their cultural backgrounds with others who may or may not come from the same cultural backgrounds as them, while observing their top five social media posts that they believe represent themselves well during a face-to-face interview. This analyzing process will look at their social media posts and see what motivates them to post a specific post in a specific way within social media by looking at their pictures, captions or comments on different social media outlets. At the same time, this research will observe the different type of identities eight participants may be expressing within social media based off the terms they choose to use. Within this research, I will also be analyzing how people may develop multiple identities within different media outlets and see how people can become influenced to adapt new behaviors due to using media.

Introduction

The concept of self when an individual utilizes social networks can be inferred based on what individuals decide to post on different forms of social media outlets. By analyzing the concept of self, we would be able to see how social media alters users' identity. I will be comparing differences in the identities people communicate face-to-face versus online interactions. Based on these observations, I will be able to see how individuals choose to describe their cultural background within the media, either by being proud of where they come from or assimilating to the new culture, they are being exposed to. By analyzing how people tend to act differently based on the different types of environments they are being exposed to – technological space or physical environmental space – we will be able to see what type of language or nonverbal cues cause an individual to behave the way they do. Due to the type of environment they are in and the type of people with whom they surround themselves, we will be looking into identity gaps individuals face such as personal- enacted, personal-enacted-relational, and personal- enacted-communal to see what causes individuals to act differently in different environments or with different people and in this case in different social media outlets (Hecht, 2002). This research will help us see how multi-layered identities are being developed simply by using different social media outlets, and also how using specific social media outlets can help us maintain or alter our identity.

As individuals, we already know that we all act differently based on who we are surrounded by or in what social setting we are in. Before the internet, self-presentation used to be internalized because we used to not have an audience

(Gonzales & Hancock, 2009). Now that technology plays a huge role in our lives, people have the opportunity to present themselves as “someone new, someone different” (Gonzales & Hancock, 2009). Due to having this opportunity, people have the ability to create their own online identities and maintain their offline identities (Gonzales & Hancock, 2009). By using media, people can adopt new behaviors that correspond to their physical appearances that they show on their social networks (Gonzales & Hancock, 2009). For instance, if an individual were to be an introvert offline but are presenting themselves as an extrovert online, they are more likely to become extroverted offline due to the self-perception they are developing online.

By individuals having the opportunity to manage their own identities online and having numerous social media outlets to use, individuals may form multiple identities due to the type of production, flow, groups, or activities they are involved in within multiple media outlets (Dixon & Straubhaar, 2012). For instance, the Hybrid Imagined Community is when the “media use facilitates the ‘imaginative (co) presence’ of the country of settlement, as well as the presence of the new country.” (Dixon & Straubhaar, 2012). This is where you can see how the media can play a different role when different generations use it. To illustrate, first-generation users strengthen their homeland identity from their homeland by utilizing media that relates to their cultural background (Dixon & Straubhaar, 2012). As for second-generation users, they utilize media to increase their connection with their new country, which leads to invisibility of their heritage culture due to the American-ness; however, they do identify with their parent homeland in a strong way but try to construct their identity through the engagement of

media (Dixon & Straubhaar, 2012). Overall, the way individuals choose to engage with media reflects their likes and cultural choices (Dixon & Straubhaar, 2012).

On another note, individuals also communicate in different ways when they are surrounded by different groups of individuals and this is known as the identity gap (Hecht, 2002). Whether an individual is online or offline, identity gap occurs when an individual faces the problem of acting like their authentic self and can act in three different ways: personal-enacted, personal-enacted-relational, and personal-enacted-communal. Hecht defines personal-enacted as a tension emerging “between the way an individual’s self-view and the way they express or perform identity through communication” (Hecht, 2002). For example, I am a Mexican/American who lives in America and I feel that I need to speak English rather than Spanish to be treated as an American rather than practicing my culture’s language. Personal-enacted-relational is when an individual performs or expresses “their ethnic-racial identity to others, and the ethnic-racial identity that is supported by relational partners” (Hecht, 2002). This is when racial identity is being socially constructed even when those raising you are not the same biological race you are. Lastly, personal-enacted-communal is an individual’s “performance or expressions of ethnic-racial identity to others, and the societal agreement on what it means to belong to a particular ethnic-racial community” (Hecht, 2002). For instance, this is when an individual follows the image that others see them as.

The reasons why individuals decide to engage in social media or with others within society is to construct a social identity where they feel that they belong within a social group. Media is also a space where cultural citizenship, social cohesion, and social stratification can be built (Lu & Chu, 2012). Depending on how much an individual is exposed within the media, individuals create physical and psychological attachment when it comes to media and can construct either a local, cosmopolitan, or a nation-state identity (Lu & Chu, 2012). A local identity is the identity in which individuals within society feel as if they belong to a group within society. Cosmopolitan identity is established when human beings feel as if they belong within a community due to sharing common mortality (Lu & Chu, 2012). Finally, nation-state identity can be best described as to when an individual feels a sense of belonging to their state or to one nation (Lu & Chu, 2012).

Whether it is online or offline, individuals go through cultural adaptation, a process through which individuals learn the new cultural contexts, rules, and customs (Nakayama & Martin, 2010). There are four types of cultural adaptation: assimilation, separation, segregation, and integration (Nakayama & Martin, 2010). Assimilation occurs when an individual gives up his or her own cultural heritage to absorb the host cultural identity (Nakayama & Martin, 2010). Separation, is when the

person maintains their own original culture while minimally interacting with the dominant group in society. This can lead to segregation, in which the compelling groups live apart from each other’s policy and practices (Nakayama & Martin, 2010). Lastly, integration is when the individuals decide to maintain both their original culture and their daily interaction with other groups within the dominant culture (Nakayama & Martin, 2010).

In the article, “Through the Looking Glass (Self): The Impact of Wearable Technology on Perceptions of Face-to-Face Interaction,” by Nicholas Bowman, Jamie Banks, and David Westerman explain, “how space in the media could be made more functionally relevant to discourses on inter-cultural dialogue and social cohesion.” (Nakayama & Martin, 2010). New media is a part of everyday life and a tool for cultural change due to the different ideas being expressed online (Singh, 2010). These new ideas shared within media shape the way we think about an event, situation, and others and impact the society we are from. New media has expanded a new communication space and has given individuals the opportunity for global communication by informing us about other cultures around the world, sharing their values and ethics, as well as their aesthetics and lifestyle (Singh, 2010). While doing this, we are exchanging what we know with others online and have formed a third culture within social media (Singh, 2010). We have created a digital culture as a news outlet to become informed of what is happening around the world (Singh, 2010).

Though media plays a role within society as a way to become informed, this can be seen as a positive thing as well as a negative thing due to the tensions and mayhem it can create within societies (Diedong, 2014). Not all cultures can find their own space within media to be able to express their cultures due to not having access to the internet and letting others know their existence. One great example would be indigenous tribes: without having the technological ability to show where they are coming from and what is going on within their society, they may become a lost culture due to people not being aware of them (Diedong, 2014).

On another note, it is up to the individual to choose how they would like to present themselves or their culture in the media. Today’s younger generation (with access to these social networks) have allowed media to play a huge role in their life. In fact, they are more likely to post online every day. As for the older generation, they are more aware of how they use the media. The older generation mainly use media to strengthen their connection with their home culture. For instance, my mother is from Mexico and she is a resident of the United States. She decided she wanted to raise her children in America within the American culture rather than her homeland culture. Thanks to media, she can visit social media sites to learn what is going on her homeland and to stay updated with her friends and family who do not live in America. In other

words, the older generation experience reflects the Uses and Gratifications Theory. This theory “attempts to explain the uses and functions of the media for individuals, groups, and society in general”, in which allows us to gain an understanding of why and how people tend to use media in a specific way to satisfy their needs (“Uses and gratifications approach,” 2017). Both the young generation and the old generation may use social media in a different way, but they use it in a manner to satisfy their needs. Both generations also become influenced by the media, but the important role to help the youth to start forming their identity is the role of their family and how they are informed about their own heritage (Dixon & Straubhaar, 2012). That is why the young generation, those coming from immigrant families, can hold a “pan-ethnic” identity (Dixon & Straubhaar, 2012). This means that they can be seen as unique due to being able to identify with their parent homeland and the hybrid-imaged community of the new U.S. (Dixon & Straubhaar, 2012).

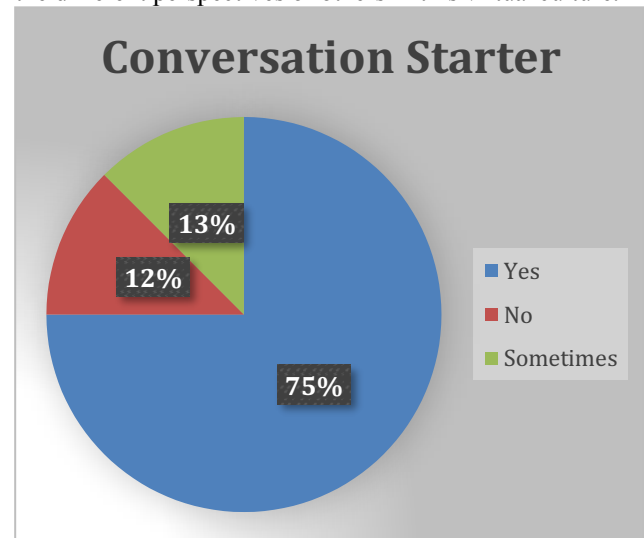
Methods

The type of data that I am looking for in this research is to understand how ethnic minority individuals’ self-present their identity on social media platforms. By conducting semi-structured interviews this will allow me to have flexible conversations with the eight participants that I have interviewed to talk about how they portray their ethnic identity through the use of hashtags, photos, what they say as their captions and what they decide to repost. Before meeting with the eight participants four identifies as female, three as male, one as neither, I asked each individual to be ready to bring in five social media post from their online platforms that they have posted and explain to me why these posts reflect their offline identity. Then, after they finished explaining to me their five posts that reflect their identity, they then defined their own offline identity in two sentences. Lastly, the participants answered a series of questions that related to their online identity and their social media usage, as well as questions that allowed them to talk about how they feature their ethnic background on their different social media platforms that they engage in.

During this study, there were four main social media outlets that the participants preferred to engage in: which were Twitter, Instagram, Snapchat, and Facebook. During these face-to-face interviews, the participants had the opportunity to describe the different ways they engaged within social media outlets. What they all came to find out was that they did hold different personalities within different outlets. Those who used Instagram did not really focus on having a detailed caption but made sure to have a presentable or already informative photos to post on this platform. However, only one participant actually used this platform to inform students of political issues to encourage their followers to become politically involved within the

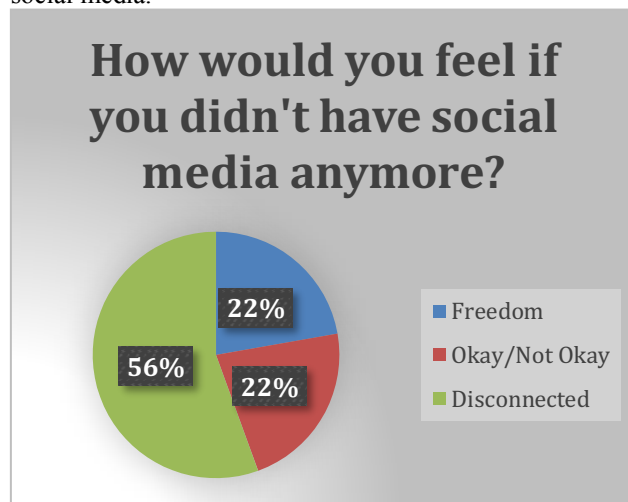
Central Valley community. When it came to Twitter, five out of the eight individuals used this outlet to express their thoughts. Whether it was talking to other people within this platform, posting their own thoughts, information, or feelings online people engage within this medium to just communicate with individuals who may or may not have the same mindset as them.

In fact, six out of the eight participants mentioned how they are more likely to follow people with similar mindset as them while one participant mentioned that they are more willing to follow people with a different mindset, and another participant mentioned that it doesn’t matter if their followers agreed with them as long as they were able to engage in a conversation with them and be able to see the different perspectives of others in this virtual culture.



The majority of these participants also mentioned that the purpose of them engaging in conversations or posting their material online is to start conversations with the people who follow them. In fact, one participant mentioned that they believe that is why social media was created: to engage in conversations online but also talk about what we see in these platforms within society. Another participant mentioned that she uses it to educate their followers of issues that they stand for and wanting to influence others to create change within their society. Yet another participant uses it to inform their followers of new topics that come up within the LGBTQ community. All but one participant mentioned that they did not use social media to be conversation starter but just to stay close to family and friends because they do not like to draw a lot of attention to themselves. When it came for the participants to describe their identity online and offline, two participants explained how their identity online tends to be more extroverted compared to their identity offline which was more introverted. Another participant also explained how they use these social media outlets to actually express their true identity online because they feel like they have to hide it from their family in real life. Meanwhile, the other

five candidates explained that they used social media to complement their life and actually “put themselves out there”. Whether it is showing what exciting events they have been up to with friends or family or what growth they have made within themselves, they used social media to show others what their life is like but tend to show different materials in different platforms. Depending on who they follow - family, friends, coworkers, or strangers - that helped the participants choose what they wanted to post online and what they did not want to share with others in social media.



When it came to asking the participants how they would feel if they no longer had social media. Only one participant mentioned that they would feel free, while another one said that it would feel “weird” at first but then they would not care because they would be more focused on their life. However, it is important to point out that six of the participants mentioned that if they were to no longer have social media they will feel isolated or disconnected. The reason for this is that within social media they were able to embrace their identity; by being able to actually present themselves the way they believe they present themselves offline to others, this allowed them to shape up their online identity and allowed others to learn what to expect for their offline identity. That is why I wanted to see how individuals present their ethnic background online since people who engage in social media can manage their identity. To point out, six out of eight participants barely post in their homeland language or their culture within their social media posts, one participant mentioned that they do not post with their homeland language at all but only one participant emphasized that they always post in their homeland language or about their ethnic culture background they hold.

Based on the ethnicity these participants held, it helped connect the different type of hashtags they connected. For instance, six participants within this research were Hispanics, one was Filipino, and one was black. For those participants who identified themselves as

Hispanics they engaged in hashtags like #Chicanex, #MissingMurderedIndegenousWomen, #Latinx, #Chingona, #SiSePuede, #MesenoMiMama, #NoEraPenal, and #MexicanProud. For the participant that identifies themselves as black, they engaged with hashtags like #BlackGirlMagic, #BlackExcellence, and #BlackLivesMatters. As for the participant who identifies as Filipino, they used the hashtag #magandangmorenx. Other hashtags that some participants shared with me were a part of the LGBTQ community and they were #QTPOC and #Joteria. The reasoning behind the usage of hashtags that these participants explained to me is to bring awareness of a certain problem or situation going on within society.

Results

This research can motivate individuals who engage in social media outlets to become more aware of the identity they are representing on social media. Individuals who engage in media will see how online posts construct their social identity because what they are posting online under their media outlets explains their character; however, this identity that they are representing online can be completely different of what their identity may be offline.

In the article “Identity in New Media” Amy Gonzales and Jeff Hancock (2009) argue, “the quality of online self-presentations may often differ from offline self-presentations, in that they are more authentic or just more thorough, future work may also evidence that the ‘how’ in how we develop identity is not only different online, but that the ‘who’ and ‘what’ of identity may be different as well (p.18). That is why it is important that we pay close attention to technology advancing throughout the years because it is here to stay and it is up to the public to create this virtual culture to become respected and trusted by promoting more positively within it rather than negativity (Singh, 2010). Language constructs the environment we all live in; the words we tend to use within our society attributes meaning to space. The cultural space, constructs meaning of various places, that we create in the media is formed by the people that engage in it (Nakayama & Martin, 2010). People create the meaning of the virtual culture. Based on what they talk online, this social constructs the type of conversations individuals has both online or offline. Therefore, these concepts need to be investigated in an insightful manner and be viewed from multiple perspectives because it is not just one generation engaging in it, but multiple.

Implications

Based in the society we live in, this influences the way individuals use social media outlets and allows us to analyze how we use media to construct new identities. With that said, it is important to inform individuals within

our society that media is not just a source that we utilize for our own amusement but it also shapes our identity based on what we are being exposed to within the media and allows us to manage how we would want our audience to see us through these technological screens.

It is essential to restate to the young generation that what they post online stays there forever – this is the type of identity they are presenting to others. Just like the application LinkedIn, which “is a social networking site designed specifically for a business community,” other social media outlets are also, in a way, an online resume for your social identity.

As time goes on, the more technology we are exposed to the more likely technology shapes our lives. Today, we walk around our society or sleep with our phone near us (we even wear them on our wrist; for example, the Apple watch) – it has become our grown up teddy bear. If we do not have our phone within reach, we tend to feel insecure. That is why it is significant to give our full attention to the additional identities added online and offline.

Future work

There are many potential works that could develop out of this study. Next steps in this line of inquiry would first include the above-mentioned statistical analysis and validation of the model. Additionally, there is the possibility of exploring other potential sources of social network data. This would expand the utility of the model by allowing it to be used with various social media network topographies. Finally, it should be possible to use data from sentimentality studies on social media to develop a method of data-driven model behavior in similar fashion to that used for the model construction. Each of these potential future studies would expand the capabilities and, thus, the value of this agent-based model as an academic tool.

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Examining Communication and Democracy in the Vietnam War

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Abstract

The Vietnam War Era is a complex and unfortunate time for United States' history. Despite US involvement beginning in 1950, large-scale discussion and public knowledge did not begin until much later. Involvement in the Vietnam War began before the American population was able to exercise their democratic right. In addition, President Truman, Eisenhower, Kennedy, Johnson, and Nixon all contributed to the deception and violation of the American people. Government officials created a palatable narrative covering the events of the Vietnam War and engaged in the war in secrecy, violating democratic rights in the process. When events developed beyond being easily concealed, the American people grew restless and resisted intensely until they were heard.

Keywords: Vietnam, discussion, communication, rhetoric, opposition, Democracy, reactions, secrecy, resistance.

In the words of the Declaration of Independence: “[w]e hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.

— That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed” (US, 1776). This declaration served to highlight the injustice by the British towards the Colonists in their pursuit of freedom. The early Americans were so impassioned by the violation of these rights that they would ultimately fight against the British to obtain their freedom. From this fact, the logical idea would be to assume that the early Americans then chose to create a government that derived power by the people for the people. It would be rational to assume that the government regarded liberty and the average American's ability to participate in the democratic process as fundamental to society. It would ultimately be rational to assume that early Americans would create a government, which encompassed the rights that they desperately wanted from the British, and the rights that were presented in the Declaration of Independence and even the US Constitution.

While this would be the logical assumption, this is ultimately, not what occurred. The United States' government unfortunately faltered in its ability to grant these rights to its own citizens. While this is prominent in large swaths of US history, a prime spotlight of the dereliction of American democratic ideals is encompassed in the Vietnam War Era. In an ideal American democracy, (in terms of what early Americans hoped for in their government) an average American would have the liberty to influence political processes. Citizens, in theory, should be able to voice their opinions in a form that their direct representation responds to by enacting policy that reflects their voice. To elaborate on this further, contextualization and vast discussion of the Vietnam War opinion is needed.

The historiography of the Vietnam War's public opinion focuses in on several prominent fields of thought. First, is the notion that although there was opposition in the later portion of the war, Americans largely supported

an attack against Communism and the protection of democracy. An example of this theory comes from Sandra Scanlon, who suggests that a considerable amount of the American population supported the war due to its goal of containing the spread of Communism. This is best noted in an excerpt where she states that conservatives had a “long-stated belief that the Vietnam War was an essential part of America's Cold War struggle against the spread of totalitarian communism (Scanlon). She continues to elaborate in further chapters, where she argues that considerable support for the war existed until the later stages of the war, when public opposition publicly dominated, and support of the war was overshadowed. Her argument falls into a broader section of literature, which highlights support for the war.

Other theories on the Vietnam War draw considerably different conclusions. Another largely prominent war opinion is that the Vietnam War faced opposition swiftly and immediately by large groups of the American people. A representative voice of this theory is H. Bruce Franklin. He suggests that “the first American opposition came as soon as Washington began warfare against the Vietnamese people by equipping and transporting a foreign army to invade their county- in 1945” (Franklin). His voice embodies the theory that war opposition began extremely early in the war; as early as the war began, as well as the fact that Americans as a whole were fundamentally opposed to the war.

Both of these theories suggest a theory on American public opinion at the same, but they lack an awareness in a fundamental aspect of public opinion. While many people had reactions to the war, these people could not truly have a valid opinion on the war because they were not given all of the information. This paper will examine the rhetoric an information presentation by government officials and select voices of the American people to highlight the lack of true liberty, democracy, and consent of the governed. The American people were largely opposed to the war, despite the fact that they were not given any amount of the full information known by government officials. Admittedly, there were groups of people who supported the war, although they did not truly have the full information in order to make that decision. This paper will examine the

flaws in communication that prevented the American people from making informed decisions in the political process.

In short, the American people wanted a voice. From the very beginning of the establishment of American government, the American people were fighting to have a voice in their democracy. While this could have resulted in a fair and productive democracy, it ultimately boiled down to a nation where the top officials made the decisions and then presented them in a limited capacity to the American people. Using an examination of the five prominent presidencies (Truman, Eisenhower, Kennedy, Johnson, and Nixon) and the public voice surrounding the Vietnam War, this paper will inspect the faults of democracy.

Beginning a discussion of US involvement in the Vietnam War requires a short historical summary of the broader situation in Indochina. In the 1880s, Vietnam was essentially a colony of the French. By the mid-1900s, however, the Vietnamese grew tired of this and engaged in a struggle for independence. Beginning in 1945, the French Indochina War was largely a struggle of a colony fighting for independent rule from France. In April 1954, the Vietnamese won their independence, which is demonstrated by the Geneva Conference. The alliances and groupings during the French Indochina War led to the post-war decision to split Vietnam at the 17th parallel into the North and South. The South identified with US allies and began to align with principles closer to a democracy, while the North found French and other influences that pushed the region into practices that were more communist in nature.

This notion of the North and South carried on until it was escalated into conflict. By 1957, forces from the North and South were fighting along the Ho Chi Minh Trail. Fighting, as well as US involvement gradually escalated into the war that would later signify and embody the Vietnam War. US involvement is frequently noted as beginning after the Gulf of Tonkin incident in 1964, which resulted in the Gulf of Tonkin Resolution. Peace talks from the United States began from the US Government formally in 1968, and the last US troops were pulled out of Vietnam in 1973, signaling the end of the war (Hanna). Despite the general knowledge that US involvement began later, approximately around the period of the Gulf of Tonkin incident; US involvement actually began much earlier. US involvement began in 1945, when the United States helped France against the Vietnamese “by equipping and transporting a foreign army to invade their country [Vietnam]” (Franklin). In addition, the US continued a pattern of providing financial aid and resources throughout the French Indochina War. This summary of the situation in Vietnam serves to be a contextual foundation for the discussion of US involvement in Vietnam

Harry S. Truman, AKA Give ‘Em Hell Harry; 1945-1953

Harry Truman began US involvement in Indochina, although he did so in secrecy. As noted earlier, Truman began financially contributing to the war in

Indochina in 1945 (Franklin). As soon as the war began, Truman began to involve the US through financial contributions. The Pentagon Papers elaborate on this further by detailing the contributions and reasons. In terms of its financial contributions, *The Pentagon Papers* documents that in “the winter of 1945-1950... the Truman Administration moved to support Emperor Bao Dai and provide military aid to the French against the Communist-led Vietminh” (Butterfield in Pentagon Papers). In the early 1950s, the documents show several cases of military and economic contributions in Indochina. All of these examples clarify the US involvement in Vietnam.

In addition, all of these contribution documentations are accompanied by the rationale behind them. For example, in December of 1949, “President Truman approved a key National Security Council study on Asia, designated N.S.C. 48/2” which illustrated that “the course of US policy was set to block further Communist expansion in Asia” (Butterfield, P.P.). This is developed further in February 1950, when the National Security Council provided an explanation for their military aid to Indochina, which centered entirely on the Domino Theory (Butterfield, P.P.). In other related examples, the Pentagon Papers outline contributions to Indochina with rationales of the fear that Indochina would fall to Communism. The threat of Communism in Vietnam was enough for the United States to begin financial involvement in the war.

While financial contribution itself is not major involvement in the war, it does pose significant issues. First, it is still action engaged in covertly by the US government. The average American people were not told about the financial contributions to the war and in many cases, official documentation of the war suggested that the information was held secretly. This is noted in several significant documents, but is highlighted succinctly in the *1952 Policy Statement by U.S. on Goals in Southeast Asia*. In this document, the National Security Council outlines a policy for keeping Southeast Asia from becoming Communist by assisting their resistance efforts. This document then outlines specific policy for Indochina, much of which incorporates a presentation of importance of Indochina to the American people. In the policy statement, covert actions and propaganda are encouraged in several aspects (NSC 1952, P.P.). In other documents, more covert behaviors, propaganda, and other forms of deception are hinted at. In short, while financial involvement is not an extreme behavior, it was still a secret to the American people and offered these Americans no choice in the matter.

In addition, this process of increasing financial involvement served to increase US responsibility in Vietnam. While the economic and military aid was not a huge action in itself, it served to pledge US support within the war and would create an interventionist precedent. This is summarized succinctly by the quote “the Truman Administration’s decision to give military aid to France in her colonial war against Communist-led Vietminh directly involved the United States in Vietnam and set the course of American policy” (Sheehan, P.P.). In short, financial involvement was not a huge step in war involvement, but it provided the precedent for covert involvement that would

last for four more presidencies.

Truman's covert involvement is noted in the *Pentagon Papers* in several documents, but it is extremely relevant in his speeches as president. In these speeches, the American people were led to believe that they were getting updates of American policy within the world, when in truth; these speeches were used as a tool to disguise the actions authorized by the President. In most cases, Truman's speeches served as a type of propaganda, where the American citizens were told to care about the various issues that would be prevalent in the Vietnam War. For example, in June of 1947, Truman gave a speech to the NAACP. In this speech, Truman says, "[r]ecent events in the United States and abroad have made us realize that it is more important today than ever before to ensure that all Americans enjoy these rights" (Truman). While this speech is focused on the rights of African Americans and is likely drawing this parallel to the tumultuous situation in Korea, it also provides an opportunity for Truman to suggest an importance in ensuring rights for all.

This notion arises in many other speeches. For example, on April 11, 1951, Truman gave a speech entitled *Report to the American People on Korea*. In this speech, Truman notes the importance of targeting the Communist who are working to endanger peace within the free world. However, in this speech, Truman makes broad statements that could easily represent Vietnam. He also notes that the Communists were attacking Korea with a larger plan of taking over all of Asia (Truman). In his speech, Truman makes large claims of the Communist danger to freedom everywhere, while also suggesting that Communism is being defeated in Korea so that it will not be an issue anywhere else (Truman). This idea that Communism is being defeated in Korea is deception to the American people. Involvement in Indochina with the goal of stopping Communism is not mentioned.

Overall, many of Truman's speeches appear to take on a role of a trial balloon, where he presents the situation in a way that gradually increases awareness of the Communist issue. While keeping the economic and military assistance a secret, Truman directs the people to focus on the issues of Communism in other parts of the world. Truman's public rhetoric serves to make involvement in the war more palatable to the American people, while maintaining its secrecy. This behavior will be continued and expanded by the presidents after him.

Even though US involvement began in secrecy, there was still rare instances of resistance. Large bodies of the American people did not know of US involvement in the war, and as a result, they were not able to resist involvement or sway government policy in any capacity. However, there still were special cases of resistance. For example, in September 1947 a meeting for the Celebration of the Second Anniversary of the Independence of the Republic of Viet-Nam allowed many speakers to denounce the war (Franklin). These speakers essentially claimed that the United States was financing colonial imperialism by supporting the French. Despite being kept in the dark to a large degree regarding US policy in Vietnam, these individuals resisted involvement even in the 1940s. Despite the US government robbing

the American people of an influence in public policy regarding Vietnam, there still were people who recognized the situation and called for the US to stop. The Truman Administration set a precedent for involvement in Vietnam with the intention of keeping all of Asia from falling to Communism. This administration also set a precedent for secrecy. From its very beginning, the American people were stripped of their opportunity to have a voice in the political process.

Dwight D. Eisenhower: AKA General Ike: 1953-1961

In Eisenhower's *First Inaugural Address* speech on January 20, 1953, he made the claim that America has "grown in power and responsibility" (Eisenhower). While this quote is likely referring in part to Korea and the Post-World War world, this quote also fits perfectly to the situation in Vietnam. During the Eisenhower Administration, Vietnam War involvement continued the same gradual escalation pattern that the Truman Administration began. This is outlined most clearly in the *Pentagon Papers*. To illustrate, the *'54 Report by Special Committee on the Threat of Communism* illustrates the escalation by outlining the conclusions and courses of action. In this document, the central idea is that the US should defeat the Communist threat by any means politically or militarily available (Report by Special Committee, P.P.). This mentality appears to motivate the rest of the decisions in Eisenhower's Administration.

For example, in June 1954 through August 1955, this report resulted in the authorization of "paramilitary operations against the enemy and to wage political-psychological warfare". This was supplemented in August of 1954 when the US states supported a plan of direct involvement and in December of 1954 when the US took over the military training in Vietnam (Butterfield, P.P.). As stated earlier, all of these actions were responses to the fear of Communism. However, this fear was not projected in conversations to the American public. In fact, the American people were led to believe that the situation in Vietnam was being managed and was showing far-reaching progress (National Intelligence Estimate, Butterfield, and P.P.). The American people were given an optimistic painting of the vastly uncertain and fear-inspiring situation in Vietnam.

Many of Eisenhower's public speeches corroborated the optimistic image being presented to the people. For example, in his inaugural address, Eisenhower presented an optimistic and powerful image of American individuals fighting to "deter the forces of aggression and promote the conditions of peace" and to consider the "Nation's strength and security as a trust upon which rests the hope of free men everywhere" (Eisenhower). This speech presents a striking positive image, and does not mention any semblance of US involvement in Vietnam. The speech only casually presents the tragic image of the French soldier dying in Vietnam and implicitly suggests that Americans could eventually have to aid the forces of freedom. He clarifies this idea in more detail in his *Chance for Peace* speech when he states "humanity is hanging from a cross of iron" and then delves into an analysis of the threat to freedom in many places around the world (Eisenhower). In this speech, he offers an image of a

potential peace, when this was just truly not the case of the time.

Eisenhower presented an appearance of a need to contain Communism and hinted at a negative situation in Vietnam, but he did not provide the American people with a truthful assessment of government action. As a result, these individuals could not have a valid and informed reaction to US involvement. While the population was largely unaware of actions, they still could occasionally infer and form suitable reactions, just as they did in the Truman Administration. For example, In April of 1954, Vice President Nixon implied in a trial balloon that US action might be needed in Vietnam, which prompted thousands of Americans to write to the White House discouraging this action (Franklin). Besides this, a Gallup poll in May of 1954, indicated that 68 percent of people opposed sending troops into Vietnam (Franklin). While these instances are not the outlandish protests depicted in later years, it is tangible proof that the American people were unhappy about this war and protested it as soon as they knew any semblance of what was occurring.

John F. Kennedy AKA “Lancer”: 1961-1963

In short, Kennedy was responsible for a significant increase in involvement in Vietnam. While keeping most of the details out of the press, Kennedy would create a significantly more developed American response. However, Kennedy also put out the presidential image that he was open and honest. In his speeches, Kennedy placed a great deal of focus on being transparent with the population. He also spoke passionately about the strengthening and preparedness needed in order to fight in Vietnam.

To illustrate, in his 1961 *“City Upon a Hill” Speech*, Kennedy emphasizes that American democracy is “a model to others” in many ways, specifically including the American courage needed to “stand up to one’s enemies” (Kennedy). He corroborates this in his 1961 *Inaugural Address* where he encourages an arms increase and a show of strength to the other nations (Kennedy). In both speeches, he implies that preparing to aid struggling nations is part of being a model democracy, and part of being an American. Kennedy used his presidential rhetoric to make fighting in Vietnam an issue of patriotism.

Besides the use of patriotism, President Kennedy uses other tools of speech to present a better image. For example, in his 1961 *State of the Union Address*, Kennedy offers a false pretense of transparency to the American people. This is best observed in the quote:

Our Constitution wisely assigns both joint and separate roles to each branch of the government; and a President and a Congress who hold each other in mutual respect will neither permit nor attempt any trespass. For my part, I shall withhold from neither the Congress nor the people any fact or report, past, present, or future, which is necessary for an informed judgment of our conduct and hazards. I shall neither shift the burden of executive decisions to the Congress, nor avoid responsibility for the outcome of those decisions (Kennedy).

In this speech, Kennedy uses his rhetoric to establish himself as the president who is making every effort to be transparent with Congress and with American citizens. He presents the idea that he will make every effort to inform the American people and Congress with information they need to make decisions on policy. While this is phenomenal, it is ultimately just a line given to the American people with no action behind it.

Later in the speech, he does go on to explain limited information about Vietnam and how they are fighting for freedom. He uses this to explain America’s responsibility and outlines the response needed; including more “air-lift capacity”, an increased “submarine program”, and an acceleration to the “entire missile program” and some form of program which can help give aid to these countries (Kennedy). He markets the aid strategy as others as new plans which he plans to ask Congress permission for, but in reality, this was already largely occurring.

His message of transparency is echoed louder in his 1961 *“President and the Press” Speech*. He clearly presents an image of transparency in the quote:

No President should fear public scrutiny of his program. For from that scrutiny comes understanding; and from that, understanding comes support or opposition. Moreover, both are necessary. I am not asking your newspapers to support the Administration, but I am asking your help in the tremendous task of informing and alerting the American people. For I have complete confidence in the response and dedication of our citizens whenever they are fully informed.

I not only could not stifle controversy among your readers—I welcome it. This Administration intends to be candid about its errors (Kennedy).

This speech offers the image of open honesty and of giving the American people a chance to influence public policy. However, this never happened in the capacity that Kennedy presented. Kennedy offered a golden image of transparent honesty, but this never occurred for American citizens.

Despite the golden image of public communication, Kennedy engaged Vietnam in covert secrecy. For example, almost in the exact timing of this speech, “President Kennedy made his first fresh commitments to Vietnam secretly. The Pentagon Study discloses that in the spring of 1961 the President ordered 400 Special Forces troops and 100 other American military advisers sent to South Vietnam. No publicity was given to either move.” (Smith, P.P.). Not only was this a secret mission and a slap to the face of the American people who were promised honesty, it was also a breach of the Geneva Agreement. In addition to deceiving his own people, Kennedy was willing to ignore terms of the peace agreement.

Kennedy took further steps, including a decision to step up the covert operations in North Vietnam (National Security Memorandum, P.P.). Without describing every operation initiated by Kennedy, a process of deepening covert operations was initiated. A notable example includes an outline for covert warfare, including spying on and sabotaging Communist bases in North Vietnam (Smith, P.P.). Covert operations continued in a pattern of secrecy

with specific control of the communication. For example, there began to be speculation about the situation in Vietnam and the response is best noted in the quote: "Administration officials effectively squelched press speculation about the troop question with carefully managed news leaks" (Smith, P.P.).

Throughout Kennedy's presidency, Vietnam involvement skyrocketed with ten times more American forces (Smith, P.P.). By October 1963, "American involvement grew to 16,732 men" (Smith, P.P.). Overall, Kennedy was responsible for significantly deepening US involvement in Vietnam while hiding it from the American people. This is best articulated in the book *Dereliction of Duty* by H. R. McMaster, as he is able to explain in a step-by-step fashion exactly how Kennedy (and Johnson) made huge errors in conducting war in the dark to the American people. Without delving too far into this book, it explains some of the major covert operations and cover-ups by Kennedy that solidify and clarify the several mistakes made by Kennedy. The American people were promised transparency and honesty but instead got wide-scale deception and increased involvement.

In this Administration, the American people finally were able to obtain some knowledge regarding war involvement. Granted, the knowledge was still extraordinarily hidden and deceptive, and large amounts of people still had very little knowledge of the true nature of war. Despite this, protest essentially began in a larger capacity under the Kennedy Administration. For example, several groups such as the Society of Friends, the Fellowship of Reconciliation (FOR), and the War Resisters League (WRL) all began denouncing war involvement (Schreiber). In addition, as noted by Franklin, "by 1963, the basis of a broad popular movement was forming" (Franklin). Franklin goes on to note that while opposition to the war would nationalize in a large way the following year, the Kennedy administration saw the beginning of anti-war coalition. War opposition was not huge due to the largely held secrets of involvement, but there were significant elements of development in this time period.

The best example of opposition from this time period comes the *Port Huron Statement* released in 1962. In this statement, a deeper understanding of the anti-war demonstration is understood. This entire document can be summarized as a plea for a say in the democratic process. The plea for a "participatory democracy" is best summarized in the quote "as a social system we seek the establishment of a democracy of individual participation, governed by two central aims: that the individual share in those social decisions determining the quality and direct of his life; that society be organized to encourage independence in men and provide the media for their common participation" (SDS). The statement essentially summarizes the need for democracy to consist of information sharing with the people and a plea for the American people to have some say in government actions. This would encompass a large degree of anti-war sentiments in later years.

Overall, Kennedy was responsible for creating a war that the US could not turn away from, while

simultaneously hiding it from the American people. Still, the American people were able to coordinate and begin to form resistance to this injustice.

Lyndon B. Johnson AKA "Landslide Lyndon": 1963-1969

In this stage, Johnson was responsible for bringing light to the situation in Vietnam as he significantly increased involvement in the war. At the same time, his revelations brought the rapid advance of anti-war demonstrations. Despite being the President running on the platform of restraint, Johnson was responsible for the worst of the Vietnam War involvement.

Johnson's speeches offer a concise look as his presentation of the war to the American people. Johnson offered little discussion about Vietnam in his speeches until after the Gulf of Tonkin. His limited information was presented in the context of a vague statement of trying to lessen involvement or through coaxed answers by questioning reporters. In his *Report on the Gulf of Tonkin Incident*, Johnson cried of the unjust action by Vietnam and swore retaliation (Johnson). From this point on, Johnson's speeches used the Gulf of Tonkin as an excuse for increasing military action. This is apparent in several speeches, including his 1964 *Remarks on Vietnam at Syracuse University* speech, his *Address at John Hopkins University*, and more.

Johnson also blamed other factors for the war. For example, in several speeches, Johnson blamed the past presidents for establishing precedent in the war (despite the fact that he was the president who involved the US most heavily). The best example is the *Address at John Hopkins University*, where he states, "we are there because we have a promise to keep. Since 1954 every American President has offered support to the people of South Vietnam" (Johnson). Another element of the blame game originates in the *Press Conference* on July 28, 1965, where Johnson stresses the perils of the Domino Theory.

Overall, Johnson's speeches do contain a vastly higher amount of Vietnam War conversation. In fact, nearly every single speech in his presidency has some type of mention of Vietnam. However, this is because of the Gulf of Tonkin. After Vietnam policy went through Congress, the American people knew of the war and were able to demand answers. Even though presidential conversation spoke frequently of the war, it did so in a way that placed blame on everybody except the President. Speeches were worded in ways that blamed others, blamed precedent, or blamed aspects that could not be corrected. Even though Vietnam conversation was much more apparent in the Johnson Administration, it was still done in a way that hid prominent aspects from the American people under cheap shifts of responsibility.

Much like the presidents before, the *Pentagon Papers* serve to explain the way in which the war was involved in without the American people's knowledge. In chapters five through ten, Johnson's policy for covert warfare was laid out in pristine detail. Johnson authorized a

great deal of covert warfare and made plans for resolutions to be presented to Congress. This warfare included various forms of “information gathering” and “destructive undertakings” where people were attacked, kidnapped or spied on for information gathering and covert warfare (Sheehan, P.P.). Another glaring example of Johnson’s transgressions comes after he agreed to bomb North Vietnam (among all other actions of covert warfare) and then gave a speech where he claimed that the policy of the US “was to furnish advice, give counsel, express good judgement, give them trained counselors, and help them with equipment to help themselves” (Sheehan, P.P.). Johnson was remarkable at deceiving the American people. In another example, “President Johnson decided on April 1, 1965 to use American ground troops for offensive action in South Vietnam... He ordered that this decision be kept secret” (NSAM 328, P.P.). Throughout the war, Johnson would make many decisions in secrecy.

In the later years of his presidency, Johnson could not hold on to the secret operations. After the Gulf of Tonkin and several prominent breeches of information, war opposition grew in huge numbers. For example, “On March 10, [1967] The New York Times published the first report... about General Westmoreland’s request for 206,000 troops. The president was furious at the leak” (Kenworthy, P.P.). Johnson began to crumble, as war policy grew unpopular inside and outside of the government. From this point on, Johnson would begin to fight an uphill battle with the massive increase of “press leaks and public criticism” (Kenworthy, P.P.). Overall, Johnson was responsible for massive expanses in the war, as well as a massive increase of public opposition.

No amount of explanation can give a full picture of the opposition during Johnson’s Presidency. However, this period encompassed huge resistance from many different individuals. Franklin characterizes them best in his book. To illustrate, Franklin notes the marches, teach-ins, mutinies, army resistance, protests, and groups that all worked to oppose the war. Franklin notes that the first anti-war opposition in this administration came when Americans selected him for his anti-war pledge, despite him committing American troops to ‘fight the war of the Asian boys’ less than 48 hours after his election (Franklin). Anti-war demonstrations also came in the form of marches, beginning in 1964 with the SDS coordinating 25,000 people in the March on Washington and eventually escalating in the late 60s to marches incorporating nearly 500,00 people (Franklin). The teach-ins also began March 1965 (Franklin).

Students also comprised a lot of the resistance in this administration. Notable forces include the Students for a Democratic Society (SDS) and Student Nonviolent Coordinating Committee (SNCC), which were both responsible for loud voices of opposition. Another prominent sample of resistance originates in the student newspapers. Across many campuses, college students created a voice of opposition in their school’s newspaper. A huge example comes from *The Comment*, the university newspaper of Bridgewater State University. Many, many schools published extremely anti-war publications, but

The Comment provides an example of a more remote school voicing opposition. This paper includes details of transgressions in Vietnam, student calls for peace, anti-war editorials, and campus interviews against Vietnam (Bridgewater). Another newspaper example is *The Cardinal*, the newspaper of the University of Madison. This paper created some of the loudest calls for opposition and was responsible for inciting many protests against the DOW chemical plant; the creator of Agent Orange. College newspapers provide major and vivid examples of the opposition developing with the development of information available to American people.

Opposition additionally found roots in the broader Civil Rights Movement. Both of the leaders of major Civil Rights Movements spoke loudly against the war. Malcolm X spoke first in his *The Ballot or the Bullet Speech* in April of 1964, where he denounced the war passionately, and called for action and cessation of war in Vietnam (X, Malcolm). Martin Luther King Jr. echoes this in several speeches. The most famous speech of MLK in this context was *Beyond Vietnam*, where he passionately and empathetically calls for the end of violence to the Vietnamese (King). Both of these individuals, as well as all of the previous examples, show the large extent at which this time became focused on opposition. As individuals learned of the war, they were quick to oppose it in any way they found possible.

Richard M. Nixon AKA Slick Rick: 1969-1974

By the time of the Nixon Administration, the war had shifted from a process of covert engagement to a process of backpedaling and trying to push an agenda of peace. In his *First Inaugural Address* in January of 1969, Nixon praises the youth for fighting diligently for peace and strongly encourages it while continuing to salvage reputation by throwing in mentions of a peace that protects South Vietnam (Nixon). Nixon at this stage of his Presidency was reduced to an attempt of cleaning up the smoldering messes of Vietnam. This is best reflected in his *Address to the Nation on the War in Vietnam* from November of 1969. While he still lies and deceives the American people, most glaringly in the statement that US involvement had only occurred for four years, he presents a specific amount of honesty to the American people (Nixon). In this speech, Nixon gives numbers of men involved, or policies implemented and of peace negotiations between countries. He uses this pretense of honesty as a backdrop to try to win support for the decision to phase in Vietnamization instead of immediate withdrawal (Nixon). In these examples as in many of Nixon’s speeches, he is truly attempting to quell the massive opposition long enough to create some form of peace in Vietnam.

Nixon’s speeches from 1969 until 1972 all serve in some capacity to inform the American public about Vietnam. Without doubt, these accounts are not entirely honest; however, they reflect that candor that has been forced from the glaring opposition of the public. At this point, the American people are furious and want answers. As a result, Nixon is forced to explain his actions to a public that desperately wants peace. This is the situation

until January of 1972, when Nixon gave his *Address to the Nation on Plan for Peace in Vietnam* that proposed a peace and withdrawal of American forces (Nixon). He markets the peace as a lasting chance for peace and a fair option to all parties and not as a placatory option for the riled-up American population.

His placating of the public would draw to a close in his 1973 speech, *Address to the Nation Announcing an Agreement on Ending the War in Vietnam* in which he announces that a peaceful negotiation has been accomplished (Nixon). In his speech, Nixon prides the terms of peace and offers heavy praises to the American forces involved. In this speech is the announcement of the end of the war that claimed nearly 60,000 American lives and nearly tore the nation into shreds of public opposition. It is clear that peace was inevitable based on the massive public outcry.

Every major opposition began in the 1960s was increased and continued during the Nixon Administration. Teach-ins, marches, protests, newspaper outcries, public speeches, riots, and more were all strikingly glaring in the Nixon Administration as well. This is outlined in great detail by Franklin, who encapsulates the fact that all of these movements grew in strength, numbers, and power at this time. A quick example of these facts comes in the large-scale demonstrations, including several million people participating in marches in 1971, the glaring 75% of veterans opposing the war, and the roughly 1,000 veterans participating in the March on Washington in the spring of 1971 (Franklin). These instances were in great abundance as American people fought to project their voices loud enough to be heard by every individual of power.

Conclusion

With Nixon pushed into a corner, it was public opposition that forced the President into a quick end to the war. After over a decade of involvement, the American people finally had enough knowledge to consolidate the power needed to end the war. These people never wanted war. The war involvement began before Americans had a choice, but as soon as they knew, they began a clear opposition to involvement. At the beginning, they were quiet, as people "believed that the government would respond to them because they believed in democracy and rectitude" (Franklin). However, this quickly proved to be false, and as the American people realized this, they got louder and bolder until they were heard. American individuals did not want to violently riot or act in the drastic ways that they did. They acted as they did to be heard, and to establish communication that would force action.

In a traditional idea of democracy, and in the democracy that this country aimed to establish as seen in the Declaration of Independence, the US government should derive its power from the people. Policy should ideally be a reflection of public opinion. However, the Vietnam War offers a glaring example of the absolute demolition of democratic principle. Power was derived in secret conversations with select people and then stifled

from the masses. The democracy of the United States was a laughing-stock example of democracy, which is especially shameful when juxtaposed next to the fact that this war was allegedly fought in the name of protecting democracy. The American people were not allowed to engage the decisions of the war until after the presentation of information, which came through leaks, accidents, and a lack of other options.

American people opposed the war as soon as they were able to. Opposition came as quickly as information did. Maybe if a global protector of democracy had intervened in the United States, Vietnam would have never occurred at all.

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World War 1914-1945: A Second Thirty Years' War

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Abstract

The prevailing view of the time period of 1914-1945 is as separate events, however this article looks at an alternative to this view by grouping the period into a single thirty year long conflict. Currently in the time period of 1914-1945 there are three recognizable events: World War One, the Interwar, and World War Two. To many it may seem normal that these events are separate since they have clear beginnings and endings but there are historical examples of grouping multiple conflicts into a single conflict. One such example of this is the Thirty Years' War of 1618-1648. This conflict shares several similarities to its more modern counterpart beyond just length. An important similarity that each period has is shared themes. These themes are common across each time period respectively and make each period distinct from the years before and after. Perhaps most important to the argument that 1914-1945 should be a single conflict is the peace, or lack thereof, during the interwar. This article also works with the difference in war experience between the U.S. and Europe and how this has affected the current view of the time period.

Keywords: World War, Thirty Years' War, Interwar

This year marks the centennial anniversary of the end of the First World War, a war which was thought to be the “war to end all wars.” World War One was a transformative event in not just European history, but also world history. It is not the only one, though, as just twenty years after its end the Second World War would begin and the world would once more become shrouded in death and violence. The outcomes of these wars have had lasting impacts on the geopolitical structure of the modern world. Before the First World War, Europe was the epicenter of world politics with the continent collectively controlling more than half of the world's population and an even larger proportion of the world's land area. After the end of World War Two, Europe was left devastated and the true power in the world was split between the

United States and the Soviet Union. Society looks at World War One and World War Two as being two wars separated by a time of peace but this view does not serve the time period justice. By looking at World War One and World War Two as separate the connections and relations between them can become unclear or even lost to some. What does serve these two wars justice, the two most devastating wars in the history of humanity, is to view them as a single event spanning thirty years: The Second Thirty Years' War.

What is the significance of this view? The first significance is that it makes the origins of the Second World War clearer. Most people can say that the Nazis caused World War Two but significantly fewer can say why the Nazis rose to power and under what circumstances. Viewing

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the two world wars as a connected single war is also significant for history teachers. At the high levels of history classes it is easy to understand how World War One and World War Two are related as there are entire classes dealing with this connection. It is at the lower levels such as high school where this can shine as it can be so easy for a student to learn about the First World War, take the test, and forget it all. By viewing the time period as a single event rather than as separate it emphasizes the links between the wars and could lead to better retention of information. Finally, and perhaps most importantly, the view of a single war brings out the common themes of the time period which were important driving factors of the conflict: imperialism, nationalism, and racism.

In order to make the argument that these wars should be viewed as a single thirty year long war rather than just World War One, the Interwar, and World War Two, this paper will identify four primary arguments. The first of these arguments is the interconnectedness of the two wars. It will look at how the two wars relate and how the Second World War was dependent on the outcome of the first. The second argument will be a comparison to the Thirty Years' War. Despite the Thirty Years' War having taken place several hundred years ago it shares many similarities to the modern wars and most importantly the length and multiple conflicts. The third argument will be the turbulence during the Interwar. The Interwar period is often seen as being a time of peace between World War One and World War Two, however it was far from it and contained very little true peace. The fourth argument will be looking at the difference in war experience between the United States and Europe from 1914-1945. Given that these conflicts were primarily fought in Europe it takes no stretch of

the imagination to see that the United States and Europe will view them differently.

In order to understand why World War One and World War Two should be grouped together into a single war, it is important to understand just what happened leading up to the First World War and what happened between the years 1914 and 1945. Before the beginning of World War One, Europe had not seen any major conflict since the German wars of unification during the 1860s and early 1870s. During this pre-war time Europe had a buildup of arms as the newly unified German Empire was the preeminent military land power with a strong industrial backing rivaling and even surpassing that of the British Empire. In an attempt to isolate France and ensure German supremacy on the continent the Germans allied with the Austro-Hungarian Empire. Originally this alliance included Russia, but Kaiser Wilhelm II failed to keep the Russians on their side and the Russians would subsequently go on to form an alliance with France to keep Germany in check with the threat of a two-front war. Later still this alliance between France and Russia would grow to include Britain because of British treaties relating to Russia, this formed the Triple Entente.

During this pre-war time, one also sees great increase in the first of the major themes of the wars: imperialism. Following the German unification was the scramble for Africa. The main event of this was the Berlin Conference where the great powers of Europe met to discuss the question of Africa and how they should divide it amongst themselves. This was meant to be a balancing act where all of the European powers would receive some amount of land in Africa in order to avoid a crisis and war breaking out. While this event was far from the beginning of European imperialism, it does represent a great

increase in it especially with regards to the World Wars. The European powers were hungry for more power at this time and their imperial ambitions were not limited to outside Europe. The great powers of Europe hoped that they could each respectively dominate the continent, none more so than the Germans whose strong land army made the prospects of continental domination quite possible. The Germans did receive land from the Berlin conference but their lands were all isolated from one another and did not hold much value to the German Empire besides matching the other European great powers.

With the First World War drawing closer a new problem was being moved onto the heat: nationalism. Wrapped up in and closely related to nationalism was racism with some groups of people or nationalities believing that they were inherently better than others, and especially those which they may rule over. Nationalism had its origins not so long before in the Napoleonic Wars just more than a century before the beginning of World War One. Throughout this time period the idea would grow and become a real nuisance for the sprawling multi-ethnic empires of central and southern Europe. Where nationalism had brought the German Empire together, it was beginning to tear apart the Austro-Hungarian Empire and the Ottoman Empire. Austria-Hungary had already had to divide itself into a dual monarchy recognizing the size of Hungarian population. Other minorities wanted this as well, most prevalent the southern Slavs in the Balkans.

This brings the timeline to the triggering event of the First World War which was the assassination of Archduke Franz Ferdinand. Franz Ferdinand was the heir to the imperial title

of Austria-Hungary. The Archduke was sent to the city of Sarajevo in June of 1914 to observe the military during some maneuvers. During a trip through the city he faced multiple assassins with the final one shooting both him and his wife. The assassins were Serbian nationalists that wanted a free and independent Yugoslavia from the Austro-Hungarian Empire. A month following this assassination, the government in Vienna declared war on Serbia arguing correctly that the Serbian government played a role in the assassination plot. Through a web of alliances which had been in place to deter warfare and maintain the balance of power on the continent, the entirety of the continent ironically found itself at war.

Originally the European powers believed that the war would be over by Christmas of 1914 just a few months away, they could not have been more wrong. In fact, many of the citizens of these countries were enthusiastic to join in the war. They thought that they would be heroes, but as it would turn out the war would only bring them tragedy.² In 1917, the Americans would enter into the war adding new life and enthusiasm to the allied powers. Following this the central powers would win the war in the east carving out several new countries from the lands of Russia. In the west with the help of the Americans, though, the war would be turned against Germany and the country in 1918 would be forced to surrender effectively ending the First World War.

It is at this point where the First World War could have remained the only World War. With German imperial ambitions destroyed and the war over the allied powers could have truly made this the “war to end all wars.” This would

² George L. Mosse, “Two World Wars and the Myth of the War Experience.” *Journal of Contemporary History*

not be the case though. The allies came with the Treaty of Versailles, the official end to the war. During the writing of this treaty both Britain and the United States wanted to avoid excessive punishments to Germany as they believed that it could lead to further conflicts in the future. France saw this differently. This was the second time that their country had been invaded by the Germans in half of a century and the majority of devastation in the western front of the war was in the eastern French countryside where the trenches stretched endlessly. The French only sought to cripple Germany so that they would never be able to challenge the French again. This can be seen as a form of imperialism as France hoped they could remain superior to Germany.

The Treaty of Versailles brought extreme punishments to the German state. First the treaty stripped Germany of large areas of land. In the east they lost considerable land to Poland including the historical port city of Danzig. This loss of land also left Germany with an exclave in East Prussia. In the west they would lose the Alsace-Lorain region to France which had been the subject of tension and war between France and Germany for more than a century. In addition, the Saar region was to become a new independent state as well. There were also smaller cessions of land to Belgium, Czechoslovakia, Denmark, and Lithuania. Next the German military was to be reduced to just one hundred thousand soldiers and the Rhineland region was to be demilitarized. Finally, Germany was going to be required to pay an unreasonable amount of reparations to the allied powers. When adjusted for inflation the amount of money that Germany was supposed to pay according to the Treaty of Versailles in modern U.S. dollars

would be roughly five hundred fifty-five billion dollars.³ These punishments were seen as deplorable to the German people and they felt wronged and insulted. The Treaty of Versailles would turn out to be the biggest mistake of the allied powers and it would lead to the continuation of hostilities in the future.

With the end of the First World War comes the Interwar period, or the time between World War One and World War Two. This roughly twenty-year period which lasted from 1918-1939 is generally perceived as being peaceful, but the majority of the time span was anything but peaceful. While the conflicts during this time were not on the scale of the world wars as they were regional conflicts, they are important because they were results of the ending of the First World War and would have profound impacts on the buildup to and the course of the Second World War. To start with there is the breakup of the former European empires of Austria-Hungary, Russia, and the Ottoman Empire. The first of these to break up was Russia. Russia was defeated by Germany before Germany lost in the west. As such Russia was not included in the Treaty of Versailles and their country had to live with the Treaty of Brest-Litovsk which carved several new countries along racial and nationality lines from the western portions of the Russian Empire. These countries included Finland, Estonia, Latvia, Lithuania, and Poland. In addition to this, the Russian state fell into a civil war between the communist Bolshevik's Red Army and the White Army which consisted of several different groups including capitalists, monarchists, and socialists. This conflict would begin in 1917 and would last until 1922.

³ Philander C. Knox, *Treaty of Versailles*, (Washington, Govt. print. off, 1919).

The second of the empires to be torn apart would be the Austro-Hungarian Empire. Austria-Hungary had always been a multi-ethnic empire and since their transition from the Austrian Empire into the Austro-Hungarian Empire they had recognized this fact. As a part of the separate peace treaty which was made with Austria-Hungary, the state was to be dissolved along roughly national borders. This resulted in both Austria and Hungary becoming their own countries as well as Czechoslovakia and the southern Slavic states. Territories were also given to Romania, Poland, and Italy.

The third of the empires to be broken up was the Ottoman Empire. For several centuries the Ottoman Empire had been weakening and was considered by many to be the “sick man of Europe.” By the time that the First World War began several of the regions that the Ottomans occupied in Europe had already been lost such as the southern Slavic states and Bulgaria. World War One saw the Ottoman Empire divided into occupation zones. These occupation zones were extensive and stripped the Ottomans of all but the northern part of the Anatolian Peninsula. The British and French carved the Ottoman held middle east into their own colonial protectorates and included in this was large parts of the peninsula. Italy and Greece both had sizeable holdings on the peninsula and Greece also held western Thrace. Hostilities in the peninsula would continue until 1920 as Turkish nationalists lead by Mustafa Kemal, later to be known as Ataturk, established the modern country of Turkey in the Anatolian Peninsula where the population was majority Turkish.

⁴ Robert Gerwarth, *The Vanquished: Why The First World War Failed To End* (New York: Farrar, Straus and Giroux, 2016).

While the old empires of Russia, Austria-Hungary, and the Ottomans were unstable due to their multiethnic and multilingual natures they did provide some level of stability by grouping the many diverse peoples of this area together. With the absence of these empires the Interwar period saw many of these newly established European countries fight many minor wars against each other over old rivalries and hatreds. This was the battleground of nationalism and racism during the time. Many of these countries, with the notable exception of Czechoslovakia, would fall to various flavors of dictatorship whether it was communist, fascist, or militarist.⁴ Quite importantly for this time period is the rise of fascism and communism. The Russian Revolution saw the rise of the world’s first socialist state, the Soviet Union. Previously, though, the communist movement had been growing in many European countries. With a defeated Germany and a new democratic Weimar Republic taking shape the stage was set for communists and fascists to enter the scene. The rise of communists and fascists in Germany can be largely attributed to the hyperinflation which occurred in 1923. This hyperinflation destroyed the middle class leaving most if not all of it in the lower class.⁵ The interwar period saw actual fighting between communists and fascists in the streets of Germany as the state was too weak to stop them. It is during this time that the NSDAP, or National Socialist German Workers Party, first came into being. In Italy, despite the state having been on the winning side of World War One, the rise of Benito Mussolini brought fascism to Italy. As the second half of the Interwar period begins, so too does the Great Depression. The

⁵ Dietmar Rothermund, “War-Depression-War: The Fatal Sequence in a Global Perspective,” *Diplomatic History* 38, no. 4 (2014): 840.

Great Depression, while affecting the United States the most, was a global depression that did still hit the rest of the world. This only exacerbated problems in already problematic areas such as Germany. It is during this time that the Germans were forced to cease paying reparations because their country could no longer support the payments, this then led to a deepening of the crisis as foreign investments were pulled from Germany. With Germany at its lowest point since the hyperinflation crisis, it was ripe for change. The change that many Germans recognized was in the NSDAP, which would become infamously known as the Nazi party.

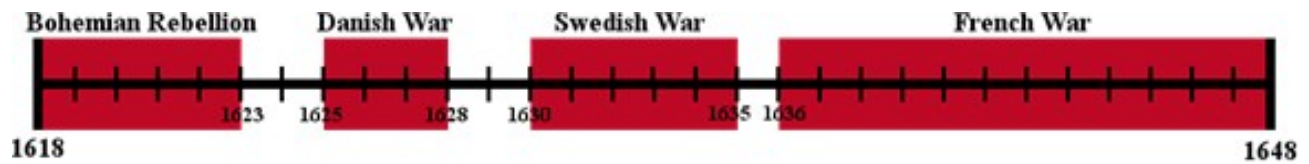
In 1933 Adolf Hitler became the Chancellor of Germany. With his acquisition of power, the Nazi party would continue to grow and seize more power in the government. The Nazis would also preach the fascist values of nationalism, racism, and imperialism. In order to answer German grievances over the Treaty of Versailles, Hitler would begin to fight back against its provisions. While Germany began to do this the allies sought an appeasement plan where they would give in to Germany's demands as they wanted to avoid war at all costs. Previous to Hitler's election, the German state had already stopped its reparation payments, by far the harshest of the punishments given to Germany. In 1935 Germany would embark upon a rearmament campaign which would also greatly strengthen the weakened industries in the country. A year later German soldiers marched into the Rhineland. This was a symbolic move showing that this land was German and it was no longer to be at the whim of the allied powers. In 1938 Austria was annexed peacefully. While this was quite a drastic action and was directly barred

by the Treaty of Versailles, it was overlooked by the allies as being the final unification of all of the German people, something that many Germans wanted during the wars of German unification. In 1938 Germany acquired the Sudetenland from Czechoslovakia. The following year Germany annexed the Czech portions of the country and set up Slovakia as a puppet state. Later the same year Germany invaded Poland marking the beginning of the Second World War.

Outside of central Europe there were other events happening that were causing disturbance in the world. In the years directly preceding the beginning of the Second World War there was the Spanish Civil War where the German-backed nationalists fought against the Republican loyalists. Most countries wanted to stay out of the war as they thought that the war could become a proxy and lead to greater conflicts. The Nationalists would end up victorious but only after huge amounts of bloodshed. Worth noting is that Nationalist Spain, despite receiving help from Germany, would not go on to return the favor and help Germany during World War Two. Across the world in the Pacific the Japanese began a brutal campaign in China which would result in the deaths of millions. One event which was especially atrocious was the Nanking Massacre where several hundred thousand Chinese were murdered and tens of thousands of Chinese women were raped by Japanese soldiers.⁶

This then leaves the world at World War Two. This is the war that most know about. In the early years of the war in Europe, Nazi Germany would conquer most of continental Europe by applying their blitzkrieg tactics. This conquest of

⁶ Wesley R Harker, "Thirty Years Without Peace," American Conservative 13, no. 5 (2014): 6-7.



Europe was the culmination of German imperialism and was what many Europeans had feared would happen even before the start of the First World War. Wrapped up in this imperialism was Nazi Germany's nationalistic and racist policies. The Nazi system emphasized Germanness and the strength of the fatherland. In addition, it also emphasized the superiority of the "Aryan" race and saw all people of the world divided into a hierarchy of racial classes with the Jews occupying the bottom-most tier. Racism in the Third Reich culminated in the holocaust where millions of people, both Jews and non-Jews, would be systematically murdered on an industrial scale.⁷

With regards to the Second Thirty Years' War, the events of World War Two are actually not as important as those before it. This was a war that was a result of the previous twenty-five years. Its existence was dependent on the mistakes of the past. The war saw the death of an era with Nazi Germany being decisively defeated. The loose ends left from the First World War were all tied up with the end of the Second World War as afterwards Europe would enter a new age, the Pax Europa, where the continent would experience an unprecedented period of peace amongst itself. The end of World War Two was the end of an era.

What is also crucial in the understanding of World War One, the Interwar, and World War Two being a single war is the comparison to the

Thirty Years' War of 1618-1648. Why the Thirty Years' War? The Thirty Years' War of 1618-1648 and that of 1914-1945 share some similarities. Both periods saw unprecedented violence and destruction, both left devastation in Europe, both primarily involved Germany or the region now known as Germany, and both involve multiple conflicts. In the Thirty Years' War there are four separate conflicts that took place: Bohemian rebellion, Danish war, Swedish war, and the French war. Each one of these conflicts is marked with some amount of peace between them. Each of the conflicts also has a distinct ending.

The zeitgeist of Thirty Years' War is marked with the struggle between Protestantism and Catholicism. The protestant revolution had begun nearly a century before the Thirty Years' War was to begin. This saw many rulers in Europe turn away from the Pope and Catholicism and instead turn to the various different flavors of Protestantism. Much of modern-day northern Germany, which at that time was a part of the Holy Roman Empire, converted to Protestantism. Worth noting with this, though, is that many of the German princes in the Empire turned to Protestantism in order to distance themselves from the Emperor, give themselves more control, and push themselves towards greater independence.⁸

Following the Defenestration of Prague, the Thirty Years' War would begin in 1618

⁷ Ian Kershaw, *To Hell and Back: Europe 1914-1949* (New York: Viking, 2016).

⁸ The figure by the author shows the dates that each war was fought between in red.

initially as a rebellion in Bohemia against the Emperor in Vienna. Over the course of the thirty years four separate wars would be fought against the Emperor with the final war resulting in an imperial defeat. This defeat was the final act of the war because after thirty years of conflict the Emperor was weak and the Empire weaker, the Emperor no longer had the means to challenge the new status quo.

While the concepts of racism, nationalism, and imperialism had not yet been invented, imperialism did play an important role in the Thirty Years' War. The empire, though divided, controlled a large swathe of central Europe which included a strong Habsburg Austrian base. The Habsburgs controlled enormous amounts of power and other European countries sought to weaken this power in order to assert their own. This is most clear with France which fought against another Catholic for the sole purpose of weakening the Habsburgs and the Empire. These ideas of imperialism would be echoed centuries later in the buildup to the First World War. In addition, the Thirty Years' War provides an important precedent for combining multiple conflicts into a single long war along the basis of shared themes. In the case of the Thirty Years' War it is religious struggle and imperialism, whereas three centuries later during The Second Thirty Years' War it is nationalism, imperialism, and racism. Links can also be drawn between the ideological struggle between fascism, communism, and liberal democracy during the twentieth century and the religious, and somewhat ideological, struggle in the seventeenth century.⁹

Another commonality that the Thirty Years' War shares with The Second Thirty

Years' War is destruction and devastation. With armies roaming around the Holy Roman Empire for thirty years, the land and people were devastated. Famine, disease, starvation, murder, rape, and more occurred in the area that would become Germany. In relative terms, the devastation and destruction of the Thirty Years' War would not be matched until World War Two.

With there being an established precedent for the inclusion of multiple wars into a single war, the links between World War One and World War Two should be more clearly shown. To start, the single most definitive factor in the buildup to World War Two was the German grievances over the Treaty of Versailles. Because of the ambitions of the French to have power over Germany and their desire to avoid another costly war with Germany, the French pushed for much of the harshness in the Treaty of Versailles. While in some aspects the French were successful in keeping Germany down, they were not successful for long as Germany wanted vengeance. The German people wanted answers for their grievances. Adolf Hitler was the man who had these answers to the misfortune of the rest of Europe. Pushback against the different provisions of the Treaty of Versailles was inevitable, unfortunately though, once Germany had rectified its' grievances, they found themselves in a position of power. It is with this new-found power that Nazi Germany pursued its imperialistic designs on Europe. Another way of saying this is that all parties were wrong in their ideas of what should be done with Germany at the end of World War Two. Too lenient and Germany would be able to dominate Europe, too strict and the country would push back and seek

⁹ Ian Kershaw, "Europe's Second Thirty Years War," *History Today* 55, no. 9 (2005): 10-17.

revenge. This failure is one of the links between the wars. This is why after the war a more permanent solution for peace was found with the unbreakable bond and reliance upon one another which was set up between Germany and France following World War Two and was the seed of the European Union.

The other important link between World War One and World War Two is the time between them, the Interwar. Generally, the Interwar is thought of as a time of peace between two of the most brutal conflicts in human history. As was demonstrated in the background information of the time period, there was very little peace time during the twenty years between the end of World War One and the start of World War Two. The Interwar period saw a number of conflicts in Europe and across the globe, the breakup of old empires in Europe, the rise and violence of communism and fascism, and the greatest economic disaster of the modern era. While officially there may have been peace, in actuality there was not.

The final argument for why World War One and World War Two should be grouped into a single war is the difference in war experience between the United States and Europe. This argument primarily deals with why Americans do not see the World Wars as being two parts of one whole. The difference in experiences is most clear when looking at World War One. To a large extent, World War One has been forgotten in the United States. This can be attributed to a couple different reasons, first is the time that the two regions spent fighting. Europe began the conflict in 1914 whereas the United States began the conflict in 1917, just a year before the war would

end. This difference in time translated to a drastic difference in the amount of lives spent in fighting. In Europe during the First World War roughly 7,000,000 would die collectively across the continent. The Americans would only suffer 116,000 casualties. In addition to this the war was fought in Europe and devastated its lands, the U.S. did not suffer any destruction in its' homeland.¹⁰

In World War Two the differences are somewhat less. The war in Europe began in 1939 whereas the war would start for the United States at the beginning of 1942. In this war Europe would suffer millions more casualties and the U.S. would once again lag behind only suffering 400,000 casualties. It should be noted, though, that nearly all of the U.S. casualties were combatants whereas much of the death toll for the rest of the world was made up of mostly civilians and non-combatants.

There are some other more general considerations to be had with regards to the difference in war experience. The first of these is how many lives were lost in all American wars. At the top of this list is the Civil War with over 600,000 deaths. This makes a lot of sense as the war was fought between two halves of the United States and was fought on American territory. This also explains why many Americans are quite knowledgeable about the Civil War and why after a century and a half the war is still very present in American minds. This also shows that casualties in World War One are only one sixth of those from the Civil War and a quarter of those from World War Two.

The final consideration is the significance of World War Two for the United States. The

¹⁰ H.D.S. Greenway, "Why World War I is So Often November 9, 2014"

Forgotten in America," *Public Radio International*,

November 9, 2014

U.S. entered the war in rough shape still recovering from the devastating Great Depression. After World War One the country had turned inward as it had done for so much of its' history. This was not the case with the end of World War Two. At the end of World War Two the United States found itself in the strongest position it had ever been in and the strongest position in the world at large. There had only been the bombing of Pearl Harbor on the mainland of the United States, beyond this the country had not seen the war on its soil. This meant that the U.S. was in a prime position to assert itself as the leading world power closely followed by the Soviet Union. The Second World War was also significant for the United States as it had to fight the war on two fronts which always makes for an intense battle and usually makes for a lost one as well, but this was not so with World War Two. The United States had come out victorious in Europe and especially in the Pacific where it had done the majority of fighting by itself.

The final question with regards to this view of a Second Thirty Years' War is how this could be implemented. In the simplest form, this view could be implemented into textbooks by making both world wars part of a single unit or chapter rather than as separate with separate standards. The idea can go farther though, with the possible rewriting of the world wars section

of textbooks to make the section more cohesive and friendlier to a new learner. Beyond school and textbooks, the idea could make its way into popular culture categorizations on various different sites, services, and programs. One such example could be on a streaming service such as Netflix where smaller categories such as World War One or World War Two would be combined into a larger world wars or Second Thirty Years' War category for the ease of the consumer.

In conclusion, the time period spanning from 1914-1945 which encompasses World War One, the Interwar, and World War Two is best viewed as a single war. Precedence for this has been established with the Thirty Years' War of 1618-1648 which encompassed four different wars linked together with common themes. Similar to this, the First World War, the Interwar, and World War Two are linked together with the common themes of imperialism, nationalism, and racism. By looking at the time period as a whole it could be easier for the subject to be taught and more importantly for the subject to be retained by students at the lower levels. The view of a single war spanning the thirty years from 1914 -1945 is significant not only because it emphasizes the common themes of the time period but also because it grants clarity to the origin of World War Two which was not in the years leading up to the Second World War but was really in the end of the First World War.

Real and Ideal: Family Communication

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Abstract

How does the difference between our idealized visions of our experiences and the actual experiences affect familial relationships, the most influential relationships to a child's development? What role does interpersonal communication play in creating these differences, remedying them, and structuring families in general? Coordinated Management of Meaning (CMM) and Relational Dialectics Theory (RDT) can help determine the effects the differences between idealized and actual experiences have on family communication, and possibly how to control those effects. CMM claims we co-create meaning through communication guided by rules. RDT sees relational life as a constant process and motion—people in relationships constantly feel the push and pull of conflicting desires. For my study of this issue, I used my family (myself and my brother, father, and mother) as test subjects, using our Thanksgiving family gathering in 2018 as context. I started with the hypothesis that I would find a difference between idealized and actual experiences in the family setting, involving failed expectations. My process was simple: I gave my family four two-part questions, the first parts asked before Thanksgiving started and the second parts asked after Thanksgiving ended. Asking the first parts and learning everyone had high hopes for the holiday but feared some upset, I observed our Thanksgiving celebration, made my own notes, and asked them the second parts, finding many common themes between everyone's answers and my own notes. Everyone desired positive family interaction and stable relationships rather than unstable ones, they all had their own worries, and as I thought, expectations were violated, but instead of our worst nightmares coming to pass, we simply didn't achieve our wildest dreams.

Keywords: family communication, real and ideal, Coordinated Management of Meaning, Relational Dialectics Theory

Introduction

Family communication is by far the most important communication setting for a person's development. The earliest and longest-lasting connections that a person forms are almost invariably those of the family, as people form connections with their family almost as soon as they're born and continue to develop those connections throughout their entire life. However, the process of family communication isn't as perfect as we'd like to believe. There's a significant difference between our idealized perception of events and the actual experiences, which has the potential to upset peace and harmony in a family and bring about conflict, and I believe that interpersonal communication plays an important role in creating these differences, remedying them, and structuring families in general.

Two communication theories can help us determine what kind of effects the differences between idealized and actual experiences have on family

communication: Coordinated Management of Meaning and Relational Dialectics Theory. Coordinated Management of Meaning, states that we co-create meaning through communication guided by rules. Focusing on the relationship a person has with his or her society, this theory analyzes shared meaning and the way we socially construct society. Relational Dialectics Theory paints relational life as a constant process and motion—people in relationships continue to feel the push and pull of conflicting desires throughout the relationship, and they want to have “both/and” relationships rather than “either/or” when speaking of opposing goals. I will also look into two aspects of familial communication: the parent-child relationship, which revolves around the way parents raise their children and how children respond to their parents, and sibling relationships, which deal in the wide range of positive and negative relationships a child has with their sibling, with the primary focus being on the parent-child relationship since I believe that is what shapes how sibling

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relationships play out (for example, whether they like or hate each other).

I have already started on my research with a study of my family's feelings about our 2018 Thanksgiving celebration—that is to say, I gave them a questionnaire of four two-part questions, the first parts asked before Thanksgiving started and the second parts asked after Thanksgiving ended. Working off of the hypothesis that I would find a difference between idealized and actual experiences for this particular family setting involving failed expectations of some kind, I learned that my father, brother, mother, and myself all had high hopes for the holiday but feared some upset with the first half of the questionnaire, made my own internal notes about my Thanksgiving experience, and asked everyone the second half of the questionnaire after the celebration was over. I found several common themes between everyone's answers and my own notes: While everyone desired positive family interactions and stable relationships rather than unstable ones, as well as several worries and fears about how this Thanksgiving could be derailed, both our desired and dreaded expectations were violated. However, this initial study only proved that a difference between my family's idealized visions of what a Thanksgiving should be and the actual events that transpired on that Thanksgiving existed. To move forward with my project, I have to prove that these differences can actually be dealt with by interpersonal communication.

Research Question & Rationale

How does the difference between idealized and actual (lived) experiences affect familial relationships, and what role does interpersonal communication play in creating these differences, remedying them, and structuring families in general? Coordinated Management of Meaning and Relational Dialectics Theory can explain conflict arising from the differences between idealized and actual experiences in family structures, looking at two aspects of a family: parent-child relationships, which will be the primary focus of the paper, and sibling relationships, which will be the secondary focus. The third and final focus will be how interpersonal communication is both the cause and the cure for this conflict.

To begin with, let us first look at the two aspects of familial communication we shall be studying. First and foremost, there is the "parent-child" relationship, which revolves around the way that parents raise their children and how children in turn respond to their parents,

and sibling relationships, which deal in the relationships that a child has with their sibling—a wide range of positive and negative relationships. The primary focus will be on the parent-child relationship, as I believe the way that parents treat their children is what shapes how sibling relationships play out—whether they like or hate each other—so the sibling relationship cannot be understood without first addressing the one between parents and children in its entirety, or at least the dimensions related to the present study.

Coordinated Management of Meaning is the main theory that I will be using to study these questions. Like many communication theories, such as Symbolic Interaction Theory which believes that people are motivated to act based on the meanings they assign to people, things and events, CMM places communication as the most important aspect of humans' lives, claiming that people "live" in communication due to its stance of social construction—the theory that people co-create social reality through communication—and lends itself to many subcategories, such as the hierarchy of organized meaning, a means of categorizing meanings that has six different levels of meaning: content, speech acts, episodes, relationship, life scripts, and cultural patterns (Holmgren, 2004), each of which is above the other in terms of prevalence. CMM also helps us recognize problems, such as unwanted repetitive patterns.

Relational dialectics theory makes four assumptions about relational life: "relationships are not linear, relational life is characterized by change, contradiction is the fundamental fact of relational life, [and] communication is central to organizing and negotiating relational contradictions" (West & Turner, 2014). The first assumption is the most important, as it characterizes relationships as constantly moving back and forth between contradictory desires. Relational dialectics' core elements are totality (acknowledging the interdependence of people in a relationship), contradiction (opposition, the central feature of the theory), motion (relationships' processual nature), and praxis (humans' choice-making capacity). There are several dialectics that this one covers, such as autonomy and connection, openness and protection, novelty and predictability, public and private, and the one that this very essay addresses, the *real and ideal dialectic*. This deals in the differences between idealized and lived relationships, such as the way that a sitcom like *Leave it to Beaver* might show an idyllic version of an event that in reality is far more nuanced.

Background/Literature Review

Much has been said and written on the subject of parenting over the years, and all of these claims are important to figuring out what needs to be said and done on the topic of family structures. There are a few things that we should keep in mind when discussing families. One of these is no doubt the fact that parents treat children differently from one another. Parents will change their parenting style as they gain experience raising children, and each child has their own needs. In addition to this, there are several other factors, such as the size of one's family, that change the way we deal with children. Birth order is one of the more important ones, as it affects the way that parents relate to their children, the way that children in turn understand and respond to their parents, and the experiences that both parents and children have. Firstborns may feel "neglected or unloved after the arrival of a new sibling" (Healthy Children, 2015), and different developmental stages amongst children determines a lot of different factors, such as the levels of attention and affection that they need. Finally, temperaments of the children play a big role in their needs, as a high-strung child will probably want more specific things than an easy-going child.

Aside from the issue of parenting, there is also the sibling relationships. Siblings often "compete for the affection and attention of their parents...compare themselves with one another, become aware of one another's strengths and weaknesses, and try to find the most comfortable and rewarding role for themselves within the family unit" (Healthy Children, 2015). In short, siblings most often have a love-hate relationship in which each sibling's feelings about the other constantly change from positive to negative depending on various factors, the most notable of which is the way that their parent treats them. If the parents treat one child favorably over the other, this can lead to resentment between the two siblings, but if the parents watch and prepare for such behavior, they can negate it and encourage positive relations between the two. Additionally, the sibling relationship is most often viewed from the position of the parent, which makes the very act of analyzing it a form of parent-child relationship.

Relational Dialectics closely relates to these issues, as well as to a related theory called "family systems theory" that is in many ways an equal and opposite theory to relational dialectics. According to this theory, family systems orient towards equilibrium by engaging "in 'error correction' designed to sustain themselves in a state of dynamic balance" (Baxter, 2004), while relational dialectics does not share this notion due to its issues] and reframing [looking at the opposition in a different light]) (West & Turner, 2014). In the context of

presupposition of a center, and instead posits that there is an "ongoing centripetal-centrifugal flux" (Baxter, 2004). These two theories are a sort of "meta-dialectic" of opposing ideals of a family: equilibrium vs. flux, a dialectic which we can understand as being the two opposing states of a family.

Research Methods & Scope Framing:

In order to use these two theories to the fullest, I shall be using what I consider to be the most important aspects from each. Firstly, the aspects of Coordinated Management of Meaning that I find appropriate for use are the hierarchy of meaning and the LUUUTT model. The highest level of the hierarchy of meaning is the "cultural pattern," which is described as "images of the world and a person's relationship to it" (West & Turner, 2014) and involves not only culture, but several other factors. After cultural patterns, there are "life scripts," which I believe tie in mostly with the parent-child interactions. Not only does a parent's experience with raising a child shape the way that they raise any other child, but a child's temperament means that each child will have different needs. After those are relationships, episodes, speech acts, and content, each of which enters into the equation of family life at some point. There is also the LUUUTT Model, which maps out the different stories that are Lived, Unknown, Untold, Unheard, Untellable, Told, and Telling (Griffen, 2014). Out of these categories, I would classify the "Lived" and "Told" as the most important to our investigation, and Unknown, Unheard, and Untellable as the second most important (for the sake of expediency, I shall streamline these three, all of which indicate some event or information that is left out of a story for different reasons, into a blanket category which I shall refer to as "Unnoticed" for the purposes of this paper). Lived are the actual experiences we share, Told are how we remember and idealize those experiences, and Unnoticed are the aspects of the Lived that we have selectively ignored in creating the Told. This "LUT" model already explains the differences between real and ideal – the details which go unnoticed by us in crafting an idealized vision of what actually happened.

Relational Dialectics also lists several ways to deal with dialectics. These include cyclic alteration (choosing different poles at different times) segmentation (choosing different poles depending on context), selection (prioritizing one pole over the other), and integration (synthesizing oppositions through three methods—neutralizing [compromising], disqualifying [exempting

the difference between real and ideal experiences applied to the family model, it's possible to characterize the different

aspects of family communication using these methods. For example, cyclic alteration and segmentation both play a role in determining the differences in the ways parents bring up different children. They may also be applied to the “equilibrium vs. flux” meta-dialectic that I posited earlier, and thus we may theorize that a family may desire a stable and full equilibrium but actually frequently and periodically shift from equilibrium to flux and back again, even in an erratic fashion. Another useful concept related to relational dialectics is the chronotope, which implies that contradictions are “best understood *in situ*” (Baxter, 2004)—in other words, in the context of the event in which they happened.

Participants:

For this exercise, I am going to start small and use an autocritography—using myself and my own family as research material. An autocritography, according to Michael Awkward, “utilizes autobiographical recall, textual criticism, and institutional analysis in a self-reflexive, self-consciously academic act that bridges the personal, social, and institutional conditions that helped to produce the scholar,” which means that it is researching oneself and one’s own experience to determine what makes you who you are today. Of course, this method isn’t perfect, because you have to acknowledge subjectivity no matter what, but subjectivity is an important aspect of what I’m looking into, so it’s not a real problem for this study. I am going to use autocritography on myself by calling forth past experiences that shape how I view my family (first my parents, then my brother Henry) and put my expectations about how they function into words. Once that has been completed, I’m going to compare these expectations to how they act really in a test setting—namely, Thanksgiving.

Materials:

For this study, I started with the upcoming Thanksgiving as a basis of experience. I’ve interviewed my mother about her plans for that day, learning that she was planning to hold it at my late grandmother’s house and invite distant relatives over to have a potluck sort of Thanksgiving), and her expectations about what it’s going to be like. After doing the same for my father and my brother, I compared these expectations to my own, and then finally compared all three of these expectations to the reality.

Procedure:

The questionnaire that I have put to myself, my parents, and my brother consisted of four two-part questions (the first parts were answered before Thanksgiving starts and the second parts were answered afterwards). These four questions are about “Looking Forward to Things” (the first part of this question, asked before Thanksgiving starts, is “What are you looking forward to the most?”, and the second part, asked after Thanksgiving is over, will be “Did what you looked forward to happen the way you thought it would? If so, did you enjoy it as much as you thought you would?”), “Not Looking Forward to Things” (the first part, “What are you looking forward to the least?”; the second, “Did you successfully avoid what you were looking forward to the least? If not, was it as bad as you expected?”), “Plans and Preparations (before)” (the first, “Is there any particular action you intend to make before Thanksgiving starts?”; the second, “How were the results of your action?”), and “Plans and Preparations (during)” (“Is there any particular action you intend to take during the Thanksgiving celebration?” and “How were the results of your action?”, respectively).

During the Thanksgiving celebration, I thought that the best option for analyzing the events there was to do just that—analyze the *events* only, rather than any specific person’s behavior. The reason for this idea was three-fold: Firstly, I thought it would be wrong to judge the behavior of my family because not only would them knowing I would be doing so affect their behavior and so affect my ability to collect data on them, but also because I thought that doing so would have been a betrayal of their trust. Secondly, I thought that an event-oriented approach to the study of the Thanksgiving celebration would prevent me from getting too judgmental of any member of my family, a gambit which paid off in spades when it came to the “turkey incident”, as I didn’t have any hard feelings for my cousin afterwards.

In addition to the initial questionnaire, once I have finished analyzing the results I will review the LUT model and the hierarchy of meaning, in which my family (or possibly myself, would answer which parts of their cultures, life scripts, relations, episodes, speech acts and content are Lived, Unnoticed, or Told. Then I would continue with a questionnaire about the “equilibrium vs. flux” meta-dialectic that I proposed, asking which of the four main responses to dialectics (cyclic alteration, segmentation, selection, and integration) is an appropriate response to the dialectic in question. Though my scope is

very limited, I believe that I can find good results on both the Unnoticed difference between the Lived and the Told and the way that people conceptualize their family.

Data:

The initial questionnaire and the answers that my parents, younger brother, and myself gave were as follows:

1. Looking Forward to things:

a. Before: What are you looking forward to the most?

i. Mom:

“I’m looking forward to sitting around *after* the meal and chatting with some of my relatives that I don’t see as often, like my brother and my sister-in-law Leigh.”

ii. Dad:

“Having good interactions with all members of our family, some of whom I haven’t seen recently.”

iii. Henry:

“I feel that the purpose of Thanksgiving would be positive interactions with the various family members, dah da dah da dah.”

iv. Me:

“I look forward to talking to all of my family members that I don’t get a chance to interact with for most of the year and all the good food that’s going to be served at Thanksgiving.”

b. After: Did what you looked forward to happen the way you thought it would? If so, did you enjoy it as much as you thought you would?

i. Mom:

“It didn’t happen the way I expected—I spoke to *different* relatives before and after the preparation of the meal, and didn’t talk that much to my brother and sister-in-law, but I enjoyed talking to more distant relatives that I see even less. I also had a more meaningful conversation with my brother’s mother-in-law who had lost her daughter three years ago.”

ii. Dad:

“Because it was a collaborative effort, and everybody tried their best, even though a certain nephew screwed up the turkey, everyone pulled together and was supportive of him, so that there was a truer spirit of cooperative enjoyment, and brought us closer to the truer meanings of Thanksgiving. I had actually dreaded the party more than I implied to you earlier, because in times past, one person—a niece—had demanded everything go her way, creating a level of stress and some resentment, and I was not looking forward to a repeat of that Thanksgiving. I was surprised that one of the best parts was a slow turkey.”

iii. Henry:

“Uh, yeah.”

iv. Me:

“Though we had a fun time playing a trivia game and I listened in on a lot of conversations, I didn’t have the time to talk to everyone there, and I didn’t eat a lot other than stuffing, pasta, and homemade pear jello (and only *two* slices of turkey), and the desserts were kind of lacking, so I didn’t achieve all that I wanted out of it. I was, however, satisfied with my interactions with my aunt and my uncle, who I haven’t seen much of lately, my presence in group conversations, even though that mostly amounted to listening, and the food that I did eat was really good.”

2. Not Looking Forward to things:

a. Before: What are you looking forward to the least?

i. Mom:

“Possibly somebody complaining that they didn’t get the food they wanted exactly the way they wanted it, and since I’m not doing all the cooking, I can’t control that. I’m also worried because it’s my sister-in-law’s anniversary of her death, and I’m worried that her children or parents might be sad.”

ii. Dad:

“I’m apprehensive that it will be more stressful just because the way the dynamic is set up that there will be discomfort, and I’m kind of worried that we’ve lost sight of the true meaning of Thanksgiving: Giving thanks to a greater power for our blessings and getting to see our blessings.”

iii. Henry:

“The mechanical incompetence of certain family members and the food blockade.”

iv. Me:

“I’m hoping that a fight won’t break out between Henry and Catherine or that there won’t be a second ‘stuffing incident,’ among other things.”

b. After: Did you successfully avoid what you were looking forward to the least? If not, was it as bad as you expected?

i. Mom:

“The lead-up to Thanksgiving was a hundred times more stressful than the actual Thanksgiving. What I thought would happen was worse than reality. Everyone was very polite, didn’t complain about the food, and I believe, because I had conversations with people beforehand, things went smoother.”

ii. Dad:

“Refer back to my answer to the first question.”

iii. Henry:

“The mechanical incompetence of certain family members did show itself, resulting in an undercooked turkey.”

iv. Me:

“There was no serious argument of any kind, though my cousin did mess up on the turkey so bad that by the time it was done, I only had the stomach to eat two pieces of it, and I was kind of mad about that, but nobody seemed to be particularly mad at him for his honest mistake, so there wasn’t much conflict.”

3. Plans and Preparations (Before):

a. Before: Is there any particular action you intend to make before Thanksgiving starts?

i. Mom:

“I plan to make sure that the lights are fixed in the house, because it’s dark in the kitchen. First, you gotta remember a little of the backstory: My mother always had Thanksgiving. After she was too old, my sister-in-law Julia always had Thanksgiving with her side of the family included. They both died within a year, and the first Thanksgiving after that, Julia’s family had their Thanksgiving and we had Thanksgiving at home. However, my brother and Julia’s now-adult children wanted to have a group Thanksgiving again. Last year we tried that at my mother’s house since it was the largest place, and it was a bit chaotic because no one knew their roles. This year, we’re trying it again and some of the same problems exist, mainly there is not one host and there is little communication about the exact plans and expectations. Therefore, this week, before Thanksgiving, I hope to talk to everyone and get particulars such as what time, who’s bringing what, etc.”

ii. Dad:

“Go hunting and avoid some of the possible upsets and doing something I enjoy instead.”

iii. Henry:

“I intend to do a great many things, such as go to sleep four times and also wake up four times. Perhaps I’ll take multiple showers, and perhaps do certain activities, make an English hunting sandwich.”

iv. Me:

“I intend to make sure that most of my work on my own project is completed before the celebration starts.”

b. After: How were the results of your action?

i. Mom:

“I was able to fix the lights, and I think it made a difference because we were there after dark, and because I got over the fact that there was no host, I participated more in setting the table and enjoying a different type of Thanksgiving, where it was more of a potluck, and I think it was more successful because everyone didn’t expect someone to host the event, so it was kind of a new tradition.”

ii. Dad:

“That went quite well, and to be honest, the day came and I didn’t really feel the energy to go hunting, but your brother Henry insisted and made a special sandwich for the hunting experience, and was able to get Eric, who we have not been in contact with much this year, and we reconnected with him and avoided much of the pre-Thanksgiving stressors, which made the holiday much enjoyable.”

iii. Henry:

“Very good.”

iv. Me:

“I didn’t have much time to do anything other than the initial questionnaire, so I had to make up for the work after by replacing some of the segments I had planned to be part of the questionnaire with retrospective analyses after the Thanksgiving celebration was over.”

4. Plans and Preparations (During):

a. Before: Is there any particular action you intend to take during the Thanksgiving celebration?

i. Mom:

“Talk to each person there.”

ii. Dad:

“I look forward to having nice interactions with the family, catching up to them, and reconnecting with them in some ways.”

iii. Henry:

“Yes.”

iv. Me:

“I plan to make observations about the holiday focused on the *events* that transpire, rather than focusing on how *people* act, so that my subjects don’t feel judged by my analysis of the holiday.”

b. After: How were the results of your action?

i. Mom:

“There were a couple of people I could have talked to a little bit more, but other people were talking to those people, so I didn’t feel like anyone was left out.

ii. Dad:

“It was not a complete success, but it was still very positive. Because there were so many people, and they tend to break off into groups, I wasn’t able to spend as much time as I would have liked with everybody, I still had many high-quality interactions with other people.”

iii. Henry:

“Perhaps.” (*Note: For him, I asked him if his planned actions worked out or not, since he gave me a vague answer to the first half of the question and I was trying to get something more specific out of him*)

iv. Me:

“I was able to get a lot of good data on events even after removing the factor of whether or not people knew they were being watched by not judging them at all, but I feel that my event-oriented approach to research—or even researching at all—hindered my ability to interact with others and enjoy the Thanksgiving festivities. So, it achieved the desired results.”

My attempt to study the events of the Thanksgiving celebration also revealed a lot of family habits that I consider to be worth considering: Firstly, nearly everyone broke off into groups to talk to rather than all talking to each other together, secondly, everyone was slightly upset about my cousin failing to cook the turkey quick enough, but no one was mad at him specifically for it, and thirdly (though this probably isn’t as significant), when we played a trivia game after eating, we went about it in an odd mix of formal and informal—all we did was answer the questions on the cards without splitting into groups or taking turns or anything like that, and people got up and left abruptly at a few stages, but we still called foul on anyone who looked at their phones unless no one was getting it right.

Analysis/Results

Each of my family members’ answers to my questions all spoke of the differences in personality between them. For example, my father was focused mainly on the philosophical and spiritual aspects of Thanksgiving, while Henry gave overtly simplistic answers like “Yes” and “Perhaps,” which signified either his viewing of Thanksgiving from a purely logical standpoint or his reluctance to take my questions seriously (either way, I expected this kind of single-word answer from the beginning, but I hadn’t considered that Henry would have given them in a way to be as unhelpful as possible). I also

learned something about myself that I didn’t know before—I was more focused on this very project than I was on enjoying Thanksgiving myself, as at least half of my answers to the questions related to the project itself. I also learned, from my answers to the post-Thanksgiving parts of my questions, that I was very regretful of the way I acted through Thanksgiving, even though I didn’t think the Thanksgiving celebration itself didn’t turn out badly in any way—it was just a little boring compared to others. However, I do admit that it was a very nice holiday in spite of that.

In fact, one opinion that both of my parents expressed was that they were both dreading the Thanksgiving celebration beforehand, which gave me an interesting bit of data: a “shared tension” of Thanksgiving that passed as soon as the party started. I also noted that Henry’s answer to the first question was very similar to my father’s answer to the same question, which indicated a feeling of reverence or admiration to him, which made sense given that Henry does a lot of things with my father, like going out hunting. This, to me, exposed a key factor of the parent-child relationship: *admiration*. In fact, looking at the results of my questionnaire, several common elements between all of my family’s answers became very apparent. I identified several themes that occurred: First, there was the theme of *positive family interaction*, seen with all of my immediate family’s answers to the first question—Mom mentioned “chatting with some of my relatives”, Dad mentioned “good interactions with all members of our family,” Henry mentioned “positive interactions with the various family members”, and even I mentioned “talking to all of my family members”. Using the meta-dialectic of “equilibrium vs. flux” that we proposed, it’s apparent that my family skews toward, or at least prefers, the side of equilibrium. However, it’s important to note that while my family clearly *desires* equilibrium, whether or not it *has* that equilibrium is another question altogether. Secondly, there was a theme of “violated expectations” in the answers to the second half of the first question—my mother said that things didn’t happen the way that she expected, my father made mention of a cousin who, last year, had demanded everything go her way that he was worried about, and I myself noted that I didn’t have the time to talk to everyone there and didn’t eat all that I wanted to. Putting these first two themes together, a dialectic formed between “real” and “ideal”, just like how I anticipated, and also suggested that while my family *desired* equilibrium, it had a hard time achieving it and holding onto it. The third theme, “Simple affirmatives”, was unique because it was only evident in

my brother Henry's responses, but regardless, it's very much worth noticing since, as noted above, it shows a lot of Henry's character. It's also worth noticing that this was a perfect illustration of the "LUT" model that I proposed, as he "Told" very little, but obviously "Lived" a lot that he wanted to keep "Unnoticed" from me. The fourth and final theme I noticed was "worry", the simplest and broadest of themes that I could think of—after all, it's something that we have to deal with almost every day of our lives. My parents were the ones who stressed out about this most, as Dad admitted that he "dreaded the party more than [he] implied" to me before the Thanksgiving celebration, and was also worried that we had "lost sight of the true meaning of Thanksgiving." My mom also expressed worry because it was the anniversary of her sister-in-law's death and that might have caused discomfort that her children, sister, or parents would be upset during the Thanksgiving celebration, and later admitted that the lead-up was "a hundred times more stressful" than Thanksgiving itself.

Aside from this, I also have to consider the observations I made during my analysis of the Thanksgiving celebration. The first claim of "coordinated management of meaning", that communication creates our social worlds, is linked to the first and third observations that I made: That everyone split off into groups, and that the level of structure used in the trivia game we played was extremely loose while still having some rules. I believe that, in the case of the first observation, that everyone at that Thanksgiving party, under the pressure of having to process too large of a "social world" that would have resulted into trying to speak to everyone, decided to split it up into smaller "social worlds," and in the case of the third, the "social world" revolved around the game of trivia that we were playing, thus explaining why there was a very loose system of rules that we were following: we had just started the game with very little precedent from other Thanksgiving celebrations to follow up on, since this was only the second time that we had brought the family together to this degree, so we tried to give it structure but had little idea how to go about doing it. Another concept, that of "logical force", ties into the second of the three observations, that everyone disliked the wait for the turkey but no one held it against my cousin. Logical force is a sub-concept of CMM, and refers to the "moral pressure or sense of obligation a person feels to respond in a given way to what someone else has just said or done" (West & Turner, 2014)—in other words, it's whatever we think is the correct and appropriate response. I believe that, since most of us thought it was wrong to blame my cousin Phillip and give

him a hard time for the turkey, we all subconsciously decided not to and instead sympathize with him, which we all viewed as a more noble thing to do.

Significance

The results of my study have, so far, shown quite a lot about how my family functions. Out of the four themes that I have identified in my family's answers, those of "positive family interaction," "violated expectations," "simple affirmatives," and "worries," I've found that three of them apply to my family as a whole, while the "simple affirmatives" applies simply to my brother's character, and that the first two showed that my family desired to be on the "equilibrium" side of the "equilibrium vs. flux" meta-dialectic that I had proposed but had a hard time achieving it.

Both Coordinated Management of Meaning and Relational Dialectics Theory have helped to explain quite a lot about familial communication. The hierarchy of meaning, the LUUUTT model condensed into the "LUT" model, and the various means to deal with a dialectic have all shown quite a lot about the ways in which the difference between real and ideal experiences impact the family life. Indeed, all of these theories have shown that there is a lot of conflict within the family structure and that anything that goes unnoticed in the process of constructing an idealized experience can demonstrate that experiences' difference from what really happened. Indeed, Coordinated Management of Meaning and Relational Dialectics reveal a difference between real and ideal experiences and several details of family conflict, and they have already laid the groundwork necessary to piece together a connection between those two elements.

Of course, this isn't all there is to the issue. There are many ways to deal with conflict and the differences between real and ideal. Coordinated Management of Meaning, for instance, advocates *mindfulness* as a means of realizing the difference between the idealized and actual experiences. Also, there are other responses to familial conflict outside of these two theories, such as parental intervention and relational maintenance. Finally, CMM and Relational Dialectics have their own flaws—CMM mostly relies on communication and does nothing for family issues that may be caused by something outside of the realm of communication, and Relational Dialectics' "both/and" perspective may be too narrow to be of much use when dealing with family conflict or the difference between real and ideal, especially if a genuine dichotomy is involved. However, I am confident that, if these two theories can find the cause for conflict arising from the

difference between real and ideal, it can certainly find the cure.

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Linear Combinations of Harmonic Univalent Mappings

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Abstract

Many properties are known about analytic functions; however, the class of harmonic functions which are the sum of an analytic function and the conjugate of an analytic function is less understood. We wish to find conditions such that linear combinations of univalent harmonic functions are univalent. We focus on functions whose image is convex in one direction i.e. each line segment in that direction between points in the image is contained in the image. M. Dorff proved sufficient conditions such that the linear combination of univalent harmonic functions will be univalent on the unit disk. The conditions are: the mappings must be locally univalent, their images must be convex in the imaginary direction and they must satisfy a normalization, which states that the right and left extremes of the image are the image of 1 and -1 respectively. In this paper, we generalize this existing theorem. The conditions of this theorem are geometric, and we would like to maintain this feature in the generalization. We show that the image may be convex in any direction and that any points on the boundary of the domain, which no longer must be the unit disk, can be the points that are mapped to the extrema, which now must be in the direction perpendicular to the direction of convexity.

Introduction

A function $f(z) = u + iv$ is **harmonic** if it satisfies Laplace's equation:

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} = 0.$$

A function is analytic at a point if it is differentiable at a point and an open neighborhood around that point. Since any function that is analytic satisfies the Cauchy-Riemann equations, all analytic functions satisfy Laplace's equation. So the analysis of harmonic functions is a natural extension of the study of analytic functions. Harmonic functions show up in many branches of physics where Laplace's equation appears, which include electricity and magnetism, and quantum mechanics. Therefore, mathematical research into these functions is motivated not only by their mathematical relevance but also their applications to physical systems. Any harmonic function f is of the form $f = h + \bar{g}$ where h and g are analytic. A function is **univalent** in domain D if $\forall z_1, z_2 \in D$ such that $z_1 \neq z_2, f(z_1) \neq f(z_2)$. Univalent functions are also known as one to one, injective, or schlicht. A bijection is a function that relates each point in the domain to a single point in the co-domain and vice versa. A function is **locally univalent** at a point if there exists a neighborhood of that point that f is univalent on. Note that a locally univalent function is not necessarily (globally) univalent; it is in general much easier to show local univalence at every point in a domain than to show univalence in that domain. The unit disk $|z| < 1$ will be noted D . One technique for solving Laplace's equation with certain boundary conditions is to form a linear combination of other known solutions to Laplace's equation (harmonic functions); the linear combination of harmonic functions is always harmonic. A linear combination of two complex functions f_1 and f_2 is $f_3 = t f_1 + (1-t) f_2$ where $0 < t < 1$. If we do this, it will be helpful to know the conditions under which certain properties are preserved. In this paper, we seek to generalize a certain theorem, which gives sufficient conditions for a linear combination of harmonic univalent functions to be univalent. This gives us a way to generate new univalent harmonic functions which could provide valuable insight into their behavior, along with the insight we gain from the theorem's themselves. To limit the scope of our work—and to provide a useful result—we will restrict our research to functions with the unit disk as their domain. We will also restrict the image of the function by convexity.

A region is convex if the line segment connecting any two points in that region is contained within the region. A region is convex in the ϑ direction if any line segment parallel to the ray $e^{i\vartheta}$ between two points in the region

is contained in the region. Specifically a function is convex in the real or imaginary direction if it is convex in the $\vartheta = 0$ or $\pi/2$ directions respectively. It is obvious that a convex region is convex in every direction.

Part of our motivation for focusing on functions convex in one direction is the following result.

Theorem 1. *Every function convex in one direction is univalent.*

Much of the existing work on univalent harmonic mappings focuses on functions convex in the horizontal direction. The most important theorem in this field is the shearing theorem, which converts a harmonic function to an analytic function. This allows us to use results on analytic functions, which are much better understood and easier to work with. We state this theorem and a useful corollary. [2]

Theorem 2 (Clunie, Sheil-Small Shearing Theorem). *A harmonic function $f = \bar{g} + h$ which is locally univalent in D is a univalent mapping of D onto a domain convex in the horizontal direction if and only if, $h-g$ is a conformal univalent mapping of D onto a domain convex in the horizontal direction.*

Corollary 3. *A harmonic function $f = \bar{g} + h$ which is locally univalent in D is a univalent mapping of D onto a domain convex in the ϑ direction if and only if $h e^{2i\vartheta} g$ is a conformal univalent mapping of D onto a domain convex in the ϑ direction.*

In order to use this powerful theorem we need to know whether f is locally univalent. We can determine this by finding what is called the analytic dilation which is denoted $\omega(z) = g'(z)/h'(z)$. A function is sense preserving if, when you take the image of the counterclockwise oriented boundary of the domain, the image will be on the left side of the boundary of the image.

Theorem 4 (Lewy). [1] *A harmonic function $f = \bar{g} + h$ is locally univalent and sense preserving in domain D if and only if $|\omega(z)| < 1$ for all $z \in D$ where $\omega(z) = g'(z)/h'(z)$*

Finally, we will make use of the following theorem by Hengartner and Schober. [3]

Theorem 5. *Suppose f is analytic and non-constant in D . Then $\text{Re}\{(1 - z^2) f'(z)\} \geq 0, z \in D$ if and only if*

- (1) f is univalent in D ,
- (2) f is convex in the imaginary direction
- (3) f satisfies normalization 1.

Where normalization 1 is:

Normalization 1. *Suppose f is complex-valued harmonic and non-constant in D . There exists sequences*

z_n^+ and z_n^- converging to $z = 1$, $z = -1$, respectively, such that

$$\lim_{n \rightarrow \infty} \operatorname{Re}\{f(z_n^+)\} = \sup\{\operatorname{Re}\{f(z)\} | z \in D\}$$

$$\lim_{n \rightarrow \infty} \operatorname{Re}\{f(z_n^-)\} = \inf\{\operatorname{Re}\{f(z)\} | z \in D\}$$

This condition says that f maps the horizontal extremes 1, -1 in the input domain to the horizontal extremes of the image; the limits and extrema are necessary for cases when the image is unbounded or undefined at the boundary.

We can now state and prove the result by Dorff which we will seek to generalize. [1]

Theorem 6. Let $f_1 = \bar{g}_1 + h_1$, and $f_2 = \bar{g}_2 + h_2$ be univalent harmonic mappings convex in the imaginary direction and $|\omega_3| < 1$ on D . If f_1, f_2 satisfy normalization 1 then $f_3 = t f_1 + (1-t)f_2$ is convex in the imaginary direction and univalent ($0 \leq t \leq 1$)

The conditions of this theorem are highly restrictive, especially in terms of directionality. The convexity of the domain is confined to one direction and the normalization forces two specific points in the domain to map to two specific points in the image. This is the motivation for generalizing the theorem.

Proof. Since $|\omega_3| < 1$, f_3 is locally univalent. By Corollary 3 with $\vartheta = \pi/2$, $h_1 + g_1$ and $h_2 + g_2$ are univalent and convex in the imaginary direction. $h_1 + g_1$ and $h_2 + g_2$ satisfy normalization 1, since $\operatorname{Re}\{h_1 + g_1\} = \operatorname{Re}\{f_1\}$ and $\operatorname{Re}\{h_2 + g_2\} = \operatorname{Re}\{f_2\}$.

So we can apply Theorem 5 to both, giving us:

$$\operatorname{Re}\{(1-z^2)(g_1^t(z) + h_1^t(z))\} \geq 0$$

$$\operatorname{Re}\{(1-z^2)(g_2^t(z) + h_2^t(z))\} \geq 0$$

Then,

$$\begin{aligned} & \operatorname{Re}\{(1-z^2)(g_3^t(z) + h_3^t(z))\} \\ &= \operatorname{Re}\{(1-z^2)(t(g_1^t(z) + h_1^t(z)) + (1-t)(g_2^t(z) + h_2^t(z)))\} \\ &= t \operatorname{Re}\{(1-z^2)(g_1^t(z) + h_1^t(z))\} + (1-t) \operatorname{Re}\{(1-z^2)(g_2^t(z) + h_2^t(z))\} \\ &\geq 0 \end{aligned}$$

By Theorem 5, $h_3 + g_3$ is univalent and convex in the imaginary direction. So by Corollary 5, f_3 is univalent. \square

This result makes sense in the context of our understanding of real functions; the combination of two one-to-one real functions is one-to-one if they are both increasing or both decreasing. This theorem corresponds to the case where both are "increasing" in the positive real direction. By symmetry, we could expect that univalence is preserved no matter which direction the function is "increasing" in. Additionally we suspect that this theorem should apply to functions convex in any direction again by symmetry.

New Results

We devised and proved a theorem that contains the aforementioned generalizations and several others.

Theorem 7. Let $f_1 = \bar{g}_1 + h_1$, and $f_2 = \bar{g}_2 + h_2$ be univalent harmonic mappings convex in the direction ϑ on a domain E , which can be analytically deformed to the unit disk. $f_3 = t f_1 + (1-t)f_2$ is convex in the ϑ direction and univalent ($0 < t < 1$), if $|\omega_3| < 1$ on E , if f_1, f_2 reach their extremes in the direction $\vartheta \pm \pi/2$ at the same two points in E .

The proof relies on a generalization by Royster and Ziegler [4] of Theorem 5. We will also use a Lemma which is itself a generalization of Theorem 6.

Theorem 8 (Royster and Ziegler). Suppose f is analytic and non-constant in D . Then f maps D univalently onto a domain convex in the imaginary direction if and only if there are numbers m and n , with $0 \leq m < 2\pi$ and $0 \leq n \leq \pi$ such that,

$$\operatorname{Re}\{-ie^{im}(1-2\cos(n)e^{-im}z + e^{-2im}z^2)f^t(z)\} \geq 0, \quad z \in D$$

Additionally, $f(e^{i(m-n)})$ and $f(e^{i(m+n)})$ are the right and left extremes, respectively of the image.

Observe that, if we identify a m and n that give us the corresponding extremes, then those numbers will necessarily satisfy the inequality. This observation is used several times.

Lemma 9. Let $f_1 = \bar{g}_1 + h_1$, and $f_2 = \bar{g}_2 + h_2$ be univalent harmonic mappings convex in the imaginary direction and $|\omega_3| < 1$ on D . If $f(e^{i(m-n)})$ and $f(e^{i(m+n)})$, where $0 < m < 2\pi$ and $0 \leq n \leq \pi$, are the right and left extremes respectively of the image, then $f_3 = t f_1 + (1-t)f_2$ is convex in the imaginary direction and univalent ($0 \leq t \leq 1$)

The proof of this lemma parallels the proof of Theorem 6.

Proof. Since $|\omega_3| < 1$, f_3 is locally univalent. By Corollary 3 with $\vartheta = \pi/2$, $h_1 + g_1$ and $h_2 + g_2$ are univalent and convex in the imaginary direction. $h_1 + g_1$ and $h_2 + g_2$ achieve their right and left extremes at $f(e^{i(m-n)})$ and $f(e^{i(m+n)})$ respectively, since $\operatorname{Re}\{h_1 + g_1\} = \operatorname{Re}\{f_1\}$ and $\operatorname{Re}\{h_2 + g_2\} = \operatorname{Re}\{f_2\}$.

We apply Theorem 8 to both functions, giving us:

$$\operatorname{Re}\{-ie^{im}(1-2\cos(n)e^{-im}z + e^{-2im}z^2)(g_1^t(z) + h_1^t(z))\} \geq 0$$

$$\operatorname{Re}\{-ie^{im}(1-2\cos(n)e^{-im}z + e^{-2im}z^2)(g_2^t(z) + h_2^t(z))\} \geq 0$$

Then we can manipulate these inequalities as was done in the proof of Theorem 6.

$$\begin{aligned} & \operatorname{Re}\{(-ie^{im}(1-2\cos(n)e^{-im}z+e^{-2im}z^2))(g_3^t(z)+h_3^t(z))\} \\ &= \operatorname{Re}\{(-ie^{im}(1-2\cos(n)e^{-im}z+e^{-2im}z^2)) \\ & \quad (t(g_1^t(z)+h_1^t(z))+(1-t)(g_2^t(z)+h_2^t(z)))\} \\ &= t\operatorname{Re}\{(-ie^{im}(1-2\cos(n)e^{-im}z+e^{-2im}z^2))(g_1^t(z)+h_1^t(z))\} \\ & \quad + (1-t)\operatorname{Re}\{(-ie^{im}(1-2\cos(n)e^{-im}z+e^{-2im}z^2))(g_2^t(z)+h_2^t(z))\} \\ & \geq 0 \end{aligned}$$

By Theorem 8, $h_3 + g_3$ is univalent and convex in the imaginary direction. Therefore, by Corollary 3, f_3 is univalent.

Finally, we are able to prove Theorem 7.

Proof. Since E can be analytically deformed to D , there exists $\sigma(z) : D \rightarrow E$ such that σ is a analytic bijection. Consider $f_1^*(z) = e^{-i(\vartheta-\pi/2)}f_1(\sigma(z))$, $f_2^*(z) = e^{-i(\vartheta-\pi/2)}f_2(\sigma(z))$, and $f_3^* = tf_1^* + (1-t)f_2^*$. All three of these are functions on the unit disk and $f_1^*(z)$, and $f_2^*(z)$ are convex in the imaginary direction. Since $f_1(z)$, and $f_2(z)$ have the same points in E which map to the image extrema in the direction $\vartheta - \pi/2$ on E . If we apply σ^{-1} , which exists since σ is univalent, to each of these points, the two new points in D will be the image extrema in the $\vartheta - \pi/2$ direction of $f_1(\sigma(z))$, and $f_2(\sigma(z))$. Therefore, those two points must map to the extrema in the horizontal direction of $f_1^*(z)$ and $f_2^*(z)$. Since both these points are on the boundary of D , let us write the point which maps to the right extreme as $e^{i\varphi_1}$ and the point which maps to the left extreme as $e^{i\varphi_2}$ where $0 \leq \varphi_1, \varphi_2 \leq \pi$. Consider $m = (\varphi_1 + \varphi_2)/2$ and $n = (\varphi_2 - \varphi_1)/2$. Then $\varphi_1 = m - n$ and $\varphi_2 = m + n$.

We merely need to prove local univalence to apply lemma 9.

$$\begin{aligned} \omega_3^*(z) &= \frac{te^{-i(\vartheta-\pi/2)}\sigma^t(z)g_1^t(\sigma(z)) + (1-t)e^{-i(\vartheta-\pi/2)}\sigma^t(z)g_2^t(\sigma(z))}{te^{-i(\vartheta-\pi/2)}\sigma^t(z)h^t(\sigma(z)) + (1-t)e^{-i(\vartheta-\pi/2)}\sigma^t(z)h^t(\sigma(z))} \\ &= \frac{tg_1^t(\sigma(z)) + (1-t)g_2^t(\sigma(z))}{th^t(\sigma(z)) + (1-t)h^t(\sigma(z))} \\ &= \omega_3(\sigma(z)) \end{aligned}$$

Since $\sigma(z) \in D$, $|\omega_3^*(z)| = |\omega_3(\sigma(z))| < 1$. We can now apply lemma 9 which says that f_3^* is convex in the imaginary direction and univalent. Then $e^{i(\vartheta-\pi/2)}f_3^*(z) = f_3(\sigma(z))$ is convex in the ϑ direction and univalent on D . Since the inner term does not affect the image, and is a bijection, $f_3(z)$ is convex in the ϑ direction and univalent.

This new theorem is much broader as we had hoped than the original. It was indeed true that the functions could be convex in any direction. Moreover, we were able generalize the other conditions more than we expected. We can now use many more domains than just the unit disk, and the conditions on the extrema have been generalized to allow their pre-image to be any two points. The beauty of this theorem is that it provides geometric conditions, which can be quickly verified for any mappings.

For example, two functions that we can combine using this theorem but not the previous theorem are $f_1(z) = z + \frac{1}{2}z$ and $f_2(z) = z - \frac{1}{2}z$ on D . They both are

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convex in the $\pi/4$ direction and map $-\pi/4$ and $3\pi/4$ to their extremes in the $-\pi/4$ direction.

These two functions are fairly simple; our generalization applies to a broad swath of functions which the original theorem misses.

It is likely possible to generalize this result to close-to-convex functions, which contain the set of functions convex in one direction. A theorem for those functions could help to subdivide the set of close-to-convex functions, similarly to how Theorem 7 divides functions convex in one direction into each individual direction. While that subdivision is easy to see, a subdivision for close to convex functions is not immediately obvious. It might also be generalizable to a wider class of domains, perhaps all simply connected domains. These would be areas for future research.

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Implementing Service-Learning in the Lower Elementary Classrooms (K-3): Examining the How and Why from the Teachers

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Abstract

The education system is always looking for a way to improve teaching methods to best educate students. Service-learning is a teaching method which reaches and teaches students as a whole because it uses experiential learning in which students can better relate to concepts and gain a deeper understanding of what they are being taught. Service-learning has been thoroughly researched and is seen as beneficial for students in the upper grade levels, especially throughout high school. Research has gradually lessened as grade levels decrease from high school through elementary school. Minimal research has been done in the lower elementary levels, grades kindergarten through third. This study conducted a survey of K-3 teachers in the Turlock Unified School District. The questions asked pertained to their teaching methods, and determine whether or not they are familiar with service-learning techniques. This study also aimed to understand how and why lower elementary teachers incorporate service-learning into their instruction. After completion of the survey, I anticipated to find a low implementation rate of service-learning among K-3 teachers. This is due to either an inexperience to service-learning techniques, or the perceived input it takes to implement service-learning outweighs student benefits in teacher's current understandings of service-learning. With these results being found to be consistent among teachers, an advocate for service-learning will be needed in TUSD.

Keywords: Service-learning, Lower Elementary Teaching Techniques

Introduction

There are varieties of teaching methods that can be implemented in the classroom to teach the necessary curriculum to students. Each teacher has their own unique way of keeping students engaged in classroom activities. One method of teaching is service-learning. Service-learning should be implemented in the lower elementary grade levels because of the way it approaches the learning process in developing the student as a whole person, not just shaping them academically.

Service-learning is the integration of service acts to the daily curriculum and learning of students. It has been stated that, "the hyphenation of the terms *service* and *learning* strongly suggests a balance between learning goals and service outcomes that can be achieved only through a combination and merger of each sphere" (Kelley, Hart, and King 2012). It teaches the students the curriculum that they need to learn while incorporating acts of service that help to support the community's relevant needs. Students who are exposed to service-learning become responsible for the learning that is taking place (Akujobii & Simmons, 1997). Students who are taught with service-learning instruction are more likely to make authentic connections to what they are learning (Ponder, Vander Veldt, & Lewis-Ferrell, 2011), which means what the students are learning becomes more relevant and memorable to them. Service-learning requires students to be active in their education, and being active itself forces engagement in the learning process (Silver & Harris, 2009). Service-learning allows students to put the knowledge that they have learned in the classroom into practice with the community (Silver & Harris, 2009).

In *Great Ideas*, service-learning is defined as "a teaching method mediated and directed by a teacher and

thoughtfully and deliberately linked to the curriculum, academic standards, and IEP goals" of the students (Gent, 2009, p. 6-7). A teacher designs service-learning activities around the curriculum designed for the specific students of the classroom, as well as the specific needs of the community. A teacher's role in this learning environment is to facilitate the learning as the students construct it; the students become responsible for being an active participant in their learning (Akujobii & Simmons, 1997).

Service-learning is commonly seen being implemented in the high school classroom. It is also becoming more prevalent in middle school classrooms. Service-learning research is limited in the elementary classrooms. However, service-learning research has been recorded from kindergarten through the university level (Monsour, 2002).

Service learning is just one teaching method that teachers can use with their students. Other teaching methods include, but not limited to: lecture based instruction, demonstration, cooperative learning, and differentiated instruction. Lecture based instruction is a teacher-centered instruction method. With this teaching method, students are not typically engaged in the learning process as they are simply sitting at their desks, listening to what the teacher is explaining. This method allows the teacher to explain the curriculum to all of the students once, not repeating themselves explaining it to multiple students at different times. Demonstration is still a teacher-centered method of instruction, but it allows for a bit more interaction than the lecture based method. Demonstration allows students to see the skill they are being taught be put into practice. Often, the teacher will demonstrate first for the students, or they will have a student who understands the task demonstrate for the rest of the students. Cooperative learning is a student-

centered approach to instruction. Cooperative learning allows students to voice what they are thinking as they become active in the learning discussion. Students are able to vocalize what they are thinking and reinforce the concepts they are learning by sharing and listening with a partner during cooperative learning. Differentiated instruction is another student-centered instruction method. Differentiated instruction reaches the different learning styles of the students, whether it helps multiple students or even one student on multiple levels, while teaching one concept. Differentiated instruction allows students to be more active in the classroom as they are not always doing the same type of learning. While a concept might be introduced in the lecture based style to help the auditory learners, a hands on activity may follow to help the kinesthetic learners gain a better understanding.

Service-learning is important for teachers to implement specifically because it develops the student as a whole person ready to engage with the world, instead of a student who is ready to succeed simply in the academic realm of the world. The Venn diagram below shows how the three different realms of a student's life come together to shape a service-learning experience. Service-learning is a student centered approach to teaching because, for one reason, it applies to the student's own individual life. It is relatable to the students. It combines the academic curriculum to the student's surrounding community in a practical, relatable, and memorable way for the student to truly experience.

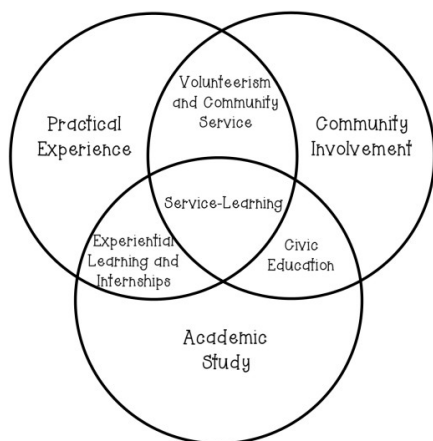


Figure 1. Service-learning Venn diagram (Fresno State, 2018).

This study is adding to previous research by further researching the use of service-learning in the K-3 classrooms. This is a preliminary study being done to have a better understanding of how service-learning is being understood and used in this area. This study is also informing, or at least reminding, teachers in the Turlock Unified School District about service-learning.

Research Question

Since there has been minimal research conducted to see the impact of service-learning at the elementary level, especially in the lower elementary grades, I want to study the implications of implementing service-learning at the lower elementary grade levels. Specifically, I want to

study how service-learning is being implemented into the classroom, such as with what content areas it is being taught in, and what benefits the teacher sees in the students' learning and other development areas, such as with their social-emotional development.

Literature Review

The Activist Learner is about how teachers implement service-learning in their own classrooms to help their students most effectively. This book advocates for the implementation of service-learning within the classroom and it expresses the various benefits that come from its use, including the benefits to self, peers, school, community, and environment. *The Activist Learner* states, "we embrace a practical approach to service learning, where curricular goals are integrated with the lived reality of students and result in some form of helpful activity and application" (Wilhelm, Douglas, and Fry, 2014). Service-learning provides a meaningful learning environment as "everything from vocabulary growth to deep strategic and conceptual understandings (such as those required by the CCSS and the next generation of standards and assessments worldwide) is best achieved when students understand the purpose and the immediate possibilities for applying what is learned in authentic, actual contexts" (Wilhelm et al., 2014). Service-learning is a teaching method that shows students how they can apply what they are learning in school into their everyday lives in a way that really matter and can make a difference.

One study conducted by Cliff Akujobi and Robert Simmons, "An Assessment of Elementary School Service-Learning Teaching Methods: Using Service Learning Goals," compared fourth grade students who had been previously exposed to service-learning in third grade to those who were not. This study showed that "most service learning activities promoted emotional intelligence and a strong social climate rather than encouraging the acquisition of complex thinking skills" (Billig, 2002). However, even with the lack of acquiring more complex thinking skills, students who were exposed to service-learning had significantly higher scores on state assessments than the students who did not have service-learning instruction (Billig, 2002). This study mostly examined the beliefs teachers have about service-learning projects and was conducted by interviewing the teachers (Akujobii & Simmons, 1997).

Another study done in the lower elementary grade levels was conducted by Katherine Scott and James Graham, "Service Learning: Implications for Empathy and Community Engagement in Elementary Children." This study examined students in three grade levels: first, second, and fifth grade. The students were involved in discussions about service learning, the planning process of the implementation of their project, the act of completing the project, as well as reflections throughout the projects completion. Each class had a different service-learning project because the students were the ones who brainstormed projects and made the ultimate decision on what project they were going to do. This study found positive results in what it was examining, there was an increase in empathy and community engagement from the start of the study to its end. However, cognitive empathy had decreased with the first and second graders and increased in the fifth graders. There was

also only a significant increase in civic efficacy in the fifth graders. These are complex concepts that are not developmentally appropriate at the first and second grade levels, and that could have effected the results of these findings. Even with the limitations found in this study for the lower elementary grade levels, there were still an abundance of positive outcomes from implementing service-learning in the classroom. This study is consistent with previous research in finding service-learning as a successful technique in engaging students in their learning, as well as helping them develop empathy and a sense of obligation to the community and being a good citizen (Scott & Graham, 2015).

In “‘Is it Good to Spend Time with Older Adults. You Can Teach Them, They Can Teach You’: Second Grade Students Reflect on Intergenerational Service Learning,” by Fair and Delaplane, second graders were active in an intergenerational service-learning project throughout the academic school year. They were paired with an elderly resident at a retirement center, who became the student’s “grandfriend.” The students took monthly trips to the retirement facility and they “would come prepared to work on a craft, draw pictures, or simply talk with their assigned elders.” A key aspect of service-learning is the reflection process, and so after each visit to their grandfriends, the students answered guided prompts that were “directive with specific connections to students’ feelings towards the experience and the course content.” This study showed that second graders were not too young for reflective writing to be seen as beneficial for them and effective for their learning process.

Methods

This study conducted an online survey reaching out to K-3 teachers in the Turlock Unified School District. The survey asked specific questions regarding to the teacher’s use of service-learning in their classroom, what they perceive as the positive and negative impacts for their students as a result of service-learning, as well as what they are able to actually record as being a result as an effect of having service-learning. This study aimed to know not just how the students are impacted from service-learning in regards to academic achievement, but also how they affected in their social-emotional development. In regards to how service-learning is impacting academics, the survey asks what content areas teachers are effectively implementing service-learning.

To have a better understanding of the teachers taking part of the survey, questions relating to the teacher’s educational background, their previous exposure to service-learning, and finally how and why they use service-learning in their classroom are asked. These questions helped to better understand the sample of teachers, as well as directed in how to answer the research question. The survey questions were constructed by referencing the questions used by Akujobi and Simmons in “An Assessment of Elementary School Service- Learning Teaching Methods: Using Service-Learning Goals” (1997).

Turlock Unified School District, TUSD, was chosen to complete this survey for a couple of reasons. One

reason simply being convenience. The school district surrounds the college campus area, and so going to the district office and necessary school sites was not a challenge on any given day. However, TUSD also has goals that align with service-learning itself. Some of their beliefs include, “People are responsible for their actions. Motivation, hard work, and persistence are necessary to achieve full potential. A quality education enriches lives by creating and expanding opportunities. The positive actions of role models inspire people to excel. Service to others is vital in building a thriving community.” Also, one of their objectives is, “All students will develop and consistently demonstrate character traits necessary to be self-motivated and responsible citizens in our community.”

With this research, the study hoped to find that local teachers see three specific areas in which their students benefit: service-learning helps to establish and develop a student prosocially (Fair & Delaplane, 2014 and Scott & Graham, 2015), service-learning establishes a positive learning environment, which fosters meaningful learning (Billig, 2002 and Ponder, Vander Velt, & Lewis- Ferrell, 2011), and by reaching the student on a personal level, teachers can then push students academically (Billig, 2002 and Silver & Harris, 2009). These three goals have been found true in previous research; however, this study would like to see these be found in this research as service-learning research is very limited in the lower elementary level (Scott & Graham, 2015). The reasoning for asking teachers questions on how and why they implement service-learning is to see if they have intrinsic motivations, or if they are simply checking a box their district has asked them to fulfill. Not having a motivated heart in planning a service-learning unit can lead to student’s not engaging in the process in which it is meant to be implemented with.

Results

Of the teachers who were emailed a survey, 140 K through 3 teachers of TUSD, 17 teachers responded back. 16 teachers agreed to participate in the survey, 1 did not. The surveyed teachers were an array of the targeted grades: 3 (18.8%) were kindergarten teachers, 5 (31.3%) were first grade teachers, 2 (12.5%) were second grade teachers, and 6 (37.5%) were third grade teachers. A majority of the teachers come from General Education classrooms, with one teacher being an Immersion teacher. A majority of the teachers, 12 (75%), also come from schools where the predominant socio-economic background of the students is medium or average. Classroom sizes of the teachers vary between 20-29 students. 10 of the teachers, 62.5%, claimed that they are not familiar with what service-learning is. Most teachers who remarked having some prior experience with service- learning mostly consisted of hearing about it in school or other professional development groups. 14 teachers, 87.5%, responded that they do not use service-learning methods within their classrooms, but 2, 12.5%, do.

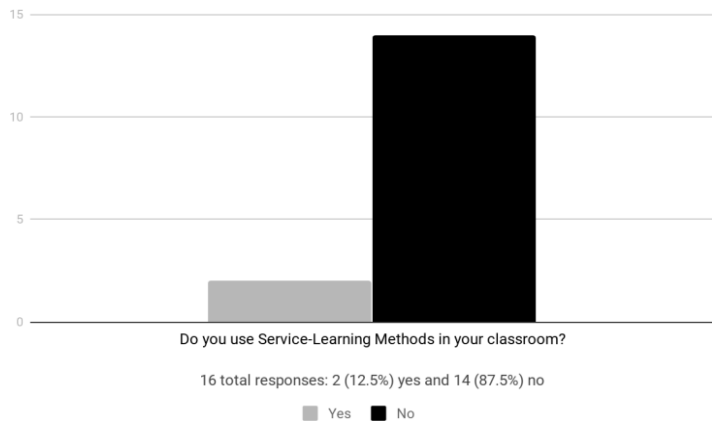


Figure 2. Survey responses bar graph (Olmstead, 2019).

The two teachers that responded to using service-learning techniques in their classroom had a few more questions to answer than the rest of the participants. They answered questions that regarded to how they implement service-learning, and what impact they see it having on their students. Neither teacher responded to using service-learning consistently in connection with a specific content area. One teacher noted a service-learning lesson connected with English Language Arts, where they read and discuss a book, do corresponding activities, and then have a corresponding project; this year they made blankets for a school in Paradise, CA. Both teachers remarked that they see service-learning helping students academically in building knowledge and helping students become engaged in what they are learning. The only negative aspect noted about service-learning in connection to impacting students academically is with the time it takes to do the project takes time away from academics. Social-emotional impacts are also seen by both teachers. No negative impacts were noted, but students are seen to have more empathy for one another, leading them to be kinder to their other classmates and also being more thoughtful. Both teachers responded that the barrier they come across when implementing service-learning into their classrooms is dealing with time.

Significance

Service-learning needs to be further explored at the lower elementary level because it has been seen to help students develop prosocial behaviors, establishes a positive learning environment, and allows teachers to reach students on a personal level so they can push the students effectively in their academics. However, with minimal research done in the lower elementary level, it is unknown if these benefits will be seen at this level too. With the small sample size of this study, as well as the very limited responses in the use of service-learning, further research is needed to make any conclusions on the effectiveness of the use of service-learning in the lower elementary classrooms.

Although the sample size of this study is small, it can be concluded that as only 37.5% of participants are familiar with and only 12.5% actually implement service-learning techniques, teachers in TUSD have had limited exposure to service-learning.

Teachers not fully understanding what service-learning is can lead them to not implement it well with their

students. Having a better understanding of service-learning can lead to a more effective implementation of it. If nothing else, this research is significant by introducing and helping clarify what service-learning is to teachers who may not have really known what it was before.

Limitations and Future Research

What was anticipated to happen from this research can be seen in the following flowchart. It lays out what this study hoped to find and then what would be done if that circumstance were to be true, if the goals of this study were not found to be consistent and the further action that would be taken, and then the least desired circumstance of little to no implementation of service-learning in TUSD and the action needed to be taken. The blackened arrow notes the circumstance that took place within this study.

Hopes of Findings in Research

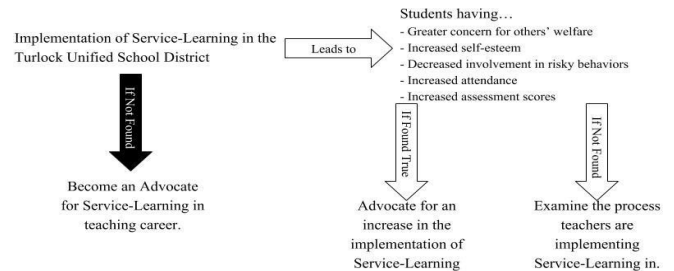


Figure 3. Hopes of Findings in Research Flow Chart (Olmstead, 2019)

This study had a very small sample size, and so that is the biggest limitation in making a generalized conclusion on the use of service-learning in the lower elementary grades within TUSD. Other limitations that may occur in implementing service-learning include the following: If teachers are not seeing the benefits for their students from the implementation of service-learning, it may be due to a few different factors that would have to be further explored. Teachers may not be seeing the benefits of service-learning in their students because the implementation was not done properly and effectively. The teachers may have only done one or two projects over the academic year, and the benefits of service-learning may only be seen after more exposure to it. The environment of the classroom and behavior of the students may also affect the results of a service-learning project being implemented. If the students do not respond or act well with one another, if they are cliquish, then that would need to be addressed first so that the students have the necessary environment available for effective service-learning to take place. Another limitation to this research could be that K-3 students may be too young to see the benefits of the implementation of service-learning. Also, teachers may not feel supported by administration or their district in implementing service-learning, as in they do not have adequate resources to properly implement what they wish to do with their students.

Future research may want to do a few things to further explore the implementation of service-learning in the K-3 classrooms. Observations of students engaging in a service-learning project may be seen as beneficial to the study and clear some questions that cannot be answered simply by the survey alone. Another thing that can be done is to actually survey, or interview, the students themselves. Questioning

the students can help explain how they view their service-learning projects, and see if their beliefs align with the beliefs that their teachers have on the impact of service-learning.

Acknowledgements

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The Importance of Keystone Species: Sea Otters in Alaska

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Abstract

Sea otters are an important keystone species in the marine system. Keystone species are species in an ecosystem that are not necessarily abundant, but those that other species greatly depend on. Without these keystone species, ecosystems could fail or drastically change. Sea otters are especially important in maintaining sea urchin populations which directly increases the health of kelp forests. It was not until the last few decades, however, that sea otter population numbers have begun to stabilize and increase to a more sustainable level, however, in some places they are still declining. Understanding whether there is a direct link between sea otters and sea health is important in understanding and determining the necessary conservation that needs to be implemented to help this endangered species. Although research has been done on the scale of impact that sea otters have on ecosystems, more research can be done to determine how sea otters affect sea urchins and kelp forests over an extended period of time. This study determined the importance of the sea otter as a keystone species of the Alaskan Islands by comparing and analyzing sea otter populations, sea urchin density, and kelp forest density over multiple decades. This comparison further confirmed the validity of the sea otter/urchin/kelp paradigm. Results have confirmed that sea urchin biomass and kelp density have an inverse relationship. Generally, my results have also shown that as the number of sea otters on an island increase, the sea urchin biomass on the island will decrease. Future studies should focus on how to apply this knowledge to the conservation of other keystone species.

Keywords: sea otters, keystone species, conservation

Introduction

Sea otters are an important keystone species in the marine system. It isn't until the last few decades that their population numbers have stabilized, however, sea otter populations overall are still in a state of decline (Jessup et al. 2004). Prior to the 21st century their population numbers dropped to a dangerously low level due to the fur trade and other negative human activities (Konar 2000). The maintenance of a healthy sea otter population is extremely important for both the sea otters and the environment. The conservation of sea otters sets off a chain reaction of positive effects on the ecosystem (Estes et al 2010). This is because sea otters feed on the sea urchins which would otherwise completely destroy kelp forests. These kelp forests are used as habitats for thousands of species of marine organisms as well as regulators of anthropogenic climate change.

The understanding of the importance of keystone species is essential because without keystone species the likelihood that entire ecosystems would fail drastically increases. The sea otter is a perfect example of a marine keystone species that both indirectly and directly benefits many trophic systems within the ecosystem (Estes et al. 2010). This research focuses on the importance of sea otters as a keystone species. This

includes benefits to the ecosystem, recovery and conservation of the species, and decline in population size. By understanding the indirect and direct effects that the lack of sea otters has on an ecosystem or some location, better and more efficient efforts may be put in to the conservation of these sea creatures.

Key Terms and Concepts

A keystone species is a species that is not necessarily abundant in numbers but is of great importance to an ecosystem (Power et al. 1996). It is similar to the keystone in an arch; if the keystone falls, the arch does as well. In this case if the sea otter population declined to an extremely low level or went away completely, the marine ecosystem would suffer drastically due to the failing of this one mammal. A keystone species often keeps a specific species of animal or other living organism in check which, in turn, keeps the ecosystem healthy. Damage to a keystone species population could set off a chain reaction of negative effects towards the ecosystem which could eventually impact human quality of life in one way or another.

When referring to the food web, which sea otters greatly impact, the term "trophic" will be used.

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“Trophic” refers to nutrition, and in this case a trophic cascade is the ripple effect that is felt when a keystone species is removed completely or greatly diminished from an existing ecosystem (Estes et al. 2016). This trophic cascade is important in understanding the impact of a keystone species.

In understanding how the trophic system works, it is important to note that sea otters are secondary consumers. Secondary consumers are either carnivores or omnivores which primarily prey on primary consumers, also known as herbivores. In this case the sea otter is considered an omnivore as it feasts on animals such as sea urchins and plants such as kelp.

Background

Sea otters, or *Enhydra lutris*, cause both direct and indirect positive effects on kelp forests and marine systems. As a keystone species, sea otters do more than just keep the sea urchin population in check. They are important in keeping kelp forests alive and intact which provides habitats for many other marine species. They also mitigate negative anthropogenic effects. Conservation of the sea otter should be of utmost importance; however, this way of thinking became popular only in the latter half of the 20th century. Identifying and negating threats to the sea otter population is important as the species population as a whole is not entirely stable. By understanding how greatly the sea otters impact the marine ecosystem, more efforts may be put in to their conservation as a whole.

Aleutian Islands. Although sea otters can be found in various locations along the west coast, particular attention should be paid to the Aleutian Islands in Alaska. These islands span westward from the mainland of Alaska through the Bering Sea (Tollit et al. 2017). This Aleutian archipelago consists of 6 island groups called Andreanof, Near, Fox, Rat, Delarof, and the Islands of Four Mountains. Sea otter populations living on these islands were among the first to recover following their near extinction in the early 20th century (Doroff et al. 2003). Although many populations recovered on these islands between 1965 and 1992, there is now an alarming trend of population decline from 1992 to 2000 (Doroff et al. 2003). Although data from subsequent aerial surveys of these populations has yet to be published from the last couple of years, previous trends indicate that sea otter populations have and will continue to decline.

Sea Otters and Their Environment. In marine biology there is a sea otter/urchin/algae paradigm (Kvitek et al. 1998). Because kelps are brown algae seaweeds, this paradigm can be referred to as the former or as the sea otter/urchin/kelp paradigm. In the presence of sea otters, kelp forests are typically left

intact and healthy which is useful as these are absorbers of carbon dioxide, a greenhouse gas. Of course, this doesn't take into consideration the many other ways that kelp forests could be damaged, such as by human activity, but the presence of sea otters seems to be a constant in areas with healthy kelp forests and other algae deposits.

Sea otters keep kelp forests in tact by feasting on sea urchins (Kvitek et al. 1998). A major part of a sea urchin's diet consists of kelp. Without sea otters keeping the sea urchin population in check, the urchins increase in size and become uncontrollable. This often results in massive sections of kelp forests being destroyed. This is important because sea otters help to decrease herbivory of kelp forests in order to turn areas that are generally sea urchin dominated into communities that are kelp forest dominated. Kelp forest dominated sections of the ocean usually have more diverse wildlife as they provide healthy marine habitats for many other aquatic species.

Kelp forests also indirectly reduce coastal erosion by reducing the harsh impact of waves (Jackson 1984). When kelp beds have been depleted because of predation by sea urchins, coastal health declines. Sea otters, however, have always been a good indicator of marine health. Because they often stay relatively close to the coastline, diseases and parasites that they acquire give scientists a good indication of which pathogens are local and dangerous (Jessup et al. 2004). This helps determine how healthy the coastal marine life actually is.

Sea otters also set off a trophic cascade if removed from an ecosystem as they are secondary consumers which control organisms from the top-down of the food web. Top-down control of a trophic system is when consumers depress the trophic level that contains the type of organisms they feed on which increases lower trophic levels (Estes et al. 2016). In other words, because sea otters consume large amounts of sea urchins, the kelp which the urchins feed on increase in population size and density. Because of this, sea otter predation has resulted in positive top-down effects. In the Elkhorn Slough, for example, the presence of sea otters has caused eelgrass beds to prosper. This increase in abundance to eelgrass has slowly mitigated the negative effects of nutrient loading in the slough (Hughes et al. 2013). This shows the importance of sea otter predation in consumer controls.

Conservation. It is not enough, however, to just acknowledge the importance of sea otters as a keystone species. Extensive effort also needs to be put in to the conservation of the sea otter. Humans fail to realize that the exploitation and decline in sea otter populations often is a result of anthropogenic reasons such as trapping, poaching, climate change, or just

carelessness. The aftermath of the Exxon Valdez oil spill is a good example of why more attention needs to be given to this important keystone species. Following this catastrophic oil spill in 1989, 878 sea otter carcasses were found floating on the surface of the water alone (Estes 1991). The exact number of sea otter deaths are not known because the sea otter population was only counted after the oil spill. If the importance of the sea otter was completely understood prior to this oil spill then more information could have been known about how detrimental this event was to the population.

Aside from catastrophes such as the Exxon Valdez oil spill, sea otters were also hunted to near extinction just over a century ago in the early 20th century, leading to overexploitation (Doroff et al. 2003). In the Aleutian Islands in Alaska, these sea otter populations were among the first to recover, however, they are now at an extreme low. It has been estimated that approximately three quarters of the sea otter population died in a span of 35 years (Doroff et al. 2003). This eradication of the sea otter occurred between 1965 and 2000. Previous information regarding the abundance of sea otters in Alaska are unknown as 1965 was one of the first years that surveys were taken and published. The main cause of mortality at this particular site was determined to be from killer whales although parasites are also a cause of death at other locations (Doroff et al. 2003). This decline in sea otter population is an alarming trend. Scientists aren't sure why their population has begun decreasing again in some locations, however, increased predation by whales is certainly one option (Slee 2009). Sea otters are also prone to infections caused by various water-borne parasites (Jessup et al. 2004). This unexpected decrease in sea otter population brings the health of kelp forests back into question.

Because of oil spills, predation, disease, and pollution, the population of sea otters has fluctuated greatly in the last decade. The loss of sea otter lives has landed the Northern Sea Otter on to the Endangered Species Act where it still remains today (Slee 2009). The state of the sea otter population is in question which leaves the general health of the entire marine ecosystem unknown.

Methods

Overview. In recent years much research has been done to determine the importance of keystone species. The importance of sea otters as a keystone species is just a small portion of that. This research consists of an extensive analysis of studies which discuss the effects that sea otters have on an ecosystem. This includes sea urchin biomass as well as kelp density. This meta-study used both published and unpublished data from official

sources to compare sea urchin density and kelp forest health and density in areas with little to no sea otters to areas with a high sea otter population in the Aleutian Islands. Graphs were generated using the collected data to determine if any trends or patterns could be seen. Percent change was also calculated in order to determine which islands experienced the greatest amount of sea otter loss, kelp density loss, and sea urchin biomass increase.

Results

The number of sea otters counted on the Adak, Attu, Kiska, and Amchitka Islands were graphed against the sea urchin biomass recorded in the year 2000 (Fig. 1). Generally, the islands with upwards of 200 sea otters had low sea urchin biomass compared to those with fewer sea otters.

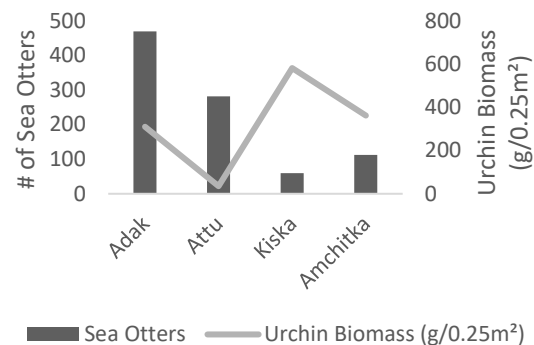


Figure 1. Sea otter abundance compared to sea urchin biomass across the Adak, Attu, Kiska, and Amchitka Islands of the Aleutian Islands of Alaska in the year 2000.

Kelp density on various islands was analyzed before and after sea otter decline over a period of 10 years (Fig. 2). All islands had a negative percent change in kelp density which suggested a decrease in kelp forests. Amchitka Island had the greatest percent change at 95% followed by Kiska at 91%. Adak Island had the lowest percent change at 82%. The average percent change between all 5 islands was 65%. Kelp density was also analyzed at Adak, Alaid, Amchitka, and Kiska Islands before and after an increase in sea urchin biomass (Fig. 3). Again, all islands had a negative percent change in kelp density. Amichitka Island had the highest percent change at 95% followed by Kiska at 91%. Adak Island had a percent change of 84% and Alaid Island had the lowest percent change at 81%. The average percent change between the 4 islands was 88%.

Kelp density was also analyzed against sea urchin biomass across the Aleutian Islands (Fig. 4).

This included data from 1987, 1990, 1993, 1994, 1997, 1999, and 2000. There was a negative correlation between kelp density and sea urchin biomass.

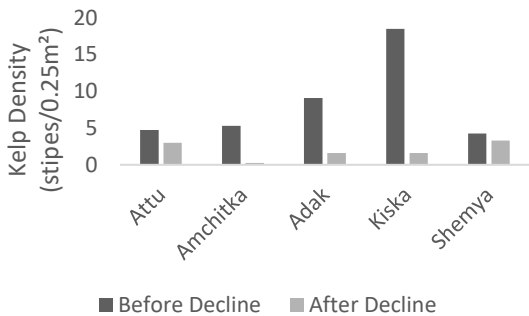


Figure 2. Kelp density on 5 islands within the Aleutian Islands before and after sea otter decline from 1990-2000.

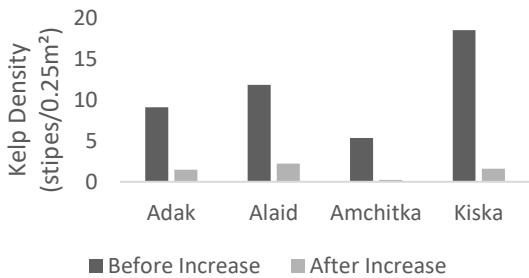


Figure 3. Kelp density on 4 islands within the Aleutian Islands before and after an increase in sea urchin biomass.

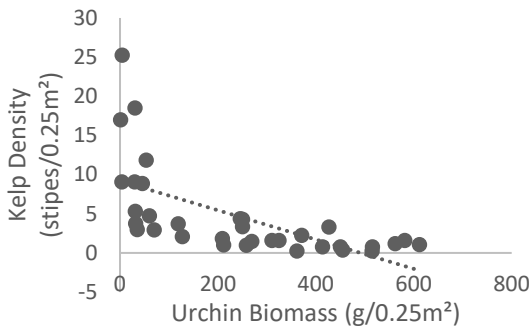


Figure 4. Plot of kelp density and sea urchin biomass trends across the Aleutian Islands of Alaska from 1987 to 2000.

Sea otter abundance on the six major island groups of the Aleutian Islands showed that all six experienced declines in population between 1992 and 2000 (Fig. 5). The number of sea otters also declined on various islands along the Alaska Peninsula from 1989 to 2001 (Fig. 6).

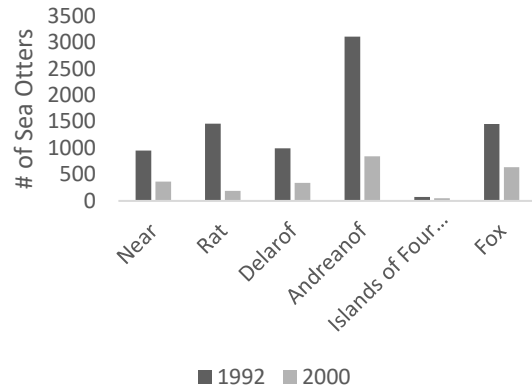


Figure 5. Sea otter abundance on the six major island groups of the Aleutian Islands in 1992 and 2000.

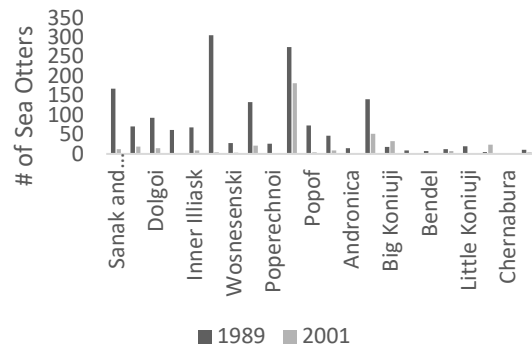


Figure 6. Sea otter abundance on various islands along the Alaska Peninsula in 1989 and 2001.

The adjusted estimate of sea otters in the Southwest, East, and Central Alaskan stock showed that the Southwest stock held the greatest amount of Northern Sea Otters while the Southcentral stock held the least (Fig. 7). This estimate is using data collected between the years of 2000 and 2008.

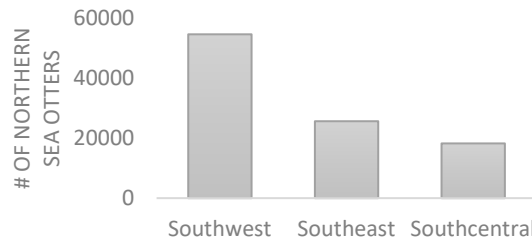


Figure 7. The number of recorded sea otters in the Southwest, Southeast, and Southcentral Alaskan stock.

Discussion

Based on the collected data, it is shown that kelp density and sea urchin biomass have a negative

correlation (Fig. 4). As sea urchin biomass increases, kelp density decreases. This trend remained constant from 1987 to 2000 in the Aleutian Islands. In figure 1, the abundance of sea otters on the Adak, Attu, Kiska, and Amchitka Islands was analyzed against the sea urchin biomass on each island in 2000. Adak and Attu had twice as many sea otter inhabitants as the Kiska and Amchitka Islands. The latter two islands also had much higher sea urchin biomasses than the Adak and Attu Islands. This is further evidence that the sea otter/urchin/kelp paradigm is true. Islands with a decreasing number of sea otters had high sea urchin biomasses and, as a result, lower kelp density.

Further confirming this idea of the sea otter/urchin/kelp paradigm were figures 2 and 3. Comparing the kelp density on the Adak, Attu, Kiska, Amchitka, and Semya Islands, it is shown that after the number of sea otters decline on an island, the kelp density declines as well (Fig. 2). Amchitka Island had the greatest decline followed by Kiska Island. Both of these islands belong to the Rat Island group which is one of the western most of the Aleutian Islands. The Rat Island group had the highest percent change of sea otters from 1992 to 2000 with a percent change of 87%. (Fig. 5). Because these islands had the greatest loss of sea otters in the 1990s compared to the other major island groups it makes sense that this was followed by the greatest change in kelp density.

On some of the same islands, kelp density decreased following an increase in sea urchin biomass (Fig. 3). Again, Amchitka and Kiska Island had the greatest loss of kelp density. These islands, as part of the Rat Island group, also had the greatest loss of sea otters from 1992 to 2000 (Fig. 5). This lends evidence to the idea that sea otters control the sea urchins which, in turn, allows kelp density to remain abundant and stable. If kelp density declines then so does the health of the surrounding marine system. Kelp forests provide homes for various marine life as well as slowing the degradation and erosion of shores (Jackson 1984).

Overall, there has been a trend of sea otter decline from the mid-1980s until approximately 2001 (Fig. 6). The major island group, the Islands of Four Mountains lost the least amount of sea otter from 1992 to 2000, however, it was a small sample size compared to the other island groups. In 1992 this island was only inhabited by 72 sea otters and declined to 52 by 2000. This island group is located in the Eastern Aleutian Islands meaning that it is closer to the Alaskan mainland than the Rat Island group. It is possible that the Rat Island group had the greatest loss of sea otters because it is very far from the Alaskan mainland.

Being far from the mainland means that it most likely does not experience great human disturbance, however, it likely suffers from a lack of sea otter immigration. It is possible that a lack of immigration would cause inbreeding among the sea otters, leading to ample disadvantageous mutations staying in the population.

Even islands that are not part of the six major island groups experienced sea otter decline from 1989 to 2001 (Fig. 6). These islands are still considered part of the Aleutian Islands, however, and contribute to the Southwest Alaskan stock (Fig. 7). Andronica Island, for example, experienced a 100% decline in sea otters during these years. The average decline in sea otters across these islands was 54%. This means that across these various standalone islands that at least half of the sea otter population disappeared in a span of only 12 years. Unless the population begins to recover, at this rate only approximately 25% of the sea otters that inhabited these islands in 2001 will inhabit them now. It is likely, however, that these numbers were skewed by the Exxon oil spill which occurred in 1989 (Estes 1991). The long-term effects of this oil spill could also explain why the least amount of sea otters reside in the Southcentral region of Alaska. This region of Alaska is where Prince William Sound is located which was also where the oil itself was spilled.

Conclusion

Sea otter populations are declining at a rapid rate. Although some populations are stable, most are experiencing a rate of decline that has landed the sea otter on the Endangered Species list. Research shows that sea otters indirectly cause many positive effects in regards to the marine system. When the number of sea otters on an island decreases, the sea urchin biomass then increases. When sea urchin biomass increases it has been shown that kelp density decreases as a result. Because kelp forests are such an integral part of local marine health it is important to make sure that they are left in tact and healthy.

One way to help sea otter populations would be to set up reserves along the Aleutian Islands. Preferably large reserves would be established instead of several small, separate reserves. If possible, reserves should also be relatively close together and connected by some type of corridor. Although this may be difficult to do because of where the Aleutian Islands are located it can be done. Also, minimizing direct and indirect anthropogenic effects would be ideal. This includes both the direct destruction of sea otter habitats

and hunting of the animals themselves. Killer whales have also begun feeding on sea otters due to overhunting of sea lions, the preferred prey of the killer whale. If humans allow sea lion populations to remain stable or increase then sea otter populations have a better chance of increasing. If sea otters, an important keystone species, are able to increase in number then the entire marine ecosystem would benefit. Conservation of these creatures is still possible and their importance has never been more clear.

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Binge Drinking Among College Students

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Abstract

Binge drinking among college students has become a major health concern. Binge drinking has been defined as drinking five or more drinks in a single setting for men. For women, it is defined as four or more drinks in a single setting. Research shows gender differences and housing status affect patterns in alcohol consumption, specifically binge drinking. For the present study, it was hypothesized that participants who identify as a male will be more likely to report binge drinking behavior as compared to female participants. It was also hypothesized that students who live on campus will be more likely to binge drink than students who live off campus. A sample of 179 undergraduate students from CSU Stanislaus between the ages of 18 and 63 were asked to indicate their gender, what their current housing status was, on campus or off campus, and what their alcohol consumption habits were. To determine whether there were differences in binge drinking behavior between gender and housing status, data were analyzed using independent samples t-tests. The research hypothesis was supported. Significant results were found relative to both gender, $t(37.818) = 3.31$, $p = .002$, $d = 0.79$, and housing status, $t(14.382) = 2.3$, $p = .039$, $d = 0.67$. As expected, male participants were significantly more likely to engage in binge drinking behavior ($n = 31$, $M = 2.6$, $SD = 1.28$) as compared to female participants ($n = 148$, $M = 1.7$, $SD = 0.99$). As was also expected, participants who reported that they lived on campus were significantly more likely to engage in binge drinking behavior ($n = 14$, $M = 2.6$, $SD = 1.34$) as compared to those who did not live on campus ($n = 165$, $M = 1.8$, $SD = 1.03$). Although the numbers did not reflect high levels of binge drinking, these findings imply that both gender (male), and housing status (on campus) have an influence on college students' drinking behavior. Limitations of the study included a small sample size, the sample being limited to only an undergraduate college student population, and a disparity between reported gender and housing status.

Keywords: binge drinking; college students; gender; housing status

Introduction

Binge drinking among college students is becoming more common over the years. "Binge drinking has been defined as drinking five or more drinks in a single setting or as drinking five or more drinks in a single setting for men and four or more drinks in a single setting for women" (Clapp, Shillington, & Segars, 2000, p.140). College students suffer negative consequences when they have alcohol in their system because it impairs their motor skills, causes health problems, and does not allow students to think as clearly as they would if they were not intoxicated. Research shows gender differences affect patterns in alcohol consumption specifically binge drinking. Students' participation in school activities such as Greek membership and students' living status are factors that studies show affect their alcohol consumption.

Binge drinking among college students is so extensive that it is causing a major health concern to all people. "High-risk

alcohol use on college campuses has prompted a concerning response from federal agencies such as the National Institute of Alcohol Abuse and Alcoholism and the US Department of Health and Human Services, as well as local efforts from community coalitions and college administrators" (Wagoner, Blocker, McCoy, Sutfin, Champion, & Wolfson, 2012, p.446). Although these programs are trying to prevent students from engaging in such dangerous alcohol-related activities, studies have shown binge drinking is still prevalent on college campuses (Wagoner, Blocker, McCoy, Sutfin, Champion, & Wolfson, 2012). Studies are trying to discover new techniques to help students' who are dealing with binge drinking and are at risk to experience negative social and psychological consequences due to high amounts of alcohol consumption (Gfroerer, Greenblatt, & Wright, 1997).

Literature Review:

Affiliation on Campus and Drinking Status

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Some research has shown students who are Greek members on campuses (such as being in fraternities or sororities or athletes) are more likely to participate in binge drinking (Smith, Finneran, & Droppa, 2014). This is because they are more likely to attend parties where alcohol is going to be served and play alcohol-related games. Alcohol is more accessible to Greek members because they are more likely to throw parties and are more likely to engage in alcohol-related games than students who are non-Greek members. The parties that the Greek members throw are for mostly for Greek members which is why they are also more likely to engage in alcohol-related games. All Greek members are invited and occasionally they will invite other peers who are non-affiliated students. Greek members pressure their peers to participate in alcohol-related games. Students feel pressured to drink because everyone else is drinking. "Students most often reported getting alcohol from a peer of legal drinking age, a sorority/fraternity party, or a bar" (Wagoner, Blocker,

McCoy, Sutfin, Champion, & Wolfson, 2012, p. 447). In other words, non-affiliated students are receiving alcohol from another student involved in a fraternity or sorority which makes alcohol available to everyone involved with those groups. Students are not only receiving alcohol from Greek organizations on campus they also receive it from their peers and bars. But being affiliated with Greek organizations puts them at a higher risk to participate in binge drinking according to research. Research suggests students are more likely to drink if involved in a Greek membership because alcohol is present during a party or social gathering.

Students reported the reasons they drink heavy amounts of alcohol is due to "social norms and wanting to have fun" (Clapp, Shillington, & Segars, 2000). It is a social norm in college many students are going to binge drink which is why many students reported feeling pressure to drink heavy amounts of alcohol at parties. Although there has been plenty of research done to support that there is a relationship among binge drinking and student's Greek status, little research has been done on students who are not affiliated with fraternities, sororities, and athletics.

Many studies conclude that Greek affiliation does not impact students' drinking status. One study has shown students who are not members of Greek organization still consume large amounts of alcohol (Smith, Finneran, & Droppa, 2014). Researchers found many factors made students vulnerable targets to excessive drinking (Young, Morales, McCabe, Boyd, & D'Arcy 2005). For example, students who had been using drugs while consuming alcohol, drank higher amounts of alcohol as their night went on. Students who participated in binge drinking also attended parties and played alcohol-related games such as their peers did who are affiliated with fraternities, sororities, and sports on campus. Many college

students regardless of affiliation on campus binge drink, and suffer negative consequences which include dizziness, vomiting, and memory loss (Smith, Finneran, & Droppa, 2014). Researchers found alcohol was widely accessible regardless of affiliation which is why many students binge drink. A mass number of students participate in pre-gaming which is defined as consuming high amounts of "alcohol before they go out to a party and after they came back from the party" (Smith, Finneran, & Droppa, 2014). "Some of the worst consequences of a night out drinking were hangovers, confusion, embarrassment, vomiting, saying things one should not have, memory loss, medical personnel or police visits, being written up by a Residence Assistant, emotional consequences and getting out of control" (Smith, Finneran, & Droppa, 2014, p.36). Basically, regardless of students' affiliation on campus many students practice binge drinking and suffer negative consequences.

Gender Differences Impact on Alcohol Consumption

Some research suggests gender is not a reliable indicator to predict a student's drinking status. "Historically, male college students have been most involved in the drinking culture on their campuses; however, research based on large epidemiological studies suggests that with each new cohort of students that enters higher education, gender differences within this age group are diminishing" (Young, Morales, McCabe, Boyd, & D'Arcy, 2005, p.142). There are many reasons to suggest why this is occurring. Women today in the United States believe in gender equality and do not let the fact that they are women get in their way of participating in things that are considered masculine. This is a reason why women today are catching up with men in terms of alcohol consumption (Young, Morales, McCabe, Boyd, & D'Arcy, 2005). Today many women do not care if binge drinking is considered masculine, they will still participate in it. Female students are more likely to get alcohol for free which contributes to an increase in alcohol consumption (Wagoner, Blocker, McCoy, Sutfin, Champion, & Wolfson, M., 2012). The fact that women reported getting free drinks more often than men is one factor to take into consideration as to why women are consuming more alcohol now than they did a few years ago. Men did not report having as many free drinks as women but have been drinking more than women in the past decade (Wagoner, Blocker, McCoy, Sutfin, Champion, & Wolfson, M., 2012).

Other research suggests it is important to take into account a student's gender to predict the likelihood of one's drinking status. Research suggests men have been drinking more than females, because it is viewed by men as a competition, to see who can drink the most. Men view binge drinking as a sport and like to compete against one another. The male students like to

see who can drink the most alcohol in short periods of time. (Young, Morales, McCabe, Boyd, & D'Arcy, 2005). This research concludes gender is an important factor to take into account when predicting college students drinking status, but the gender gap may be closing soon according to another research.

Housing Status

Another important factor to look at when predicting binge drinking is a student's housing status. Research suggests students who live away from their parents tend to binge drink more frequently (Gfroerer, Greenblatt, & Wright, 1997). This is due to the fact they are away from their parents' and are at a new stage in their lives where they have more freedom. College students who move out of their parents' home are experiencing the world for themselves, and do not have their parents constantly consulting them with the decisions they make. Students who live on college campuses are adjusting to having alcohol accessible to them for maybe the first time (Gfroerer, Greenblatt, & Wright, 1997).

Students are at a critical and exciting new chapter in their lives, and with their parents out of the picture, they are going to be experimenting with new things, such as binge drinking. Moreover, students have parties without their parents knowing, which contributes to why binge drinking is more prevalent among students who live away from their parents. When students attend parties, they do not have to pay for alcohol. If alcohol is free and students' parents are not around, they are more likely to drink. Many students experiment binge drinking because it is much easier for them to try when they do not have their parents around. Alcohol is easily accessible and is free when students go to a party, so students feel inclined to experience it.

Conclusions

Overall, research suggests many factors contribute to college students participation in binge drinking. It is important to take into account students' affiliation on campus, gender, and living status when looking for groups to aid in alcohol-related problems. Many universities are setting up counseling programs to help students deal with the negative consequences after they have binge drank (Gfroerer, Greenblatt, & Wright, 1997). Not only have students affected themselves, but others around them when they binge drink. "Alcohol use among college students is becoming a health concern to the public" (Clapp, Shillington, & Segars, 2000). College students drinking is a community problem, because after consuming high amounts of alcohol students usually drive and are more likely to injure or kill themselves and others around them. They

are also more likely to perform deviant behaviors in the community. When students are intoxicated, they are more likely to commit non-consensual acts against other students or people in the community (Wagoner, Blocker, McCoy, Sutfin, Champion, & Wolfson, 2012). Which is why it is such an important topic to research in order to tackle the vulnerable targets who need to seek help.

My research will be to see if our campus, California State University, Stanislaus, has large amounts of students who binge drink. Most research done has been in United States Universities, however many of these research findings were not done in California, so it will be interesting to see if our campus is like other campuses in the United States. Most research was done on non-affiliated students on college campuses and had only a few numbers of subjects, and the majority were Caucasian male students (Smith, Finneran, J., & Droppa, 2014). Researching our campus will be different because we have a diverse student population. The campus at California State University, Stanislaus is primarily a commuter campus, composed largely of first-generation students. This type of research will allow us to see if our campus needs to establish programs to help students deal with the negative consequences of drinking high amounts of alcohol.

Methods

Overview. A sample of 179 undergraduate students were recruited through the CSU Stanislaus Department of Psychology online participant pool (SONA). Participants ranged from 18 to 63 years of age. Anyone who was under 18 was excluded from the study. All participants were given 1 SONA credit for participating in the study, which counted as experimental credit for a psychology class. Students were made aware of the study from instructors, and flyers.

The research design is a 2 X 2, within-subjects design to examine factors pertaining to the effects that gender and housing status have on drinking behaviors. The independent variables are gender and housing status. Participants were asked to identify whether they are male or female and whether they live on campus or off campus. The dependent variable is reported binge drinking behaviors measured using a drinking behavior survey. The measures used in the study are a demographics questionnaire and a drinking behavior survey. The demographics questionnaire consists of 11 questions designed to assess the participants' personal characteristics, including questions regarding whether or not they consume alcohol. The drinking behavior survey consists of two questions, both using a 5-point Likert scale of measurement with one designed to assess their binge drinking status, with the second question designed to assess a personal view on how the participant views drinking, and finally, one close-ended

question designed to assess the participant's likelihood of having difficulties with the legal system due to drinking behavior.

Participants were recruited through SONA. Those who were interested were able to access further information about the study, the Consent Form, questionnaires, and the drinking behavior survey through Qualtrics. Once a participant agreed to participate, he or she was instructed on how to advance through all portions of each section, beginning with the Consent Form. Upon completion of the Consent Form, the participants were instructed to complete a demographics questionnaire, at which time they were asked if they consumed alcoholic beverages. Those who indicate that they do not consume alcohol were directed to the end of the survey. Participants were then instructed to complete the drinking behavior survey. At the conclusion of the experiment, the participants were then directed to the debriefing sheet, at which time they were thanked for their participation, and the purpose of the study was explained to them. It was clarified to them that the study's purpose is to understand factors pertaining to gender and housing status and its effects on binge drinking.

Results

To determine whether there were differences in binge drinking behavior between gender and housing status, data were analyzed using independent samples t-tests. Both research hypotheses were supported. Significant results were found relative to both gender, $t(37.818) = 3.31, p = .002, d = 0.79$, and housing status, $t(14.382) = 2.3, p = .039, d = 0.67$. As expected, male participants were significantly more likely to engage in binge drinking behavior ($n = 31, M = 2.6, SD = 1.28$) as compared to female participants ($n = 148, M = 1.7, SD = 0.99$) (see Figure 1). As was also expected, participants who reported that they lived on campus were significantly more likely to engage in binge drinking behavior ($n = 14, M = 2.6, SD = 1.34$) as compared to those who did not live on campus ($n = 165, M = 1.8, SD = 1.03$) (see Figure 2).

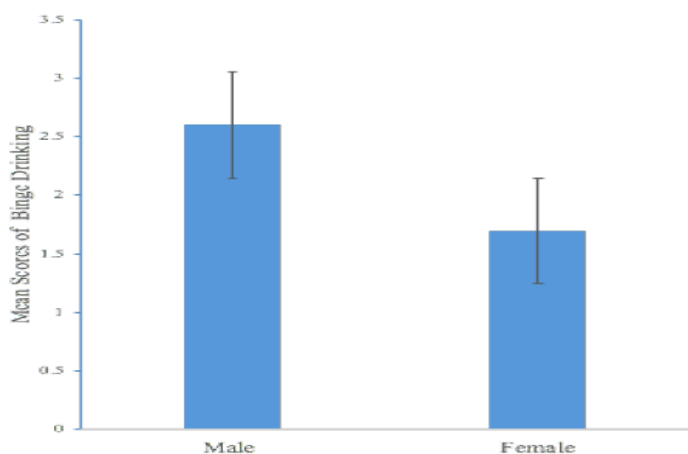


Figure 1. Mean score of binge drinking relative to gender.

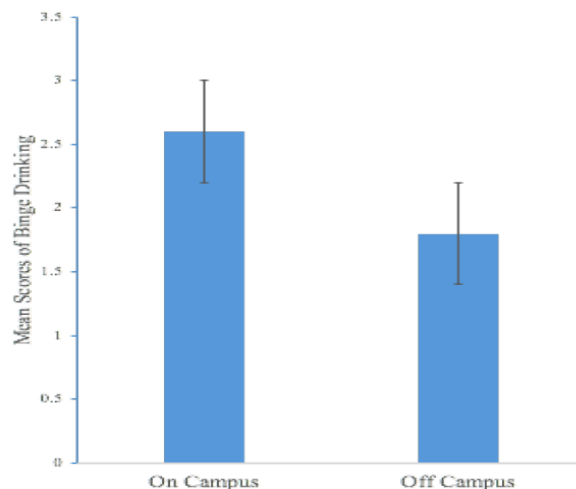


Figure 2. Mean score of binge drinking relative to housing status.

Implications

Although the numbers did not reflect high levels of binge drinking behavior, these findings imply that both gender (male), and housing status (on campus) have an influence on college students' drinking behavior. These findings are consistent with previous research suggesting that gender and housing status influence students' drinking behaviors (Young, Morales, McCabe, Boyd, & D'Arcy, 2005). Limitations of the study included a small sample size, the sample being limited to only the undergraduate college student population, and disproportionate ratios pertaining to genders and housing status. These findings will aid in the implementation of outreach programs against the danger of binge drinking on the California State University, Stanislaus campus.

Future work

There are many potential works that could develop out of this study. There needs to be more research done on campuses with diverse student populations. More data will need to be collected in the future to better understand the nature of our campus. Larger sample sizes and inclusion of the graduate student population will improve our understanding of our campus.

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The Effect of Story Modality on Comprehension and Emotional Engagement

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Abstract

With the rise in popularity of audiobooks, it is important to evaluate the influence story modality has on story comprehension and story engagement. Research is divided on how story modality affects comprehension in adults. Furthermore, research on emotional engagement with a story tends to view emotional engagement as a predictor for comprehension. The present study aimed to contribute to the investigation of the effect of story modality on comprehension and emotional engagement. We had non-directional hypotheses. Thirty-three participants (29 females, 4 males, $M_{age} = 22.03$) were randomly assigned to either read or listen to two stories. One story was fiction and the other was nonfiction. All participants answered questions to assess story comprehension and emotional engagement. Data analyses showed that comprehension scores of participants in the reading condition ($n = 16$, $M = 7.75$, $SD = 1.44$) did not significantly differ from those of participants in the audiobook condition ($n = 17$, $M = 6.94$, $SD = 2.14$), $t(31) = 1.27$, $p = .214$. Additionally, emotional engagement scores of participants in the reading condition ($n = 16$, $M = 4.81$, $SD = 1.00$) did not differ significantly from those in the audiobook condition ($n = 17$, $M = 4.55$, $SD = 1.18$), $t(31) = 0.66$, $p = .512$. In addition to small sample size, limitations included a homogenous sample (most participants were female psychology students), the lack of a time delay before the comprehension task, and the relatively short duration of the stories. These results may have implications for classroom settings. Some students may show a preference for one modality over another. The present study shows that providing different forms of materials may not significantly impact a student's ability to learn.

Keywords: modality, comprehension, emotional engagement

Introduction

With the adaptations of technology, stories can be delivered in several ways. One way is with books or printed text. Another increasingly popular modality is through an audiobook. According to the Audio Publishers Association (2017), audiobook sales increased by 33.9% in 2016. They also found that 48% of listeners were under 35 years old. Listeners had claimed that audiobooks helped them complete more books because they can multitask while listening, bring their audiobooks anywhere they take their phone, and they enjoyed being read to (Audio Publishers Association, 2017). This rise in popularity brings into question how reliable oral comprehension is in adults and if audiobooks provide the same experience as reading a book. This idea is important for both recreational reading (or listening) and classroom instruction. Differences in cognitive processes and perceptions for differing modalities continue to be studied.

Most recent studies that evaluate differences in reading and oral comprehension examine children because it is assumed that by adulthood, a person's oral

and reading comprehension will be at the same skill level because these cognitive processes evolve at the same time. However, Mayer and Moreno (1998) sought to find these differences in college students when working with multimedia. Participants were shown instructional images that were simultaneously paired with either visual text or narration. The results showed that those with narration better recalled the information than those with visual text. They proposed two explanations for their findings. The first explanation involved split-attention. While it possible to simultaneously listen to instructions while viewing images, it is not possible to view an image and read the text beneath it at the same time. The second explanation involved a dual-systems approach; in working memory, there is a system for auditory information and a system for visual information. Both of these systems can store a limited amount of information at a time. Thus, pairing images with visual text took up more space in working memory than images with narration, and those with narration were able to out-perform those with visual text. Rummer, Schweppe, Furstnber, and Scheiter (2011) aimed to further distinguish the two explanations proposed by Mayer and Moreno (1998) by evaluating

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whether or not those with narration could still outperform those with visual text when the modalities were presented sequentially or simultaneously. Their results supported the split-attention explanation rather than the working-memory explanation, showing that initial perceptions were more important in comprehension than working memory. They also found that narration was only more successful with recently displayed information rather than the entire information set. Although the present study does not look at the use of different modalities in a multimedia setting, these two studies bring to light what cognitive processes need to be considered when evaluating differences in modalities and what differences may occur between presented visual and auditory stimuli.

In the previously mentioned studies, comprehension is most often looked at in terms of the recall of semantic memory, but another interesting factor to look at with types of story modalities is how they affect reader engagement. Nell (1988) defined a story's ability to pull a reader in as entrancement. During entrancement, a reader is fully immersed and is reading effortlessly. Nell's (1988) attentional model attempts to explain what is necessary for entrancement to occur. Unlike typical reading models, Nell (1988) suggests that higher modes of comprehension processes control attention. Stories that individuals find more entrancing take up less cognitive space and allow for more attention on the presented stimuli (Nell, 1988). This notion is supported by a study that looked at the recall abilities of children from a Native American community when they were either directly told a folktale or overheard the folktale (Tsethlikai & Rogoff, 2013). They found that the participants were able to recall better when they had overheard the story than when they were told to remember the story. Here the cliché "selective-attention" comes to mind. Tsethlikai and Rogoff's (2013) findings suggest that when someone is more interested in a story, such as when they eavesdrop, they are giving more attention to it and thus are more engaged with its contents.

Sousa, Carriere, and Smilek (2013) also found that a person's ability to pay attention to the story and their engagement will affect their comprehension of its contents. All of the study's participants were given three excerpts from a story. They read one excerpt aloud, listened as someone else read them an excerpt, and read an excerpt to themselves. At regular intervals throughout each excerpt, participants were asked if they had been mind wandering. Overwhelmingly, results showed that participants mind wandered the most during the listening condition and scored lower on a memory test than the other two conditions. Sousa et al. (2013) concluded that when an individual is more physically engaged with material, they will be more

interested in and have more comprehension of that material.

The purpose of this study was to examine the effect story modality had on an adult's story comprehension and emotional engagement. The work by Nell (1988), Tsethlikai and Rogoff, (2013), and Sousa et al. (2013) all used engagement, or some form of engagement, as a predictor for comprehension. However, this study aims to assess modality as a predictor of engagement. Due to the lack of previous studies directly related to this study, I had non-directional hypotheses when evaluating the effect story modality has on comprehension and emotional engagement. I expect the findings to further add to the literature on the use of different story modalities inside and outside the classroom.

Methods

Participants. A sample of 33 students (29 females, 4 males), were recruited through the CSU Stanislaus Department of Psychology online participant pool (SONA). The age of the participants ranged from 18 to 37. There were roughly the same number of participants for each college year (9 freshmen, 6 sophomores, 8 juniors, and 9 seniors), with the exception of 1 graduate student. Most participants were psychology majors (54.5%). All participants were given 4 SONA credits for participating in the study, which may have counted as experimental credit for a psychology class. Participants were also offered to enter a raffle to win a \$25 gift card. One winner was selected at the end of data collection.

Design. This study looked at one independent variable (story modality) and two dependent variables (story comprehension and emotional engagement). The story modality independent variable was between-subjects and had two levels: the reading condition and the audiobook condition. Participants were randomly assigned to one of the two groups. Participants were given two stories to examine. One was nonfiction and the other was fiction. The order in which they received each genre was counterbalanced. After participants read or listened to a story, they were asked questions to measure the dependent variables, story comprehension and emotional engagement. Story comprehension refers to a person's ability to retain information and details about a story. Emotional engagement refers to how a person emotionally interacted with a story and its characters.

Materials and Measures. The measures used in the study were a basic demographics questionnaire, the story comprehension questions, and the emotional engagement questions. The demographics questionnaire consisted of 4 questions designed to assess some of the participants' personal characteristics. The story comprehension questions were multiple choice and a participant's score was the number they got correct (see

Table 1). The emotional engagement questions were Likert-scale questions on a scale from 1 to 7, 1 being extremely disagree with the statement and 7 being extremely agree with the statement (see Table 2). Responses to these questions were averaged for each participant.

Participants encountered different materials dependent on what level of the story modality independent variable they were placed in. In the reading condition, the story excerpts were printed out on white printer paper. The text was Times New Roman 12-point black font. In the audiobook condition, participants listened to the audiobooks of the excerpts with a pair of headphones. Each participant encountered a fiction and nonfiction story. The fiction story was an excerpt from *Gathering Blue* by Lois Lowry and the nonfiction story was an excerpt from *Confessions of a Sociopath: A Life Spent Hiding in Plain Sight* by M.E. Thomas.

Table 1
Comprehension Questions¹

Fiction Story Comprehension Questions	
1.	How does Kira's village generally view the physically disabled? a. The disabled can be helpful by doing small tasks around the village b. The disabled are a burden on the village and should be killed* c. The disabled are a nuisance, but the village will still help care for them d. The village has advanced technology that will make the disabled strong again
2.	What does Kira's village believe needs to be done after a person dies? a. Someone must watch the spirit leave the body* b. Someone must bury the body deep underground within four days of the person's death c. An extensive ritual must be carried out to make sure the gods accept the spirit of the person that died d. The body must be burned, and the ashes scattered around the Field of Leaving
3.	Which of the following is <u>NOT</u> a reason Katrina fought to keep Kira alive? a. Kira had strong hands b. Katrina would not be able to have another baby of her own c. Katrina knew someone who could fix Kira's leg* d. Katrina saw something special in Kira's eyes
4.	What did Katrina say happened to Kira's father? a. He was killed by a beast while out hunting* b. He was killed by an illness that had spread through the village c. He fell off a cliff and died d. He ran off with another woman
5.	What did Katrina's brother say to Kira at the Field of Leaving? a. He said he was sorry for her loss b. He said Kira was no longer wanted in the village c. He said he would help her rebuild when she returned to village d. He did not say anything*
Nonfiction Story Comprehension Questions	
1.	What did the author do when she realized there was a baby opossum in the pool? a. She did nothing b. She tried to drown it* c. She saved it d. She called animal control to deal with it
2.	How did the author feel after being scolded for trespassing? a. She felt a murderous rage build up in her* b. She felt remorse that she broke the law c. She felt nothing and went on with her day like nothing happened d. She felt annoyed
3.	Why does the author call herself a sociopath rather than a psychopath? a. They are two completely different disorders that are often mistakenly used interchangeably b. She actually calls herself both a sociopath and a psychopath c. She would call herself a psychopath if she ended up in jail d. She feels that there is a negative connotation associated with the word <i>psycho</i> * ¹
4.	How does the author feel about herself? a. She hates herself b. She feels neutral about herself c. She thinks highly of herself* d. She is ashamed of her disorder
5.	What does the author primarily struggle with due to her being a sociopath? a. She struggles to read and write b. She finds it hard to make friends c. She cannot keep a long-term job d. She cannot appropriately respond to other's emotions*

¹ Highlighted rows represent correct answers.

Table 2
Emotional Engagement Questions

Fiction Story Emotional Engagement Statements	
1.	I felt proud of Kira's bravery.
2.	I was angry that the village looked down on disabled people.
3.	I felt sad that Kira was alone.
4.	I was worried Kira had to return the village.
5.	I felt admiration for Kira's mom.
Nonfiction Story Emotional Engagement Statements	
1.	I was angry with the author's actions.
2.	I felt sorry for the author.
3.	It angered me that the author was uncaring.
4.	I felt scared that someone I know could be a sociopath.
5.	I was annoyed by how self-absorbed the author was.

Procedure. All participants were greeted by the researcher and were asked to read over the informed consent form shown to them on a computer screen via Qualtrics at which time their rights were explained to them. All participants then selected the "Yes, I give my consent" option before proceeding. They were then instructed to complete the demographic survey via Qualtrics. Once the demographic survey was completed, the Qualtrics programming randomly assigned participants to either the reading or audiobook condition, as well as the order they received the two stories.

If they were assigned to the audiobook condition, they were given headphones to wear. They were given a sample audio to test the sound quality before the study began. Then, they were told to listen to the first story without taking notes. If they were assigned to the reading condition, they were told to read the story without taking notes.

After the first story, participants answered the comprehension questions then the emotional engagement questions for the story. The questions always immediately followed the story. Then, they were given the second story and answered the questions for it.

At the conclusion of the experiment, the participants were debriefed by the researcher. The experimenter gave participants a copy of the informed consent and debriefing forms. The experimenter thanked the participants for participating in the study. The purpose of the study was then explained to the participants. It was clarified to them that the study's purpose was to examine factors pertaining to story modality method.

Results

A participant's comprehension score was the number of questions they got correct for each story. I did not have a specific directional hypothesis for the effect story modality would have on comprehension. Each participant had two comprehension scores – one

for each story genre – and these two scores were summed for their total comprehension score. The mean and standard deviations for each group were calculated and are shown in Table 3 and Figure 1.

An independent samples t-test was used to compare the comprehension scores of those in the reading condition to those in the audiobook condition. The results showed there was no significant difference between the two groups, $t(31) = 1.27, p = .214$. Comprehension scores of participants in the reading condition ($n = 16, M = 7.75, SD = 1.44$) did not significantly differ from those of participants in the audiobook condition ($n = 17, M = 6.94, SD = 2.14$).

Table 3
Descriptive Statistics for Comprehension Scores as a Function of Experimental Condition

Condition	<i>n</i>	<i>M</i>	<i>SD</i>
Reading	16	7.75	1.44
Audiobook	17	6.94	2.14

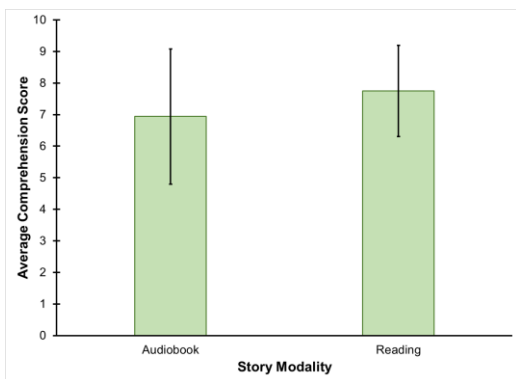


Figure 1. The average comprehension score for each group. Error bars represent standard deviation.

A participant’s emotional engagement score was measured using Likert-scale questions. I did not have a specific directional hypothesis for the effect story modality would have on emotional engagement. Like comprehension, participants had an emotional engagement score for each story genre. For each story, their emotional engagement score was an average of their responses. For their final emotional engagement score, the score from each story were averaged together. The mean and standard deviations for each group were calculated and are shown in Table 4 and Figure 2.

An independent samples t-test was used to compare the emotional engagement scores of those in the reading condition to those in the audiobook condition. The results showed there was no significant difference

between the two groups, $t(31) = 0.66, p = .512$. Emotional engagement scores of participants in the reading condition ($n = 16, M = 4.81, SD = 1.00$) did not differ significantly from those in the audiobook condition ($n = 17, M = 4.55, SD = 1.18$).

Table 4
Descriptive Statistics for Emotional Engagement Scores as a Function of Experimental Condition

Condition	<i>n</i>	<i>M</i>	<i>SD</i>
Reading	16	4.81	1.00
Audiobook	17	4.55	1.18

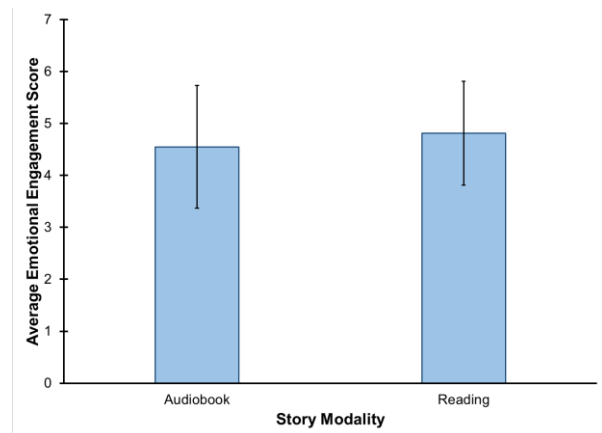


Figure 2. The average emotional engagement score for each group. Error bars represent standard deviation.

Discussion

The purpose of this study was to determine the effects story modality had on story comprehension and emotional engagement. There were non-directional hypotheses due to the lack of directly related studies in the literature. The results showed that there was no significant difference in comprehension scores or emotional engagement scores between those who read the stories and those who listened to the stories. The results support the research done by Rummer et al. (2011) that found no differences between the two groups when they were presented alone.

Limitations. The present study had several limitations could have impacted the results. In addition to small sample size, the sample was homogenous (most participants were female psychology students). There was also a lack of a time delay before the comprehension task. Without a time delay or distractor task between the story and comprehension questions, participants could have easily retained and recalled

information. A ceiling effect may have also occurred; i.e., the comprehension questions for each story were too easy. The stories themselves were also relatively short, and results may have shown differing scores if the stories were longer or if there were more story stimuli. The emotional engagement questions may have also had weak internal validity as it could be argued that they did not accurately measure the construct. Lastly, differences may have been found if a within-subjects design had been used to assess individual differences rather than a between-subjects design that looked at group differences.

Future work. Future studies may want to use an eye-tracking device to measure an individual's attention on material presented to them visually and visually with narration, then compare this to comprehension and emotional engagement scores. They may also want to assess the validity of learning style preferences when using different modalities in an educational setting.

Implications. Nonetheless, these results may have implications for classroom settings. The present study shows that providing different forms of materials may not significantly impact a student's ability to learn. Learning more about how people retain information can serve to improve how our current society is educated and entertained.

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Pickleweed Vigor in a Californian Salt Marsh: A Remote Sensing Approach

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Abstract

Only about 10% of California's historical coastal wetland prior to 1850 exists today. Since wetlands provide valuable ecological and societal services, measures have been implemented to protect and restore these ecosystems in recent years. However, there is still a large need for information on these ecosystems to better inform management and policy in the face of a changing environment. This study attempts to fill some of this knowledge gap by examining drought impact on pickleweed (*Salicornia virginica*) health in the Californian coastal wetland located at Salinas River National Wildlife Refuge and how it can be assessed using fine resolution remote sensing data. Since pickleweed is a succulent, it was expected that the drought would have minimal effect on the observed health with the majority of the stress being observed at the height of the drought (2016). Therefore, the objective of the study was to determine which parts of the wetland, if any, came under stress during the most recent Californian drought (2011-2016) and if fine resolution remote sensing would be a viable tool for this type of research. RapidEye imagery from August or September 2014, 2015, 2016, 2017, and 2018 was used to conduct the study using QGIS for analysis. Images were classified using supervised classification into four categories (Water, Healthy, Stressed, and Bare Soil) and area was calculated for each year. Healthy areas had a large fluctuation through the five years assessed. However, data shows that there is a positive correlation between healthy plants and wet years. Therefore, the data suggest that drought did have an adverse impact on the salt marshes and that fine resolution remotely sensed data is viable for this research.

Keywords: *Remote Sensing, Pickleweed, Wetlands, Drought, Geospatial Applications*

Introduction

Wetlands serve important ecological and societal functions in terms of biodiversity and ecosystem services. Drought is a weather event that can have major impacts on biodiversity primarily by creating a lack of water for plants, a condition that decreases the abundance of plants in an area. As there are more frequent and severe weather disturbances such as drought, wetland mapping and assessment will be of growing importance to conserve the biodiversity of and ecosystem services provided by wetland vegetation. In fact, only about 10% of California's historical coastal wetland prior to 1850 exists today (California Department of Fish and Wildlife, 2001). Recent studies observe that wetland management has a multi-scalar need for information, but the information available is either not complete, inconsistent, or not easily accessible (L.-M. Rebelo et al., 2009). One way to obtain this data is through remote sensing. Remote sensing includes using passive or active sensors to collect spatial data with little to no intrusion. Many forms of remotely sensed data exist, from Radar and Sonar to Light Detection and Ranging (LiDAR), Satellite Imagery, and Aerial Imagery. Satellite data is composed of images of reflected visible and infrared portions of the electromagnetic spectrum. Various calculations can be derived from these images to assess myriad conditions in a landscape. For example, remote sensing and geospatial

technologies were used to assess spatiotemporal changes in plant vigor during the most recent California drought (2011-2016) in a pickleweed (*Salicornia virginica*) dominated wetland at Salinas River National Wildlife Refuge (SRNWR). In some regions of the state, such as San Pablo Bay, this shrubby, perennial succulent provides habitat for endangered species; thus, this population of pickleweed is an important proxy for analyzing the effects of drought on pickleweed dominated wetlands throughout various regions of the state that harbor endangered species. While pickleweed health and environmental response may be factors in this analysis, this is an observational study focused on analyzing drought impacts on *S. virginica* and our ability to use fine resolution remote sensing methods to collect that data to be used for future wetland assessment and management planning.

There have been several case studies related to collecting information on wetlands with geographic information systems (GIS) and remote sensing. One important case study combined Landsat TM (satellite imagery) data and ground truthing (accuracy assessment) to create a thematic map of Muthurajawela Marsh in Sri Lanka. A similar approach was applied to collect data on a wide variety of wetlands across the world, allowing for more precise monitoring and change prediction in wetlands (Rebelo et al., 2009).

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Regarding *Salicornia virginica* monitoring with remote sensing, one study determined that dominant species along the Petaluma River have different canopy structures and, therefore, have different spectral signatures. It is discussed that vegetation indices (calculations using light reflectance of vegetation's surface to determine health) are crucial to this type of analysis and that the normalized difference vegetation index (NDVI) that was calculated provided accurate estimates of vegetation health in the ecosystems studied. Landsat TM (thematic mapper) bands 1, 2, 3, and 4 were used to calculate the vegetation indices for the study. This approach can be used to analyze canopy/plant condition using a spectral signature of water absorption. As such, they concluded that the use of multispectral analysis is promising for future research and monitoring (Zhang et al., 1997).

Methods

Site Selection

Pickleweed is found throughout the state and houses endangered species such as the salt marsh harvest mouse (*Reithrodontomys raviventris*). Gaining a better understanding of how this plant reacts to changing environmental conditions may inform further conservation efforts in many parts of the state. With multiple prior studies focusing on the San Pablo Bay area, Salinas River National Wildlife Refuge was selected to broaden the scope of current literature. This selection was made because of the similarity in plant composition and close geographic location to San Pablo Bay (Fig. 1).



Fig. 1: SRNWR Location (U.S. Fish and Wildlife Service)

Analysis

High resolution ($\leq 30m$ pixel size) datasets are important to ensure that the desired area of interest is correctly identified. High resolution images allow data to

be assessed at smaller spatial scales and produce a more accurate representation of the ground conditions. Normalized difference vegetation index (NDVI) is a method that uses the red and infrared portions of the electromagnetic spectrum to measure plant stress. NDVI is comparison between reflected infrared light and red light from an object's surface to determine if it is healthy vegetation (Fig. 2).

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

Fig. 2: Normalized Difference Vegetation Index (GIS Geography)

Therefore, the sensor used for this study to be able to collect at least 4 bands (Red, Blue, Green, and Near Infrared). RapidEye imagery is available starting October 2013 through Planet Labs' Open California Initiative. The need for inexpensive imagery that has high resolution and the necessary bands led to the use of RapidEye imagery, which has 5m resolution and collects the necessary bands making it an appropriate sensor for this study (Planet Team). The 5m resolution size means that each pixel side measures 5 meters on the ground, thus the image covers 25 square meters.

This study relies on the comparison of drought years to wet years within the context of the appropriate water year. Water years, a set time that encompasses the entire rainy season, are calculated from October 1st through September 30th the following year. Since the full impacts of the drought would most likely correspond to the amount of precipitation received during a water year, efforts were focused on conditions in August and September. To get accurate measurements of the stress conditions at SRNWR, efforts were focused on conditions during August or September beginning in 2014. RapidEye imagery for each of the five years was downloaded for August or September 2014, 2015, 2016, 2017, 2018 (Planet Team). These images capture conditions between drought, wet, and average water year conditions.

Using Quantum GIS (QGIS), subsets, or smaller sections of an image, of the study site were extracted from the original images to ensure the analysis performed was, indeed, on pickleweed dominated sections of the wetland (QGIS Development Team, 2017). This was accomplished by using a plant community map provided by the Refuge Manager (Fig. 3). Using a minimum distance algorithm, which assigns pixel values based upon proximity of other similar pixels, a supervised classification was performed that classified each pixel into one of four macroclasses; Water, Healthy, Stressed, and Bare Soil. Training data are areas of the image where the software is told what to classify pixels of a certain value as. The training data for the classification was

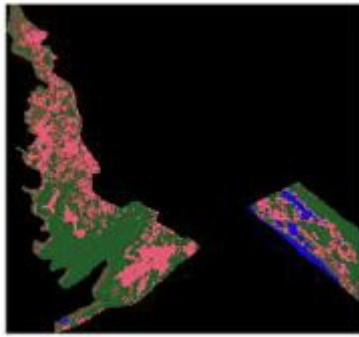


Fig. 8: 2017 Classification (Wet)

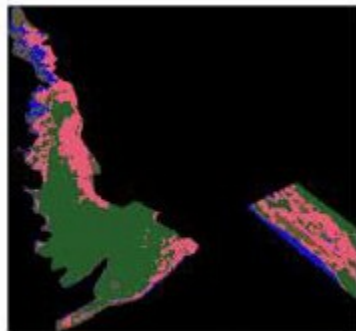


Fig. 9: 2018 Classification (Wet)

Here $T_f - T_a$ represents the difference between foliage and air temperature, $(T_f - T_a)_u$ represents the upper baseline, and $(T_f - T_a)_l$ represents the lower baseline (Hatfield, 1990). In contrast with NDVI, a high WSI value indicates stress while lower values indicate healthy vegetation. WSI was calculated from the values using ArcGIS, with values ranging between 0.0 – 1.0. Data points with WSI values above .65 were classified as stressed. These data were added to the random point layer overlaid on the extent of the study area. These data were compared to that of the supervised classification for 2018 to ensure accuracy of the model.

Results

Remote Sensing Data

For SRNWR, the five classified subsets (Figs. 5, 6, 7, 8, 9) show a visual difference between years in the amount of healthy and stressed vegetation. Water was the one class with the least amount of presence in all years

Table 1: Area and % coverage for each year

Salinas River	2014			2015			2016			2017			2018		
MacroClass	Area (m ²)	%	% of Avg Precip	Area (m ²)	%	% of Avg Precip	Area (m ²)	%	% of Avg Precip	Area (m ²)	%	% of Avg Precip	Area (m ²)	%	% of Avg Precip
Water	8600	2.29	62%	11475	3.07	NULL	10575	2.83	13.6%	15450	4.13	15.2%	26225	7.01	NULL
Healthy	119775	32.01	62%	171800	45.91	NULL	156475	41.81	13.6%	168700	45.08	15.2%	199625	53.34	NULL
Stressed	194450	51.96	62%	139475	37.27	NULL	177425	47.41	13.6%	107700	28.78	15.2%	106600	28.49	NULL
Bare Soil	51400	13.73	62%	51475	13.76	NULL	29750	9.95	13.6%	82375	22.01	15.2%	41775	11.16	NULL

and healthy vegetation had the largest area in 2018 at 199,625 m². The area of healthy vegetation fluctuates throughout all five years but increases starting in 2017. In earlier years, stressed vegetation was more prominent across the landscape. Starting in 2017, the fluctuation in the amount of stressed vegetation present is less dramatic (Table 1 and Figs. 10 and 11). Similarly, healthy and stressed vegetation

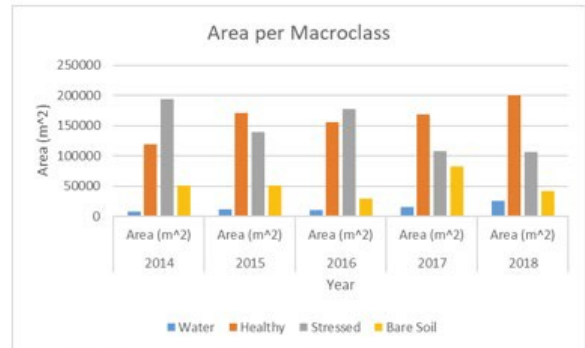


Fig. 10: Area per Macroclass

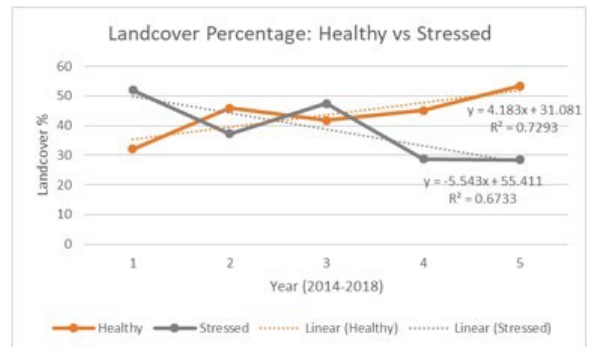


Fig. 11: Landcover Percentage Comparison

follow this same pattern in the three years for which landcover (%) was compared to historical average rainfall (% Average Precip) (Table 1 and Figs. 12 and 13). Weather data is incomplete for two of the five years (2015 and 2018). These data were excluded from the comparison (State of California).

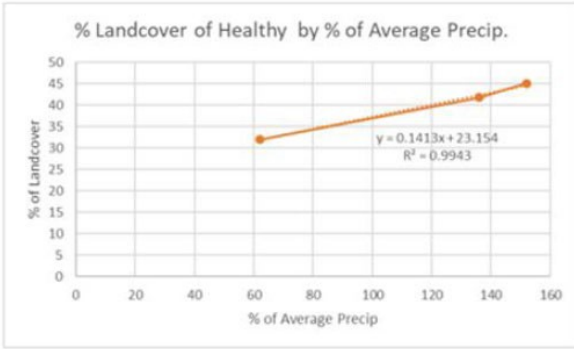


Fig 12: % Healthy landcover in terms of precip.

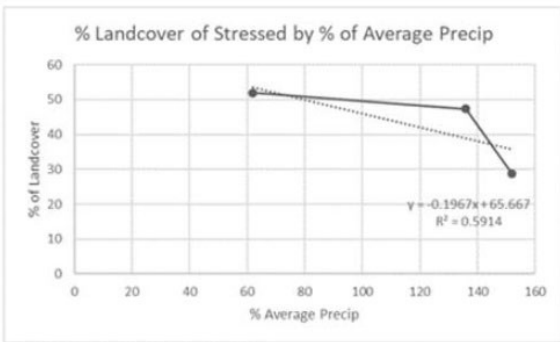


Fig. 13: % Stressed landcover in terms of precip.

Ground Truthing Data

The ground truthing data mostly corresponds to the remote sensing data. Foliage was as much as 12.6 ° F higher than air temperature, and 10.9 ° F cooler than air temperature. Using these values, the calculated WSI values varied between values of 0.0 and 1.0. After classification of the points as described in the methods, five of the forty points did not match up with the classification, including three points that indicate stressed vegetation and two points that indicate healthy vegetation where the opposite result is represented in the remotely sensed data (Fig. 14).

Discussion

Remote Sensing Data

Both the area of healthy and stressed vegetation varied greatly between the five years. Stressed vegetation decreased after 2017 (Figs. 10 and 11), suggesting that the drought stressed the pickleweed, especially in 2014 and 2016. During the wet 2017, a dramatic downward trend in the total area of stressed vegetation is observed, as the amount of healthy vegetation starts to recover (Fig. 11). The results suggest that the ecosystem is sensitive to weather patterns and is adversely affected by drought (Fig 12 and 13). Stressed vegetation fluctuated less as healthy vegetation began to recover, however, which indicates

that there are potentially further stress factors present in the salt marshes that were not assessed (such as lack of nutrients and wind stress).20614

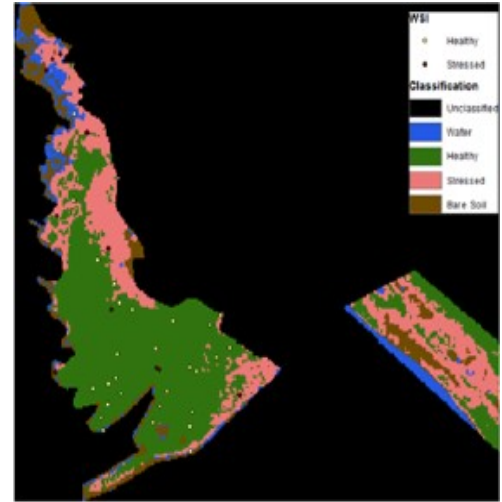


Fig. 14: Field Data and 2018 Classification

Ground Truthing Data

Out of the 40 points collected and assessed, 35 agreed with the remote sensing data. These results support the remote sensing model’s findings for 2018 and suggest that the model was accurate in describing on the ground conditions in SRNWR. Since each data point only reflects the measurements from a single plant, and each remote sensing pixel is the mean value for 25m2 on the ground, there is a chance that this disagreement comes from the discrepancies between the sampling size of the two datasets.

Conclusion

Limitations of this study come from the quality of the data, specifically availability of precipitation data, and the total area of plants sampled at each survey point. Future studies should look at the ecosystem with higher temporal turnover, over entire seasons, and with larger sample plots to gather more spatiotemporal information. Additionally, weather data should be collected from an onsite weather station to increase the amount of precipitation data available for analysis. The addition of more information may tease out additional subtleties in the changes in the stress found within the wetland and to further improve future models and analysis.

Conservation requires planning for current and future environmental conditions. The results from this study help inform how drought impacts California’s coastal salt marshes. Additionally, since data were able to be collected and statistically analyzed, fine resolution remotely sensed data can be deemed a viable tool for salt marsh studies. Having a greater understanding of how ecosystems respond to environmental changes helps

inform further conservation efforts. Therefore, this study and similar others help inform the decision-making process and future conservation planning efforts.

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Practical Technopathy: Using Non-Invasive Brain-Computer Interfaces and Neural Networks

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Abstract

Within the last decade, advancements in Neural Network systems and Brain-Computer Interfaces have paved the way for more innovative approaches to human-computer interactions. While current fads in the user interfacing in electronic systems have focused on the convenience of voice or gesture-activated devices, a tangible increase in the affordability and accessibility of neural activity sensing technology has created a ripe environment for new research and commercial application. As a possible side step from more physically intrusive sensing mechanisms, researchers have begun looking into the feasibility of mental connectivity through electronic interfacing. The focus of this project was to ascertain the practicality and accuracy of a commercially available Neural Sensing device in conjunction with connected living devices and integrated hardware systems. The conducted experiment showed that while complexities and complications abound, tangible progress can be made in a relatively short time. The experiment showed that although distractions can distract from the overall consistency of detection and correct execution of action, the overall results should be satisfactory for everyday use. In conjunction with the purpose of other similar studies, it is the aim of this project to one day revolutionize our interactions with complex electronics as well as provide new avenues of access for the physically disabled.

Keywords: brain computer interface, neural network, experimental I/O

Introduction

In the last decade, the world of Artificial intelligence as well as advanced prosthetics and portable EEG sensing devices has seen rapid advances at the hands of innovative researchers and companies such as Emotiv and the Open BCI project. This new world of Neural Engineering begs the question: Can practical technopathy be achieved using Brain-Computer Interfaces and Neural Networks? In layman's terms, can devices be effectively controlled using only mental commands?

As a precursory article to Neural Networks, Clarke et al., (2015) explains how human neurology and cognitive function can be emulated and exploited in order to solve nonlinear problems and improve understanding of machine and human learning. Through this emulation, Neural Network systems can be designed so as to stand up to the rigor of "noisy", or imperfect data processing and pattern association. These Markovian and Non-Markovian decision making networks must utilize switch-states, or mandatory logic checkpoints, in order to solve problems through trial-and-error. Even when lacking prior context, Neural Networks can decipher and interpret patterns in input data with modern examples ranging from speech recognition to brain-wave identification, with the later

being the most relevant to the exploration of Brain-Computer Interfaces.

Nakayama and Inagaki (2006) showed that Human Neural activity could be monitored via a magnetometer device and interpreted by a Neural Network system, thus creating a refined Brain-Computer Interface (BCI). Brain wave patterns are picked up through electrodes attached to the head and then fed into a Neural Network artificial intelligence which then "learns" from the noisy data in order to establish exploitable patterns. Neural Networks can weed out the "noisy" data that previous attempts at creating BCIs have been thwarted by.

Nakayama and Inagaki (2006), as foundationally important as it is, fails to address the concerns that still plague this iteration of Brain-Computer Interfaces. These issues, talked about in detail by Papageorgiou, Lisinski, Mchenry, White, & Laconte (2013) are multitasking, attention, and conflict monitoring, though it is suggested that there are more imperceptible hurdles to effective BCIs. While it is relatively straightforward to monitor the neural activity of an individual concentrating on a single task, when multitasking or other similarly distracting functions are introduced, the effectiveness and practicality of BCIs can wildly vary. In Papageorgiou et al. (2013), whole brain signal-to-noise ratio was observed in individuals performing visualized counting tasks. Researchers found

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that the signal-to-noise ratio was skewed towards mostly unusable noise when performing tasks not already integrated with BCI devices. Subjects could be “trained” to operate BCI devices in a way that bettered the overall signal-to-noise ratio, making BCI devices more feasible.

In more recent developments, BCI and Neural Network applications have been augmented by additional testing parameters and mechanisms, such as those found in Nurse, Karoly, Grayden, and Freestone (2015) to include more stochastic methods, improving overall performance and accuracy of Neural Network interpretation. Unlike previously established methods of feature selection and extraction from brain-wave activity, the method proposed by Nurse et al., (2015) using stochastic, or randomly selecting, algorithms to reduce the need for a-priori, or deductive reasoning, information, allowing neural network systems to achieve an accuracy rating of 78.9% when applied to common motor function pattern identification. It's possible that this research can lead to more accurate analysis and interpretation in the future using more sophisticated magnetometers.

In the meantime, practical applications of Brain-Computer Interfaces are already being explored using EEGs and other magnetometers, as shown in Figure 1. by researchers such as Abiyev, Akkaya, Aytac, Günsel, and Çağman (2016). Using head-mounted electrodes, such as those used in Nakayama and Inagaki (2006), an electric wheelchair can be controlled using output derived from Neural Network processing of neural activity data. Functional BCI devices utilizing feature selection and stochastic methods found in Nurse et al., (2015) could theoretically be made as cheaply as \$900 or less.

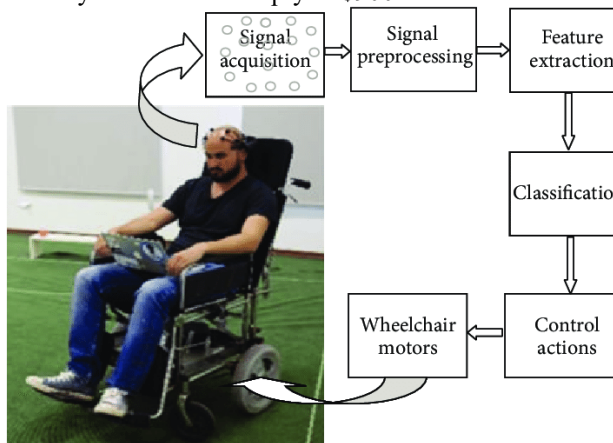


Figure 1. Using the Emotiv Epoc, wheelchair control was achieved. Abiyev et al., 2016

It's possible to take this human-computer interaction even farther through the use of invasive, direct neural input devices such as those used in Ajiboye et al., (2017). In this case, a patient with Chronic Tetraplegia was able to regain motor function through the use of a robotic arm which was slaved to a Brain-Computer Interface implanted in a intracortical-based neural prosthesis (deep

brain implantation). Ajiboye et al., (2017) produced a staggering task accuracy rate ranging from 80 to 100%, allowing the 53-year old man to perform increasingly complicated tasks using single-joint and multi-joint robotic arms. 463 days after implantation, 11 out of 12 attempts at using the arm were successful. While successful, it prompts the question of whether or not similar results can be achieved with less invasive means.

To many, the concept of controlling electronic devices using only one's thought is pure science fiction, though seemingly practical devices already capitalize on the idea. The accuracy and efficacy of the concept is still relatively unknown, as is its practicality. How far can we go with this technology and how practical are Brain Computer Interfaces overall? Does the task to be performed determine practicality? How much of a role does the context and environment of a task matter? Can trained Neural Network BCIs be used for more than one concurrent user?

Methods

Overview

To determine the efficacy (accuracy in terms of time and context) and practicality (cost and generalizability) of Neural Network assisted Brain-Computer Interfaces (BCI), a brain-wave monitoring device was used to measure brain-wave activity under a variety of stimuli in order to train a Neural Network to properly respond. For the sake of studying variance in brain-wave activity and its effect on the training of the neural network, external stimuli were introduced to elicit unique brain wave patterns. In most cases, a true-false identification was made whether a unique, repeatable pattern could be established by the neural network and then acted upon per task performed. To do this, the participant will spend at least 30 training cycles configuring the “neutral”, “push”, and “pull” states of the BCI with distinct mental commands visualized for the last two. The efficacy and accuracy of these commands will be tested via a testing apparatus using an Arduino Microcontroller and LED breadboard. Several more trials are planned with increasing complexity, but for the purposes of this project, only one task was analyzed: turning on and off a light.

Participant(s)

The initial experiments will be conducted by one individual over the course of several trials that increase in intellectual and mechanical complexity. Difference in sex, age, and race could lead to different neural activity during trials, thus changing results but it is not the focus of this experiment. This article covers only this first experiment.

Materials

A simple control board was made using 1 LED diode connected to an Arduino Uno microcontroller. The LED was configured with to match the corresponding

mental commands mentioned above. The Arduino Uno was programmed with a basic response loop and acted upon information provided by an Emotiv Insight sensing device after it was processed first by the Emotiv BCI and then passed through a Node-RED framework to the microcontroller. The primary intended testing apparatus would be the Emotiv Insight as seen in figure 2, which retails for around \$300, while the connective Arduino Uno microcontroller and LED diode diagnostic kits would add an additional \$50 onto expense. The total projected cost for the equipment required to complete this experiment was around \$400 with taxes and shipping included.



Figure 2. Emotiv Insight Device. “Emotiv Insight Portable EEG.” Emotiv, www.emotiv.com/product/emotiv-insight-5-channel-mobile-eeeg/.

Procedure

For initial configuration the participant used the Emotiv BCI in conjunction with the Insight sensing device to train a baseline neutral state as well as two distinct mental commands. After 30 training cycles were established, accuracy and consistency of commands was verified using the BCI’s live demo mode (pushing a virtual box around an environment). The Insight and BCI were then attached to an Arduino UNO over a serial COM connection and Node.js running Node-RED was used to establish node based flows for LED control. The commands were then tested for use on a blue LED light to see if the mental commands could be used to turn the light on and off.

Results

While initial results were marred by technological setbacks (frequent disconnects and freezing), this first trial demonstrated that such complex BCI interactions were possible. The participant was able to mentally command the light to turn on and off with relative consistency. The control logic designed for this project insured that the system wouldn’t flip the light on and off despite the near constant input and instead contextually choose when to turn the light on or off in conjunction to the mental command frequency and intensity. Because of the binary

nature of success in this initial trial, all desired outcomes were established and the project was a success.

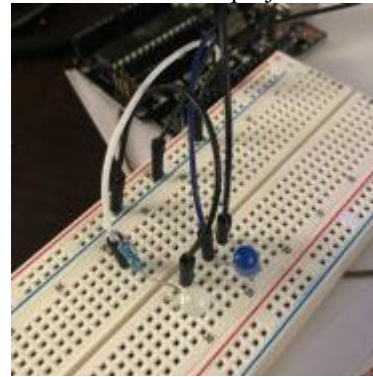


Figure 3. The completed testboard, connected to an Arduino.

As an alternative source of information, the BCI did present us with interesting ways to understand information about the human brain. The Emotiv device attempted to sense facial expressions and mood changes in addition to the requested data and while they sometimes influenced the accuracy of training process, they do provide us additional opportunities for more complex interaction.

Discussion

While the results did show that successful ventures could be made using a relatively low cost solution, there were numerous setbacks and difficulties to conducting this experiment independently and with low funding. The Emotiv Insight, while cost-effective, is fairly finicky in its sensitivity and overall usability. It requires a special low-power Bluetooth adapter to work properly and has a very small maximum effective range. The company does sell an adapter that is alleged to increase the range and battery life of the device, but I lacked the funding to acquire it. Additionally, Emotiv as a company does not publicly disclose their data or sensing algorithm and required constant wifi connection in order to have access to usable data. The margin for faulty data acquisition was uncomfortably high as any partial connectivity loss usually caused BCI crashes or loss of EEG sensitivity.

If the experiment were to be conducted again with a better budget, the OpenBCI project sensing device would be selected instead as it would allow me to store and analyze brain wave data locally as well as configure the device into a more user-friendly format.

Implications

Brain-Computer Interfaces are a relatively alien concept to most of society, though they hide a powerful benefit to almost everyone. If it is possible to measure, isolate, and interpret brain activity accurately and

effectively enough, we could one day eliminate the need for keyboards and other input/output devices while also ushering in an age of brain-controlled technology, from advanced prosthetics to widespread connected living devices. With modern advances in Neural Networks, now might the time that the “noisy” data of the brain can finally be interpreted in a meaningful and practical way. Degenerative neurological diseases and conditions could be treated in a practical, non-invasive method, allowing the possibility for regained mobility and freedom of expression.

Future work

Using this project as the groundwork for future expansion, it is possible that more complex trials could be attempted. One of the fundamental problems with this BCI and others that I would like to address in future works is the limited capacity for distinct mental commands. In most systems, you are effectively limited to 4 simultaneous sensed connections, and for good reason. Rather than expand upon this restriction, I would like to work within it to instead create a “context-sensitive” comprehensive sensing apparatus that would utilize external sensing devices such as infrared camera retinal tracking and reflective object permanence markers to isolate feedback to localized areas. In short, this would allow the same mental commands to be reused for larger environments and make it so that a person only has to be looking at the object they intend to interact with for the same complex interactions to occur.

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Gendered Speech in Schools: The Relationship between Gender Schema Theory and Self-Esteem

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Abstract

How does the use of gendered speech affect students' self-image and therefore their achievement? That is what I hoped to discover with this study. Previous studies have looked at factors such as emotion regulation, friendship making skills, and anxiety as variables that affect student achievement, but I found a lack of studies focused on discrimination based on gender. I have asked college-aged students to reflect on their kindergarten through college experiences and how they might have been shaped based on internal and external factors. To name a few: toys given as a child, gender roles at home, school activities, gender (a)typicality, and self-esteem. By learning, how students' self-esteem may be affected by gendered speech, school faculty and staff can adjust their instruction so that all students may feel safe and valued. Further studies may be useful to build upon my research, by changing the age range/location of participants surveyed.

Keywords: gender, self-esteem, self-image, equity, stereotypes

Introduction

Students' academic success suffers if they do not feel a sense of belonging in the classroom. Abraham Maslow (1943), a psychologist famous for creating the Hierarchy of Needs, explains that one's basic needs (safety and security) must be met before one can focus on higher learning. Ostracization based on not abiding by gender stereotypes/roles is just one of the ways a student may feel insecure. Therefore, it is important for the classroom teacher to foster an environment where students can feel like they belong whether they fit into the social constructed gender roles or not. Both current and future elementary school teachers may benefit from learning the effects of gender schemas on student success.

Gender schema theory is defined as how children adjust their behaviors to align with the norms of their culture (Cherry, 2017). Since this theory implies that social factors influence children's behaviors, it is important to look at one of the most influential factors for young children: school. Children spend at least 6 hours a day, 5 days a week at school, so it is no question that their experiences while at their school campus have some role in shaping their beliefs and behaviors. Sadker and Silber (2007) explain that biases in the classroom based on gender can be subtle and almost unrecognizable, which is why it is so important to actively observe and focus on specific skills (such as a teacher changing their teaching style) in order to create a more equitable and effective classroom environment.

Kenner's (1999) study shows the importance of not only examining student's perception of self, regarding gender, but also the teacher's beliefs about gender

differences. In her study, by sampling 122 teacher's perceptions, she was able to link how their beliefs influenced their students. Her results showed that the age of a teacher had an impact on whether they perpetrated sex-typed and non-sex-typed views of gender. Sex-typed teachers (those who identify with their gender and process information through the lens of that gender) made up 67% of the sample and were aged 23-35 (Kenner, 1999). This correlation shows that more experience teaching might lead to lower usage of gender-typed language.

Palsdottir, Asgeirsdottir, and Sigfusdottir (2012) conducted a study examining gender differences in wellbeing of students aged 10-12. Eleven thousand, three hundred eighty-seven students participated in an anonymous questionnaire about how they felt at school. Results showed that boys significantly reported higher feelings of "bad" compared to female students. The feeling of "bad" was measured via variables such as numbers of friends, relationship with teacher, lesson comprehension, and bullying. This shows that the way a teacher conducts their classroom affects their students and that there may be differences based on the student's gender.

Patterson (2012) conducted a similar study regarding self-perceived gender typicality in students and the influence of stereotype endorsement in elementary schools. Patterson's participants included students aged 6-12 partaking in an interview process. Students who perceived themselves as gender-typical endorsed gender-stereotyped traits (i.e. playing with toys that aligned with their gender) and made claims that would be classified as gender-stereotypes. The opposite was true for those students who perceived themselves as gender-atypical. This study is

important because it shows that even at a young age, children are influenced by their culture and make decisions based on their interpretations. This ties in to the theme of the endorsement of gender stereotypes potentially lowering a child's self-esteem if the child's behaviors do not align with those of their culture.

Gender schemas can therefore be shaped through mediation or lack thereof. Nathanson, Wilson, McGee, and Sebastian's (2002) study exemplifies this by their experiment which consisted of showing a show that promoted gender roles and either an adult mediating, actively opposing those gender stereotypes, or by the adult saying nothing. Because the results of the study were that the children in the mediation group attributed atypical gender characteristics with each gender and the control group attributed typical gender stereotypes with each gender, it is implied that these findings were significant. These results suggest that similarly positive results may occur at a school setting if teachers actively participate in mediation and stray from rigid speech.

Sandra Bem is referenced in nearly all the articles I have reviewed as she is the psychologist famous for developing the gender schema theory as well as the Bem Sex-Role Inventory (BSRI). The BSRI measures one's psychological profile on a scale of how masculine or feminine one's traits are, with equal numbers of both scales translating to androgynous, or neutral ("Bem Sex-Role Inventory," 2018). This scale which is integral to the understanding of gender roles and stereotypes, has been met with criticism for various reasons. Datnow discusses that one of these reasons is that Bem failed to define the terms "masculinity" and "femininity," rendering her scale less credible because there is no definite basis to form claims about either of the terms (2007). Through this research project, I hope that I can find evidence that supports the BSRI and tie its philosophy to the concept of gender stereotypes in schools and how they may affect children's self-esteem and self-image. Some may also argue that there are other contributing factors that affect a student's levels of self-esteem such as anxiety or emotion regulation. It is not to say that those are not valid issues that influence a student's self-image or self-esteem, but it is important to note how integral a role gender schema play in children's development as well.

There are methods available to elementary school faculty members to enact that can positively influence children's gender schemas by increasing the flexibility of their perceptions of gender, and therefore positively affecting their levels of self-esteem. This study is important because through my research, I have found many studies simply stating that gendered speech does negatively impact students' perceptions of gender typicality, but do not examine the implications. Therefore, I find it imperative to discover methods that can better engrain flexibility in students' perceptions of gender stereotypes, as well as how doing this may positively influence their self-esteem. It

will be important to understand not only the link between the two concepts, but also how strongly correlated they are. Does having a typical gender expression for one's gender lead to higher levels of self-esteem? Does having atypical gender expressions lead to lower self-esteem? Can mediation, and simply discussing the fact that gender stereotypes are present in society, including in our schools, actually help students who have lower levels of self-esteem? I truly hope that through conducting this survey, I will find answers to these questions. As I have previously stated, it is nice to know that these two concepts are related, but I am interested in seeing if there are ways to intervene or to help those students with lower self-esteem.

Methods

Participants. Participants included college-aged students at CSU Stanislaus (18 years of age or older). A total of 135 students participated: 87% identified as female, 8% as male, 1% as transgender female, 0.7% as transgender male, 0.7% as non-binary, and 0.7% was unsure. Likewise, 44% of participants identified as White or Caucasian, 43% as Hispanic or Latino(x), 5% as Asian, 3% as Indian, and 2% as Black. Seventeen percent of participants were first-years, 9% sophomores, 34% juniors, 37% seniors, and 1% graduate students.

Materials. An online questionnaire via Qualtrics was used to collect data.

Design. The design of my study is a quantitative negative correlation study since I believe that the higher use of gendered speech used by teachers will cause lower levels of self-esteem in students. The source, as I mentioned before, will be an online questionnaire, made via Qualtrics. The questions be a mixture of those created by me, Sandra Bem's (2018) BSRI-12, and Rosenberg's (1965) Self-Esteem Assessment Scale. The BSRI-12, is a scale made to measure a person's expression of gender: masculine, feminine, or androgynous. This Self-Esteem Assessment scale asks seven questions in a 4-point Likert Scale format, and based on how the participant answers, would explain how high or low their self-esteem is. The goal of using these sources is to see if there is a correlation between gender role expression and self-esteem level.

Therefore, in total, my survey is designed to measure: the participants' expression of gender, the participants' level of self-esteem, the participants' views on gender roles, and the participants' experience of gender roles/stereotypes, if any. Learning about and comparing all these things will hopefully shed some light on my hypothesis, which is that use of strict gender stereotypes in society, notably, in schools, leads to lower levels of students' self-esteem.

There are 16 questions in total. Samples of the survey questions are listed in Appendix A.

Procedure. I created a questionnaire for college-aged students to answer questions reflecting on their experiences in classroom settings. Factors such as gender

stereotypes, gendered speech, and inclusion will be covered in the questionnaire. A section of the questionnaire will pertain to their current situations in college classrooms and another section will regard earlier experiences in education such as elementary and middle school. Participants will be told that the survey they complete is meant to explore how gendered speech in schools might influence students' self-esteem. I include an informed consent form, which can be viewed in Appendix B.

No deception will be used. Participants are made aware of the confidentiality of the survey before accepting to take the survey. I expect the survey to take, at most, twenty minutes. The Likert and multiple-choice questions will not take very long, however, the open-ended questions may take longer for participants to answer, and therefore will account for most of the time taken for the survey. I tested the survey by taking it myself, and it took me about fifteen minutes to complete. Participants will be debriefed at the end of the survey, thanking them for taking the time to complete the survey, and will be dismissed by explaining they are finished and can exit the survey.

Results

Most of both females and males were given toys that aligned with their gender as children. Nine percent of males were given a mixture of both feminine and masculine toys and 36 percent of females were given a mixture of feminine and masculine toys. Females were the only gender that received toys that either are considered gender neutral, or toys that aligned with the opposite gender. Examples of gender-neutral toys include building blocks stuffed animals, and bicycles. Examples of feminine toys include Barbies, kitchen sets, toy cleaning supplies, and baby dolls. Examples of masculine toys include action figures and toy cars.

All genders except for male and transgender male, participants felt considerably higher levels of exclusion in their k-12 classes versus their college level classes. Zero men and zero transgender men reported feeling excluded in their k-12 career, yet one of both these groups felt excluded in their college career. As for inclusion, participants who identified as female, transgender female, non-binary, and unsure all felt higher levels of inclusion in their college classes. One hundred percent of transgender females, non-binary, and unsure participants reported feeling included in college. On the other hand, more males reported feeling included in k-12 versus in college, but at a negligible amount (52% to 47%).

Most participants either only rarely or never heard gender equity discussed in their k-12 classes by faculty/staff members. Only 13% of females and 20% of males sometimes talked about gender in these grades. Females are the only gender listed that often talked about gender in their classes (3%). Much that changes in college. 100% of transgender, non-binary, and unsure participants either sometimes or often discuss gender in their college

classes. Ninety percent of males and 82% of females either sometimes or often discuss gender in their classes.

Most participants regardless of which group they belonged to, stated that they currently discuss gender disparities with their peers. Gender disparities were defined as "equity, roles, and stereotypes" in this survey. In most cases, a participant who answered "yes" explained the way they discussed gender as constructive. However, one third of the men who stated yes, talk about gender negatively. One stated that he uses gender stereotypes with his friends to "insult each other" and another stated that his friends "only bring up gender equity to complain about it... joke about gender stereotypes in relationships" and that "their discussions are often annoying and reductive."

Only non-binary, transgender male, and transgender female participants had a majority of their group state feelings of discrimination by their peers based on their gender. Only 30% of males and 27% of females felt they had been discriminated by their peers based on their gender. Interestingly those who said no listed other factors they believed to be the reason behind discrimination such as personality, sexual orientation, physical appearance (i.e. height) or race/ethnicity.

Using the BSRI-12, the majority of those who identified as female agreed or strongly agreed with not only feminine traits, but also the masculine traits. In some cases, females answered more strongly in the masculine traits than males (i.e. "has leadership abilities" 33.33% of females strongly agreed with compared to the 0% of males that did). Interestingly, more males strongly agreed with feminine traits versus masculine traits (the highest percentage of males answering "strongly agree" was at 27.7% for the feminine trait "affectionate" versus at 9.09% for the masculine traits "strong personality" and "defends own beliefs" When responding to the masculine traits, most men only agreed or somewhat agreed with them. The same was true of the transgender, non-binary, and unsure participants, where their answers weren't skewed one way or the other but were a mixture of both masculine and feminine traits.

As a collective whole regarding the Self-Esteem Assessment, most students responded positively to the questions asked. The questions where the majority had the lowest scores were "at times I think I'm not good at all" (59.69% agreed or strongly agreed – 60% of females, 58.33% of males, 100% of transgender males and non-binary, and 0% of unsure and transgender female participants), and "I wish I could have more respect for myself (58.91% agreed or strongly agreed – 58.93% of females, 58.33% of males, 100% of transgender and non-binary participants, and 0% of unsure).

Implications

The implications of this study are that by changing the way schools talk about gender, students may cognitively and emotionally benefit. Schools play an influential role in

children's development, which is why if a student is exhibiting atypical gender behaviors, it is important that the mentality among faculty members is that that is acceptable. By teaching methods that do not encourage gender roles or stereotypes and by having resources on campus for children to talk about their feelings, students can potentially have a higher self-esteem and self-image.

I intend to teach young impressionable students in the future, and I want to do my best at supporting their self-image in any way possible rather than evoking feelings that lower their self-esteem. Many participants will come from Liberal Studies classes, so it is likely that they will have some understanding of the relationship between the two. However, the pool of students who are Honors students at CSU Stanislaus, range from a variety of majors, so it is likely that concepts such as sociology, gender stereotypes, self-esteem, and schemas are terms they are unfamiliar with.

Future work

For my study, I was limited by only including participants of college-age (18 and older) and asking them to reflect on current and past school experiences. Future studies could benefit from asking students who are younger than eighteen, as it would be interesting to discover how those students perceive the situations they are currently in, and if school instruction has changed since my participants were in primary/secondary school. Additionally, my sample size ended up being majority female and only consisted of students of the central valley. It would be interesting to see this study conducted elsewhere, such as the bay area or even out of state. Having more male participants would also most likely widely alter the data.

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Effects of Perceived Parenting Styles on Depressive Symptoms

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Abstract

There is extensive research that examines the relationship between gender differences and perceived parenting style on depressive symptomatology among children adolescents, but a dearth of studies among college-aged students. Therefore, students ($N = 156$) from Stanislaus State were recruited through Qualtrics ($n = 37$) and Summer 2018 Student Orientation sessions ($n = 119$). Each student answered 12 questions from the Major Depression Inventory (MDI) scale, which asked how they had been feeling over the last two weeks. Additionally, participants answered a statement, with respect to the scenario that resembled the recollection of their parents' style of rearing, when they were growing up. A one-way, analysis of variance revealed the following: 1) those with uninvolved/neglectful parents reported the most depressive symptoms, whereas those with permissive parents reported the least depressive symptoms; 2) males reported more depressive symptoms than females; 3) females with neglectful parents reported the most depressive symptoms; and 4) males with neglectful parents reported the fewest depressive symptoms. The present study will aid in the prevention of mental health development, due to individuals having the ability to assess their current or to-be parenting style.

Keywords: depression, symptoms, parenting style, gender

Introduction

Depression is common amongst any age group; however, it is predominant in young adulthood. Depression affects an estimated one in 15 adults in any given year and one in six people will experience depression, at some time in their life (American Psychiatric Association, 2017). Depression is a mood disorder, which causes a persistent feeling of sadness and loss of interest from enjoyable activities. Furthermore, depression may be classified based on symptom severity (mild, moderate, or severe). Symptoms of an individual with mild depression may include irritability or anger, insomnia, hopelessness, and self-loathing. On the other hand, moderate depression may include symptoms such as reduced productivity, excessive worrying, and problems with self-esteem. A person with severe depression experiences hallucinations, delusions, and suicidal thoughts or behaviors. However, the prevalence of depression also varies from gender. For instance, the burden of depression is 50% higher for females than males (World Health Organization, 2004, p. 36).

Depression may be a result of factors such as academia, employment, and family or relationship concerns. Nonetheless, depression may also be triggered from a young age, mainly through their parent's thoughts, feelings, and behaviors toward child-

rearing. Diana Baumrind, a developmental psychologist, created four parenting styles. The first, authoritarian, is when parents believe that rules should be followed, without exception. On the other hand, authoritative parenting is when rules and consequences are enforced; however, the opinions of the child are taken into consideration. The third style, permissive, is when parents are lenient with the child and solely intervene if a serious problem arises. Uninvolved/neglectful parents, generally have little to no knowledge of their child's whereabouts and therefore, must raise themselves.

Research has shown depression symptomatology, as a result of an individual's perceived parental style. Children reared by an authoritative parenting style had fewer depressive symptoms, in comparison to children reared by an authoritarian parenting style (Niaraki & Rahimi, 2012). Smetana, Crean, and Campione-Barr (2005) found that individuals with an authoritative parent have less depression in late adolescence. Piko and Balázs (2012) found that depressive symptoms were highest among females with authoritative parents, who were extremely controlling or demanding. According to Olutunde (2017), individuals with a permissive parent have a significant relationship with depression among adolescents. Authoritarian and uninvolved parenting styles were most highly associated with levels of depressive symptoms in adolescence (Lipps, Lowe,

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Gibson, Halliday, Morris, Clarke, & Wilson, 2012). Furthermore, adults who remembered authoritarian or uninvolved parents reported more depressive symptoms than did adults who remembered authoritative parents (Rothrauff, Teresa, & An, 2009).

The present study was conducted to understand differences in depressive symptomatology, from two variables (perceived parenting style and gender). Research from the study will add to the literature, through the following hypotheses: 1) those with uninvolved/neglectful parents will report the most depressive symptoms, whereas those with authoritative parents will report the lowest depressive symptoms; 2) females will report more depressive symptoms than males; 3) females with permissive parents will report the most depressive symptoms; and 4) males with authoritarian parents will report the fewest depressive symptoms.

Method

Participants

56 men and 63 females were recruited from five California State University, Stanislaus, Summer 2018 New Student Orientation (NSO) sessions. 6 men and 31 females were also recruited through the use of Qualtrics. A Qualtrics link was created and distributed to the Program for Academic and Career Excellence (PACE), McNair/Honor, and Educational Opportunity Program (EOP) students from California State University, Stanislaus. Participants were allowed to opt out at any given time throughout the study and if they wished to do so, did not receive any compensation. All of the participants were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (American Psychological Association, 2002).

Materials

Four custom materials were created for the present study: two informed consent forms, a survey, and a debriefing form. The survey consisted of demographic questions, questions from the Major Depression Inventory (MDI) scale, statements about each parenting style, and questions about daily experiences. The MDI scale used in the survey consists of 12 questions about how the participant has been feeling over the last two weeks. The participant had the option to choose from six statements (e.g., all of the time, most of the time, slightly more than half of the time, slightly less than half of the time, some of the time, and at no time). Raffle tickets were distributed at the end of the study, in which the participant provided their contact information to be entered into a drawing for a gift basket.

An outside, anonymous link on Qualtrics was used to resemble the in-person raffle tickets. A coffee mug, notebook, scantrons, index cards, and planner were purchased from the campus bookstore. The purchased items were then assembled into a gift basket, with the winner being randomly selected after the data analysis.

Procedure

First-year students/freshman and transfers were recruited from the McNair Scholars Program booth during Summer 2018 NSO sessions. I introduced myself to the students and asked if they would like to participate in a research study. If the student conveyed interest, I briefly explained the study to them and answered any questions they had. If the student wished to continue, I handed them a clipboard which contained a pen, two consent forms, and a survey. The participant read and signed one of the two consent forms. The second consent form remained unsigned, as it was solely for his or her record. The participant then proceeded to fill out an anonymous survey, which between 15 to 20 minutes to complete. After the survey was completed, the participant was handed a debriefing form. Participants then received a raffle ticket. The filled-out raffle ticket was then placed into a bucket and saved until the day of the drawing for the gift basket. After the participant finished and left the booth, I sorted and placed the documents in a manila envelope.

Additionally, Qualtrics was used to create and distribute a consent form, survey, and debriefing form to other California State University, Stanislaus students. The participant either clicked "I agree to participate" or "I do not agree to participate" on the consent form. The participant had the option to print out the consent form for his or her record. If they agreed to participate, they proceeded to complete a survey which also took between 15 to 20 minutes to finish. Following the survey was a debriefing form. Participants were then directed to an outside, anonymous link where they provided their contact information, to be entered into the same raffle drawing from the NSO sessions.

Data analysis

A one-way, 2 x 4 analysis of variance (ANOVA) was conducted, with an alpha level of .05. The dependent variable was the depression scale, MDI, developed by the World Health Organization's Collaborating Center in Mental Health. The independent variables were the participant's gender and style of parenting in which the participant was raised, as perceived by the participant. There were two genders (female and male) and four parenting styles (authoritative, authoritarian, permissive, and neglectful).

Data collected from 156 useable surveys were entered, aggregated, and transferred to the Statistical Package for the Social Sciences (SPSS) Software. The MDI scores were totaled and compared with the averages (means) of each parenting style and gender group.

Results

After the data analysis, the result of the one-way ANOVA between parental style and gender was, $F(3, 148) = 1.05, p = .37, \eta^2 = 0.02$. Therefore, there was not a significant relationship between both variables. Results also indicated that individuals with uninvolved/neglectful parents reported the most depressive symptoms ($M = 60.33, SD = 11.48$). On the other hand, those with permissive parents reported the lowest depressive symptoms ($M = 52.57, SD = 14.48$). Compared to females ($M = 55.60, SD = 13.31$), males ($M = 57.43, SD = 9.56$) reported the most depressive symptoms. Females with uninvolved/neglectful parents reported the most depressive symptoms ($M = 62.80, SD = 10.92$). On the contrary, males with neglectful parents reported the fewest depressive symptoms ($M = 48.00$). However, there was only one in and therefore, the next group of males with the lowest depressive symptoms were those with permissive parents ($M = 55.00, SD = 13.86$).

Discussion

The present study aimed to understand individuals' level of depression, as a result of their gender and style of parenting, in which they were raised with. Three of the four hypotheses were proven to be incorrect; meanwhile, the remaining hypothesis was partially correct. Limitations included the sample size not being representative of the target population and recruitment method/environment. The proposed goal of the study was for there to be 60 individuals (30 females and 30 males) in each parenting style; however, that was not the case for any of the four groups. For instance, there were merely 6 participants (5 females and 1 male) in the neglectful group, in comparison to the 112 participants (60 females and 52 males) who had authoritative parents. Additionally, recruitment from NSO sessions was a significant limitation to the group inconsistency. At the NSO sessions, both incoming freshmen and transfer students were easily distracted due to the noise level and time constraint from scheduled activities. Moreover, many students were not interested in participating, predominantly first-year students who were not familiar with the importance or significance of a research study.

Future Research

Future research could focus on the correlation between depression symptomatology and perceived parenting style from both parents, instead of as a whole. However, the phrase could be reworded to, "Think about when you were growing up and select the one (1) scenario that best describes your relationship with both your mother/father and mother/father." Additionally, suggested improvements include recruitment from solely one platform and two hypotheses. Amazon Mechanical Turk would suffice for recruitment, particularly because there is the option to limit how many individuals can be in a particular group. Gender differences are vital and therefore, the hypothesis that can be used again is, "Females will report more depressive symptoms than males." Depression levels amongst participants are an essential variable and hence, the hypothesis to also keep is, "Those with uninvolved/neglectful parents will report the most depressive symptoms, whereas those with authoritative parents will report the lowest depressive symptoms."

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Setting the Stage; Drafting the Theatre Department Student Handbook

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Abstract

Over time, the needs of a work environment and culture fluctuate, with practices and policies created or modified to accommodate those needs. Within the past three years the California State University, Stanislaus Theatre Department has experienced changes in faculty and staff, including a shift in leadership. The new department chair, Eric Broadwater, seeks to build structured, cohesive, and consistent environments for students, faculty, and staff. In an effort to aid future students in the department, we have created a comprehensive student handbook to create policy, manage expectations, and institute follow through. In the past 20 years, there was no centralized document for new students to learn expectations, policies, and procedures. Any existing documents have been concentrated to specific areas of the department, such as the costume and scene shops. Students had to learn expectations, requirements, and standards over time, usually verbally, and from various conflicting sources. This created a climate of tension and confusion that divided students, faculty, and staff. The handbook will be a student resource for department policies and procedures based on existing in-house documents, policy examples from other California State University theatre departments, and collaborations with faculty and staff. Topics covered include degree requirements, student opportunities, general operating procedure, and information on the production process. The success of implementing the handbook will be measured by student satisfaction surveys to be handed out each year over the next five years. These surveys will measure the goals of creating policy, managing expectations, and instituting follow through.

Keywords: Theatre, theatre management, policy

Introduction

As a double major, I have spent six years pursuing my undergraduate degrees in theatre and business. It is easy to know the ins and outs of a department after being a student for so long. When not in class, I spend much of my spare time on campus in the theatre department doing homework, talking with friends and colleagues, and occasionally lending a hand to move large set pieces. The building has become a second home with fellow students as an extended family, which tends to happen when people go through hours of classes, rehearsals, and performances together. At this point, I might as well be the wizened grandfather telling “back in my day” stories and sharing my knowledge of the department.

The Theatre Department at California State University, Stanislaus provides a generalist Bachelor of Arts degree, a minor, and a concentration in Liberal Studies where students are able to learn about and participate in the various aspects of theatre. These include acting, directing, lighting, carpentry, costuming, design, stage management, box office, theatre history, and more. Students are able to combine coursework with practical experience by participating in a minimum of six productions during their major degree. Being a small department affords them additional opportunity to gain skills, as positions are readily available to be filled. The department has six productions a year, including one production for children, a dance concert, and Theatre Under the Stars on the outdoor amphitheater. In addition, the Theatre

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Club on campus works with the department to mount a student-led production annually. Students are able to hold university assistantships to work in the costume shop, box office, and theatre office. There are also travel opportunities to professional conferences available, including the United States Institute for Theatre Technology and the Kennedy Center American College Theatre Festival, where students often compete to gain national recognition for acting and technical skills.

Within the past three years there have been changes in the faculty and staff dynamic. Some people have left or retired, with new faces filling vacant positions. The most impactful shift has been in leadership, with Eric Broadwater as the new department chair. Since taking this role, Professor Broadwater has been working to expand the department by leading work to expand curriculum, adding emphases to the major, improving faculty/student relations, and creating a set of formalized policies for faculty, students, and staff.

Motivation

When I started as a freshman attending New Student Orientation, I was given a packet of information about the university, general guidelines and rules, and student resources. The College of Business had plenty of written documents to answer questions and provide guidance to students. As for the Theatre Department, there was a bi-annual meeting where students would meet faculty and staff and discuss upcoming events. The only item handed out was a form for students to list their prior experience and note which tech positions they would want if not cast in a play.

In the past 20 years, there was no centralized document for new students to learn expectations, policies, and procedures in the theatre department. Any written documents that exist have been concentrated to specific areas of the department. For example, the costume shop has written policy regarding fittings, costume etiquette, and food policies. Meanwhile, the scene shop has its own set of safety rules that are only posted in the shop itself. Professor Clay Everett, technical director of the Theatre Department, had a production handbook that provided the basis for the comprehensive version. It mostly focused on the production process and had

some academic and general policies. Unfortunately, this document was not regularly given to students and most were unaware of its existence. Otherwise, the only documents students regularly received were course syllabi, which would change with every course. With no central document, students have to go to each source to find information, learning as they went through the program.

Often, students have been confused regarding the expectations that they needed to meet for academics and productions. Despite required semester advising, students would still not understand all of the required courses they needed for graduation or when to take them. Many theatre courses are taught every other semester or every other year. This combined with a lack of understanding would cause some students to miss signing up for classes they needed to graduate in the usual four years.

Another example lies in the Rehearsal and Performance Requirement (R&P), a one unit course that students take for credit in being in a production. Theatre majors are required to take R&P during at least six different semesters. Usually, students are allowed to take more than one unit of R&P at a time, but only one per semester counts towards the requirement, unless the major is a transfer student. In this case they are allowed to have two simultaneous units of R&P for two semesters to meet the six unit requirement within two years. In addition to the confusing parameters to count towards the degree, students are often confused about what fulfills a single R&P. Some believe that all they need to do is work a single position for credit, even if that position only works the shows. The actual expectation is that students will put in 60 hours of work to earn the unit. There are multiple production positions that only work in few weeks before a show and do not meet the time minimum. Nevertheless, students have still received credit because of a lack of follow through and the fact that the expectation was never formalized into policy.

Another area of confusion comes with strike, which is when cast and crew take down the set and technical equipment of a production after the final performance. For the department, it can be critical to finish strike quickly, as the spaces usually need to be used for classes, other productions, or even commencement ceremonies at the end of every spring semester. The more people that help with strike, the faster it goes. I have seen expectations constantly

fluctuate in determining who needs to be at strike. It has varied from just cast and crew of the show, to everyone enrolled in R&P, to all majors in the department. The constant changing has left students with different accounts of what they need to do, causing some to either be present when they are not needed, or absent when they are required to be there.

If students were provided department and major specific information upon arrival, they would have the tools to plan academics and schedules with advising help. They would also have a better idea as to the time and work commitments expected of them. Theatre, as an industry, can be demanding on an individual both physically and mentally, and students should be aware of these commitments at the start of their academic career. Otherwise, students are at risk of becoming frustrated and disenchanted with theatre, which can lead to them switching majors and shrinking the size of the department. This has happened multiple times while I have been a theatre major and I experienced many of these frustrations myself. Knowing I could combine my love of theatre with organizational knowledge from my business major, I resolved to provide a student handbook to the department so that future students would not have these experiences.

Goals

The creation of the handbook will support Professor Broadwater's goals to build structured, cohesive, and consistent educational and work environments for students, faculty, and staff. In an effort to aid future students in the department, the handbook will be used as a basis to create policy, manage expectations, and institute follow through.

Create Policy

Since the department had so little written policy, it was clear that most of the handbook would be created from scratch. Generally accepted norms needed to be formalized in a single written document to ensure faculty, staff, and students are following the same information. New policy will fill gaps of either common misconceptions, such as with the R&P requirement, or necessary safety measures, like how to handle fake weapons for productions.

Manage Expectations

A common issue among students has been a lack of understanding of what they are expected to do within the department. Some go above and beyond the necessary requirements, while others unknowingly underperform. Verbal communication has proven ineffective and inconsistent, showing a need for a baseline that everyone can refer to.

Institute Follow Through

With new policies in place and expectations outlined, it will need to be clear what happens when these policies are not adhered to, such as the strike policy. While some policies have a degree of flexibility, others such as safety and academic integrity must be dealt with strictly. Repercussions will be left at the discretion of faculty and staff per university guidelines.

Methods

Work on the student handbook began by accumulating all current written policy for the department. These documents included a production handbook draft, costume shop policies, course syllabi, student assistantship information, etc. Once these were compiled, they were read to pull information specifically for the handbook. All information from the production handbook was used in the comprehensive student handbook.

Next, documents from outside the department were collected to provide a guide for how the handbook information would be organized. The chairs of other theatre departments in the CSU system were e-mailed requests to provide any available examples, documents, or advice. Responses included handbooks, policies, and website links. Subsequently, these were also looked over for pertinent sample information and structure.

The final step has been corresponding, meeting, and collaborating with faculty, staff, and students to ensure the handbook is accurate and encompasses all essential department needs. Scene shop policies were retrieved from the campus technical director, Clay Everett, and scene shop supervisor, Bo Henry. Costume shop policies were transferred from current documents and discussions with the costume shop supervisor, Janetta Turner.

Other academic and rehearsal etiquette was taken from course syllabi and generally known theatre practices.

Product

The working draft of the handbook is currently 29 pages long. Out of 63 sections and sub-sections, only five need to be written, modified, or added to before being printed and given to students at the beginning of the 2019-2020 academic year. The first section outlines general information about the department, including contact information, curriculum, and student opportunities throughout the academic year. Next, general rules and expectations are laid out regarding classroom and rehearsal decorum, communication, and student use of department assets. The final section details the general performance process from auditions to strike, as well as descriptions of possible production assignments that students may take during the semester.

The handbook was given a title page for formality and easy identification. The working copy is seen in figure 1. The contents of the handbook are also aesthetically designed to provide ease to the reader and better organization. Pictures were also provided to enhance a mind's eye picture of what students may be doing when part of the department. Example pages from the handbook can be seen in figures 2, 3, and 4. To view the full table of contents, see figure 5.

Further versions and formats of the handbook may be created to better fit the needs of the department. One option is to include the handbook with a calendar, and disburse it to students at the beginning of the semester. A summary version of the handbook will also be created for quick reference.

Follow up and conclusion

The introduction of the handbook will provide new students an information source that will help them embark down the path of a theatre major. The success of the implementation will be measured by student satisfaction surveys conducted over the following academic years. Focus of the questions will be whether new students felt well-informed regarding department policy and expectations after reading the document, as well as take suggestions for additions or changes to the content. Once established, faculty and

staff will be able to use student feedback and adjust the handbook accordingly. It is expected that the needs of the department and students will change over time, so the handbook will be considered a living document that is subject to change. With this flexibility, the handbook will be able to continuously help incoming students to the CSU Stanislaus Theatre Department for years to come.

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I would like to begin by thanking Eric Broadwater for acting as faculty mentor in this endeavor and his steadfast determination towards improving the Theatre Department. Special thanks to Clay Everett for providing his production handbook as the foundational content of this work. To the department faculty, staff, and students whose input was essential for the contents of the handbook. For providing examples of policy from their own departments, thanks to Ann Alter from Humboldt State University, Marie Maslowski from Cal Poly Pomona University, J. Daniel Herring from CSU Fresno, Jeff Janisheski from CSU Long Beach, Dave Mickey from CSU Fullerton, Josh Machamer from Cal Poly, Dr. 'Niyi Coker and Dr. Katie Turner from San Diego State University, Meredith Greenburg from CSU Los Angeles, and Scott Horstein from Sonoma State University. To the Honors Program for providing a platform for students to delve into what they really care about. Finally, to my friends, family, and fiancé for their ongoing support in all of my endeavors.

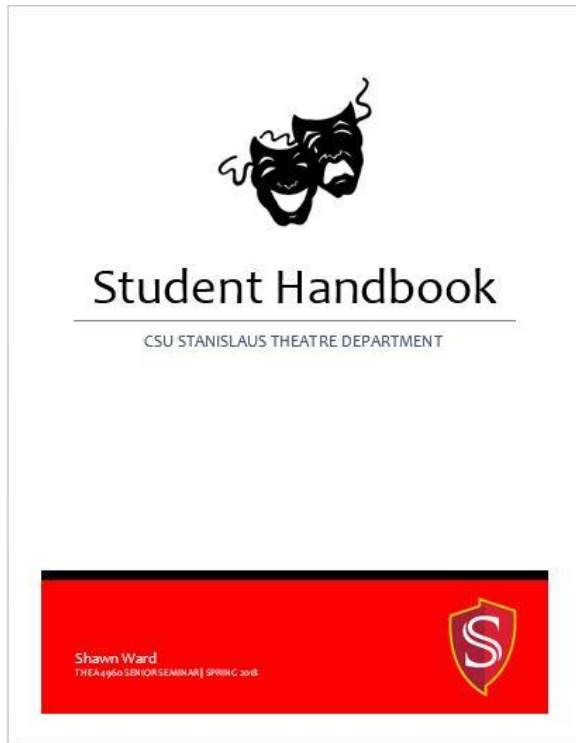


Figure 1: Handbook Cover Page

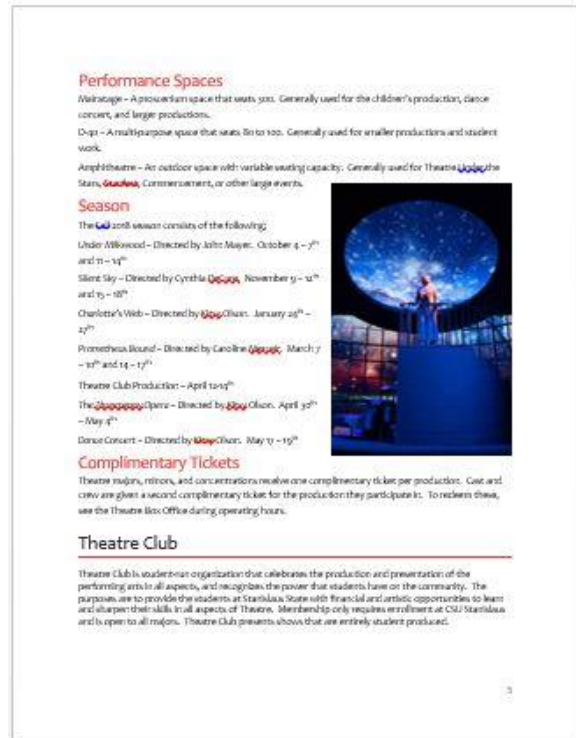


Figure 3: Handbook Page 5



Figure 2: Handbook Page 4



Figure 4: Handbook Page 6

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Figure 5: Table of Contents

Harmonic Motion Equations with Related Applications

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Abstract

The paper will focus on the understanding of harmonic functions and their relationship with its applications. Particularly, we will be investigating its foundations in differential equations and numerical methods and its effect on the expression of mathematical models. Using ordinary differential equations along with numerical methods further analyzes various mathematical applications often seen in spring problems and in the oscillations of objects. Thus, we begin on a comprehensive understanding of harmonic functions and their relationship with its applications, particularly investigating its foundations in four different types of ordinary differential equations. The equations include the homogenous, non-homogenous, resonance and damped equations. In order to create a thorough understanding, we must take a closer look at systems which contain an oscillatory motion. In addition, important concepts such as amplitude and frequency will be incorporated to fluently comprehend the background information given and further explain the applications of harmonic motion equations. Through the implementation of MATLAB, visual representations of the equations and their coefficients were created and analyzed to further determine the importance in the variance of coefficients. Furthermore, being able to thoroughly comprehend how each equation varies from one another builds a correlation on the emphasis of real-world applications on simplistic and ordinary mathematical concepts and equations. In conclusion, the resulting information may be used as an invaluable resource for students and construct an oscillatory system varying from elementary mathematics to higher level applicational mathematical equations.

Keywords: Ordinary Differential Equations, harmonic motion, frequency, oscillations, resonance, damping force, homogenous, non-homogenous.

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Introduction

The purpose of this research is to demonstrate the importance of mathematics and mathematical modeling. Through the use of Differential Equations and Harmonic Motion Equations, we will further investigate the impact of external forces and their role oscillating objects. By investigating the motion of a system, it will shift focus on the sinusoidal curve when external forces are acting upon it.

Now, we will focus on some important terms that are necessary to grasp the idea of harmonic motion. A simple harmonic motion is defined to be an oscillation motion under a retarding force proportional to the amount of displacement from an equilibrium position [9]. A few ideas that we will explore include resonance, frequency and oscillation. Resonance is defined as the condition in which an object is subjected to an oscillating force having a frequency close to its own natural frequency. Frequency is described as the number of waves that pass a fixed place in a given amount of time. Finally, oscillation is a repetitive back and forth motion at a constant velocity [9].

In this paper, we will investigate four different differential equations to analyze the movement of a harmonic system. These equations are:

- (1) $x''(t) + k^2x(t) = 0$
- (2) $x''(t) + k^2x(t) = \cos(wt)$, where $w \neq k$
- (3) $x''(t) + k^2x(t) = \cos(wt)$, where $w = k$
- (4) $x''(t) + 2\lambda x'(t) + k^2x(t) = \cos(wt)$

The first three equations are described as simple harmonic motion. They analyze the behavior of an oscillating object from a theoretical point of view. The fourth equation is also a mass system, but includes a damping factor which affects the behavior of the equation. By adding the damping force, it creates a more accurate and realistic movement of the system.

One of the most important aspects of these equations are the variables. In order to have a firm grasp on the meaning of the equations, we must break down every variable and look at its meaning. This will allow us to understand every part of the equation. In the appendix, there will be a chart in which every term and coefficient will be explained in detail.

Origin of the Homogeneous Equation

It is necessary to understand the basis of these equations and their origin in order to understand the impact of each equation. The foundational differential equation is reliant upon two simple free-motion equations: Hooke's Equation and Newton's Second Law. They are important because the differential equation, $x''(t) + k^2x(t) = 0$ is a result of a combination between these two foundational equations. We will proceed by exploring both Hooke's Equation and Newton's Second Law and how they are

use to create the introductory differential equation of motion.

Hooke's Law states that the amount stretched is proportional to the restoring force [5]. When coming up with these equations, there are certain criteria that have to be met to show that it is a simple harmonic motion (SHM) equation. That is:

- 1) There is a restoring force proportional to displacement from equilibrium
- 2) Potential energy is proportional to the square of the displacement
- 3) Period/Frequency is independent of the amplitude
- 4) Position, velocity, and acceleration are sinusoidal in time (modeled by sine and cosine)

First, we will take a look at Hooke's Law and how it pertains to SHM equations. With Hooke's Law, we need a distance of displacement, $x(t)$, and a spring constant that exerts an equal and opposite force. The equation for Hooke's Law is:

$$F = -s \cdot x(t)$$

where s is our spring constant acting in the opposite direction on the force being applied. The other variable, $x(t)$, is our restoring force proportional to the displacement of equilibrium.

Now we will take a look at Newton's Second Law. Newton's Second Law pertains to the behavior of objects for which all existing forces are not balanced. That is, the acceleration of an object is dependent upon two variables — the net force acting upon the object and the mass of the object. [9] This is where we get the formula:

$$F = ma$$

It is also important to note that acceleration is the second derivative of displacement with respect to time. That is

$$a = \frac{dv}{dt} \text{ and } v = \frac{ds}{dt}$$

Notice how in both laws, the equations for both are dealing with force, F . Since both of the equations are pertaining to force, we are able to set them equal to each other and get:

$$F = m \cdot x''(t)$$

$$m \cdot x''(t) = -s \cdot x(t)$$

Dividing both sides by the mass we get:

$$x''(t) = \frac{-s}{m} \cdot x(t)$$

Since our spring constant is equal to Newtons over meters we have the

$$s = \frac{N}{m}$$

Notice that the units for Newtons is $(1 \text{ kg}) \cdot \left(\frac{m}{s^2}\right)$. Then we have the equation

$$s = \frac{kg}{s^2}$$

$$s = \frac{kg}{\frac{s^2}{kg}}$$

Which simplifies down to

$$s = \frac{1}{s^2}$$

Now we will introduce a new variable, k measured in units of $(1/s)$. Thus, we come up with the new term $k^2 = (1/s^2)$ and introduce this constant into the original equation, getting

$$x''(t) = -k^2x(t)$$

Upon adding our new term to the other side, we get our final product that is a simple harmonic motion equation that looks like:

$$x''(t) + k^2x(t) = 0$$

In combining Hooke's Law and Newton's Second Law of Motion, we create an equation that is identical to the homogeneous differential equation. This equation is also known as the Harmonic Oscillator equation, which describes the theoretical, or natural movement of the object without any outside forces affecting its movement. As described above, $x(t)$ describes the displacement of the object over time, while $x'(t)$ describes the velocity of the object over a given time period.

Homogeneous Equation

Our Homogeneous Equation is $x''(t) + k^2x(t) = 0$. To find the solution of the homogeneous equation, we must first find the auxiliary equation related to the harmonic motion equation. In the auxiliary equation, we assign every n th-order derivative with a n th-order exponent. Thus, $x''(t)$, second derivative, will be written as n^2 and $x(t)$ will be written as 1. Thus, the auxiliary equation will be:

$$n^2 + k^2 = 0$$

Our solutions to the auxiliary equation will be complex, equaling

$$n_1 = ki \text{ and } n_2 = -ki.$$

Now that we have the solutions, we can create a general solution with our complex numbers. Our general solution for our differential equation will be:

$$x(t) = c_1 \cos(kt) + c_2 \sin(kt)$$

Through our general solution, we are able to see that the natural frequency of the object is k . This means that there are no external forces acting on the system. In reality, this equation treats the object as if it were inside a vacuum. The homogeneous solution becomes a building block for the non-homogeneous solution. In looking at the solution to the homogeneous equation, we can see that there are many variables that

need to be taken into consideration. These include the arbitrary constants c_1 and c_2 . When these two variables have different values, they can change the expression of the equation. There are four different possible cases include:

- 1) $c_1 = c_2$
- 2) $c_1 > c_2$
- 3) $c_1 < c_2$
- 4) $c_1 = -c_2$

As mentioned earlier, we observe each case to account for each possibility in the real world. As initial conditions change from scenario to scenario we will verify that the solutions will behave similarly for the homogeneous case. Later we will discuss the non-homogeneous case in which the amplitude will vary slightly. As one can see in the graph below, the amplitude in the homogeneous equation stays constant, with no variations to the size in amplitude in each wave.

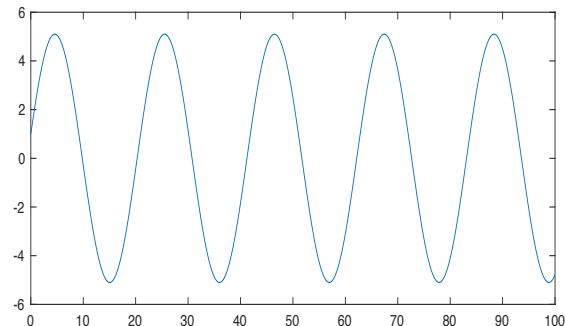


Figure 1. Graph of Homogeneous Equation

The Non-Homogeneous Equation

The non-homogeneous equation is $x''(t) + k^2x(t) = \cos(wt)$, where $w \neq k$. As one can see, it is very similar to the homogeneous equation, except there is an outside force acting upon the system ($\cos(wt)$). This equation will analyze the motion of the object when it is close to resonance. This focuses on external forces that may affect its frequency. The particular solution to the equation will be an equation containing sines and cosines. Since the equation is very similar to the homogeneous equation, our solution will be almost identical to that of the homogeneous solution, but with the addition of the particular solution. Thus, our solution will look like:

$$x(t) = c_1 \cos(kt) + c_2 \sin(kt) + x_p$$

The particular solution can be found using the method of undetermined coefficients.

Let

$$x_p = A \sin(wt) + B \cos(wt),$$

where x_p is the particular solution to the non-homogeneous equation. The particular solution is necessary because we no longer have a homogeneous

equation. Since our equation is equal to $\cos(wt)$, we must consider its derivative as well. That is why

$$x_p = A\sin(wt) + B\cos(wt).$$

Then, we take the first and second derivatives of the particular solution

$$x_p' = Aw\cos(wt) - Bw\sin(wt)$$

$$x_p'' = -Aw^2\sin(wt) - Bw^2\cos(wt)$$

Next, we plug the particular solution into the differential equation, so we will have,

$$x_p''(t) + k^2 x_p(t) = -Aw^2\sin(wt) - Bw^2\cos(wt) + k^2[A\sin(wt) + B\cos(wt)] = \cos(wt)$$

$$-Aw^2\sin(wt) - Bw^2\cos(wt) + Ak^2\sin(wt) + Bk^2\cos(wt) = \cos(wt)$$

$$A\sin(wt)[k^2 - w^2] + B\cos(wt)[k^2 - w^2] = \cos(wt)$$

Now, set the cosines on each sides of the equation equal to one another and the sines equal to each other. Thus,

$$A\sin(wt)[k^2 - w^2] = 0 \text{ and } B\cos(wt)[k^2 - w^2] = \cos(wt)$$

Therefore,

$$A = 0 \quad \text{and} \quad B = \frac{1}{k^2 - w^2}$$

So,

$$x_p = \frac{1}{k^2 - w^2} \cos(wt)$$

Thus, the solution for the Non-Homogenous case is:

$$x(t) = c_1\cos(kt) + c_2\sin(kt) + \frac{1}{k^2 - w^2} \cos(wt)$$

The non-homogeneous equation is very important because it is considered a more realistic situation. By adding the $\cos(wt)$ on the opposite side of the equation, it begins to integrate the outside forces that affect the system. By incorporating the $\cos(wt)$ to demonstrate the outside forces, it converts the differential equation from a theoretical viewpoint to an application problem. Below, is a graph of the non-homogenous case so that one may have a visual representation of what the equation signifies.

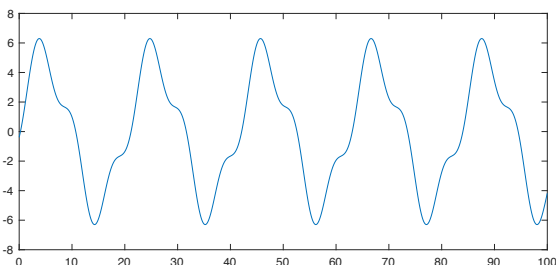


Figure 2. Graph of Non-Homogenous Case

Resonance Equation

Our third equation focuses when the system reaches resonance. If the system's external forces cause it to meet the natural resonance of the system, it can cause the system to move uncontrollably. Since there is no particular method that can solve when $w = k$, we will approximate its solution through limits. We will begin by taking the limit of the solution of the non-homogenous equation and using it as our base for this solution. Thus,

$$\lim_{w \rightarrow k} (c_1\cos(kt) + c_2\sin(kt) + \frac{1}{k^2 - w^2} \cos(wt)).$$

Our main priority will be evaluating

$$\lim_{w \rightarrow k} \left(\frac{1}{k^2 - w^2} \cos(wt) \right).$$

Directly evaluating our limit would result in an indeterminate form. Thus, L'Hospital's rule is necessary to solve the limit. So,

$$\text{L'H} \lim_{w \rightarrow k} \frac{-t\sin(\omega t)}{-2\omega} = \frac{t\sin(kt)}{2k}$$

Therefore, our general solution for the Resonance Equation is:

$$x(t) = c_1\cos(kt) + c_2\sin(kt) + \frac{t\sin(kt)}{2k}$$

We consider the case where $w = k$ because at this point, the oscillations of the object have achieved resonance. Once the oscillations begin to increase, they continuously become large. In a spring system this means they have gone beyond their elastic limit. Thus, in order to stop the oscillations from achieving resonance, we need a damping force.

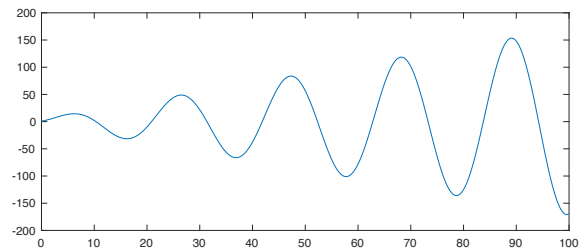


Figure 3. Graph of Resonance Equation

Introduction to the Damped Equation

The fourth equation also inquires the movement of the system, but includes a damping force, unlike the other equations. A damping force is a retarding force such that over time the oscillations of the moving object become increasingly smaller by

reducing the amplitude. The damping force is important in modeling realistic systems, as it forces the system to return to equilibrium. Since the system is not suspended in a vacuum, there will be at least one damping force due to the surrounding medium. The damping force creates three different scenarios for the equation: overdamped ($\lambda^2 - k^2 > 0$), critically damped ($\lambda^2 - k^2 = 0$), and underdamped ($\lambda^2 - k^2 < 0$).

While considering the external forces of the equation, we must also consider the effect of the damping force on the system. In most cases, the damping force exists in order to force the system back into equilibrium. Without the damping force, the system would continue to oscillate indefinitely. The damping force may be expressed through friction, shock absorbers, and many other things that help return the motion to equilibrium.

In order to determine if the fourth equation is overdamped, critically damped, or underdamped, we must look at the auxiliary equation,

$$x''(t) + 2\lambda x'(t) + k^2 x(t) = 0$$

And find its solution. The damping force is denoted by 2. This force is what enables the mass system to approach equilibrium over time, thus allowing the oscillatory displacement of the object to become minimal. Once we set up and find the solutions to our auxiliary equations, we get:

$$n^2 + 2\lambda n + k^2 = 0$$

$$n = \frac{-2\lambda \pm \sqrt{4\lambda^2 - 4k^2}}{2} = -\lambda \pm \sqrt{\lambda^2 - k^2}$$

Now that we have the solutions to the characteristic equation for (4), we can now figure out if the forces acting upon our equation are over, critically, or underdamped. To do this, we focus on the discriminant, $\lambda^2 - k^2$.

Overdamped Equation

If $\lambda^2 - k^2 > 0$, we refer to this situation as overdamped. One real life application to overdamped motion is through the modelling automatic paraplegic doors. The design of these types of doors includes a spring, which is damped. This damping allows the door to open and close at a chosen rate [8]. This damping is overdamped because the opening and closing is not an oscillatory motion. When the motion is overdamped, we notice the damping constant, $\beta = 2\lambda m$, is larger when compared to the spring constant, k , thus resulting in a smooth, generally non-oscillating curve. The solutions are modelled by the following, $n_1 = -\lambda + i\sqrt{k^2 - \lambda^2}$ and $n_2 = -\lambda - i\sqrt{k^2 - \lambda^2}$

$$x(t) = c_1 e^{n_1 t} + c_2 e^{n_2 t}$$

$$x(t) = c_1 e^{(-\lambda + i\sqrt{k^2 - \lambda^2})t} + c_2 e^{(-\lambda - i\sqrt{k^2 - \lambda^2})t}$$

Thus, the case of overdamped occurs results in the above characteristic equation $x(t)$ and can be used as a basis in modeling applications such as the design of paraplegic doors and more.

Critically Damped Equation

If $\lambda^2 - k^2 = 0$, then we say that it is critically damped. When an object is critically damped, the curve will graphically cross the horizontal axis once, achieve maximum amplitude, and over time decrease to 0. Properties of the curve that we notice are that it is continuous and contains oscillations with infinitesimally small amplitudes. Physical systems that exhibit critically damped motion are shock absorbers on cars. The springs in the shock absorber will react to any shock, such as driving over a speed or pot hole, due to the spring coming back to equilibrium at a fast rate [4]. A noticeable property of the damping force associated with being critically damped is any decrease in the force can result in an oscillatory motion. The solutions for the critically damped scenario are modeled by the following,

$$n_1 = -\lambda \text{ and } n_2 = -\lambda$$

$$x(t) = c_1 e^{-\lambda t} + c_2 t e^{-\lambda t}$$

Thus, our characteristic equation is shown above and can be used in the modelling of the functionality of shock absorbers and many other applications.

Underdamped Equation

Finally, if $\lambda^2 - k^2 < 0$, then the equation is underdamped. Physically, what is happening to the object moving in underdamped motion is the amplitude of the object is decreasing over time. Physical systems that experience underdamped motion are suspension bridges, which exhibit this type of damping due to their design. The suspension bridge is designed with suspension cables made of springs, and are designed with a piece called a girder which helps weigh down the bridge. Because of external forces acting on it, the bridge will swing in an oscillatory motion, thus the girder acts as the damping force which slowly decreases these oscillations to the point of becoming close to zero [7].

When underdamped, we notice the damping constant, β , is small when compared to the spring constant, k . The most important phenomena associated with underdamped motion is that as $t \rightarrow \infty$ the amplitude of motion, $e^{-\lambda t} \rightarrow 0$. The solutions for the underdamped scenario are modelled with the following,

$$n_1 = -\lambda + i\sqrt{k^2 - \lambda^2} \text{ and } n_2 = -\lambda - i\sqrt{k^2 - \lambda^2}$$

$$x(t) = e^{-\lambda t} [c_1 \cos(\sqrt{k^2 - \lambda^2} t) + c_2 \sin(\sqrt{k^2 - \lambda^2} t)]$$

This final case of damping is modelled above and generally produces the most oscillatory motion out of the three cases of damping, this is due to the sine and cosine terms within the characteristic equation. This can be used to model many different mass systems such as suspension bridges or pendulums.

Non-Homogenous Cases

We have examined the homogeneous model (4) and found solutions for each type of damping: overdamped, critically damped, and underdamped. However, much like the homogeneous equation (1), this case is mostly theoretical and does not account for any external forces acting upon the object. Thus, we consider the more applicable, non-homogeneous equation (4)

$$x''(t) + 2\lambda x'(t) + k^2 x(t) = \cos(\omega t)$$

Since we have solved for the characteristic equation above when solving the homogeneous solution. We will now find the particular solution by letting

$$x_p(t) = A \cos(\omega t) + B \sin(\omega t)$$

By substituting in the first and second derivatives of $x_p(t)$ we obtain the following equation

$$-w^2 A \cos(\omega t) - w^2 B \sin(\omega t) - 2\lambda w A \sin(\omega t) + 2\lambda w B \cos(\omega t) + k^2 A \cos(\omega t) + k^2 B \sin(\omega t) = \cos(\omega t)$$

Next, we must solve for the coefficients A and B through the method of undetermined coefficients we have the following system of equations.

$$(k^2 - w^2)A + 2\lambda w B = 1$$

$$-2wA + (k^2 - w^2)B = 0$$

The solution to the system is $A = \frac{k^2 - w^2}{(k^2 - w^2)^2 + 4w^2 \lambda^2}$ and $B = \frac{2\lambda w}{(k^2 - w^2)^2 + 4w^2 \lambda^2}$. We must note though, $k \neq w \neq 0$, and $\lambda \neq 0$. Thus, the solutions to the non-homogeneous equation follow the following cases:

Case I: $\lambda^2 - k^2 > 0$ (overdamped)

$$n_1 = -\lambda + \sqrt{\lambda^2 - k^2} \quad n_2 = -\lambda - \sqrt{\lambda^2 - k^2}$$

$$x(t) = c_1 e^{n_1 t} + c_2 e^{n_2 t}$$

$$x(t) = c_1 e^{(-\lambda + \sqrt{\lambda^2 - k^2})t} + c_2 e^{(-\lambda - \sqrt{\lambda^2 - k^2})t}$$

Case II: $\lambda^2 - k^2 = 0$ (critically damped)

$$n_1 = -\lambda \quad n_2 = -\lambda$$

$$x(t) = c_1 e^{-\lambda t} + c_2 t e^{-\lambda t}$$

Case III: $\lambda^2 - k^2 < 0$ (underdamped)

$$n_1 = -\lambda + i\sqrt{k^2 - \lambda^2} \quad n_2 = -\lambda - i\sqrt{k^2 - \lambda^2}$$

$$x(t) = e^{-\lambda t} (c_1 \cos(\sqrt{k^2 - \lambda^2} t) + c_2 \sin(\sqrt{k^2 - \lambda^2} t))$$

The particular solution,

$$x_p(t) = \frac{k^2 - w^2}{(k^2 - w^2)^2 + 4w^2 \lambda^2} \cos(\omega t) + \frac{2\lambda w}{(k^2 - w^2)^2 + 4w^2 \lambda^2} \sin(\omega t)$$

is used to model any external forces that are acting upon the mass system. When modeling the mass systems, we must consider external forces in order for the model to be accurate in the real world. These external forces come in many forms. When modeling the design of shock absorbers, we can consider speed bumps or suddenly breaking as an external force. When designing a paraplegic door, we consider the force exerted on the door when one opens or closes it, when they don't use the button. In a more complex case when we examine the suspension bridge, this particular model does simplify the scenario since we are only considering one external force in a system which exhibits many external forces. However, if we choose to consider one force, this external force could be something such as wind velocity which can cause the bridge to swing at higher amplitudes.

We do take some liberties in just considering the case where our homogeneous equation is equal to $\cos(\omega t)$. This is representative of a *possible* external force meaning there could be some error in the modeling. However, through further research more accurate models can be formed and catered to specific applications.

Some important points to consider are the type of damping that occurs in each equation. The case of underdamping relates most closely to objects under harmonic motion. This is due to the oscillatory nature of the sine and cosine functions. Damping happens due to the $e^{-\lambda t}$, which behaves as a strictly decreasing amplitude for the characteristic equation. The value gets smaller and smaller as time increases, which implies the maximum and minimum values of the characteristic equation approach 0 as t approaches ∞ . The particular solution for all cases will still be in motion but the damping force applied to the object is strong enough to keep the object close to equilibrium.

Below are some images of the graphs of each damping case. The independent variable is the time and the displacement is our dependent variable.

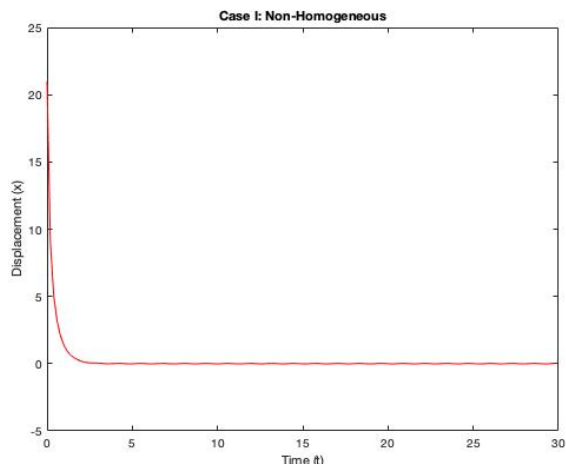


Figure 4. Graphical images of the non-homogeneous version of overdamped equation.

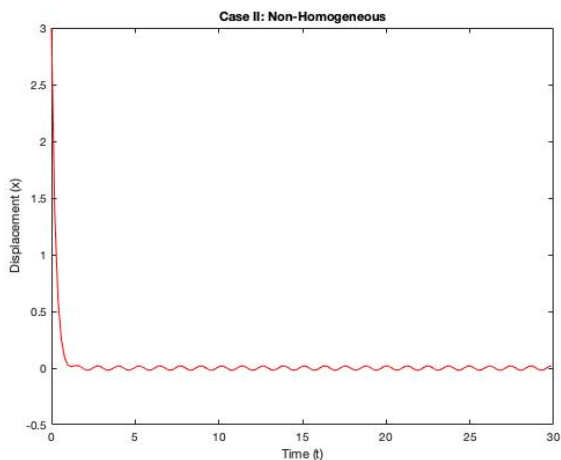


Figure 5. Graphical images of the non-homogeneous version of critically damped equation.

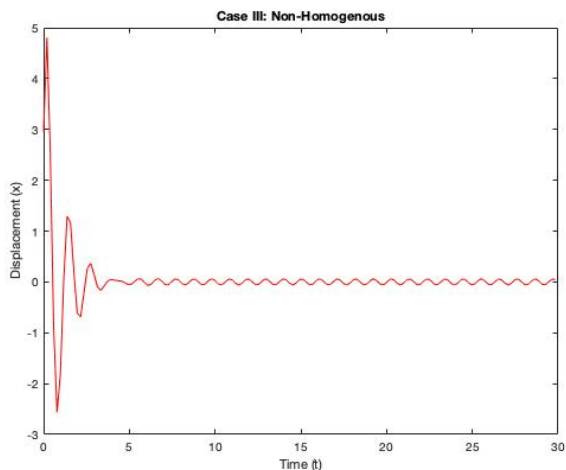


Figure 6. Graphical images of both the homogeneous and non-homogeneous versions of underdamped equation.

As the graphs show, the damping force has a large impact on the expression of these equations. When the damping constant is larger than the spring constant, the graph does not oscillate basically at all, attempting to return to its equilibrium state as quickly as possible. In the case of critically damped, the situation is very similar, except the damping constant and spring constant are equal to each other. This can be reflected in the graph, following suit after the overdamped equation, but it does not reach equilibrium as quickly. In the case of the non-homogeneous case, the system continues to oscillate, but with a much lower amplitude. In our final case, the underdamped situation, the graph crosses the x-axis many times, further reinforcing the notion that the damping constant is smaller than the spring constant. This causes the system to oscillate much more than the other two cases. As time progresses, the amplitudes of the graphs decrease dramatically in an attempt to stay at equilibrium. Overall, these graphs are important for a deeper understanding of the meaning behind each equation.

Conclusion

In conclusion, through this paper we have been able to review the importance of mathematics and mathematical modeling. Having discussed differential equations and simple harmonic motion equations, we were able to understand the causes and effects of external forces and their oscillating object that occur in real life application such as: shock absorbers, guitar strings, and springs. With this paper students will be able to have a thorough grasp of these equations which creates a basis for the understanding of its applications. As it is seen that the simple harmonic equations configured through Hooke's Law and Newton's Second Law of physics. While the study of these ordinary differential equations may seem simple, their applications are found in other STEM fields. These fields can include, but are limited to: Chemistry, Engineering, and Physics.

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Appendix:

Coefficients/ Terms	Meaning
$x(t)$	This term represents an object’s displacement over time. The way we can interpret this term is how far an object is oscillating from its equilibrium (starting) position
$x''(t)$	The acceleration of an object over time. This would be the acceleration of each oscillation of an object.
k^2	The k^2 coefficient is used to help find the period constant for the characteristic equation of our solutions. k^2 represents the square of the period constant. The characteristic equation is the part of the solution $x(t)$ found when calculating the homogeneous solution. Another characteristic of k^2 is $k^2 = \frac{s}{m}$, where m is the mass and s is the spring constant. These are important because they help determine the coefficient in the harmonic motion equation.
w	The period constant of the function. This coefficient is used to find the period, $T = \frac{2\pi}{w}$, where T is the time in seconds for oscillations of some external force. A period constant, k , is also present for the object’s oscillations. We can use this formula for period because the oscillations create a sinusoidal wave. This coefficient is also used for finding the Frequency, which is $F = \frac{1}{T} = \frac{w}{2\pi}$, the amount of oscillations per second.
$\cos(wt)$	This function in (2) and (3) is representative of some sort of external force on the system that causes it to go out of equilibrium. This could be a driving force that causes greater oscillations of the object.
$k^2x(t)$	This term is said to describe a part of the restoring force, which is a force that gives rise to an object in equilibrium. This term is composed by the product of the square of an object’s period constant and its displacement. This term follows Hooke’s Law.
2λ	2λ is referred to as the damping force of the mass system. This force allows the mass system to return to equilibrium and makes it a more applicational problem rather than a theoretical equation. The coefficient can be broken down as $2\lambda = \frac{\beta}{m}$, where β is the damping force and m is the mass of the object.
β	β is considered the positive damping constant of the equation. In most cases, the β is negative because it moves in the opposite direction of motion.

Table 1: Explanation and Importance of Terms and Coefficients.