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Failure to Demonstrate the Effects of Chewing Gum on Cognitive Performance

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Failure to Demonstrate the Effects of Chewing Gum on Cognitive Performance

There is evidence reported in Johnson and Miles (2008), Kanoski, Hughes and Jones, (2011), and Scholey, Haskell, Robertson, Kennedy, Milne and Wetherell, (2009) that chewing gum is linked to higher cognitive performance. Several types of research have reported positive data displaying the benefits linked to improved memory while chewing gum during a multitude of tasks. The purpose of the current research is to further the understanding, by using a problem-solving anagram test.

Cognitive psychology focuses on how people acquire, process, and store information. Two prominent areas of research that can represent higher cognitive function are studies in memory and problem solving. Memory is referred to as the process of retaining information over a period of time (Baddeley & Hitch, 2017). Examples of different areas of memory research include examination of variables affecting false memory, short-term memory, long-term memory, and context-dependent memory. False memory is a fabricated or distorted recollection of an event (Loftus & Bell, 1975). Short-term memory involves the recall of information after the passage of a relatively short time, roughly 18 seconds or less without any form of memory rehearsal (Baddeley & Hitch, 2017). Long-term memory is thought to be large-capacity storage system to retain memory for experiences and information for an extended period of time accumulated throughout one's lifetime (Atkinson & Shiffrin, 1968). Context-dependent memory is the improved recall of specific episodes or information when the context is present at both encoding and retrieval (Carr, 1925).

Problem solving in cognitive psychology refers to the mental process that people go through to discover, analyze, and solve problems. Examples of problem solving research include examining the use of heuristics and solving both arithmetic and anagram problems. A heuristic is

a mental shortcut or rule-of-thumb strategy that allows people to solve problems and make judgments quickly and efficiently (Evans, 1987). Arithmetic problems can be of various types that require the manipulation of the relationships among numbers, shapes, and quantities. Anagram problems involve forming a word or phrase by rearranging the letters of a different word or phrase (Walker & Stickgold, 2010).

Chewing gum has been shown to affect the physiological functions (Tucha, Mecklinger, Maier, Hammerl, & Lange et al., 2004). In their study 75 participants either chewed gum, carried out the motions of chewing gum, and the control group did not chew gum. Tucha et al. (2004) concluded that those who chewed gum and carried out the motion of chewing scored higher than the control group. Smith (2009) reported additional effects of chewing gum on physiological systems of the body, in a cross-over study involving 133 participants and test sessions when they were chewing gum. Approximately half of the volunteers were tested with noise, a stress condition, while the rest were tested in quiet. Approximately half of the participants were given mint gum or fruit gum in separate sessions while the other half were the no-chew control group. The participants rated their mood at the start and end of each session, had their heart rate monitored over the session, and saliva samples were taken to measure cortisol levels, which is a good indicator of alertness and stress. Heart rate and cortisol levels were higher when chewing (Wilkinson, Scholey, & Cohen, 2002).

In addition to the reported effects of chewing gum on physiological systems, effects of chewing gum have also been reported that examined the effects of chewing gum on a number of aspects of cognitive performance. Participants that chewed gum carried out tasks measuring a range of cognitive functions, such as aspects of memory, selective and sustained attention, psychomotor speed and accuracy (Smith, 2009). Reaction times were quicker in the gum

condition and this effect became bigger as the task became more difficult. Research by Allen, Galvis and Katz (2006) found a slight improvement in exam performance between students who chewed gum during a lecture to those who did not. Johnson and Miles (2008) showed that the students in a chewing gum group scored higher on a standardized math test than a no gum control group. Tucha et al, (2004) showed an improvement on the participant´s learning when testing math performance on 8th graders. They measured standardized test scores and sections of the Texas Assessment of Knowledge and Skills (TAKS) and the Woodcock Johnson III Tests of Achievement (WJ-III) and class grades of eighth grade math students. Students in the gum chewing condition improved standardized test scores and maintained higher grades in the math class compared to those in the no-gum chewing condition (Tucha et al., 2004). This suggests that chewing gum may have enhanced encoding of information learned in class, rather than improving general cognitive performance or ability.

Experimental research has also been conducted on chewing gum and memory. Performance on both immediate and delayed word recall have been found to be better in a gum chewing condition than in a no-gum control (Baker, Bezance, Zellaby, and Aggleton, 2004; Wilkinson, Scholey, & Wesnes, 2002). Similarly, Stephens and Tunney (2004) found that chewing gum led to an improvement in immediate recall and delayed recall when compared to sucking a hard candy. However, other research has not supported a facilitating effect of gum on word recall (Smith, 2009; Tucha et al., 2004). Smith (2009) found that chewing gum did not improve memory when participants were asked to recall a story. Baker, Bezance, Zellaby, & Aggleton, (2004) provided a possible explanation for this disparity suggestiong that the beneficial memory effects attributed to chewing gum may be due to context-dependent effects. If a participant both learns and recalls information in the same environmental context, or state, then

recall is generally superior compared to a condition where the learning and recall contexts/states are different (Baker et al., 2004).

There is some evidence that chewing gum induces context-dependent memory effects (Baker et al., 2004). The examines the effects of gum chewing on standardized test scores and class grades in a group of 8th grade math students conducted by Johnston and Miles (2008) also indicated the possibility of context- dependent recall. Furthermore, Rickman, Johnson, and Miles (2012) reported that when different amounts of gum are given to participants (one piece versus four pieces), memory is better when the same amount of gum is chewed at the time of earning and recall. However, other research has failed to find a context-dependent effect with chewing gum. An experiment using flavor of gum as the context was examined by Johnson and Miles (2008) showing that although flavorless gum and mint flavored strips led to reported change in mouth activity, they did not induce context-dependent memory which suggests that neither flavor nor the sensation of chewing leads to context effects in memory. Overman, Sun, Golding and Prevost (2009) did not find a difference between chewing gum and sucking a sweet with the same flavor on context-dependent memory.

With regard to working memory, Stephens and Tunney (2004) found that chewing gum led to an improvement in spatial working memory span but only under conditions of greater difficulty, in this case, it was a dual-task version of the working memory tasks. Wilkinson, Scholey, and Cohen (2002) showed that chewing gum could lead to both improved spatial and numeric working memory. Memory in healthy adult participants were examined under four different conditions, no chewing, mimicking chewing movements, chewing a piece of tasteless chewing gum, and chewing a piece of spearmint flavored chewing gum (Wilkinson at el., 2002).

Several mechanisms have been proposed to account for the facilitation in performance observed when gum is chewed during and prior to cognitive testing. For instance, Stephens and Tunney (2004) argued that the improved performance of those who chewed gum was due to an increased availability of glucose in the brain associated with increased metabolic activity. Stephens and Tunney, (2004) suggest that insulin is secreted as a response to the anticipation of a nutritional load, which in term promotes glucose uptake. Chewing gum's effect on mood and cortisol levels have also been examined as an explanation. It showed that partaking in chewing gum has a positive effect on mood during stress and that changes in salivary cortisol mirrored these results (Stephens & Tunney, 2004). The performance on the tasks were significantly better in the group that chewed gum (Scholey, Haskell, Robertson, Kennedy, Milne, & Wetherell, 2009).

Others have relied on the arousal theory (Sanders, 1986) to suggest that the facilitative effects of gum chewing on cognitive performance were due to the accompanying increases in alertness and arousal. For instance, numerous studies have shown that gum chewing elevates heart rate and blood pressure (Smith, 2010; Wilkinson et al., 2002), and heightened cortisol levels (Smith, 2009). If chewing gum is associated with increases in arousal and a corresponding shift in cognitive function, it is unclear why many studies find little or no performance advantages of gum chewing. For instance, Tucha et al. (2004) found that chewing gum was only associated with improvements on sustained attention. It is possible that methodological differences between studies can explain some of the discrepancies in findings (e.g., Scholey et al., 2009).

Although chewing gum has been reported to improve recall, other studies have not indicated such an effect. In addition, some initial findings that chewing gum has a context-dependent effect on memory have not been replicated. There is also some evidence for an effect

on working memory, although it may be dependent on level of task difficulty. The research on chewing gum and memory has been quite extensive, without arriving at any clear overall conclusions. Onyper, Carr, Farrer, and Floyd, (2011) explain how time may be a factor because performance was only enhanced when chewing gum was done 5 minutes before the cognitive testing and only on some of the cognitive domains.

The current experiment investigated whether chewing gum while completing a cognitive task, would produce cognitive benefits. Cognitive performance was compared between three different groups, one group chewed a sugar gum, another chewed sugar-free gum, and the third group was a control group that did not chew gum. All three groups of participants were then tested using the same anagram test. I hypothesized that the scores of those who chewed sugar and sugar-free gum would be higher compared to the control group. This hypothesis was based on Sanders' (1986) arousal model, suggesting that mastication would increase arousal and lead to improved performance. I also hypothesized that the scores of the participants who chewed sugar gum would be higher than both the scores of the sugar-free and control participants. This would be consistent with the glucose theory that suggested that delivery of sugar to the brain as a result of insulin secretion from the sugar content in gum was responsible for the improved performance of participants who chewed gum (Stephens & Tunney, 2004).

Participants

My research participants consisted of 48 Concord University undergraduate students. The participants were both males and females between the ages of 18-25 years.

Materials

Every member in the study received the same anagram test, consisting of 36 scrambled words (see Appendix A) and a consent form (see Appendix B). I also used 20 packs of Juicy

Fruit gum containing sugar for Group Sugar. There were 20 packs of sugar-free Juicy Fruit gum for Group Sugar Free. The two types were provided to examine whether the sugar content had an effect on test performance.

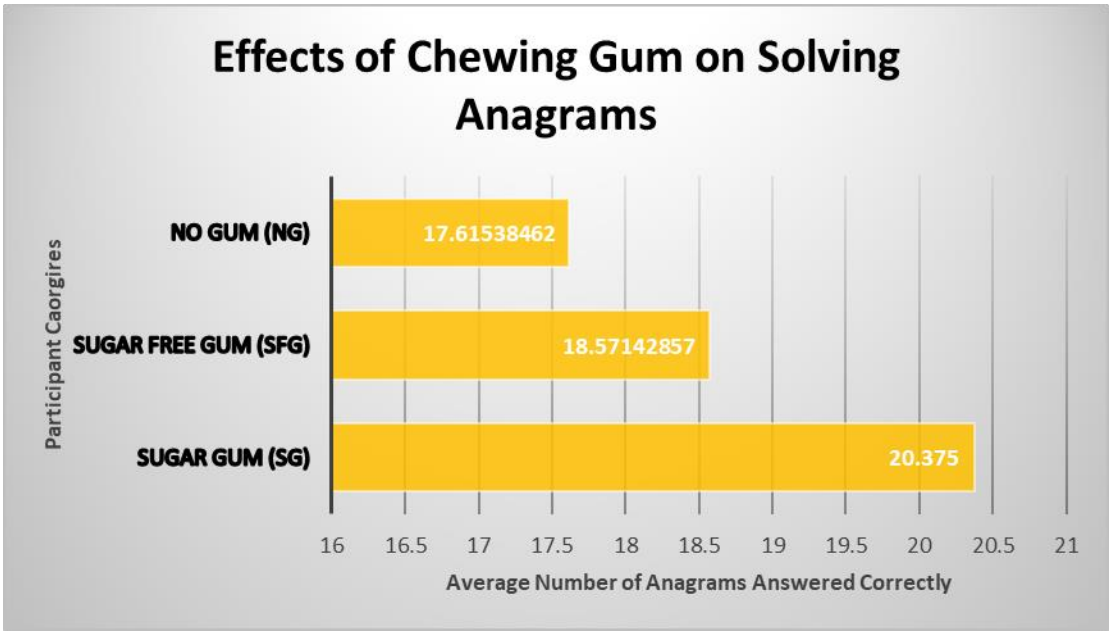
Procedure

In total, 48 individuals were assigned and tested in three different groups. Group Sugar consisted of 17 participants that chewed the sugar gum and were tested together. Group Sugar Free consisted of 16 participants that chewed the sugar free gum. Finally, Group Control consisted of 15 participants that did not chew gum. Each participant was given 15 minutes to complete their anagrams. If chewing gum, they were instructed to replace the piece of gum in their mouth with a fresh piece of gum every five minutes. If participants were chewing gum they started chewing as soon as they began testing. The dependent variable in the study was the number of anagrams that each participant correctly completed.

Results

Group Sugar had a mean of 20.375 correct answers, Group Sugar Free had a mean number 18.2 correct answers, and Group No Gum had a mean of 17.615 correct answers (see Figure 1). The mean number of anagrams correctly solved for each group was analyzed using an analysis variance (ANOVA). The ANOVA analysis failed to reveal a statistical difference between the three groups F, $F(2.41) = 0.567$, $P = 0.571$. Planned contrasts were then conducted and also found no significant differences between groups, all t's $(41) \leq 0.990$, all p's ≥ 0.328.

Figure 1:



Discussion

I had two hypotheses, the first, based on the insulin theory (Stephens & Tunney, 2009) was that Group Sugar would solve more anagrams than both Group Sugar-Free and Group Control. One limitation of the study was the absence of a measure to assess increased glucose/ insulin secretion to validly test whether the glucose theory does or does not affect the results. Kanoski, Hughes, and Jones (2011) stated that intake is associated with cognitive impairment, with a specific emphasis on learning and memory functions that are dependent on the integrity of the hippocampus. The data suggested no significant differences between the three groups. The second, hypothesis, based on the Arousal theory (Sanders, 1986), was that both Group Sugar and Group Sugar Free Groups would solve more anagrams Group Control. The second hypothesis, consistent with the arousal theory (Sanders, 1986), I predicted that both Group Sugar and Group

Sugar-Free would solve more anagrams than Group Control. Results were not consistent with this prediction as there was no significant differences between the three groups.

One possible explanation for this pattern of results is the level of arousal of the participants during the study. Yerkes and Dodson (1908) suggested that moderate arousal would typically be optimal for performing a variety of cognitive tasks. They also reported that task complexity may mediate this effect. The anagram test may have been too complex or difficult for that level of arousal for my participants. This could also be a reason why anagrams have not been used as the cognitive task in previous studies on chewing gum. There is a wide variety of research on the affects chewing gum has on memory and little that focuses specifically on psychological affects and problem solving, this could be another reason why anagrams are not used and why there is so much more information and studies on the effects of chewing gum and memory.

Chewing gum may have possible effects on mood, the initial increase in arousal may affect cognitive performance after a certain amount of time chewing and testing, or after the act of chewing has finished. A notable limitation of the study in assessing the second hypothesis is the absence of measure of physiological arousal, which makes our conclusions regarding the role of arousal only speculative. As reported by Scholey et al. (2009) chewing gum was associated with reduced cortisol during performance of a stressful multi-tasking. Smith (2009) emphasized the rise in cortisol as indicating increased alertness which was supported by the self-reported alertness data, but a rise in cortisol also indicates a heightened physiological stress response, though this interpretation is somewhat problematic given the reduced reported stress in Gray, Miles, Wilson, Jenks, Cox, and Johnson (2012). It is possible that time spent chewing and the timing of measurement of cortisol could explain differing effects, consistent with the time-on-

task trends (Gray et al, 2012). Previous research shows that chewing gum 5-15 minutes before cognitive testing begins shows more promising results in favor of enhanced cognitive performance (Gray et al, 2012). In future studies, this factor will need to be taken into consideration and applied. In order to ascertain why chewing gum may have different effects, a thorough examination of different effects should include the measurement of physiological arousal in the central nervous system potentially employing EEG methods, cortisol levels, and heart rate.

In conclusion, although the current study failed to support either hypothesis, the results should still be taken into consideration when trying to gain an understanding of the varied patterns of results reported with chewing and chewing gum on cognitive performance. To my knowledge, this is the first attempt at examining the effects of chewing sugar and sugar free gum on solving anagrams.

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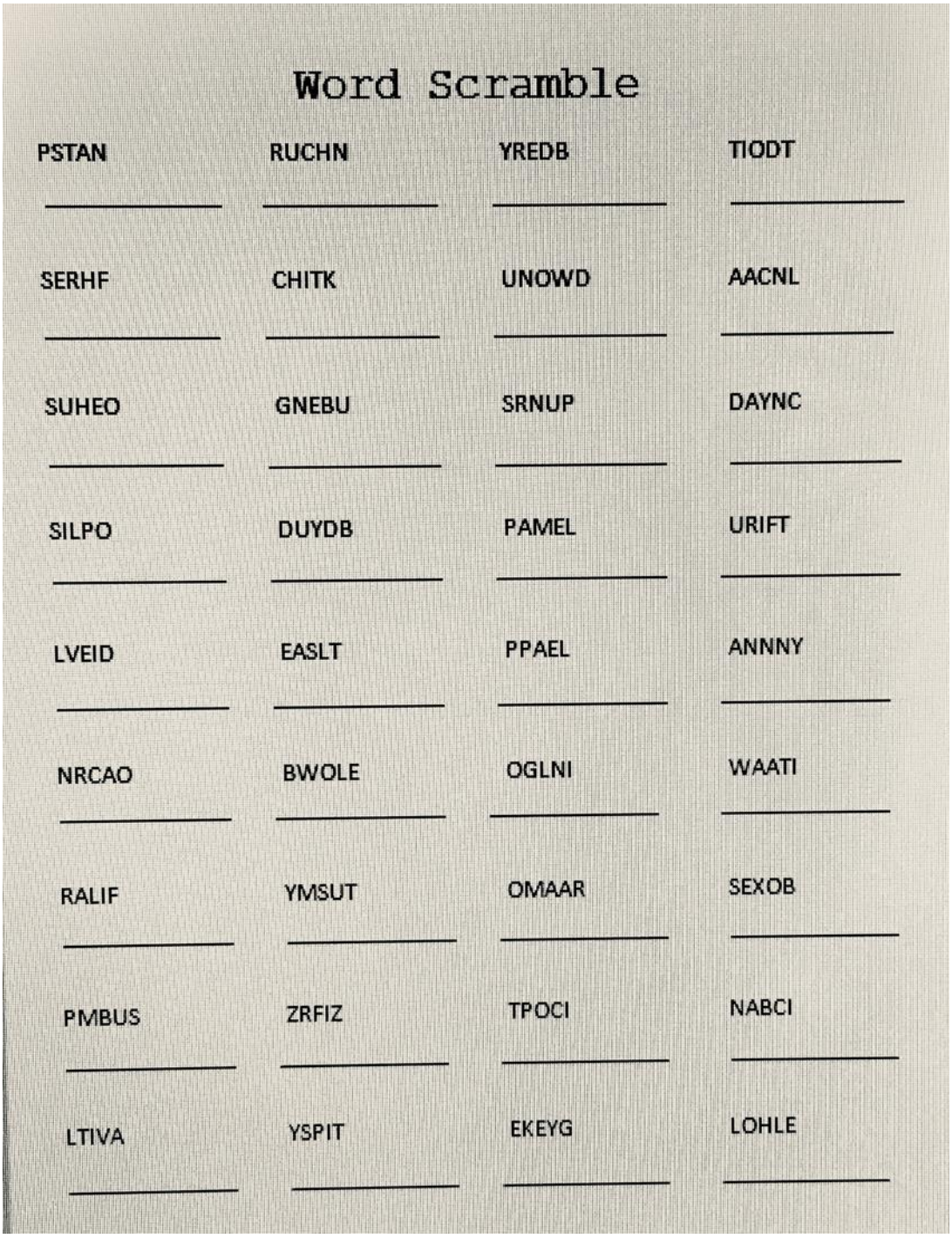
Appendix A:



Word Scramble

PSTAN _____	RUCHN _____	YREDB _____	TIODT _____
SERHF _____	CHITK _____	UNOWD _____	AACNL _____
SUHEO _____	GNEBU _____	SRNUP _____	DAYNC _____
SILPO _____	DUYDB _____	PAMEL _____	URIFT _____
LVEID _____	EASLT _____	PPAEL _____	ANNNY _____
NRCAO _____	BWOLE _____	OGLNI _____	WAATI _____
RALIF _____	YMSUT _____	OMAAR _____	SEXOB _____
PMBUS _____	ZRFIZ _____	TPOCI _____	NABCI _____
LTIVA _____	YSPIT _____	EKEYG _____	LOHLE _____

Appendix B:

Funded by McNair Scholars Program

I agree to participate in a research project lead by Emily Davis an undergraduate research student in the McNair Program at Concord University in Athens WV. The purpose of this document is to specify my participation in this project as a subject.

1. I have been given sufficient information on this project and the researcher has explained in writing and orally the instructions and the purpose of this project.
2.
3. My participation in this project is voluntary. There is no explicit or implicit coercion whatsoever to participate.

4. Participation involves committing 15 minutes of my time to solve as many anagrams as possible. I am also required to adhere to the instructions during the duration of the test. I understand my anagram test will be scored and recorded as research data, but my name will not be tied to the anagram test in any way.

5. I have the right to leave at any given point to leave the testing area and quit my test. Also, I have the right to refuse chewing the gum provided.

6. I have been given explicit conformation that my name will not be required or identified at any given time during the research process.

The Impact of Implied Racial Identities and Criminal Records on Employment

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The Impact of Implied Racial Identities and Criminal Records on Employment

The United States has the largest prison population in the world, with approximately 20 million felons and approximately 7 million people under the supervision of the criminal justice system either in prison, jail, on parole, or on probation (Bureau of Statistics, 2014). The consequences are devastating for the millions of people in and out of prison in the U.S. Felons are largely unable to vote; they have difficulty securing housing; there are significant barriers to employment, and they find themselves largely unable to reintegrate into their communities. Even those currently not incarcerated are under some form of supervision in a mass "supervised society" and left under conditions of probation or parole that can quickly land them back behind bars for minor technical violations (Miller, 2016). It is not surprising then, given these constraints, that over 60 percent of felons return to prison within three years of release (Bureau of Justice Statistics, 2014).

These effects are even more substantial for minorities. In the U.S. today, 1 in 3 black men spend time in the criminal justice system, compared to 1 in 17 white men, according to The Sentencing Project (2017). For women, the statistics are much different, but with the same inequality when comparing black women to white women: 1 in 111 white women will become incarcerated compared to 1 in 18 black women. Minorities face longer and harsher sentences than their white counterparts (Stolzenberg, 2013) and face many challenges with both implicit and explicit bias throughout the court process (Kang, 2012; Cornell, 2002). The bias that creates these sentencing disparities for minorities within the criminal justice system then continues to create barriers for them upon release. One of the greatest obstacles to reintegrating them into productive members of society is finding work after release from prison. While felonies create barriers to gaining employment, some studies suggest that race creates an even larger obstacle,

and the combination of race and a felony conviction can have serious consequences for job applicants. Devah Pager's (2003) groundbreaking study, for instance, found that an African American job applicant is half as likely to get hired as a similarly-qualified white applicant *who has spent time in prison*. The criminal justice population has increased 500% in the last 40 years, now impacting 2.2 million Americans (The Sentencing Project, 2017). This disproportionately affects minorities and leads to significant disenfranchisement in their communities. It is vital that we fully understand what is happening in our country in order to address this pressing social problem.

Research Question

Do the criminal records and racial identities of job applicants impact their likelihood of being considered for employment?

Literature Review

Studies suggest that job applicants with criminal records are treated differently by employers compared to the treatment of non-offenders. In one study, 122 California employers were surveyed on their willingness to employ ex-offenders. Less than 25% reported that they would consider somebody with a drug conviction, 7% for a property crime conviction, and 1% for a violent offense (Alexander, 2012). In a review of other research in this area, Harry J. Holzer and his colleagues (2002) found that only 40% of employers were willing to hire an ex-offender. Employers are much less likely to hire ex-offenders than any other disadvantaged group. Ex-offenders are also much more likely to be hired in fields like construction or manufacturing that do not require interaction with customers or the public. Not only do 60% of employers report that they would not even consider an ex-offender for employment, but employment consideration becomes increasingly less likely, depending upon the type of offense. Employers are more

willing to hire offenders with non-violent drug charges than when the offence was a violent one (Holzer, 2002). This becomes even more relevant when combined with racial bias.

Overarching patterns of segregation continue to impact minorities in significant ways. Minorities have a more difficult time getting jobs in white neighborhoods and have a difficult time moving into white neighborhoods due to the structures that keep them segregated. According to audit studies from the U.S. Department of Housing and Urban Development (HUD, 2013), blacks and Latinos were denied available housing between 35 and 75 % of the time. Minority applicants were steered toward specific neighborhoods, quoted higher rents, and shown fewer apartments in worse conditions according to Zhao, Ondrich, & Yinger, (2004), and whites were shown more rentals and given more options. The same practices are at play in the granting of bank loans. Whites were given more information and more assistance in getting loans. Minorities received less encouragement to return and get a loan, and they were denied at higher rates. Minorities were also steered toward higher interest rates on their loans. Whites were twice as likely to get mortgages approved than African Americans of the same income and gender. In Sociology this is called redlining.

This funneling of minorities into specific neighborhoods is mirrored in the job market. Eduardo Bonilla-Silva explains that "The 2000 U.S. Census shows whites are still more likely than blacks to be employed in managerial and professional occupations" … "Blacks in contrast, are disproportionately employed in service occupations" (Bonilla-Silva, 2006). These along with previous findings suggest a pattern of downward funneling of black people in the job market.

Racial discrimination when compounded with a felony conviction becomes an enormous obstacle. The number of people in the criminal system has gone from less than two million in 1980 to almost seven million today (Bureau of Justice Statistics, 2017). Even after an inmate's

sentence has been completed and they have served their time, their punishment continues in the form of job discrimination. This is compounded for minorities, who even without a conviction are still stereotyped as criminal (Agan & Starr, 2016), and have the same prospects as white felons. Sarah Shannon and her colleagues (2011) explain their work in this area:

> The total number of non-African American ex-felons has grown from 2.5 percent of the adult population in 1980 to over 6 percent in 2010. For African-Americans, ex-felons have increased from 7.6 percent in 1980 to over 25 percent in 2010. . .” by their “estimates, about 3.4 percent of the adult voting age population have once served or are currently serving time in a state or federal prison. (Shannon, 2011, p. 11-12)

The effects of mass incarceration will have long lasting consequences on not just the individuals, but on our society as a whole. Unable to get work, apply for many welfare programs, vote, or get housing, felons continue to be punished long after their sentences are over. Instead of being able to reintegrate into society and back into their communities, felons find it harder than ever to assimilate, leading to continued problems and recidivism. The further study of the issues felons and minorities face could lead to insights into helping reduce the amount of recidivism, and the prison populations.

Amanda Agan and Sonja Star (2016) conducted an experiment using over 15,000 applications sent to 4,292 stores in New York and New Jersey. Testing the effects of “Ban the Box” (BTB) policies, Agan and Starr (2016) used job applications to test the effects of discrimination before and after the policies went into effect. The policy was created to lessen discrimination against felons by eliminating the “check box for felony” part of job applications. Employers would still be able to conduct background checks but not until later in the application process under this bill. What this field experiment determined was that racial bias was increased rather than decreased by this policy. While discrimination against felons was lessened, employers stereotyping of black applicants as felons seemingly increased. Before BTB went in to

effect, white applicants received a 7% higher callback rate at affected employers, while the racial gap increased to 45 % after the policy went into effect. Racial discrimination was less prevalent in New York (6%) than in New Jersey (38%), and they hypothesized that this could be due to New York being more integrated than New Jersey. The racial gap was also higher in whiter neighborhoods.

A study was conducted in New York City (Pager, Western & Bonikowski, 2010) using young white, black, and Latino men. Unlike Pager's 2003 study, this study did not examine the impact of a felony conviction. The results suggested that race was again a significant barrier for prospective employees. The researchers found that white men received a call back or job offer 31% of the time, compared with 25.2 % for Latinos and 15.2 percent for blacks. Like Pager's earlier study, black men once again had half the chance of white applicants for employment. Using the same audit methods, the prospective employees could record firsthand experience of "categorical exclusion" that is outright favoritism for the white employee, and "race-coded job channeling" that is channeling minorities into lower job titles and white ones into higher job titles. Down channeling occurs when an applicant applies for a position and is told that the position is unavailable and instead is offered a lesser position or one that has minimal customer contact. In cases where channeling occurred, black applicants were consistently channeled down, and white applicants where channeled up.

In Devah Pager's (2003) study she explored the ways in which employers consider both race and felony convictions in hiring decisions through an employment audit study design. Four matched men were used as testers applying for real jobs in Milwaukee, Wisconsin. They had similar height, weight, and mannerisms, and they were also coached to speak in the same manner in order to avoid any bias the employer might have. The only differences between the pairs were

their race and felony status. One of the black men and one of the white men were given a felony drug conviction on their applications. The original study used 350 real jobs taken from the Sunday classifieds and a state sponsored website. Pager's study found that the white applicants with criminal records were half as likely to be called back as their white counterparts without a record. Surprisingly the study found that black applicants were less likely to receive a callback than their white counterparts *with a felony*. Race, it seemed, was a bigger penalty than a felony conviction.

In their field experiment in Chicago and Boston, Marianne Bertrand and Sendhil Mullainathan (2003) produced similar results to Pager (2003). In their study titled "Are Emily and Greg more employable than Lakisha and Jamal?" researchers used names on applications to "manipulate the perception of race." The names were chosen by using a name frequency data calculated from birth certificates of all babies born between 1974 and1979 in Massachusetts. They then tabulated the names by race by their highest frequency in each racial group, and as a check for distinctiveness they conducted a survey in various public areas asking each respondent the general attributes of race of each name. The names that led the respondents to readily attribute the expected names were kept, and the ones that led to an ambiguous response were discarded. Over 5000 resumes were sent out to 1,300 employment ads in Boston and Chicago for positions in sales, administrative support, clerical services, and customer services. The randomly assigned black or white sounding names were given either high quality or low quality resumes. The applications were sent to prospective employers and call backs were recorded. While 83% of the applications did not receive a call back, 8.3% of employers called white applicants, and 3.5% called black applicants. This means that black applicants would need to submit 50% more applications than whites to receive a callback. White applicants were 49% more likely to get a

call back than their black counterparts in Chicago and 50% more likely in Boston. The racial gap was evident in both male (52%) and female (49 %) resumes. Though more female resumes were used in administrative job openings and male resumes were almost exclusively sent to sales, there was a slight bias in favor of female applicants in sales. It was not, however, statistically significant. Resumes were also manipulated to show different levels of education and job experience. Results suggest that while better quality resumes helped white applicants, quality in resume made little difference for black applicants. These results suggest bias begins early in the employment process before applicants are even met. The suggestion of race from the name could mean employers are not discriminating using race, but are assuming socioeconomic status based on stereotyping. Though they do suggest this is the case and use addresses from higher and lower class addresses in randomly assigned neighborhoods to try to investigate whether this is true. Since there is no difference in treatment of applicants based on neighborhoods, it could mean this is either not considered or that neighborhoods are not scrutinized in the hiring process.

Stereotypes and Attitudes can be either implicit or explicit, and affect most of our daily decisions. The bias being tested for in this study is Implicit Bias. It is bias in the decision making process that is not necessarily in conscious awareness. Explicit Bias is when a person is aware of and condones their bias, as in a bias against “health food” because it “tastes bad”. Implicit bias is harder to detect because it is not something a person is consciously aware of. It has been documented as affecting court proceedings, in all areas from arrest to sentencing (Kang 2012). With all other things being equal black men are more likely to be arrested, more likely to get longer sentences, and more likely to receive the death penalty than their white counterparts. A meta-analysis was conducted on criminal cases in Florida, and it was found within each racial group the more Afrocentric the persons features the longer their criminal sentence up to 8

months. When comparing trials and sentencing it was found that racially charged cases were more likely to be fair owing to the jurors being more aware of bias and correcting themselves more stringently. The same was found for Judges. When judges were made aware of implicit bias before each case they became more mindful of their discussion making processes and cases became more equivalent (Kang, 2013).

The purpose of my experiment was to test for implicit bias. Using the same names that were chosen for the Bertrand and Mullainathan (2003) study, I tested whether names and felony status would have an impact on the employment during the application process. I hypothesized that results would be similar to previous findings in showing bias against the felonies and names.

Methods

Participants

Students were tested from the Business Department of Concord University, 38 from freshmen classes and 16 from a senior class, with ages ranging from 18-31 years.

Materials

There were 3 different job descriptions (Sales Manager, Cashier, and Stocker) and a demographic survey. The 12 resumes were created using the same template and had the same designs, the same amount and type of work history, and the same amount and type of education. There were six names that implied white race, half of which had felonies, and six names that implied black race, half of which had felonies.

Procedure

An experimental design was used to determine whether college students consider race and felony status when sorting prospective job applications. We tested students from several

introductory-level business education courses and compared them to students in a senior business class. Business students were chosen because they are the most likely to follow career paths where they might participate in the hiring process. Students from these classes were told that we were conducting a psychological study of the hiring process. Of the 54 students participating, 38 were from freshmen classes and were compared to the 16 participants from the senior level course. Each student was given 3 fictional job descriptions and a packet of 12 resumes and was asked to pick their top two applicants for each position.

The job positions were Cashier, Sales Manager, and Stocker. The participants were given 12 resumes consisting of four applications with appropriate experience per job title. Stereotypical names were used to imply either white race or black race. Two "white" names and two "black" names were used on the resumes designed for each job title. For each job title one of the "white" and one of the "black" applicants had a felony record reported. The applications with the implied white racial identities had similar work experience as the applications with black implied racial identities; similar work experience, similarly ranked education levels and the same resume template and formatting. After participants completed their selection process, we examined and compared the results to see if there were any differences between the percentage of implied white applicants being selected for a position compared to the implied black applicants, despite having the similar qualifications as the implied black applicants.

Results

Several criteria were measured using a Chi Squared test. We measured whether there was an overall effect, and whether the participants chose applicants for job descriptions based on the characteristics of their applications. We then measured for bias against the names and the felony status for the freshmen and the seniors and compared the results. We also measured whether

there was a bias against the stereotypically white or black sounding names for applicants with felony status. Using a Chi Squared test, we found that there were significant overall effects when we tested for assignment, for the seniors $x^2(22) = 76.67, p < .01$, $x^2$and the freshmen$(22) = 152.093, p < .01$. Both freshmen and seniors showed significant results, suggesting that when placing job applicants, participants considered either job history, felony status, name, or some combination of these characteristics. When we tested specifically for job history, there was a significant effect for both the seniors, $x^2\ (4) = 64.00, p < .01$ and the freshmen $x^2\ (4) = 116.66, p < .01$. Suggesting that job history was taken into account when placing applicants and they were not placed by chance. When testing for felony bias we found no significant effect for the seniors, $x^2\ (5) = 5.25, p > .10$,however, we did find a significant effect for the freshmen $x^2\ (5) = 32.358, p > .01$ .There was no significant effect for name bias for the freshmen, $x^2\ (5) = 6.839, p > .10$, or the seniors, $x^2\ (5) = 1.875, p < .10$ .When testing for bias for names between felons, we did find a significant effect for the freshmen, $x^2\ (1) = 8.33, p < .01$, but not for the seniors $x^2\ (1) = 0.08, p > .10$.

Discussion

My hypothesis that effects would be consistent with previous findings was only partially supported. Neither the freshmen nor the seniors displayed bias toward the names that previous findings found (Bertrand & Mullainathan, 2003). Though the freshmen did not display the same bias toward the names by themselves, they did when there was a felony added. They were more likely to hire an applicant with an implied white name with a felony than an applicant with an implied black name with a felony on their resume. Since the seniors displayed no measurable bias against either of the groups, I would suggest that something happens to lessen the bias during the four years spent in college. A meta-analysis of research conducted on classroom

programs and education, and interracial interaction between students in social and school environment showed significant improvement in racial understanding and tolerance, acceptance of diversity, and positive college experience (Denson, 2017). Currently college populations in the US consist of 30% minorities and this number is expected to increase to 40% in the next 20 years (Denson, 2017).

Neither group of students displayed the same bias against names on the applications as in the Bertrand and Mullainathan (2003) study. Data on age and educational levels were not acquired for either the Bertrand and Mullainathan (2003), or Pager (2003) studies for comparison. A study by Pew (2010) confirms that interracial dating and marriage is more acceptable for millennials than any previous generation, and Millennials are more likely to have friends of other races than previous generations. If students are more likely to have friends and other relationships with races other than their own this could account for some of the differences in our data, as interracial interactions have been shown to lessen bias (Denson, 2017). Continued research on age group and bias could be further explored. The bias that was found was concentrated among felons. If the education received was a factor in lessening bias perhaps the institution of programs for educating employers in the need for hiring felons could be explored. In court cases where the judge or prosecutors were given prior training on the effects of implicit bias, differential treatment and sentencing was greatly reduced (Kang, 2012). Cognitive testing has been developed to help individuals become aware of their own biases. Through Project Implicit an individual can take the Implicit Associations Test (IAT) and learn in a few minutes what types of positive or negative associations they may hold. The test measures the strength of the associations held between concepts like black or gay, and stereotypes like clumsy or athletic and their mental associated evaluations like good or bad. Simple tools like these, and skills that

teachers already use like covering the names on test to prevent bias in favor of students they may favor, are simple solutions to lessening implicit bias.

The largest bias displayed was against the applicants with the felony status, which is inconsistent with previous findings (Pager, 2003). In the Pager (2003) study the largest bias was against black men. Although, senior students did not demonstrate any bias against hiring felons, however, it should be noted that while the testing was taking place for the senior class a student commented to the class that they would not want to hire a felon, and the teacher stated that she had done so in the past and would again. It is possible that the teacher's words influenced testing. Research (Nestar, 2014) has documented the Milgram Authority affect and something similar may have contributed here.

In studies reviewing implicit bias and malleability of merit, people were more likely to pick the choice they liked and then back it up with reasons why (Uhlmann, 2005). When male and female job candidates were presented to prospective employers, employers first chose the candidate they liked and then backed it up with criteria. In several experiments (Uhlmann, 2005) participants were asked to pick a choice of applicant for either a stereotypically male job position, or a stereotypically female job position. When the job was stereotypically female work, like teaching women's studies, women were more likely to be more favorable in hiring a female for the position, but men were not. When the job position was male, like police chief, men were more likely to hire a male candidate, but women were not (Uhlmann, 2005). The men and women who participated did not however display any bias or discrimination. Instead they changed their standards of "what it takes" for the job depending on what their favored candidate had on their resume. When a candidate for police chief was male and had characteristics like "street smart" or "family man" these became more important. When a woman had them on hers

they became less important. Uhlmann (2005) describes this as maintaining a "personal illusion of objectivity". It has been documented that humans tend to trust people who look and act like themselves (Verberne 2016, Mackinnon 2011). This tendency can lead people to make biased choices even in high stakes choices like hiring (Uhlmann, 2005) or sentencing (Kang, 2012).

There is a relationship between age and crime. Criminal activity peaks during adolescence and early adulthood and then declines with age, presumably after the frontal lobe is more fully formed (Ulmer, 2016). This holds true across genders, and possible rises in crime statistics are caused by a rise in this population at any given time (Ulmer, 2016). Though black youth are more likely to be stopped, interrogated and arrested than white's they are no more likely to engage in crime than whites, even though they are more likely to be subjected to the causes of crime, such as poverty, discrimination, and residence in poor communities (Agnew, 2015). If then attempting to decide who to hire, the key demographic of whether a person will be trustworthy, it is not their gender or race it is their age.

Minorities face multiple points of discrimination, from the Criminal Justice System to getting a job and housing. The effect of the war on crime and war on drugs policies has been demonstrated not to work according to LEAP; the Law Enforcement and Action Partnership a group of law enforcement officers and criminal justice professionals who are dedicated to ending the drug prohibition in favor of rehabilitation. Longer prison sentences and minimum mandatory incarceration create influx of criminals, and people who become unemployable facing continued bias and restrictions on their rights (Laird, 2013). With 20 million felons in the U.S. and another 7 million in the Criminal Justice System this country has turned criminality into an industry. As more than 600,000 people enter the labor force from prison annually the need for better hiring practices is a necessity. Establishing employment is the largest factor for determining recidivism

rates (Boehm, 2017). After failing to gain employment, limited opportunities and no way to support themselves many convicts return to crime. “No one benefits – not inmates, not taxpayers, not the general public when re-entry to society is so often followed by re-entry to prison” (Rivers, 2017).

Relating this to my findings, freshmen group displayed bias toward the felon group, and bias toward the Black sounding names when they were paired with a felony, however the seniors displayed neither of these biases. This signifies that there is a possibility of changing biases. Education and interaction with groups outside of a person’s normal groups could be the key to confronting and changing our own biases, and provide greater equality and opportunities in hiring practices.

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Installation Art: The Relationship Between the Artist, the Art, and the Viewer

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Installation Art: The Relationship Between the Artist, the Art, and the Viewer

Installation art has been an important development in the modern art world, starting in the late 1960's and evolving from other widely known art forms such as performance art, environments, and happenings. Despite its popularity and importance, Installation Art is widely under-studied. Because of the lack of research, it is difficult to outline a 'true' definition of Installation Art. Although, Installation Art can be briefly described as any art form that treats any space in its entirety like a single piece, is created with the space in mind, and always acknowledges a reciprocal relationship between the viewer, work, space, and the artist. However, finding a description or explanation of the "relationships" present within Installation Art is even more difficult. This work will explore the different "relationships" that are held by the various components in Installation Art, and their importance to the larger piece as a whole. I will review scientific research on an audiences' preferences, or "aesthetics," as well as scholarly articles on the history and components on defining Installation Art. I will also be reading statements from artists and viewers on their connection to separate pieces of art. Finally, I will be pulling information from my own personal experience creating the work, and will relate that back into my studies. The goal of this work is to define, to the best of my abilities, what constitutes Installation Art, and what the "relationships" found to be necessary for defining Installation Art are, as well as how the two are related.

Proposal

Background

For my senior art show at Concord University, April 26th of 2018, my exhibition will feature my ceramic Installation piece titled "Inept." The exhibition will consist of

multiple ceramic sculptures of "Squatty Boys:" small humanoids, lush with moss and fungus, sans head and arms, who are built to crouch low to the ground and interact with the spaces within the gallery. My work represents my struggle with art and maturity. The connection that the audience shares with my work is very important. The Squatty Boys short stature draws the audience low to the ground to view the pieces fully. Also, because they are rather small and on the ground, audiences must be mindful when walking, keeping their eyes low and on my work. Through these methods, I plan to make the audience hyper-aware of the work, allowing them to emotionally connect to the physical state of the Squatty Boys, therein, making them a part of my gallery.

Objectives

I want to understand more fully the significance of the viewers' emotional interaction with a given work in regard to Installation Art, and develop a more complete definition for Installation Art. To do so, this paper will first identify what Installation Art is, what are its nuances, and how has it evolved. Secondly, this paper will identify and understand the relationship between art and artist, the art and viewer, and the viewer and artist. Third, this paper will relate these concepts together, to form a more well-defined understanding of these relationships. Finally, I will relate these concepts to my own work and elaborate.

A true definition of Installation Art has yet to be conquered. Despite the growing popularity and importance of installation in the contemporary art world, Installation Art has received little attention from scholars (Reiss). Therefore, The Oxford Dictionary's definition of Installation Art will serve as a base level definition for this paper to build off of. The 1988 Oxford Dictionary defines installation as a "term which came into vogue

during the 1970s for an assemblage or environment constructed in the gallery specifically for a particular exhibition.'' (Reiss) Installation Art can be created out of any medium, any act, or any idea. Installation Art can be pictorial or abstract, controlled or spontaneous, objects can be included, or not (Reiss). However, they must be made with the gallery in mind. In concurrence, The Glossary of Art, Architecture, and Design Since 1945, (1992), articulated that the ''word 'installation' has taken on a stronger meaning, i.e., a one-off exhibit fabricated in relation to the specific characteristics of a gallery space… In the late 1980's, some artists began to specialize in constructing installations which the result that a specific genre- 'Installation Art'- came into being (Reiss).''

Through these definitions, the idea of what ''Installation Art'' is can be manifested into a gallery exhibition where the artwork is cultivated with the gallery space in mind. However, this could lead one to understand Installation Art and ''environments'' as synonyms, when they are not. Environments, as understood in the art community , can be described as creating specific settings or conditions in a gallery space; i.e. creating an environment for the viewer to experience. This definition is the same as The Oxford Dictionary's1988 definition of installations; an assemblage or environment constructed in the gallery specifically for a particular exhibition. Allan Kaprow; American painter and assemblagist, who helped to develop the concepts of performance art, as well as ''Environments'' and ''Happenings,'' during the 1950's-60's, acknowledges that while an environment can be defined as installations, installations cannot be defined as an environment (Reiss). Environments came about during the 1950's, prior to Installation Art. The idea of environments developed slowly over time, and evolved into the separate art form known as installation.

The difference between Installation Art and environments can be found within the underling meaning, or purpose, of installation. Installation Art is made separate by its importance placed on the viewer as an integral part of the piece. The space of the gallery is taken into consideration, and the work is created to serve the gallery space - similarly to an environment. However, Installation Art treats the entire space, and everyone in the room, like a single, cohesive piece (Reiss). In Installation Art, the viewer is treated as a necessary component of the work, and the meaning of the work is conceived during the interaction between the viewer and the art (Reiss). In 1993, Arthur Danto, an art critic for The Nation magazine, author of over 30 books, including "After the End of Art," and a longtime philosophy professor at Columbia University, stated that, regarding Installation Art, "it is impossible to speak of any one piece without having undergone the experience it demands (Reiss)."

The allure of Installation Art varies across the testimony of different Installation Artists. Some artists are drawn to the appeal of a "temporary space." Installation Art is made specifically for a certain space or gallery, is only fully realized when the viewer comes in contact with the space and the work, then is removed. This fleeting experience is one reason why historians and scholars have not delved into the research of Installation Art; because it is so difficult to examine in such short bursts of time (Reiss). However, other artists have differing reasons for their romance with Installation Art. Alice Aycock, an Installation Artist during the 1970's, speaks about her connection to the spaces and the appeal of *working* with a gallery as apposed to *putting* work in a gallery. Aycock, referring to the gallery space at 112 Greene Street, stated

> "The 112 space was not holy. It was a place that artists could call their own— a real alternative. Each artist set up hours, actually moved in, and worked in a really free way. [George] Trakas cut a hole in the floor. It was a completely different way of making sculpture.You didn't even think about it, you just responded to the place (Reiss)."

Adam Gopnik, a writer for The New Yorker since 1986 and art critic, found the appeal of Installation Art to be in its' meaning. Gopnik felt thatInstallation Art was, "unified more by a common ideology than by a common set of forms—unified more by what it is trying to accomplish than by the way it looks (Reiss)."

For others, the value of Installation Art comes from its ability to create a "sacred" artistic space out of ordinary spaces. Ilya Kabakov, Russian-born draftsman, painter, and conceptual artist, said, "The alternative spaces … are not the highest level of art . . . as museums are, and placement of installations into museum sacred space makes installation also sacred (Reiss)."

Despite the differing connections to Installation Art, the viewers' participation remains a necessary factor in actualizing the meaning of the piece. Patrick Ireland, a pseudonym used by Brian O'Doherty, is an Irish art critic, writer, artist, and academic. Ireland expresses the importance of this relationship by stating,

> "[My] work . . . has a . . . conception of the viewer, not as an eye, nor a brain, nor a bundle of reflexes moving a corpus around, but one that offers a person to make his own space, to live in his own space (Reiss)."

The definition of "participation" for the viewer varies for each individual installation piece and each individual viewer. Participation could mean to implore the viewers to do something within/to the space, or simply make the audience confront the piece and simply experience (Reiss). An anonymous reviewer of Patrick Irelands' Rope Drawing #1 at 112 Greene Street, 1973 described their experience with the work as such,

> "In the anteroom of the gallery a rope sculpture, resembling the ribcage of a dinosaur, almost engulfs the space and creates an environment....The various angles from which the ribs are viewed fascinate the beholder, mixing shadows on the walls with crossing lines of the physical piece. Consequently this aesthetic sculpture engages the viewer in a perceptual dialogue (Reiss)."

Irelands' Rope Drawing #1 represents a fantastic example of Installation Art. Not only was the piece done with the room in mind, the piece also transformed the space into something greater and more complex. Ireland also created a "perceptual dialogue" with the viewer by forcing the viewer into a new realm and creating a relationship between the space and the amateur audience.

The idea of participation by the viewer creates a specific scene in ones head: viewers within a gallery space interacting with art. When we think of a "space," we think of an area that, in some way, is separate from another area. When we think of space within the contexts of art, we often think of a gallery. However, any space can be transformed into an installation piece, regardless of walls or boundaries. Artist, poet, and architect, Vito Acconci, took the idea of installation to a much grander scale. During October 3-25, 1969, Acconci completed "Following Piece." In this piece, Acconci would choose random individuals on the streets of New York and follow them throughout the

city until he lost them when they entered a store, subway, house, etc. Acconci felt disconnected with the city and its' people, and wanted to find his place amongst the heartbeat of New York. He felt that, by subjecting himself to the lives, decisions, and environments of the individuals he followed, he would obtain greater since of the self as part of the whole (Jackson).

In an interview with the author, Shelley Jackson, Acconci describes his connection to the individuals he followed, "Any time you do something, you make decisions about time and space. I wanted those decisions to be out of my hands. I could be dragged, carried along by another person, I could be a receiver. I could be the agent of the overall scheme, but I didn't want to be the agent of the particular action. I could make the ultimate decision that my space is going to change now, but I don't know where it's going to go (Jackson)." New York City became his space, and the random individuals he followed became the art. In this scenario, Acconci himself was the audience, subject to the nuances of the individuals 'built' for the space of New York.

Possibly the most shocking of Acconci's installation works, and the most important in the context of viewer participation and the overall relationship between viewer and artist, is titled "Seedbed," lasting 9 days, 8 hours a day, over a 3-week exhibition at the Sonnabend Gallery, New York 1972. During this piece, Acconci would hide underneath a wooden ramp in the floor, while the audience entered an empty gallery. The audience would walk around the empty space while Acconci would crawl around the space under the ramp, following the sound of their footsteps, and masturbate (Jackson). Acconci describes his unusual relationship to the viewer to Jackson;

> "I had done a number of performances in which when a person enters, I'm there, and I thought, there's something wrong with that. I don't want to be the prime point in the space. I wanted to be somewhere where I blended with the space … Under the floor seemed to be the most fertile, because I could move under the floor, therefore I would be relatively coincident with viewers' feet… but something has to come from my position, under the floor, to viewers' position on the top of the floor… [by] masturbating. But it was important that the viewers have to, not necessarily know that I'm masturbating, but they have to hear me. Masturbating under the floor is a private activity. Moving around under the space where people are walking, concentrating on viewers' footsteps, and using the footsteps as an impetus to a sexual fantasy, that maybe turns the private into public. I depend on you to be walking, so I can fantasize about you (Jackson)."

Viewer participation is vital to the 'life' of Installation Art, that without having experienced a particular piece of art, it is almost impossible to truly analyze and critique the piece. This nuance of Installation Art has also prevented Installation Art from being fully studied. However, researchers are able to study the emotional responses of viewers when they see and/or experience a piece.

In 2012, scientist Edward A. Vessel, Professor of English G. Gabrielle Starr, and engineering scientist Nava Rubin, conducted a study at New York University titled, *"The Brain on Art: Intense Aesthetic Experience Activates the Default Mode Network."* The goal of the study was to observe the sensitivity to positive and negative emotional

aspects of aesthetic experience, and the evidence for individual differences correlated with personal differences in aesthetic evaluation (Vessel).

Aesthetics can be described as our perception of external objects as related to the principals of beauty and artistic taste, regardless of any apparent function of the object (Vessel). This simply means whether or not a person has any emotional response to an artwork. The ability to study this phenomenon of aesthetic experience has only recently became available as recent neuroimaging technology has developed. To study the individual aesthetic response to different artworks, the team at NYU used fMRI and behavioral analysis to study and identify two distinct patterns of neural activity exhibited by different sub-networks of the individuals (Vessel).

To conduct this study, the team at NYU chose 16 observers from NYU whom all had normal or corrected to normal vision. Observers were instructed to observe a set of 109 images while lying in a scanner for 6 seconds each, and to rate each image on a scale of 1-4, responding to the question "How strongly does this painting move you?". This includes, but in not limited to, emotional responses that would lead a viewer to described the artwork as beautiful, strange, or ugly. The instructions for this study were as follows,

> "Imagine that the images you see are of paintings that may be acquired by a museum of fine art. The curator needs to know which paintings are the most aesthetically pleasing based on how strongly you as an individual respond to them. Your job is to give your gut-level response, based on how much you find the painting beautiful, compelling, or powerful. Note: The paintings may cover the entire range from "beautiful" to "strange" or even "ugly." Respond on the

> basis of how much this image ‘‘moves’’ you. What is most important is for you to indicate what works you find powerful, pleasing, or profound (Vessel).’’

The artworks were chosen from the Catalog of Art Museum Images Online Database, and ranged from a variety of cultures such as American, European, and Japanese, and different historical periods (Vessel). Images were both representational and abstract, and commonly reproduced images were not used to avoid recognition (Vessel).

After the initial ‘‘gut-response’’ review of the images during the scan, the participants were given a questionnaire. Participants were then shown the same set of images in the same order for 6 seconds each, and asked to now to ‘‘rate the intensity with which each artwork evoked the following evaluative/emotional responses: joy, pleasure, sadness, confusion, awe, fear, disgust, beauty, and the sublime (Vessel),’’ on a 7 point scale for each image.

The results indicated that aesthetic experience involves the integration of sensory and emotional reactions linked with personal relevance (Vessel). Meaning that, each persons ‘‘aesthetic experience’’ for each individual piece was specific to that person. Each image that was highly ‘‘recommended’’ by one participant was, subsequently, given a low ‘‘recommendation’’ by another (Vessel). These aesthetic responses are paradoxical; as while the same images were given a high score and also a low score, the aesthetic responses and reasoning for the individuals differing scores were based on a myriad of differing emotional responses. However, the team at NYU feel that their research can explain this paradox. In their conclusion, they state,

> ‘‘The emerging picture of brain networks underlying aesthetic experience presents a potential solution to this paradox. Aesthetic experience involves the

> integration of neurally separable sensory and emotional reactions in a manner linked with their personal relevance. Such experiences are universal in that the brain areas activated by aesthetically moving experiences are largely conserved across individuals. However, this network includes central nodes of the DMN that mediate the intensely subjective and personal nature of aesthetic experiences, along with regions reflecting the wide variety of emotional states (both positive and negative) that can be experienced as aesthetically moving (Vessel.)"

This breaks down to state that while aesthetic experience can be measured in largely the same areas of the brain across all participants, a persons individual experiences and connection (relevance) to the image will sway their aesthetic response. The aesthetic response of individuals is found to be highly subjective. Each person, based on their personal experience, will find different levels of aesthetic responses for different emotional reasoning (sadness, sublimity, ect.), regardless of the content of the image (Vessel). In relation to Installation Art, the viewer, while integral to the fruition of Installation Art, will experience and engage with the art in his/her own personal way. This gives endless subjective meanings to the installation piece itself, and allows for a wide verity of interpretation and connection by the viewer.

While the relationship between the viewer and the art is subjective, there seems to be a common theme amongst the relationship between the artist and their artwork. Patricia Townsend interviewed 30 professional artists to explore the state of mind experienced during the process of creating art. Townsend identifies three stages in the

creation of art, termed; genesis, development, and separation. Although these stages typically follow a chronological order, progression through the stages may be altered depending on problems, new concepts, and material limitations (Townsend). Movement between the stages, reverting back to a previous stage, and becoming stuck in a stage is common. However, all artists will eventually move through the three stages to produce a finished piece. In the abstract, Townsend states,

> "An analysis of the interviews suggests that the artistic process may be considered in terms of stages and I have termed these 'genesis' (referring to the conception, gestation and birth of an idea for a new work), 'development' (referring to the relationship between artist and nascent artwork as the artist engages with her medium) and 'separation' (referring to the release of the artwork into the outside world, usually in an exhibition). In viewing the artistic process in this way, I draw a parallel between the relationship between mother (or care-giver) and child and the relationship between artist and artwork (Townsend)."

The 'Genesis' stage can be described as the gestation and birth of a new idea or a future work. It is the point when the creation of a piece of art begins. Some artists interviewed described this moment as a sudden realization or epiphany. Those artists who experienced this 'frisson' explained the feeling of being 'inspired' rather than working through the idea. Instead of spending conscious time brain storming and planning an idea, these ideas seem to suddenly manifest inside the mind of the artist (Townsend). Much like salt in boiling water, the water is the mind of the artist, and each grain of salt is a different part of an idea. All the grains of salt are being stirred around in

hot water, but remain separate. Suddenly, the salt is gone, and you make the realization that you now have salt-water. This 'ah-ha' moment is described by artist Simon Faithfull,

> "It must have been knocking around… until that moment when I absolutely needed to have an idea… Something about what happened revealed to me something about the nature of those ideas; that they're sort of… in solution and then at some moment drop out of solution and sort of become crystallized. They feel like there's something I've been chewing on and mulling over but in a very unstructured incoherent way (Townsend)."

Artist Russell Mills describes a similar experience,

> " I have a certain set of ideas in my head – passions that I want to explore. So you're constantly looking for things that connect... It's what I call shed mentality … to be so curious about the world that you absorb all these diverse ideas and then somehow make something new out of them. That's what I think creativity is about (Townsend)."

Other artists describe their 'genesis' as a constant synthesis of different elements and ideas that will eventually lead them in a new direction and a new work. Artist 6, a painter who wished to remain anonymous, describes this experience thus,

> "The starting point for a painting can come from desire to be with the material in a particular way, either because I'm curious about it, because I want to revisit something, or I want to… tap into something in myself I haven't got to the bottom of… So it comes from all sorts of different sources. And it can come from a past painting, it can come from another artwork, it can come

> from a conversation you've had … again it relates back to your constant response to things in the world that you're tapping into (Townsend)."

The 'development' stage refers to the phase of the artistic process in which the artist's engage with their medium and begins to create a piece (Townsend). There is often a disconnect between the ideal image within the mind of the artist and what is being produced. Artists face many challenges when creating a piece, such as difficulties presented by the materials used, and the artists own limitations. Judith Goddard describes this discrepancy between her work and her 'perfect' manifestation of her idea. Goddard states, "You have these ideas that are perfect in your head and you have to actually make them happen and you then have to deal with the imperfect world – the material realization of your idea (Townsend)." All forms of art, painting, graphic design, sculpture etc. have limitations. For example, paint can only be worked with on canvas for so long before it will dry, and ceramics are subject to explode in the kiln. As an artist begins to face limitations within their work, their 'perfect manifestation' of their idea dissipates. Goddard describes that the development of the final piece will come about through a negotiation of 'conceptualization, visualization and materialization;' a dialogue between artist and medium (Townsend).

This dialogue is a negotiation between the artist and their work. John Aiken describes this negotiation,

> **"**Although you know what you're doing, what the result is is something different… After a while you've no idea of how you got to where you've got

> to. What you've got is something that's got its own life, its own energy, and therefore you automatically are in a dialogue with it because it's different. It's not the sum of its parts. It's something that is rather strange in some cases and you think what's this absolutely awful thing I've made… But it's kind of interesting… That dialogue may very quickly turn into divorce but it's still a dialogue. It's not a romantic notion of a dialogue. It can be a very focused and a very kind of cold dialogue but you are getting something back because you never can predict what's going to happen. So each action is taking a risk, is taking a speculative step. If knew what it was going to be I wouldn't start it. Because I could just imagine it. So I want to make something where I don't know what it's going to be (Townsend)."

Instead of battling these limitations and disappointments, Aiken treats these road-blocks like opportunities. By allowing himself to succumb to the unexpected, he is able to respect and value to medium of his work and the overall finished piece. George Meyrick attests to the feeling of anxiety and panic that can come along with allowing yourself to be vulnerable to the artistic process. Meyrick states,

> "You're buried in what you're doing… the concentration, intensity, increases exponentially possibly… It does get like a sort of welding torch – a sort of white heat of something there. You're right in it and you're not thinking about anything else except how this will go, what might happen (Townsend)."

Townsend states that all artists describe becoming 'lost' or 'enveloped' in the act of creation. However, the limitations of the work, and the combined since of anxiety

along with loosing oneself in the activity, can result in a since of 'disorientation,' "That process of disorientation that is quite a difficult state to stay in," states artist Hayley Newman, "not having any markers or anchors or anything that can establish what this thing is that you're supposed to be doing or grappling with (Townsend)." Dryden Goodwin describes it as an "oscilla[tion] between being very conscious – because you've got to make practical decisions – and being very intuitive and reactive (Townsend)."

This disorientation can be panic-inducing, but is also a necessary process in making art. Aiken captures the fast-paced urgency of creating while speaking about the process to Townsend. Aiken states,

> "I would say it's like heightened reality and being in a trance at one and the same time. So you become totally absorbed in something which could be very mundane and at the same time your thoughts are racing and you're making lots of decisions and you're going forward and you're going back and you're unpicking it and you're developing it and you're imaging something (Townsend)."

Educationalist Anton Ehrenzweig describes this particular state of mind as integral to the process of creating art. Ehrenzweig describes this processes as a 'flexible scattering of attention' and an 'unconscious scanning,' where the artist is able to group all the diverse elements of the work together in their mind and focus on the larger piece (Townsend). Ehrenzweig calls this a "smooth oscillation between focused and unfocused modes of perception (Townsend)." An environment must be

created in which an artist can properly foster this 'smooth oscillation' in order to create a cohesive and satisfying piece. In this respect, the artist acts as 'environment mother' in relation to the developing artwork (Townsend). The artist is deeply involved in the 'white heat' of their emotional and physical engagement with the work, and this relationship can be related to that of 'child-mother.'

'Separation' defines the final stage in an artists creation of a work. Separation refers to an artist presenting their work to the outside world, usually in the form of a gallery exhibition (Townsend). This is often the most difficult part of the processes for the artist. In this stage, the work becomes 'exclusive' from the artist. It can now exist separately from the artist as its' own entity. Once presented to an audience, the work is subject to the different representations and understandings of the individual viewers. They will judge its' importance, meaning, and whether or not it is aesthetically pleasing (Townsend). Sian Bonnell describes this separation much like cutting an

> "…umbilical cord. They are my children you know and I have to cut it. I have to cut and you've got to get yourself to a point where you can do that… It's part of me till then and then it's not part of me but there is still a raw thing (Townsend)."

Again, we see the 'child-mother' relationship between artist and artwork. Other artists speak to this relationship in regards to separation. Kay Tabernacle states, "I think I have a relationship with things when they're finished. I definitely have a relationship with them afterwards…It then has a different life. It might have a

life being up in an exhibition and people talking about it… an independent thing (Townsend)."

According to Ehrenzweigs' three-stage model of the artist's process, "there is a gradual progression from the predominance of projective identification towards perceptive identification as the work approaches its final form (Townsend)." In the first stage, the artist combines ideas and elements, either consciously or subconsciously, then projects them onto the piece, finally during 'separation,' the artist retrieves these fragments of themselves and allows the artwork to assume its own identity as imparted by the audience (Townsend). This process brings about the emotions such as pride, anxiety, or loss; similar to the feeling of a child leaving the home.

The concept of separation is becoming ever more prevalent as my senior art exhibition draws closer. The concept of "the integral viewer" was first introduced to me during an Art History Seminar conducted by Jack Sheffler on the topic of Installation Art. This idea of creating a work in which the audience, and their connection to the specific work, is in itself the art, resonated with me. From there, this idea became the focus of my research, and developed into the basis of my senior art exhibition. I want to create an exhibition that will prompt the viewer to examine or re-examine their own "coming-of-age" narrative. I want to evoke the pull between childhood and adulthood by focusing on the growing pains inherent to that struggle.

At the time I learned about Installation Art, I was struggling to adapt to my life as a full time college student, full time employee, and living independently. The stress of responsibility was overwhelming at times; regardless I always made my

situation work. I was, however, unable to reconcile with feelings of self doubt. I worry routinely over my decisions and efforts, wondering if I am doing enough, succeeding enough, and being enough. Emotionally exacerbated; I wanted to manifest these negative feelings in a physical sense . This became the basis for my senior art exhibition; Inept.

I believe all individuals experience these feelings of confusion and internal chaos while maturing. My sculptures are informed by these internal states. They became a direct reflection of my own perception of myself. They are squatting, covered in moss and stagnant because I felt as though I was not progressing correctly in my art and I felt trapped by certain elements in my life. They are headless and armless, because I felt as though I was unable to develop or execute worthwhile ideas. They are Inept.

My sculptures, called Squatty Boys, are made out of stoneware clay, and decorated with preserved moss and decorative faux flora. Creating a sculpture begins with a sketch. Usually, I would draw how I was feeling that day, and that headless lump laying on the floor would become the blueprints for my sculpture. My mid sized and larger pieces are built in sections, hollowed out, and attached. The smaller pieces, called Sprigs, are sculpted out of a single lump of wedged clay, and are solid. All works are dried slowly before entering a bisque fire. Once fired, the larger pieces are spray painted and decorated while the small works are flocked.

The Squatty Boys are created with small detail and put on the ground in an attempt to make the viewer hyper aware of my work and draw the audience in, focusing on a moment between the viewer and the work. It is in this moment that I

hope for the audience to emotionally connect to the physical state of the Squatty Boys, therein, making the viewer a part of my gallery.

Installation Art is a complex integration of the delicate and varying relationships between the art, the artist, and the viewer. In this paper, these relationships have been identified, and a more finite definition of Installation Art has been developed. Installation Art can be described as any art form that treats any space in its entirety like a single piece, is created with the space in mind, and always acknowledges a reciprocal relationship between the viewer, work, and the artist. These reciprocal relationships can be identified as that of mother-and-child (for the artist and art) and a myriad of varying relationships and connections that are individual for each viewer who encounters the art. This paper has also identified the integral importance of the relationship between the viewer and the work/space, and the reasoning behind why an artist would want to display their work in an installation. Finally, these concepts are related back to my personal experience and motive for constructing this paper.

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Using Volcanic Ash to Constrain the History of Glacial-Interglacial Lake Levels in Summer Lake, Oregon.

Cameron McNeely

2018

Abstract

With field data collection and lab analysis performed during this project, alongside previous research done in the area involving chronostratigraphy of the volcanic ash layers deposited by surrounding volcanoes and a geologic history of the area, a time frame is identified for when the unconformities in our designated research location most likely occurred relative to volcanic eruptions throughout the region. With this information, a correlation is made between the unconformities and ice age events, which were taking place during time of deposition. As this connection is made between the given eruptions and glacial events during that time, alongside information collected with our field and lab data analysis, estimated lake water levels can be determined based off of the events that are marked by the tephra in the area. It will not only explain the missing sediment deposits, but it will show the fluctuation in lake water level over time in relation to the glacial and interglacial events that were taking place as well.

Introduction

Geology of Area

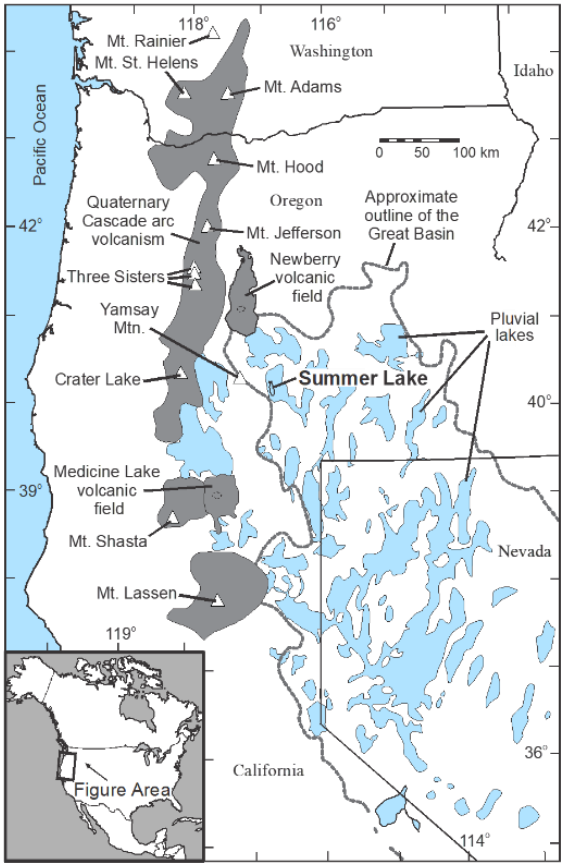

Figure 1: Regional map showing the location of Summer Lake and the surrounding Volcanoes as well as the other pluvial lakes in the area.

Source: Kuehn, S.C., and Negrini, R.M., 2010, A 250 k.y. record of Cascade arc pyroclastic volcanism from late Pleistocene lacustrine sediments near Summer Lake, Oregon, USA: Geosphere, v. 6, doi: 10.1130/ges00515.s1.

Summer Lake is located in the composite basin of what was originally the Pluvial Chewaucan Lake which also includes Abert Lake and Alkali Lake. (Figure 1) These interconnected lakes are located in fault controlled basins developed within grabens or half grabens and are bound by horst blocks. (Pezzopane SP1) Allison (1983) observed that Lake Chewaucan created erosional and depositional shorelines in various locations around the basin. Sediments found along the walls of the Ana River Canyon show lacustrine and deltaic deposition occurred over the past 250,000 years and are most likely visible due to block faulting and fluvial dissection. (Allison 1982) Originally, Allison created a partial tephrochronology accompanied with lithologic descriptions for the first few meters of the Canyon, but Davis (1985) created a more complete one which included the discovery of multiple tephra beds. The clay and silt deposits in the area were most likely deposited in an environment with little to no turbulence over extended periods of time, and well sorted sand lenses reflect shallow lake conditions. (Erbes 2001) These thin silt and sand lenses indicate wave base disturbances. Unconformities are shown in the form of mud cracks throughout the Canyon area. This suggests that lake conditions were perennial throughout the majority of the late Pleistocene. (Erbes 2001) Other Unconformities are marked by brecciated carbonate layers, which reflect a high energy environment.

Climate Record

The late Pleistocene landscape of the western United States was characterized by vast lake systems indicative of a hydrologic balance. (Ibarra et al. 2014) Pluvial lake systems in the Basin and Range Province indicate greater moisture availability during glacial periods. Ibarra also says that the geographic extent and temporal trends of the latest Pleistocene lake levels suggest that orbital conditions and changes in atmospheric circulation imposed wetter and/or cooler conditions on the western United States. (2014) Many of the lake highstands occur during Heinrich Stadial, which occured several thousand years after the Last Glacial Maximum. Climate models of the Last Glacial Maximum tend to predict that the Pacific Northwest was a more arid area. Paleoclimate records suggest reduced precipitation as well. (Worona and Whitlock, 1995; Bradbury et al., 2004). Ibarra continues to state that most studies infer that Pleistocene lake levels record precipitation amounts driven by changes in midlatitude atmospheric circulation. (2014) A detailed paleoenvironmental record has been created for the Summer Lake basin individually based on cores and outcrop sites. Geochemcial and paleontologic indicators show that climate change occurred during the study interval of 250ka – 5ka. (Cohen et al 2000) This section of time is particularly interesting because there is a great amount of evidence of glacial and interglacial events in the area. Samples from various water sources in the central and southern Great Basin show evidence of increased precipitation multiple times between 80-60ka. (Smith et al 1983) An unconformity found in the area indicates that the lake underwent multiple lake-level excursions throughout the middle and late portion of the Pleistocene. (Cohen et al 2000) Summer Lake, Oregon has an arid environment and on average only has around 273mm of rain per year. With that, the main vegetation in the area consists of sagebrush and rarely juniper trees. In all, this area has had major climate changes all the way up to present day representing the arid climate which was previously described.

Tephra and Geochronology

Tephra beds are often used as stratigraphic markers because they can be linked back to their source volcanoes and dated, helping to determine the age of the sediments deposited in between the ash layers. It helps to determine the age of eruptions as well and the range for how far the material from the source volcano can travel. Newberry Volcano, in particular, has a low angle shield that stretches around 30 km east-west and 50 km north-south, with over 50 known tephra

beds identified in the area. (Kuehn and Foit 2006) It is the largest volcano in Oregon, covering an area of 1300 km^2 and reaching a height of 2433m, and its oldest eruption dates back to 1.2 million years ago. Tephra layers from different eruptions usually have a varying glass composition, as well as different minerals present making it possible to identify what the source volcano is and when the eruption occurred. However, glass composition is most useful for identification of identical tephra beds in outcrop because the glass composition stays constant over distance. (Kuehn and Foit 2006) The dates used to correlate with the outcrops and beds for this project came from tephra sample analysis done at other locations. Table 1.1 shows correlative unit and the age for each bed, simplified from Table 3 by Kuehn and Nagrini. (2010) By analyzing these tephra deposits, frequency of eruption as well as the magnitude and hazards of different events can be determined and described. (Kuehn and Nagrini 2010) Tephra beds can also help to link glacial and terrestrial records over long distances. (Kuehn and Nagrini 2010)

Table 1.1 Reference Bed Units and Related Ages (Simplified)

Unit	Age (ka)
Mazama Tephra	7.545
Tephra in GISP2 Core-Mazama Tephra	7.627
Mount St. Helens Mp- Bed D	22.9
Bed 18- Trego Hot Springs	24.8
Wono- Bed F	29.1
Mono Lake excursion	33.9
Bed 12- Mount St. Helens Cy	47.43
Pumice Castle Bed 6	71
EMSH tephra bed- Bed I	83
Shevlin Park Tuff- Bed AA1	255
Pringle Falls D- Bed GG	211
Antelope Well Tuff- Bed KK	171
Bed LL	160
Qdt-Qto tephra- Bed NN	300

Methods

Field Work

The field area consisted of three separate but connected outcrops which varied in tephra content due to erosion and lake levels during the time of deposition. (Figure 2) Sample collection methods included trench digging, cleaning of the outcrop, and identification of the different tephra layers compared to other sediments. Once these tasks were completed, various tools were used to carefully remove small amounts of each tephra layer, which were then put into separate

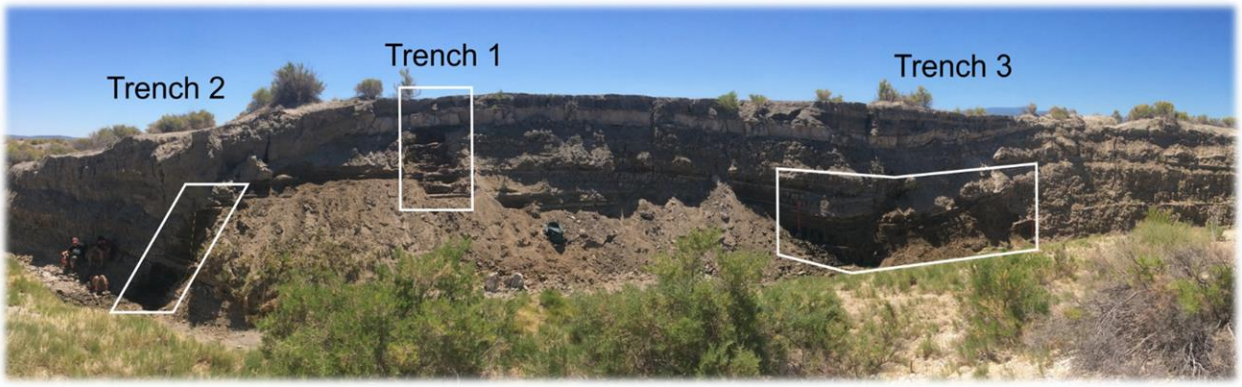

Figure 2: Image showing the three outcrops relative to one another that were used for sample collection during this project. Photo Taken by Dr. Stephen Kuehn.

bags with labeling that included the work area, samples number, and year of collection. This process was done for every sample collected and then the samples were stored for travel and shipment back to the preparation lab in West Virginia.

Lab Work

Sample Preparation

When unpacked, each sample was given a unique catalogue number and then sample preparation was started. A majority of the samples were sieved to remove particles that were smaller than 20 microns because several samples were lost in shipment from the field. Coarser samples from close to the source volcano were crushed before the sieving process began. They were then cleaned with a diluted HCl solution and Alconox mixture. An ultrasonic cleaner was then used to clean the samples

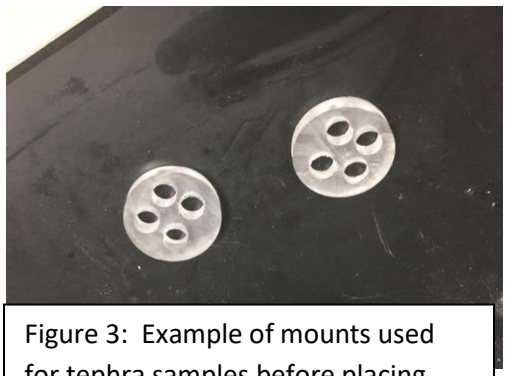

Figure 3: Example of mounts used for tephra samples before placing them in the microprobe.

further. The samples were then mounted in circular acrylic mounts using epoxy and polished with a final polish on 1 micron diamond lapping film. Sides of the samples were then trimmed to make them easier to put into the microprobe as the top surface was also polished to remove any excess epoxy. (Figure 3)

Sample Analysis

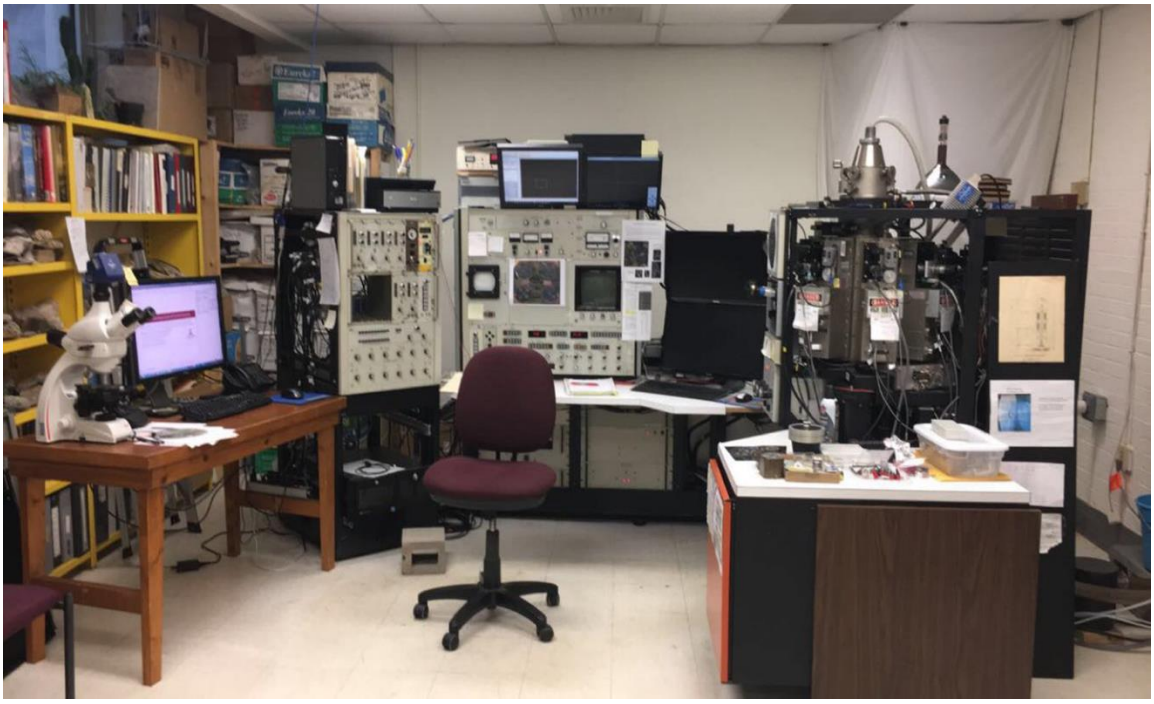

Figure 4: Concord University's ARL-SEMQ electron microprobe, used for chemical analysis of tephra samples.

Samples were analyzed to measure the content of certain elements using six spectrometers of an ARL-SEMQ electron microprobe. (Figure 4) In the routine setup, tephra samples are analyzed for SiO2, TiO2, Al2O3, FeO, MnO, MgO, CaO, Na2O, K2O, P2O5, Cl, and BaO. Analysis of four reference glasses was also performed before and after each sample was ran on the electron microprobe for quality control. The reference glasses include: Lipari obsidian ID3506 (Kuehn et al 2011), BHVO-2g, NKT-1g, and Orthoclase glass. Analytical and data reduction procedures are similar to those of Kuehn (2016), but with Ba added. Based on size of the shard of volcanic glass in the tephra, anywhere from a 4 micron beam to a 10 micron beam was used to perform the analysis. Small beam diameter is necessary for most samples due to the very thin glass shards. A time-dependent-intensity (TDI) correction was used for Na, the tephras and Lipari standard. There is also an interference correction for the overlap between Ti and Ba X-ray lines,

making the analysis more precise. The routine was based on maximizing precision to help distinguish minute differences between chemically similar samples.

Interpretation

Physical Data Analysis

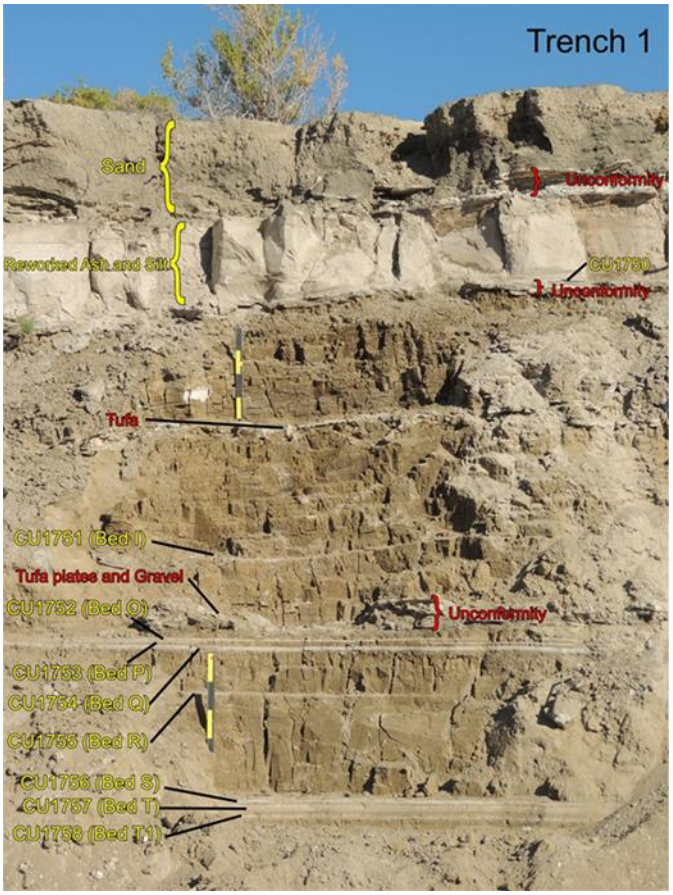

Figure 5: Trench one outlining layers, labeled in yellow, and unconformities. Tufa plates and gravel sized sediments compose most of the unconformities present within this trench, labeled in red. Meter sticks for scale.

Photo taken by Dr. Stephen Kuehn and labeled by Cameron McNeely.

Photographs of each trench that were dug and used for sample collection were analyzed and labeled for geologic interpretation. Trench one included multiple unconformities between the ash layers and some of these included tufa plates as well as gravel sized sediments. (Figure 5) All ash layers that were sampled were also labeled so that the photograph could be compared to the known chronostratigraphy from previously done research in the area. Similar labeling was done with photographs of trench two and three as well, giving us the ability to observe correlations between the trenches relative to each other in outcrop, especially in regards to unconformities and tephra layers compared to elevation. (Figures 6 &7) Faulting was also observed and recorded within trench three. The total fault movement was estimated to be around five feet in one area and average of 1.3 feet in another area of trench three.

A graph of marine records of sea level and oxygen isotopes over multiple ice age cycles is used as a comparison to the lake levels in the field area. (Figure 8) Lakes such Summer Lake

record related regional changes. The peak of the last ice age over to the left of the graph, was around 20 thousand years ago. If you look at some of the peaks and valleys on the curve, you can see the fluctuations that occurred over time. If the sea level is low, such as where the last ice age was, the lakes were relatively bigger compared to times where the sea level was high.

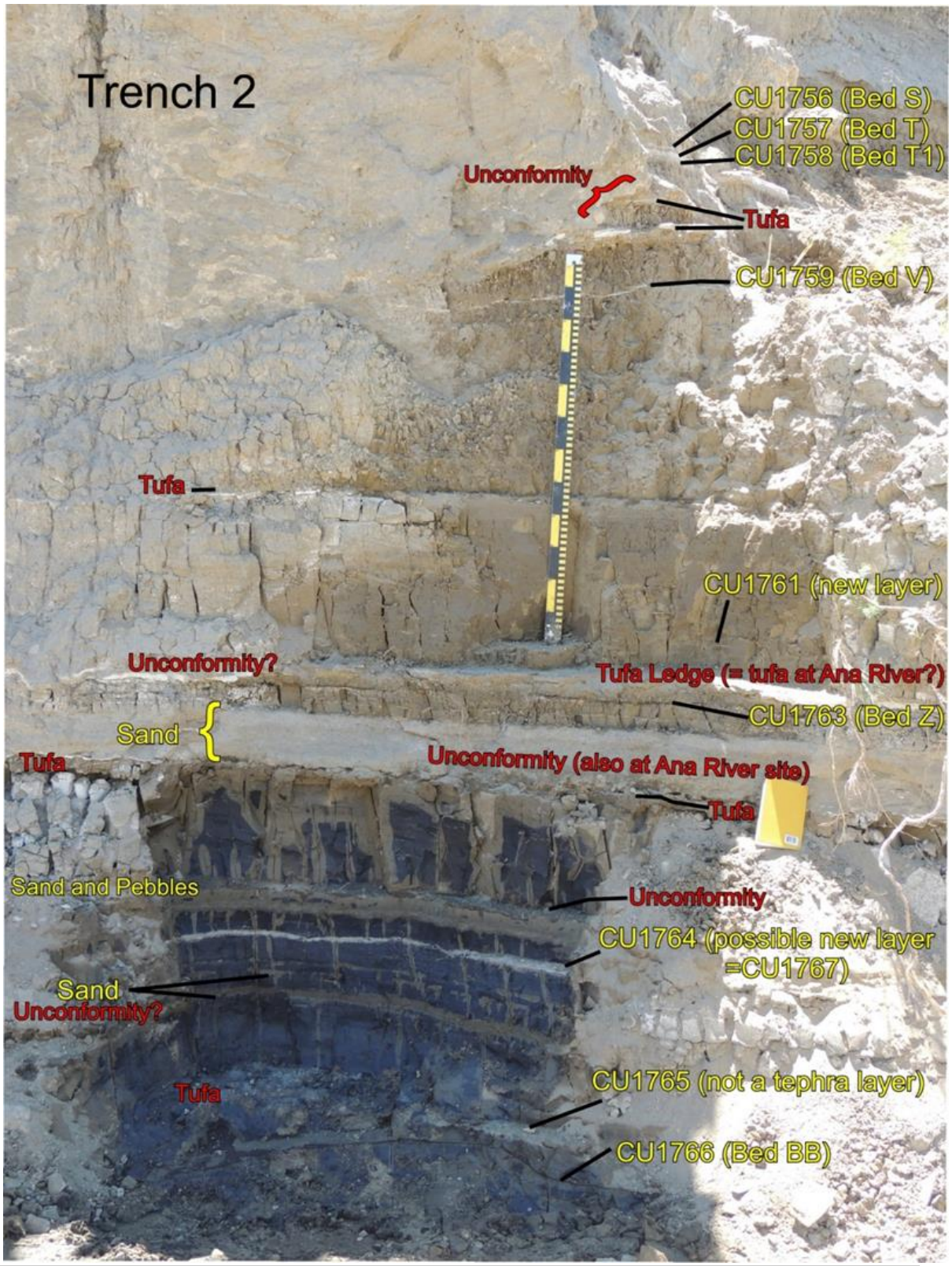

Figure 6: Trench two from field area. Tephra layers are indicated with yellow labeling as in the image from Trench one, and the unconformities are also labeled with red as in the first image. Meter stick and field notebook for scale.

Photo taken by Dr. Stephen Kuehn and labeled by Cameron McNeely

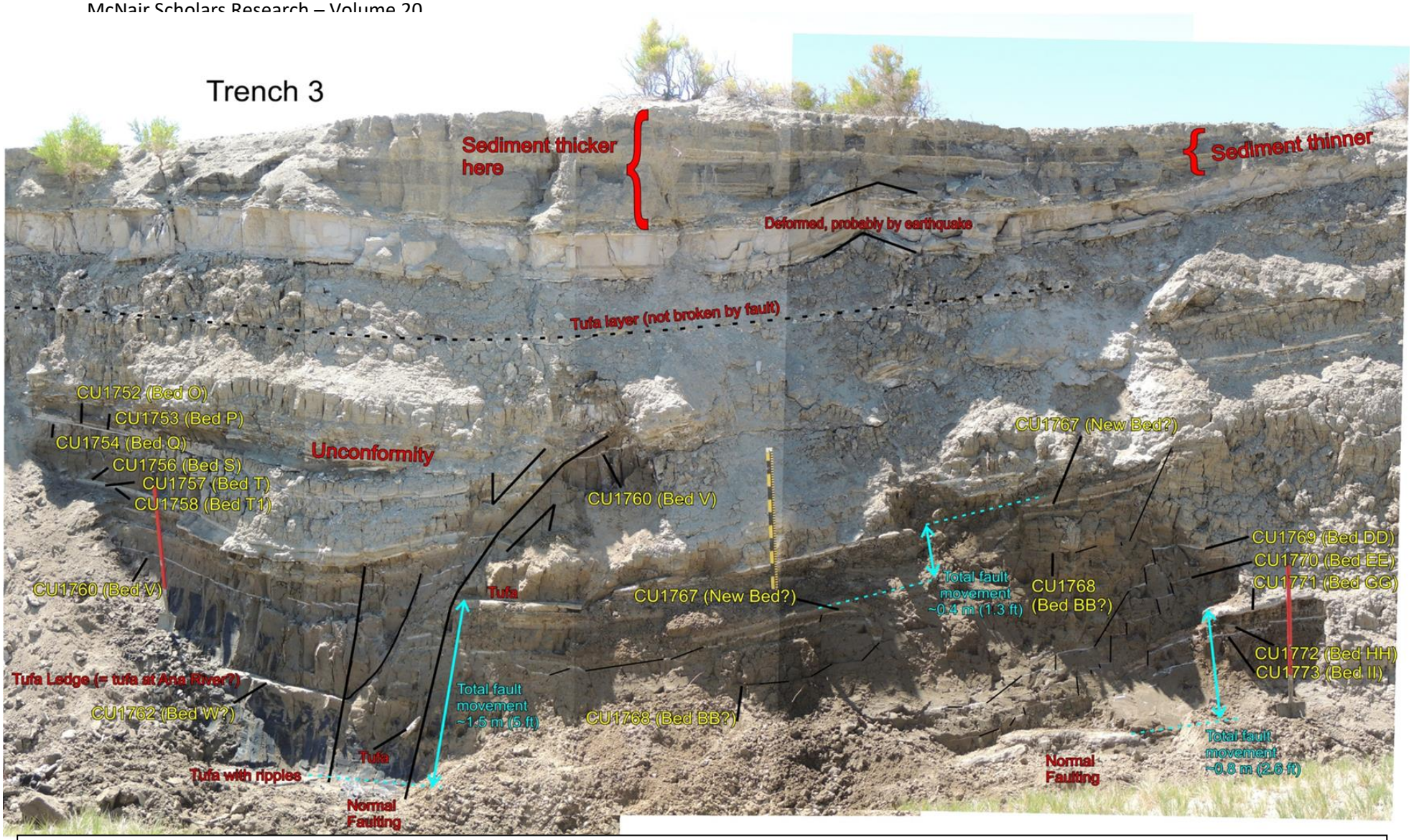

Figure 7: Field trench 3. Tephra beds are outlined with yellow and unconformities are designated with red labeling. The black dotted line that runs almost horizontally across the trench shows a tufa layer that is not broken by the fault, indicating that it formed after the fault movement occurred. The estimated fault movement is indicated with blue labeling. Meter stick for scale.

Proto taken by Dr. Stephen Kuehn and image labeled by Cameron McNeely

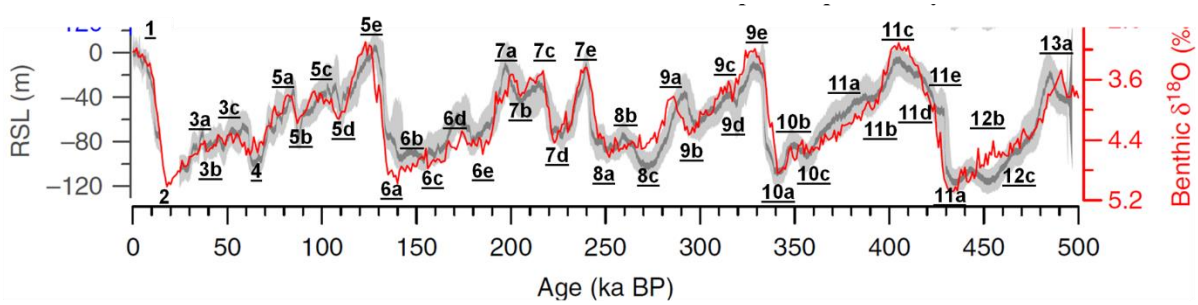

Figure 8: Graph relating sea level to relative ice ages. (age in ka) When sea level is lower, lakes are larger. When sea level is higher, lakes tend to be smaller.

Railsback et al., 2015, An optimized scheme of lettered marine isotope substages for the last 1.0 million years, and the climatostratigraphic nature of isotope stages and substages. Quaternary Science Reviews Vol 111 Pages 94-106

Chemical Data Analysis

The chemical data taken and analyzed in our lab was compared to existing reference data from other sites in the basin and data from the surrounding source volcanoes. The ages of each bed and its placement in the stratigraphic sequence were also considered when trying to match our samples to previously recorded beds. When correlations can be made to multiple lines of evidence, those beds are considered to be named and matched with more confidence. (Lowe et al. 2017) Table 1.2, below, shows the averages of each element that the sample was tested for, for each individual sample as well as the standard deviation. To the right within the table, the bed that the sample matches best to, is also listed. The samples have also been separated by location.

Conclusion

By taking the information from the graph of sea level changes above (Figure 8), and the rough time estimates for each of the ash beds, we can align them with the stratigraphy of the outcrops used in this study. Sample CU1750 is roughly 67 thousand years old and the unconformity underneath it aligns with the 5a unconformity from the sea level graph. When the sea level was high here, the lake level was low, creating this area of missing time. Sample CU1751, or Bed I, is roughly 83 thousand years old while beds O and P are roughly 175 thousand years ago. The unconformity between these two beds is really interesting because there is roughly 100 thousand years of missing time and sediment between the two, helping to confirm that there

were likely two unconformities that occurred. For there to be a time gap that large, there is a large amount of sediment missing from the stratigraphic record at this location. These two unconformities also correlate with the peaks in sea level, which indicates that the lake levels were low enough for sediment to be eroded away or not deposited, as well as for the tufa plates to form. A similar situation is seen with trench two, although the time gaps between the samples aren't as large. For example, there is a gap of only five years between sample CU 1763 and sample CU 1766. There is likely an issue with the relative dates available because of the small gap in time between these samples.

In all, better age controls would help significantly with this research because we could have more precise dates for both eruptions and the unconformities or ice ages relative to those eruptions. When lake levels are low, sea level tends to be high which makes this research relevant to recent climate change discussions. The unconformities represent low water levels and a drier climate while the lake sediments represent higher water levels and a wetter climate. And as an overall conclusion, lakes are one of the best natural archives for environmental and climate changes because they store all information available not only for their area.

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Table 1.2 - Summary geochemical data for tephra glasses

Results normalized to 100% totals (accounts for halogens=oxygen)

Sample		SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Cl	BaO	Total	n	Layer Identification
High Cut Bank Locality (samples CU1750-1773)																
Trench 1																
CU1750	Average	70.32	0.658	14.85	2.87	0.066	0.787	2.41	4.92	2.79	0.128	0.166	0.081	100.0	18	Bed 8
	StDev	0.55	0.021	0.26	0.11	0.017	0.070	0.17	0.29	0.10	0.012	0.016	0.025			
CU1751	Average	76.86	0.093	13.79	0.92	0.035	0.236	1.47	4.04	2.41	0.041	0.075	0.060	100.0	17	Bed I
	StDev	0.29	0.013	0.20	0.05	0.019	0.021	0.05	0.25	0.10	0.007	0.009	0.031			
CU1752	Average	70.20	0.619	14.75	2.92	0.041	0.804	2.87	4.52	2.96	0.121	0.154	0.079	100.0	22	Bed O
	StDev	0.60	0.042	0.19	0.16	0.016	0.072	0.19	0.34	0.08	0.013	0.018	0.020			
CU1753	Average	71.68	0.324	14.32	2.70	0.079	0.320	1.29	5.40	3.65	0.058	0.112	0.080	100.0	21	Bed P
	StDev	0.26	0.008	0.14	0.07	0.018	0.025	0.03	0.28	0.07	0.007	0.008	0.024			
CU1754	Average	72.23	0.310	14.29	2.64	0.075	0.286	1.23	5.03	3.70	0.055	0.105	0.079	100.0	25	Bed Q
	StDev	0.33	0.006	0.17	0.06	0.019	0.014	0.03	0.40	0.06	0.006	0.008	0.016			
CU1755	Average	73.79	0.207	13.91	2.11	0.063	0.108	0.77	4.81	4.01	0.028	0.119	0.105	100.0	17	bed R
	StDev	0.24	0.009	0.14	0.08	0.014	0.019	0.04	0.33	0.06	0.005	0.009	0.022			
CU1756	Average	74.59	0.186	13.47	1.75	0.046	0.121	0.61	5.05	3.95	0.026	0.138	0.086	100.0	17	Bed S
	StDev	0.21	0.011	0.19	0.09	0.013	0.016	0.04	0.17	0.08	0.006	0.007	0.027			
CU1757	Average	74.65	0.177	13.43	1.66	0.046	0.110	0.60	4.88	4.23	0.017	0.140	0.092	100.0	23	Bed T
	StDev	0.26	0.017	0.16	0.07	0.011	0.010	0.02	0.28	0.20	0.012	0.010	0.045			
CU1758	Average	74.92	0.171	13.36	1.65	0.049	0.098	0.53	4.80	4.20	0.018	0.139	0.088	100.0	21	Bed T1
	StDev	0.22	0.009	0.13	0.05	0.015	0.013	0.02	0.29	0.17	0.004	0.010	0.019			
Trench 2																
CU1759	Average	72.93	0.220	13.99	2.45	0.063	0.152	1.18	5.16	3.64	0.031	0.124	0.095	100.0	20	Bed V
	StDev	0.27	0.009	0.16	0.05	0.014	0.014	0.03	0.36	0.09	0.006	0.012	0.019			
CU1761	Average	73.20	0.224	14.07	2.43	0.066	0.153	1.18	4.85	3.60	0.034	0.128	0.104	100.0	11	**New Layer**
	StDev	0.24	0.013	0.11	0.05	0.010	0.016	0.04	0.25	0.10	0.006	0.023	0.019			
CU1763 pop 1a	Average	57.72	2.261	13.42	10.87	0.193	2.959	6.27	4.27	1.46	0.461	0.071	0.065	100.0	11	Bed Z
	StDev	0.60	0.086	0.16	0.32	0.020	0.209	0.33	0.29	0.11	0.034	0.010	0.034			
CU1763 pop 1b	Average	57.56	2.008	14.27	10.39	0.181	2.980	6.20	4.45	1.44	0.411	0.068	0.066	100.0	11	Bed Z
	StDev	0.72	0.072	0.36	0.51	0.022	0.375	0.38	0.24	0.24	0.031	0.017	0.021			
CU1763 pop 1c	Average	56.75	1.703	15.33	9.69	0.166	3.621	6.63	4.44	1.20	0.355	0.061	0.061	100.0	8	Bed Z
	StDev	0.37	0.060	0.28	0.39	0.012	0.211	0.12	0.28	0.07	0.022	0.015	0.017			
CU1763 pop 2	Average	65.32	1.094	15.21	5.35	0.128	1.284	3.33	5.52	2.31	0.312	0.105	0.059	100.0	2	Bed Z (population 2)
	StDev	0.22	0.009	0.10	0.04	0.021	0.069	0.01	0.19	0.00	0.001	0.002	0.023			
CU1764	Average	71.86	0.387	14.35	2.64	0.079	0.315	1.26	6.05	2.81	0.060	0.135	0.084	100.0	24	Possible new bed,
	StDev	0.32	0.017	0.18	0.08	0.015	0.029	0.06	0.39	0.06	0.007	0.011	0.035			equivalent to CU1767
CU1765	Mixture, Not a primary tephra bed															
CU1766 pop 1	Average	57.86	1.508	16.03	8.78	0.158	3.115	6.38	4.56	1.18	0.338	0.067	0.047	100.0	15	Bed BB (equivalent to
	StDev	0.52	0.056	0.26	0.24	0.023	0.176	0.18	0.39	0.20	0.014	0.015	0.021			CU1768)
CU1766 pop 2	Average	59.50	2.002	13.90	9.63	0.172	2.636	5.52	4.61	1.46	0.452	0.082	0.053	100.0	10	Unidentified
	StDev	1.18	0.086	0.38	0.54	0.028	0.336	0.25	0.24	0.13	0.026	0.011	0.031			
Trench 3																
CU1760	Average	73.09	0.221	14.11	2.48	0.074	0.160	1.17	5.00	3.47	0.034	0.120	0.097	100.0	20	Bed V
	StDev	0.27	0.009	0.13	0.06	0.017	0.010	0.03	0.30	0.11	0.005	0.015	0.023			
CU1762	Average	76.95	0.075	13.76	0.91	0.041	0.197	1.45	3.79	2.67	0.034	0.071	0.064	100.0	15	Bed W/OO
	StDev	0.34	0.009	0.15	0.03	0.016	0.014	0.04	0.29	0.08	0.007	0.009	0.030			
CU1767	Average	71.91	0.385	14.23	2.69	0.082	0.316	1.26	5.96	2.92	0.054	0.139	0.094	100.0	25	Possible new bed,
	StDev	0.29	0.017	0.16	0.07	0.020	0.022	0.07	0.25	0.04	0.006	0.010	0.027			equivalent to CU1764
CU1768	Average	57.73	1.567	16.02	8.83	0.160	3.223	6.45	4.37	1.21	0.341	0.069	0.041	100.0	22	Bed BB (equivalent to
	StDev	0.26	0.067	0.31	0.32	0.023	0.131	0.21	0.29	0.11	0.018	0.006	0.017	0.0		CU1766)
CU1769	Average	69.56	0.599	15.07	3.23	0.105	0.666	1.94	6.19	2.34	0.118	0.134	0.071	100.0	16	Bed DD
	StDev	0.32	0.014	0.11	0.06	0.019	0.020	0.05	0.41	0.04	0.008	0.009	0.019			
CU1770	Average	70.28	0.491	15.07	2.97	0.101	0.497	1.66	6.19	2.47	0.087	0.139	0.071	100.0	19	Bed EE
	StDev	0.23	0.014	0.14	0.07	0.018	0.033	0.06	0.20	0.06	0.008	0.008	0.023	0.0		
CU1771	Average	70.16	0.490	14.99	3.28	0.110	0.501	1.78	5.85	2.55	0.095	0.137	0.088	100.0	13	Bed GG

Sample		SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Cl	BaO	Total	n	Layer Identification
	StDev	0.23	0.013	0.11	0.08	0.012	0.031	0.08	0.25	0.06	0.009	0.012	0.017	0.0		
CU1772	Average	72.46	0.308	14.25	2.62	0.081	0.246	1.15	5.70	2.94	0.043	0.141	0.089	100.0	19	Bed HH
	StDev	0.26	0.012	0.11	0.07	0.018	0.016	0.04	0.27	0.05	0.007	0.008	0.024	0.0		
CU1773	Average	71.85	0.333	14.63	2.85	0.096	0.278	1.27	5.58	2.87	0.054	0.136	0.091	100.0	26	Bed II
	StDev	0.42	0.014	0.19	0.07	0.013	0.018	0.06	0.48	0.07	0.009	0.013	0.024	0.0		

Additional localities in same field area (samples CU1733-1749)

CU1733	Average	76.67	0.080	13.67	0.88	0.026	0.190	1.48	4.29	2.56	0.040	0.068	0.062	100.0	29	Probably Bed I, possibly bed W
	StDev	0.26	0.008	0.18	0.06	0.014	0.019	0.05	0.24	0.11	0.007	0.010	0.025	0.0		
CU1734	Not a primary tephra bed - sample contains a mixture of reworked tephras; some grains are similar to bed E1, Bed F (Wono), and Paulina Creek tephra															
CU1735	Not a primary tephra bed - sample contains a mixture of reworked tephras															
CU1736	Average	76.55	0.089	13.77	0.87	0.053	0.207	1.50	4.19	2.61	0.039	0.072	0.066	100.0	26	Probably Bed I, possibly bed W
	StDev	0.25	0.009	0.27	0.05	0.073	0.018	0.05	0.25	0.11	0.008	0.014	0.028	0.0		
CU1737	Average	64.21	0.918	15.87	5.15	0.102	1.716	4.24	5.07	2.35	0.204	0.115	0.071	100.0	30	Excellent match to bed K K
	StDev	1.64	0.068	0.34	0.68	0.028	0.394	0.70	0.39	0.27	0.026	0.021	0.022	0.0		
CU1738 major pop (reworked)	Average	74.39	0.307	13.93	1.37	0.076	0.214	0.77	2.64	6.04	0.027	0.138	0.126	100.0	10	Unidentitified
	StDev	0.25	0.013	0.14	0.06	0.017	0.019	0.04	0.14	0.08	0.010	0.009	0.030	0.0		
CU1739	Average	68.81	0.664	14.87	3.61	0.095	0.721	2.38	5.61	2.92	0.133	0.098	0.105	100.0	18	NN
	StDev	0.29	0.018	0.13	0.10	0.022	0.032	0.08	0.30	0.06	0.012	0.010	0.024	0.0		
CU1740	Average	76.55	0.087	13.78	0.88	0.033	0.209	1.48	4.33	2.49	0.039	0.073	0.070	100.0	28	Probably Bed I, possibly bed W
	StDev	0.27	0.011	0.12	0.05	0.017	0.016	0.06	0.32	0.12	0.006	0.012	0.022	0.0		
CU1741	Average	71.14	0.427	14.70	2.36	0.053	0.400	1.45	5.24	3.93	0.066	0.142	0.120	100.0	30	Matches FF-9 (CU1079)
	StDev	0.43	0.023	0.18	0.08	0.015	0.038	0.08	0.31	0.10	0.009	0.012	0.024	0.0		
CU1742 pop1	Average	69.15	0.688	14.92	3.41	0.081	0.636	2.08	5.17	3.49	0.167	0.115	0.125	100.0	10	Unidentified
	StDev	2.13	0.211	0.64	0.85	0.028	0.383	0.76	0.40	0.57	0.082	0.013	0.016	0.0		
CU1742 pop2	Average	61.20	1.620	15.07	7.90	0.156	2.060	4.69	4.54	2.18	0.441	0.089	0.084	100.0	22	Unidentified
	StDev	1.09	0.157	0.39	0.69	0.027	0.354	0.45	0.44	0.26	0.050	0.011	0.033	0.0		
CU1744	Average	73.03	0.423	14.52	2.04	0.046	0.467	1.66	4.64	2.90	0.068	0.160	0.085	100.0	14	Mazama
	StDev	0.29	0.014	0.17	0.09	0.016	0.039	0.08	0.36	0.14	0.010	0.012	0.016			
CU1745	Average	76.54	0.082	13.80	0.89	0.035	0.210	1.50	4.28	2.51	0.037	0.063	0.066	100.0	18	Probably Bed I, possibly bed W
	StDev	0.28	0.008	0.13	0.04	0.017	0.018	0.06	0.24	0.07	0.008	0.009	0.024			
CU1746	Average	76.62	0.088	13.71	0.91	0.029	0.212	1.47	4.20	2.60	0.042	0.069	0.063	100.0	12	Probably Bed I, possibly bed W
	StDev	0.19	0.007	0.16	0.02	0.016	0.019	0.07	0.15	0.16	0.006	0.008	0.025			
CU1747	Not a primary tephra bed - sample contains a mixture of reworked tephras; some grains are similar to bed NN, Bed F (Wono), and Paulina Creek tephra															
CU1748	Average	73.67	0.321	13.91	2.05	0.047	0.328	1.44	4.77	3.24	0.057	0.107	0.081	100.0	26	Bed F (Wono)
	StDev	0.57	0.033	0.24	0.16	0.014	0.058	0.16	0.25	0.10	0.012	0.013	0.023	0.0		
CU1749 major pop (reworked)	Average	74.48	0.264	13.77	1.79	0.045	0.293	1.33	4.52	3.29	0.064	0.101	0.075	100.0	15	Bed F (Wono)
	StDev	0.35	0.018	0.20	0.10	0.011	0.036	0.07	0.35	0.08	0.010	0.016	0.025			

Effects of Emotional Arousal and Valence on Recall: Fabrication of False Memories

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Abstract

False memory refers to the phenomena in which an individual recalls fictitious details of an event or events, or the recollection of an entire fictitious event. The effect of emotions on the fabrication of false memories is a highly progressive and diverse field of study. The current research will test, specifically, the effects of emotional arousal on recall and indicate if high levels of correct memory recall correlates to high levels of arousal. Participants will complete the Beck Anxiety Inventory (BAI), as well as a modified version of the Deese-Roediger-McDermott (DRM) (Roediger, Watson, McDermott, & Gallo, 2001) to successfully measure arousal, coordinate groups, and gauge the effects of mood on the fabrication of false memories. The implications from previous theoretical research suggests that participants who exhibit high levels of arousal will be more likely to fabricate false memories, regardless of the identified emotion. However, the goal is to test the effect of emotion on false memory as well as identify specific emotions that cause the highest levels of false memory fabrication for future implementations.

Keywords: false memory, arousal, emotion, Beck Anxiety Inventory (BAI), Deese-Roediger-McDermott (DRM).

Effects of Emotional Arousal on Recall: Fabrication of False Memories

The presence of false memories in society is immeasurable, with many experiencing several each day. Whether it is remembering leaving your keys on the table when they are in the car, or recalling an argument that never occurred, false memories lurk in the minds of everyone. One of the most debated and researched topics of false memories are the origins of the memory. Although it is unknown as to their exact cause, there are many theories that incorporate the explanatory dimensions of false memories. Within the current research, the goal is to identify particular emotions that influence the fabrication of false memories and the levels of arousal that accompany these emotions. However, it is important to discuss previous research that attempts to explain the development of false memories, as the field is highly diverse and many theories exist that trace the origins of false memories. False memories can be characteristics of controlled experiments, traumatic experiences, developmental issues, or the product of everyday life (Brainerd & Reyna, 2002). It is the goal of the current research to evaluate the influence of emotion and arousal on false memories, while examining other causes and implications.

Major Theories and Cognitive Concepts

An important factor when analyzing false memories is concept of storage failure, which is traditionally referred to as the primary cause of the fabrication of false memories (Reyna, Holliday, & Marche, 2002). This interference, believed to partially or totally destroy original memories, can be influenced by the application of misleading information, which is said to destroy details of original memories (Loftus and Brewin,

1997). However, Belli and Loftus (1996) concluded that misleading information does not destroy details of memories, but distorts them, resulting in a false memory.

Another form of interference, retrieval interference, is defined as being interference derived from the competition of memories during recall (Reyna et al., 2002). One version of the retrieval hypothesis suggests that although both the original and post-event memories are retained, the original and post-event memories compete, resulting in the post-event memory blocking the original with recently encoded misinformation (Morton, Hammersley, and Bekerian, 1985). Evidence exists that supports the claim that memories are not destroyed, but distorted and/or overpowered by more recent details. When researchers implement better retrieval cues paired with improved testing conditions (Titcomb & Reyna, 1995).

An additional prominent hypothesis suggests that false memories are derived from social demands towards and response biases within cultures (Reyna et al., 2002). Prevalent in many societies, yet widely underestimated and overlooked, is the presence of a dominant influencer, typically a single individual, whose influence is nearly absolute. According to McCloskey and Zaragoza (1985), social demands could account for false memories because the source of information is considered credible; therefore, the individual is more inclined to defer to this information rather than the original details when observed in empirical studies. This favoring of credible sources of information results in a response bias for the false details. Media influence is also connected to these biases, resulting in contamination that influences and increases false memory. This concept compliments the idea of the misinformation effect, as over exposure to

misleading information is believed to impair memory (Loftus, 2005). These theories suggest the foundations for the cause of false memories; however, many theories are more specific as to the cognitive effects that result in confabulation.

The majority of research focusing on the cognitive aspects of false memories revolves around three prominent theories of explaining these phenomena: *fuzzy trace theory, source-monitoring framework, and the activation monitoring theory* (Leding, 2012). Fuzzy trace theory suggests that every memory created is subsequently separated into two parallel memory traces: the verbatim trace, or original memory, and the gist trace, comprised of back-ground information. The verbatim traces consist of the original information for the incoming memory that is based from reality, while the gist traces are comprised of general, meaning-based representations of previous knowledge and comprehensions (Leding**, 2012).** According to Brainerd and Reyna (2002), remembering the verbatim trace, or the exact content of the memory, is not necessarily crucial, but the validity of the back-ground information that make up the gist trace are crucial in memory, as this information is typically probable details that are recalled over reality.

Source-monitoring framework is an extension of the reality-monitoring framework, which refers to the ability to distinguish between internally and externally generated memories (Johnson, Hashtroudi, & Lindsay, 1993). Internally generated memories are memories derived from such things as individual thoughts, dreams, and imagination, while externally generated memories form from perceived events. This theory incorporates the importance of perceptual information, contextual information, semantic details, affective information, and cognitive operations. These cognitive

operations, in specific, correlate with the fabrication of false memories in the regards that they incorporate records of organization, elaboration, retrieval, and identification of stored memories (Johnson et al., 1993).

Johnson and colleagues delve further into the cognitive operations by discussing research into the brain regions implicated in source monitoring (Johnson et al., 1993). Frontal regions of the brain have significant effects on source monitoring, and thus have significant effects on false memories. Dysfunction in the frontal lobe has the potential to produce deficits in source monitoring, resulting in disruption in memory flow and disruption in item recognition, cued recall, and trivia performance. Dysfunction in the temporal and diencephalic areas of the brain cause disruptions in source memory, as these areas are known to consolidate memory characteristics and reactivate memory records. This research suggests that disruptions in source monitoring can result in disruption in the encoding of events and details or disruption in heuristic or systematic source-monitoring judgment processes, where available relevant information is not accessed, inappropriate criteria for making decisions is used, or heuristic and systematic processes are not used to check each other.

The theory of activation monitoring is the most closely related theory to the concepts of emotions and arousal, specifically arousal, and how they influence the fabrication of false memories. Activation of a concept in memory is believed to spread to related memories, then arousing them. Within the activation monitoring theory, the presence of false memories is believed to be caused by the activation of a related concept that is not the original concept through the associative effect, where the activation is

spread from the original concept (Roedinger et al., 2001; Leding, 2012). Due to the individual not monitoring the source of the activation of the memory, similar to source-monitoring, a fictitious or distorted event is the result. This activation, or arousal, of memory concepts has many implications in the real world. Evidence suggests that during eye witness testimonies, for example, items in memory would be activated (Leding, 2012). As it pertains to emotions and arousal, the relative strength of the emotions and arousal at the onset of the memory plays a role in the activation during recall.

Research by Kensinger (2004) discusses the implications of the amygdala relative to arousing items and selectively attending to them in an effort to enhance memory. It is reported that patients with damage to this area fail to show modulation of attention by emotional arousal, resulting in them being unable to distinguish between arousing and non-arousing targets when presented with a task. Neuroimaging studies suggest the amygdala plays a crucial role in mediating in selective attention toward emotional stimuli, as it becomes activated by even small amounts of emotional stimuli. Kensinger (2004) discusses the relationship the amygdala and the hippocampus have in the effect of emotional arousal on storage. The amygdala influences the hippocampus via stress hormones, consolidating their functions. It is believed that the amount of words remembered or forgotten from the task correlates to the amount of activation in the hippocampus, while the activation of the amygdala was related to successful memory formation and recall, but only as it pertained to arousing words.

Emotional Valence and Arousal

According to the research, the dimensions of emotion are best characterized into emotional valence and arousal. Along with this, the author states that the dimensions of valence ranges from highly positive and highly negative, while the dimensions of arousal range from calming to exciting, or soothing and agitating (Kensinger, 2004). The author suggests that much of the current literature pertaining to emotion and arousal relative to false memories, as they fail to investigate the contributions of valence dimensions and the arousal dimensions to the memory enhancement effect. It is suggested that emotional arousal is a significant influence for memory, specifically false memories, however, it is believed that memory can be influenced by positive and negative valences without the elicitation of arousal. This acknowledges that valence and arousal may have some significant effect on memory, while suggesting that they may work independently to contribute to memory formation and retrieval (Kensinger, 2004).

Using the Dees-Roediger-McDermott (DRM) paradigm, Storbeck and Clore (2005) investigated the effects of emotion and mood on the fabrication of false memories, presenting subjects with lists of words that were frequently associated with a critical lure for recall and recognition. It was observed that a lower level of false recall in the negative-mood group was present. Relating to the fuzzy trace theory, Storbeck and Clore (2005) concluded that gist processing was the cause of their results and that the mood, or emotional state, influenced the processing, causing a reduction from negative mood. Further research shows variations in cognitive processing that are associated with emotional states (Corson & Verrier, 2007).

The work of Corson **(2006),** however, contradicts the findings of Storbeck and Clore (2005), believing that arousal combined with emotion is the true cause of confabulation. It is suggested that rather than the emotion, or valence, being the cause, the level of arousal, or activation, is the determining factor in fabricating false memories. Within the study, Corson (2006) used two positive-mood groups, one with high arousal (happiness) and the other low arousal (serenity, relaxation), and two negative-mood groups, one with high arousal (anger) and the other with low arousal (sadness). It was concluded that the groups with higher levels of arousal, happiness and anger, lexical decisions were facilitated while the groups with little to no arousal did not lead to any facilitation. It was also found that the happy and serene groups denoted a positive valence to the adjectives of the word list. Relative to these groups, the angry and sad groups denoted a negative valence to the adjectives.

While the work of Corson (2006) refuted the evidence of Storbeck and Clore (2005), the work of Brainerd, Holliday, Reyna, Yang, and Toglia (2010) found that when using the Cornell/Cortland Emotion Lists, there was a significant effect in memory distortion for valence, however, there was no significant effect for arousal; therefore, they research suggests that valence is an influential factor in forcing confabulation. They concluded that negative valence elevates confabulation as long as the effects of valence are not confounded by arousal. Although there was no main effect for arousal, the researchers established that false memories were in greater quantity for high-arousal items than for low-arousal items. Subsequently, this research suggests that the words

themselves produce their own levels of emotion and arousal, as the items could be rated with high or low level scores (Brainerd et al., 2010).

Implications

The work of Leding (2012) offers many implications for the effective manipulation of emotions and arousal for successful persuasion techniques, as well as proper criteria that should be met to warrant success. The uses of alpha and omega strategies, strategies for making an argument stronger and more persuasive, are highly encouraged. A useful strategy regarding emotions is making messages more persuasive, which is imperative to success. To succeed, a strong argument with vividness that appeals to the emotions of the recipient must be used. Another strategy is to avoid resistance that could ultimately bar the pursuer from achieving their goal. By avoiding resistance, it is possible to depersonalize the argument, reducing the risk of an unwanted emotional response. More importantly, as it pertains to false memories, Leding (2012) describes a number of strategies and techniques used to elicit false memories and force confabulation. The first of these, the misinformation effect, proposes that individuals can form memories of events that never occurred simply by having the concept suggested to the individual. This concept incorporates several mentioned previously, including the concept of social demands. When a credible source or a group consensus is convincing, a false memory is likely to form. If the information is arousing enough, it is likely to be retained and recalled. The second of these techniques involves imagination inflation and implantation. Similar to the first, this technique involves forcing the participant to imagine how some events could have happened in the past, usually something that would elicit an emotional

response, implanting details into their memory, and then requesting they recall it later. It is reported that this results in the participant believing the imagined event. The final strategy discussed focusses on the use of intense and prolonged interrogations to elicit a false confession. Using alpha and omega techniques, such as consensus and avoiding resistance, it is possible to cause an innocent individual to internalize the false confession, create false details of the event, and then confess to a crime they never committed (Leding, 2012). The success of this practice is dependent on the interrogators persistent use of emotionally arousing cues.

Brainerd et al. (2010), discusses the implications of research findings on the law. It is stated that the majority of evidence that determines innocence or guilt is focused around memory reports by the victim, eyewitness testimonies, and suspects, resulting in many false accounts because of the distortion of memory. Victims of traumatic events, or witnesses of these traumatic events, often recall false information because of the negative valence and high levels of arousal producing higher levels of false memories, says Brainerd et al. (2010). Their study acknowledges that the emotional content of their research is far less compared to traumatic events; however, they conclude that their participants' emotional reactions were similar to real life events and their results are consistent with previous research.

The above discussion has highlighted the major theories of false memories and their origins, as well as the believed influences of emotional valence and arousal and the implications of using them to achieve a goal. It reviews a range of experiments and their

conclusions. The next section elaborates further on the proposed technique and an account of the methods for the experiment.

Method

Participants

Participants (N=15, age range: 18-25 years) were recruited by campus wide emails, visitations to classrooms of participating professors, and flyers posted on the Concord University Campus. Inclusion criteria included being between the ages of 18-25 and a current, enrolled student at Concord University. Exclusion criteria included: having previous experience with the research (i.e., participating in past research conducted by the researcher). Participants received extra credit in their courses for their participation.

Materials

Participants engaged in a visual task adapted and modified from the DRM Paradigm using 2 sets of visual scenes of varying content created by the researcher (Roediger et al., 2001). One set of visual scenes (8 images in 8 scenes) consisted of images with several lure images intended to mislead the participants, while the other had no lure images. A total of 128 visual images were used.

Procedure

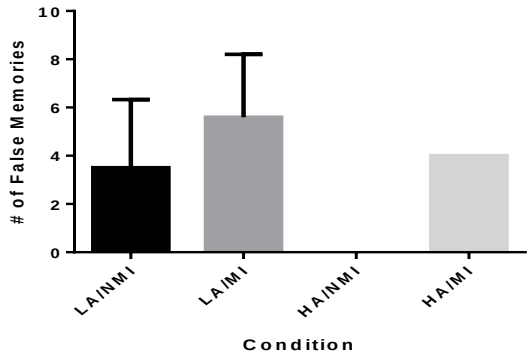
Participants were separated into 1 of 4 groups, based on their scoring on the BAI and the order in which they appeared for testing. These groups consisted of: High Anxiety/No Misleading Information (HA/NI), High Anxiety/Misleading Information (HA/MI), Low Anxiety/ Misleading Information (LA/MI), and the control group Low Anxiety/No Misleading Information (LA/NMI). Participants in the MI groups viewed the

set of visual images that included the lure images. The visual images were selected from online databases. Participants were placed in the testing location where they were to view each visual scene for approximately 15 seconds, after which they were required to describe the visual scene in as much detail as possible while the researcher recorded their responses. Participants were required to return exactly one week after the initial test to perform the task again, however, they were not required to view the visual scenes again. The researcher administered a que word to indicate the visual scene and the participant was required to recall as much information about that particular scene as possible.

Results

The hypothesis was not supported. Data from the LA/NMI group was compared to that of the LA/MI group using an unpaired t-test. It was revealed that there was no significant difference between the groups; $t = 1.339$; df = 11; $p = 0.2075$. It was not possible to compare the HA groups to each other or with the LA groups, as there were 2 participants in the HA/MI group and none in the HA/NMI group. The evidence does not suggest a potential for significant difference if the data collected followed the current trend. Figure 1 shows the number of reported false memories of each group.

Figure 1



Concluding Discussion

According to Leding (2012), there has been an increased interest in the study of false memories in recent years; however, many studies focus on the cognitive aspects rather than the emotional and behavioral influences. There are significantly fewer studies using emotional arousal and valance as their independent variable, providing little information as to the possible applications of the findings of such research. Possible applications of the current study, if conducted again with a larger sample size, include the use of information in the making of or adjustment of persuasion techniques, as well as exclusion techniques for law enforcement when attempting to get truthful confessions. Significant findings could result in an increase in accurate and truthful confessions or eyewitness accounts due to appropriate interrogation tactics, resulting in fewer false confessions and false testimonies.

As outlined previously, the desired outcome of this study was to observe a larger number of participants exhibiting high amounts of stress fabricate more false memories than the other groups. As mentioned, anxiety and stress are ultimately considered negative valence emotions with high emotional arousal. According to Isen (1999), positive moods result in a larger number of conceptual relations resulting in memories that are more accurate. An alteration of the current study could explore the neurological aspects of false memories, observing the influence of positive and negative mood on item specific

In order to gain a complete understanding of the influence of emotional arousal and valence on recall and their influence on the fabrication of false memories, it would be

necessary to conduct a study with a much larger sample size to climate the confound of having too little data for analysis. A possible confound of this study occurred due to flooding of the testing location, causing a sudden shift in the environment resulting in many participants being tested in two significantly different locations. The flooding also resulted in a significant delay in data collection.

Response bias may have also influenced the results of this study. Steps were taken in an attempt to help eliminate response bias, like excluding participants with previous knowledge of previous experiments conducted by the researcher, as they are similar in design. Several participants were barred or removed mid study due to admitting they were aware of the purpose and design, suggesting the potential for others to have been aware without informing the researcher. Of course, there is always the possibility of researcher error affecting the outcome of the study. Further research is needed to test the efficacy of the current study design and the relevance of emotional arousal and valence on the fabrication of false memories.

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THE VON RESTORFF EFFECT IN MARKETING

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Abstract

The focus of this this research is to find out the effect on the consumers mind and body, that is built because of applying the von Restorff Effect in promotional campaigns. I aim to see whether the von Restorff effect is the key to effective advertising, and brand imaging. In addition, whether there is a significant difference on consumer attraction for ads containing the VR effect, compared to those that do not. What we are attracted to as customers, may also be influenced by our social class, perception towards a brand, as well as memory. To test my theory. An experiment will be conducted, in which two groups of four candidates will each participate. Group A & B, will both be exposed to visual aids. I am focusing on media advertising, so the visual aids can serve as a replica of an ad. Group A will be exposed to the visual aid of words and images that will have distinctive typography, color, and contrast. It will also have logos of well-known companies. The control group on the other hand, will be exposed to simple images, and pictures, with no isolation effect. To be more specific, none of the contents will be a different color or form. The participants in the group will be of different ages ranging from 18-50 years old, and will be tested on their recall at the end of the experiment.

The isolation effect is a memory phenomenon whose discovery is frequently attributed to Hedwig von Restorff (1933). It claims that, if all, but one item of a list is similar on some dimension, memory for the different item will be enhanced. (Fabiani and Donchin 1995). Advertising is a very important promotional tool in marketing, also the best known, and most widely discussed form. It covers many aspects, however for this cause, we are mainly focused on the non-personal aspect, involving mass media (e.g., TV, radio, magazines, newspapers). With more products coming out daily, consumers have limited time, and vast options. The ads must capture, intrigue the consumer, and further depict how the company can satisfy the needs and wants of the person. With so many companies competing to retain, and gain new customers, there are many choices for consumers. Therefore, why do we choose a particular brand out of the haystack? Is it the von Restorff effect capturing our attention, does it fall to other independent variables such as memory, or is it because of our brand loyalty, and the brand image of the company.

Introduction

Marketers aim to build a good relationship with the consumer, to build brand loyalty, and show a product worth purchasing. Value is an important factor in a beneficial, and continuous exchange. This is basically the customers perception of the benefits of the product or service, against all the costs of acquiring it and consuming it. Benefits of a product can be identified from the performance of the product, how it feels to use it, as well as feelings of self-esteem from owning a brand. With this, we see how psychology is used in promotional campaigns to attract potential customers. To establish these key elements of a successful business, marketers need to have a channel of communication between consumer and producer, which in turn is advertising.

According to the American Marketing Association, advertising is defined as any paid form of nonpersonal communication about an organization, product, service, or idea by an identified sponsor, the paid aspect of this reflects the fact that, the space or time of advertising is mostly bought. However, it is still the most cost-effective way to reach large target areas. To be more specific, the average commercial on the major networks during evening prime-time programming, reaches 6 million households. It is also a valuable tool for building brand equity, and a powerful way to provide consumers with information, as well as influence their perceptions. With current competitors aiming their promotional efforts at their target market, competitive advantage is a necessity. Advertisers create unique and favorable images, as well as associations for a brand. This can be very important for companies selling different products or services, that are difficult to differentiate based on functional attributes. Further research into advertising techniques, can shed light on how future marketers can satisfy the customer, it might be the solution to

consumers getting exactly what they want and need, and companies keeping fruitful relationships with current and potential customers.

Of equal importance is the how marketers approach consumers, as well as the of the von Restorff effect. Hedwig von Restorff was born in Berlin on December 14, 1906. After an education focused on classical languages, she entered the University of Berlin at the age of 20 and studied philosophy, psychology, and the natural sciences. She obtained her Ph.D. under the supervision of Gestalt psychologist Wolfgang Köhler (1887–1967) in the year 1933, also the year of her first publication, announcing her discovery of what is known to this day as the "von Restorff effect" or "isolation effect" (von Restorff 1933). In the words of one reviewer: "In 1933 von Restorff reported a series of studies, the results of which may be summarized in the following statement: :"Isolating an item against a crowded or homogenous background facilitates the learning of that isolated item" (Wallace 1965, p. 410). Marketers may use some techniques to integrate an isolation effect into an ad. To start off with, the use of negative space in an advertisement, which is essentially an empty space around a logo or image. It is used to make the reader focus on the image or text without distractions. Secondly, using consistent color throughout a marketing campaign, helps to create association with the brand, and can induce different emotions. Furthermore, repetition is also very important, as it reinforces the idea and message. Finally, the color and contrast, can make an advertisement appealing and create a response in memory. Our question is whether the isolation effect alone is the key to attracting new customers and keeping them.

Literature Review

Attention is a very important factor, in the sense that; if an isolate is seen in a list, attention is focused on the isolate, and it is recalled better due to a higher level of encoding. Moreover, according to von Restorff, and Kohler, it was the main cause of the isolation effect. Their research was the groundwork to this phenomenon, and other psychologists have concluded this, or have similar explanations. An example is the notion that the isolation effect resulted from surprise induced by the change from preceding items: "Surprise increases the attention paid to the item, and hence the likelihood of recall" (Green 1956). It was also stated that surprise was our reaction to a noticeable or important occurrence. In addition, distinctiveness plays an important part in the process, as it is what catches our attention to begin with. Indeed, this makes sense, however, according to Reed Hunt "the distinctiveness of what is being viewed should be considered as an independent variable"

Although the effect has been attributed to attention, several researchers (e.g. Fabiani and Donchin 1995; Hunt & Lamb 2001) have pointed out that the effect cannot solely be a matter of attention. If an isolate is presented early in a list, there has not been any time to build up an expectation of how the elements should look, concluding that there is nothing to draw attention. Hunt and Lamb, took a whole new perspective to the isolation effect. Instead of focusing on the isolate, the authors attributed the effect to the balance of similarity, and difference among the elements in a list, hence creating an advantage for the isolated element. According to Hunt and Lamb (2001) this is due to organizational and distinctive processing. Organizational processes result from encoding similarities among the different items in a list, while distinctive processes result from encoding similarities

and differences among these elements. Furthermore, Fabiani and Donchin (1995) stated that the isolation effect occurred because the isolate and the homogenous elements were stored in different lists. Therefore, interference arises between the homogenous elements as they share the same storage space; the isolate on the other hand is stored separately. Reed Hunt refined Fabiani's and Donchin's model (1995) further. He pointed out that the reason why the isolate is stored separately from the homogenous items was its advantage in terms of balanced similarity and difference processing. Nevertheless, with all the different approaches taken, a successful von Restorff effect was observed, depicting that it seems influence the consumers mind.

Advertising is the forefront for communication with a company's target market. Once the promotional efforts have reached a potential customer, he or she must make a purchase decision. They develop an intention to buy a product from a certain brand. These intentions, are generally based on a matching of purchase motives, with benefits or characteristics of the brands under consideration. The customer still has to make the actual purchase, and additional decisions may include, where to buy, and how much money to spend. There is often a delay between the purchase decision, and the actual purchase. For example, complex purchases, such as a vehicle or personal computer. On the other hand, for nondurable products, that include low-involvement, like grocery items, the customer may already have a shopping list in mind, before departing. This may be because the person has developed brand loyalty. Namely a preference for a specific brand that results in its repeated purchase, or in some cases, the brand of the product does not matter to the consumer. According to the American Marketing Association; 93 percent of consumers say they prefer a specific beverage, which shows the impact it can have. The isolation effect in

ads is good for attraction, and a solid brand image is essential for the long-term success of a company. Marketers strive to develop, and maintain brand loyalty among consumers. They use reminder advertising to keep their brand names in front of consumers, maintain prominent shelf space in stores, and deter consumers from switching with promotional campaigns. Indeed, this is not easy, because for many products, fewer than 50 percent of consumers are loyal to one brand. Marketers must continually strive to maintain their loyal customers, while replacing lost ones. They must ensure that consumers have top-of-mind awareness of their brands, so that they are quickly recognized, and considered.

There are many factors that affect a consumer's choice, including the isolation effect, hopefully this research can help shed light on how it is integrated into marketing, as well as the effect on consumers and promotional campaigns.

Experiment

To portray an outcome of the isolation effect, I conducted an experiment with 20 participants. The experiment was relatively inexpensive, and lasted for an hour and thirty minutes. In addition, the sampling size was quite small. In total there were 20 participants. I approached 10 individuals of ages ranging from 18 – 21. Most of which were from my peer group, or college. The other 10 participants were aged 30 years and above. They consisted of my fellow senior associates at Walmart, which is also my workplace. A change in the experiment was the fact that instead of showing two separate visual aids to each group, they were shown both visual aids, one after the other. As mentioned before, one visual aid, or PowerPoint contains words and pictures of different color, and typography, as well as logos from already famous companies. The second visual aid would be basic, with nothing that would be considered to have an isolation effect. Each visual aid contained a

total of 6 slides, and I allowed the participants to view each of them for a period of 1.5 minutes. After the viewing, I tested each of my participants on their recall, and they were also asked to write a few sentences, on why they remembered, or forgot what they did. On the visual aid containing an isolation effect, 70% (14 0ut of 20) of the participants remembered at least two pictures or words, On the other hand, less than 50% of the participants remembered anything for the basic visual aid.

Some participants stated that their recall was based on the color, font, placement of items, as well as their knowledge or experience, with some brands shown. Which included well-known brands such as, Mercedes Benz, Jordan, Wells-Fargo, Ziploc etc. Therefore, we could say that there was a positive outcome, and a von Restorff effect was indeed evident.

Conclusion

During the experiment, I also noticed that one or both distinctive items recalled, were already known brands, currently present in society. This touches on the topic of brand imaging again. We can clearly see that advertisements are indeed the forefront to a marketing campaign. Going deeper into it, we gain an understanding that advertisements aim to tap into personal lives, and most important appeal to emotions, with just an advert, billboard, or even picture. This I believe is the most important factor in the mix. It is done by understanding your target market, which has been made a little bit easier with the features of social media, and its interaction. Marketers in a way, can influence our perceptions, in the sense that companies still attract new customers daily. It can be achieved with the isolation effect in advertisements, as well as how some products are viewed in society. High-end luxury items such as cars, property, clothes, and even food can boost confidence, self-esteem, and present a lifetime of never ending wonders. However,

everyone is different, and materialistic items do not necessarily appeal to all. Again, that is where understanding your target market comes into play, understanding who can afford your product, who wants it, and how can you retain that customer.

According to the data, we can understand that all these variables, such as advertising, brand imaging, and brand loyalty, are all in a mix working together. However, they all must be in sync, to have a successful outcome. In the sense that the advertisement, containing the von Restorff effect, is the forefront of communication. If this ad does not intrigue, and relate with the potential consumer, then the exchange or process of purchase will not happen. If it does make an impact and the company delivers what it has promised to its consumer, then I believe brand loyalty is achieved, with repeated purchases of course. This in turn is the end goal of an advertisement, to keep a fruitful, and continuous exchange between consumer and producer.

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Effects of Prior Anxiety Level on Nicotine Place Conditioning in Adolescent Female Rats

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Abstract

There are many changes occurring in adolescents, not only in the body but the brain as well. With the changes that are taking place, adolescents are more vulnerable to the effects of nicotine. Little research has been done pairing anxiety to nicotine reinforcement in adolescent female rat models. This study examines the relation between prior levels of anxiety and reactivity to nicotine in a place conditioning apparatus. Female adolescent Sprague-Dawley rats (P30) were divided into high anxiety and low anxiety groups using the elevated plus maze along a median split. High anxiety rats were compared to low anxiety rats for their reactivity to nicotine versus saline controls during acquisition of a biased place conditioning paradigm. The findings of this study were a small non-significant increase in the high anxiety nicotine subjects with non-significant decreases in the control and low anxiety nicotine subjects. The results suggest that more research needs to be done.

Introduction

Fear is a normal reaction when being introduced to a threating situation (Steimer, 2002). When fear becomes more important than the situation requires or when it appears in an inappropriate situation or recurs chronically, anxiety occurs (Bourin, Petit-Demouliere, Dhonnchadha, & Hascoet, 2007). Anxiety can be modeled in rats using several techniques; one of these techniques was used in a study done by Smith and colleagues in which rats received electric foot shock, a technique known as fear conditioning (Smith, et al. 2006). Most models involve exposure of subjects to external (e.g. cues paired with foot-shock, bright light or predator odor) or internal (e.g. drug states) stimuli that are assumed to be capable of inducing anxiety in animals (Bourin, et al., 2007). The elevated plus maze which will be used in the current study, also models anxiety. This apparatus is used to measure anxiety in rats, an anxious rat will spend less time in the open arms and more in the enclosed arm (Bourin, et al., 2007.

Developmental Differences

Each day more than 3,200 people younger than 18 years of age smoke their first cigarette (US DHHS, 2017). Individuals who start smoking during adolescence have a greater addiction liability and greater difficulty quitting than do individuals who delay use until adulthood (Elliot, Faraday, Phillips, & Grunberg, 2005). It is believed that individuals who begin smoking at an early age are more likely to develop higher levels of dependence with significantly higher rates of addiction than are adults who start at a later age (Torella, Badanich, Philpot, Kirstein, & Wecker, 2004). Adolescents may have more sensitivity toward nicotine than adults (Torella, et al., 2004). The prefrontal cortex (PFC) is one of the last areas of the brain to mature during adolescence and smoking during adolescence could delay and hinder brain development

(Goriounova & Mansvelder, 2012). The PFC has been linked with anxiety and mood disorders (Davidson, 2002). An underdeveloped or incomplete PFC could impede decision making and impulse control. In short, if adolescents partake of nicotine they could exhibit future addictions and psychological disorders in adulthood due to their PFC not being fully developed.

One reason that nicotine is so addictive is because it increases the levels of dopamine in the brain (Davidson, 2002). This is damaging to adults, but even more so in adolescents. Adolescents are more susceptible to the rewarding effects of nicotine in the brain than adults. Several studies have been done that provide evidence that this relationship exists. It takes less nicotine to produce place conditioning in adolescent rats than adults (Shram & Le, 2010; Torella et al., 2004; Torres, Natividad, Tejeda, Van Weelden, & O'Dell, 2009). Dopamine receptors are overproduced prior to puberty and pruned back to adult levels afterward, however, if the brain is bombarded by dopamine these receptors are pruned back more than is needed (Teicher, Anderson, & Hostter, 1995).

Nicotine Place Conditioning

Place conditioning is a widely used behavioral procedure to measure drug reward and reinforcement in laboratory animals and has been successfully employed in adolescent animals (Bolanos, Garmsen, Clair, & McDougall, 1996; Campbell, Wood & Spear, 2000). There are two methods used in place conditioning, biased and unbiased (Cunningham, Grememl, & Groblewski 2006). The biased method allows the animal explore the apparatus to determine which side of the apparatus the animal has a preference for. Once preference is established, drug is administered on the non-preferred side of the apparatus. In the unbiased method, the side of the apparatus where drug is administered is randomly assigned. The biased method was used for this study. An

apparatus is considered "biased" when the average time that untrained animals spend in each test compartment deviates from expectations based on chance (Cunningham, et al., 2006).

Adolescent Place Conditioning

Age differences in nicotine's effects have been widely studied (Smith, et al., 2006; Torella, et al., 2004; Torres, et al., 2009). There is evidence that suggests adolescents require a lower dose of nicotine to exhibit place conditioning than adults (Sharam & Anh, 2010; Kota, Martin & Damaj, 2008). Studies have also shown that adolescent females utilize more tobacco products and have a greater difficulty stopping nicotine use as compared with age-matched males (Natarajan, Wright, & Harding, 2011).

How Stress and Anxiety Impact Place Conditioning

Human and animal studies have identified stress as a factor in drug addiction (Bila et al., 2017). There are various methods of inducing stress in rodent models; these can include tail pinch (Piazza, Deminiere, Le Moal, & Simon, 1990) or foot-shock (Brielmaier, McDonald, & Smith, 2010). Rats that received foot-shock required smaller doses of nicotine to induce a conditioned place preference (CPP) than those that did not (Brielmaier, et al., 2010). This models the theory that humans that are under stress are more likely to be at risk for drug addiction. Exposure to stress is used in the reinstatement of CPP in rat models, the results showed that amphetamine-induced CPP during adolescence can be reinstated by the exposure to stress (Cruz, Leao, Marin, & Planeta, 2010). Rat models with high levels of anxiety has also been shown to develop CPP than those with lower levels of anxiety (Falco, McDonald, & Smith, 2014).

Methods

Subjects

Subjects were 20 adolescent female Sprague-Dawley rats that was received in the laboratory at postnatal day (P) 22. The rats habituated for seven days and handled for two to three minutes each day for three days prior to testing. The rats were housed in a climate-controlled facility and on a 12h light/dark schedule (lights on at 0700). All testing was done during the light cycle. They were pair housed in Plexiglas cages with standard rodent chow and water available ad libitum.

Drugs

Nicotine or saline were administered subcutaneously (s.c.). Nicotine was derived from (-)- nicotine hydrogen tartrate diluted in a 0.9% saline solution and pH was adjusted to 7.0. The dose of 0.4 mg/kg of nicotine (freebase) was administered. Place conditioning testing immediately followed the injections.

Elevated Plus Maze

The elevated plus maze, which is an apparatus that can be used to model the levels of anxiety-like behavior in rodents, was used to divide the rats into two groups consisting of low anxiety and high anxiety groups. The rats were at (P30) at the start of this test. Between each set of rats, the maze was cleaned with 30% isopropyl alcohol to eliminate odor cues. The elevated plus maze is made of dark gray PVC consisting of two opposite open arms and two opposite closed arms surrounded by a high wall. Lights were placed at the edge of the open arms and the light level was adjusted to approximately 14 lx. The rats were placed at the center of the apparatus facing the open arms. No drug injection was given during this time. The rats were allowed to explore the apparatus for 5 min. Behavior was recorded with a video camera. The

variable of interest was how much time each rat spent in the open arms. Rats that spent more time in the open arms were classified as low anxiety. This was determined by a median split. The operational definition of entrance into an arm is when a rat has all 4 paws in the arm of the apparatus. The elevated plus maze was used to determine low and high-level anxiety, this was determined by the time each rat spent in the open or closed arm of the apparatus. The rats were divided into two main groups of low anxiety and high anxiety based upon results of the elevated plus maze. Within the two main groups rats were further divided into sub groups of nicotine and saline each consisting of five rats per group.

Conditioned Place Conditioning

The apparatus used has three chambers with guillotine style doors that block out each side of the chamber. One chamber is white, one black and the middle chamber is grey. During the pre-test day, which occurred on (P 32), the rat was placed in the middle compartment on the first day and be allowed free access to the entire apparatus for 15 min. The time spent in each compartment was measured and calculated. After the first day, chambers were divided back up with guillotine doors in place. On the post-test day, the rats were again given free access to the entire chamber for 15 minutes. A 15-min pretest was conducted to determine initial side preference. As other research suggests (Brielmaier, McDonald, & Smith, 2010), the CPP apparatus was biased, with animals preferring the dark side of the chamber. Following the pretest rats in the saline group were injected with saline in both the white and dark chambers, this was the control group of the experiment. The rats in the nicotine group were injected with nicotine and saline alternating between the black and white chambers. The nicotine group was injected with nicotine on the non-preferred side all rats strongly preferred the black chamber of the apparatus. All rats were confined in the compartment they received injections at for 15min. On

day (P 41), the guillotine doors were removed allowing the rats to explore the apparatus testing to see which side of the apparatus they prefer. Entrance into a chamber was determined by all four paws crossing the threshold of the chamber.

Statistical Analysis

Anxiety-like behavior was analyzed by how much time the rat spent in the open arm of the elevated plus maze and this behavior was determined by a median split. For the CPP analysis, scores were calculated by subtracting the time each animal spent in their non-preferred chamber on the post-test day from time in seconds spent in the initially non-preferred chamber on the pre-test day. The different scores of the drug groups were compared to the saline groups to show results of CPP.

Results

There was a non-significant increase in the high anxiety nicotine subjects on the difference score which is derived from the time spent in the white chamber on the post-test day minus the time spent in the white chamber on the pre-test day (Figure 1). There were non-significant decreases in the control and low anxiety nicotine subjects (Figure 1). Due to the results of the test, the hypothesis of this research cannot at this time be supported.

Discussion

Adolescent female Sprague-Dawley rats were separated into high anxiety and low anxiety groups using a median split, based upon the time spent in the open arm of the elevated plus maze. These groups were further split into nicotine and saline groups. The subjects that were in the high anxiety group showed a non-significant increase of time in the non-preferred side of the chamber. The results that were found suggest that future research may elicit positive findings. Should this test be done again either the nicotine dosage needs to be reviewed or more

days spent in the place conditioning apparatus. In the study performed, there were no tactile floors used. If this study is recreated then the use of tactile floors could produce a different result.

Other research has found that an intermediate nicotine dose of 0.4 mg/kg of body weight produces rewarding effects in adolescent male but not female rats, this suggest that there are developmental differences between male and females (Torres, et al., 2009). There is little research that has been done in female adolescent rats, in part due to data not being available to ascertain the amount of nicotine that needs to be administered to achieve nicotine place conditioning the dose of nicotine could be increased to support the hypothesis of this study. One major finding of the study done by Torres et al (2009) was that adolescent female rats displayed nicotine-induced (CPP) at a lower nicotine dose than the adults. The Torres study utilized the Wistar strain of rats. However, since the Sprague-Dawley rat was used in the present study a lower dose of nicotine was used based on previous research with adolescent males and females (Lenoir, et al 2015). Other research suggest that female rats have more difficulty in demonstrating CPP it took at least five injections to establish the conditioning but at a lower dose (Podun, Yararbas, Nesil & Kanit 2017).

Previous studies have also found that adolescents have more difficulty in quitting smoking, and have more sensitivity to nicotine (Elliot, et al 2005; Torella, et al., 2004). Identifying anxiety as a precursor to nicotine use, could enable those more susceptible to drug use, particularly adolescents, be aware of the susceptibility that they may have to future drug use. If anxiety could be treated before the initial use of nicotine, this could lower the rate of nicotine use, especially among adolescent populations.

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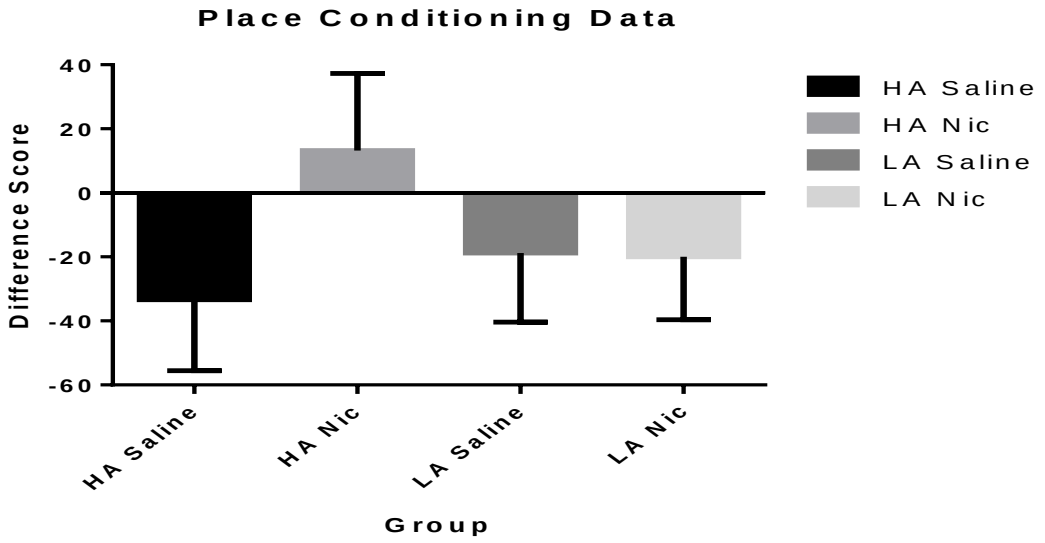

Figure 1 The difference scores represent the conditioned place preference (CPP) behavior of the nicotine and saline. Among the high anxiety group there was a small but insignificant increase of (CPP) *p= 0.5047 and among the low anxiety group there was no increase. The difference score was calculated by subtracting the pretreatment time in the white from the postreatment time in the white.

Designing an Undergraduate Molecular and Cell Biology Project-Based Laboratory Course

Corrina Robertson

Abstract

Presented here is a laboratory course for an undergraduate molecular and cell biology class that is designed to introduce the students to multiple techniques commonly used in the field as well as mimic an undergraduate research experience. The objective was to design a project involving cloning human alpha-tubulin (TUBA1B) into an enhanced green fluorescent protein (EGFP) mammalian expression vector and expressing it in mammalian cells to be visualized via fluorescence microscopy in various stages of the cell cycle. To prepare for the students' project, two plasmids were prepared. First the TUBA1B gene was cloned into a vector that will serve as the template for the students' PCR reaction. The second plasmid prepared was the pEGFP mammalian expression vector. The students will clone the TUBA1B gene into this vector and use it to express the EGFP-tubulin fusion protein in mammalian cells.

Introduction

Microtubules are protein filaments that are involved in many cellular processes, such as cell division, intracellular trafficking, and cellular motility, in eukaryotes (1). Microtubules are mostly used to form mitotic spindles as well as the interphase network (2). Microtubules are composed of tubulin, a protein that is made up of heterodimers of alpha-tubulin and beta-tubulin and each of these heterodimers interact to form protofilaments which subsequently form microtubules (1). Polymerization dynamics, the forming of polymer chains, is important to microtubule function (3). It is the alpha and beta tubulin heterodimers that are so dynamic in their growth behavior that they are responsible for microtubule network rearrangement (3). Microtubules go through cycles of stability and instability (1). This dynamic instability results in either growth or shortening of the ends of an individual microtubule (4). This dynamic behavior is dependent on whether the tubulin hydrolyzes GTP, otherwise known as guanosine triphosphate (1). If the tubulin hydrolyzes GTP to GDP, the top layer of tubulin that stabilizes the entire microtubule structure, known as the lateral cap, is lost (1). The kinetics of this process is especially important in beta-tubulin (1). Dynamic instability can be analyzed by the growth or shortening rate of the microtubule as well as the catastrophe or recovery of the microtubule (4). The term "catastrophe" refers to the microtubule converting from the growth or pause period to the shrinking period, whereas the term "rescue" or "recovery" refers to the microtubule converting from the shrinking or shortening period to the growth or pause period (4). It is the different dynamic behaviors that may play a role in certain phases of the cell cycle, such as the pulling apart of chromatids and the regeneration of the microtubules to repeat the cell cycle.

Since this experiment uses GFP (green fluorescent protein)-tagged tubulin, it is beneficial to explain how expressing the cloned proteins and observing the dynamics of the cytoskeleton through use of this method works. Fluorescent proteins are applied in a variety of ways. Fluorescent proteins, such

as GFP, can be used to mark or stain certain organelles within or on a cell or they can be used to follow the intracellular dynamics of proteins such as tubulin (5). Green fluorescent protein is a product of a study that was done by researchers in the 1960s involving the bioluminescent properties of a jellyfish, *Aequorea victoria* (5). This jellyfish contained a protein, aequorin, that was responsible for producing a blue light (5). Along with this protein, a non-luminescent protein was also found and because it turned green under ultraviolet light, it was named green fluorescent protein (5). It was later confirmed that both proteins worked together to produce the light that was characteristic of the jellyfish (5). Incorporation of GFP-tubulin into microtubules has been proven an effective method because the GFP-tubulin does not negatively impact the function of the microtubules in yeast (6). Before this method, it was very difficult to analyze and measure the function and dynamics of microtubules in mammalian cells that were in the process of going through the cell cycle. Only a small fraction of a population of cells is in mitosis and it was difficult to microinject fluorescent tubulin at the same time a cell was undergoing the mitosis (6). Through use of GFP-tubulin, scientists have been able to quantify and analyze the microtubule dynamics in cells undergoing the cell cycle (6).

One purpose for studying the intracellular dynamics of microtubules is so we can gain a better understanding of diseases such as cancer. It is already known that drugs that inhibit mitosis work by suppressing the dynamic behaviors of microtubules and thus kill tumor cells because they can no longer divide. The first group of anti-mitotic agents include Vinca alkaloids such as vincristine, vindesine, and vinblastine, colchicine and combretastatins, halichondrins, estramustine, and cryptophycins. These drugs act by destabilizing the microtubule and inhibiting the polymerization of microtubules. The second group of anti-mitotic drugs include paclitaxel, otherwise known as Taxol, docetaxel, which is also known as Taxotere, discodermolide, and epothilones. These drugs act by stabilizing the microtubule and stimulating microtubule polymerization. The most crucial action of these two groups of drugs is the suppression of spindle-microtubule dynamics because it causes mitosis to be delayed or blocked at the

transition between metaphase and anaphase. Instead, these drugs will induce apoptosis in cells. These drugs are selective in that they perform these actions without affecting the mass of the microtubules. This advantage is common in all anti-mitotic drugs and is partly why they are classified as such. For these drugs to affect the mass of the microtubules, they would have to be administered continuously in high doses. However, while these drugs are very effective as treatments for cancer, they are hardly applied in a clinical setting due to their adverse side effects. Because these drugs are cytotoxic, not only do they cause DNA damage and apoptosis of the harmful cells, but also of the harmless cells. These drugs also have the potential of leading to neurotoxicity and hematological toxicity (4).

Taxol is one of the most crucial additions to cancer-treating drugs over the past several decades. Taxol was discovered when the NCI (National Cancer Institute) extracted plants and tested them for anticancer activity as part of a screening program. Extracted from the Pacific Yew tree in 1966, the microtubule-stabilizing properties of Taxol were not discovered until 1979. Specifically, Taxol binds to the beta-tubulin subunit and causes the microtubule to be stabilized by inducing conformational changes in the M-loop of beta-tubulin. This results in more stable interactions between protofilaments that are next to each other. By slowing down and suppressing microtubule dynamics, Taxol can block mitosis even when significant microtubule bundling is absent (4). Another action of Taxol is that it induces assembly of free microtubules thus leaving centrosomes and kinetochores without the capacity to organize microtubule assembly and this is due to the disappearance of the cytoplasmic microtubule complex and the mitotic spindle (7). Vincristine, colchicine, and nocodazole act by disturbing microtubule function by attaching to beta-tubulin sites. This binding induces microtubule depolymerization and thus cause cells to arrest in mitosis. It is thought that this arrest is triggered by a series of biochemical reactions that allow for chromosomes to properly attach to the mitotic spindles before anaphase—if the drug disrupts this attachment, then the metaphase to anaphase transition is inhibited (8).

Procedures

Cloning

To prepare the template for the students' PCR reaction, PCR was performed to amplify TUBA1B from pEGFP-tubulin-6 using the following primers: 5' - GAT CTC GAG TGC GTG AGT GC – 3' and 5' - GGT GGA TCC TTA GTA TTC CTC TCC TTC - 3'. The PCR product was then TA cloned into the pCR 2.1 vector. A restriction digest with EcoRI and PCR using the TUBA1B primers were used to verify that TUBA1B had been cloned into the pCR 2.1 vector.

To prepare the pEGFP mammalian expression vector, pEGFP-tubulin-6 was cut with XhoI and BamHI and the vector backbone was purified. The following oligonucleotides, 5' GAT CCC GGG CCC GCG GTA CCG TCG ACT GCA GAA TTC GAA GCT TGA GC 3' and 5' TCG AGC TCA AGC TTC GAA TTC TGC AGT CGA CGG TAC CGC GGG CCC GG 3', were annealed and then ligated to the pEGFP vector backbone. The plasmid construct was transformed into competent *E. coli* cells. The resulting pEGFP-C1 plasmid was checked for reconstruction of its multiple cloning site by cutting individually with EcoRI, XhoI and BamHI.

Microscopy

pEGFP-tubulin-6 DNA was transfected into JEG-3 cells using lipofectamine. 24 hours after transfection the cells were fixed with formaldehyde and stained with DAPI. Cells were observed under the fluorescence microscope.

Results & Discussion

To prepare for the students' project, two plasmids were prepared from the pEGFP-tubulin-6 construct (Figure 1). PCR was used to amplify and TA clone the TUBA1B cDNA from the pEGFP-tubulin-6 plasmid into the TOPO TA cloning vector (pCR 2.1). The pEGFP-tubulin-6 plasmid was also cut with XhoI and BamHI to extract the TUBA1B cDNA before reconstructing the original multiple cloning site of

pEGFP-C1. Complementary oligonucleotides for the removed region of the pEGFP-C1 multiple cloning site were designed with XhoI and BamHI overhangs. The oligonucleotides were annealed to one another and then ligated into the pEGFP backbone.

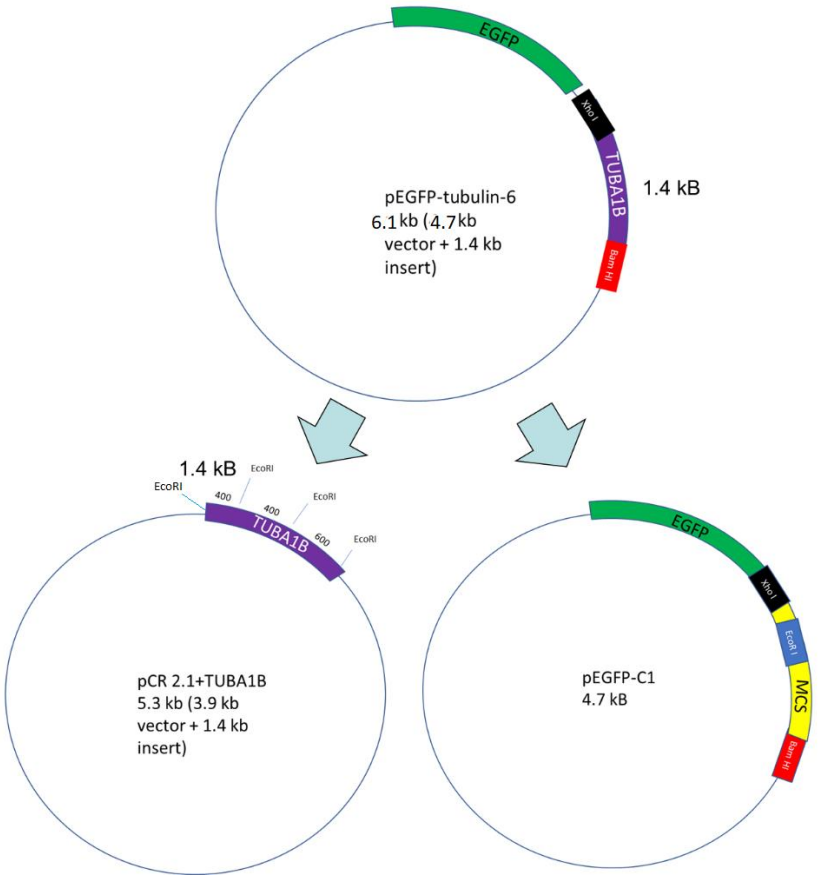

Figure 1: The student's PCR template and EGFP-fusion protein mammalian expression vector both of which were derived from pEGFP-tubulin-6.

Minipreps of the pEGFP-tubulin-6 plasmid were performed. This DNA was used as the template for a PCR reaction to amplify the TUBA1B cDNA prior to TA cloning. These samples were ran on a gel

(Figure 2). The size of the tubulin cDNA is approximately 1.4 kB (lane 7) and the vector with EGFP and tubulin is approximately 6 kB (lanes 3 & 5).

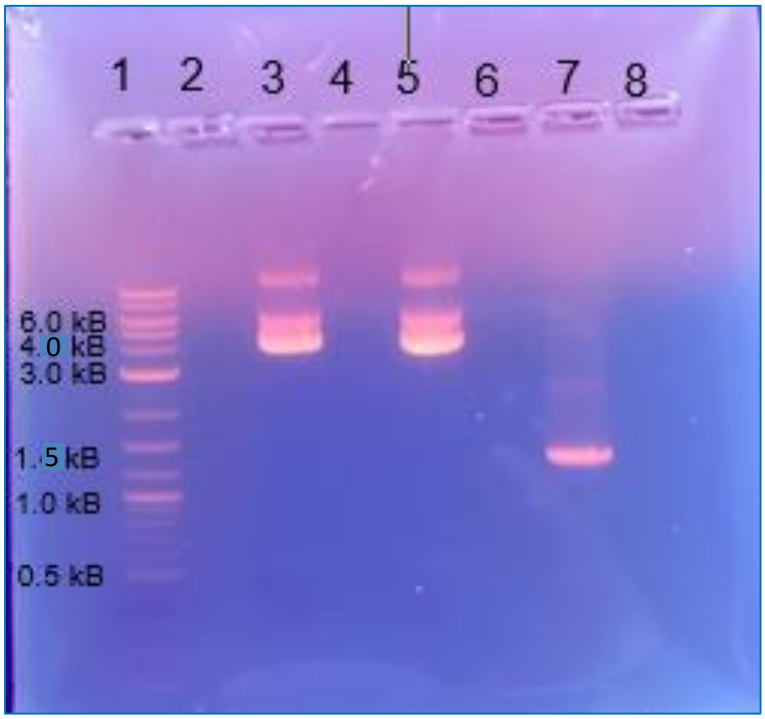

Figure 2: Gel electrophoresis of pEGFP-tubulin-6 miniprep DNA and PCR of tubulin from that template. The lanes are as follows: lane 1 ladder; lanes 3 & 5 mini-prep DNA of pEGFP-tubulin-6; lane 7 PCR of TUBA1B from pEGFP-tubulin-6 template.

After getting the results from the previous gel, I extracted the DNA from lane 7 of the gel and performed TOPO-TA cloning. The pCR 2.1-TOPO vector was open with thymine overhangs and once the PCR product TUBA1B was placed in, topoisomerase sealed the nicks. This pCR 2.1 + TUBA1B plasmid was transformed into bacteria so that more of this plasmid could be made. pCR 2.1+TUBA1B was cut with EcoRI primarily to make sure the tubulin was indeed present in the vector. The pCR 2.1 vector has one EcoRI cut site and TUBA1B has three EcoRI cut sites (Figure 1) and so if it were in the vector, we should have gotten four bands which is what we saw. One band should have been 0.6 kB, two bands should have been 0.4 kB, and the other should have been 3.9 kB (Figure 3 – lanes 1-5). pCR 2.1 + TUBA1B was

also used as the template in PCR reactions with TUBA1B primers to further ensure the gene had been cloned into the pCR 2.1 vector (Figure 3 – lanes 8-12).

pEGFP-tubulin-6 was also cut with XhoI and BamHI to isolate the vector backbone from the tubulin gene. This was ran on the gel and we saw a clear band at 1.4 kB, which was the tubulin gene, and a band at 4.5 kB, which was the vector backbone (Figure 3 – lane 6). This backbone was isolated and used to reconstruct its original parent vector, pEGFP-C1.

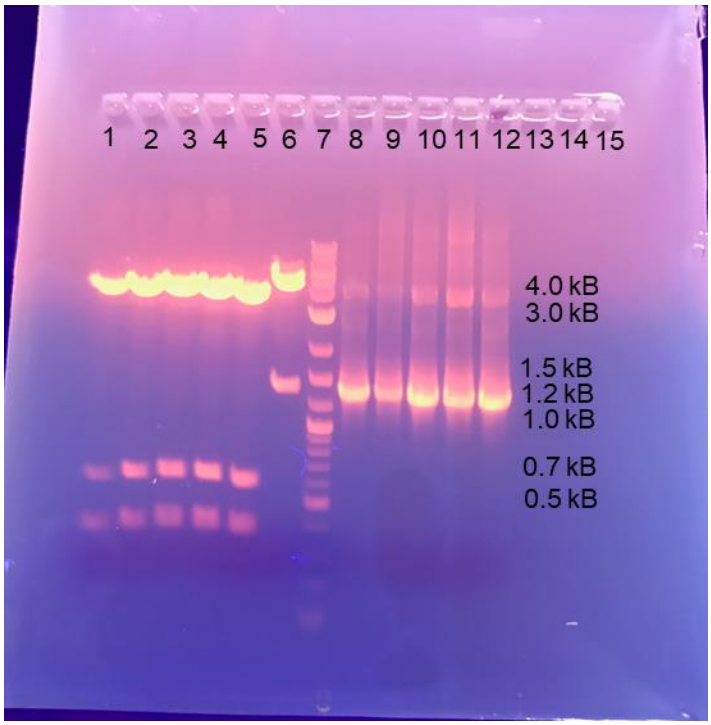

Figure 3: Checking pCR2.1+tubulin by cutting with EcoRI and by PCR. Also cutting pEGFP-tubulin-6 with XhoI and BamHI to isolate the vector backbone. The lanes were as follows: lanes 1-5 were potential constructs of pCR2.1 + tubulin cut with EcoRI, lane 6 was pEGFP-tubulin-6 cut with XhoI and BamHI, lane 7 was the DNA ladder, and lanes 8-12 were potential constructs of pCR2.1 + tubulin used as template to PCR TUBA1B gene.

To reconstruct pEGFP-C1, a missing region of the original parent vector's multiple cloning site had to be reintroduced. This was accomplished by designing complementary oligonucleotides for the missing region with XhoI and BamHI overhangs on the ends. The complementary oligonucleotides were

first annealed to one another and then the XhoI and BamHI overhangs were used to ligate to the vector backbone isolated above. If the original multiple cloning site has been reconstructed, an EcoRI site should now be present in the plasmid. To check this, restriction digests on potential constructs were performed using EcoRI (Figure 4).

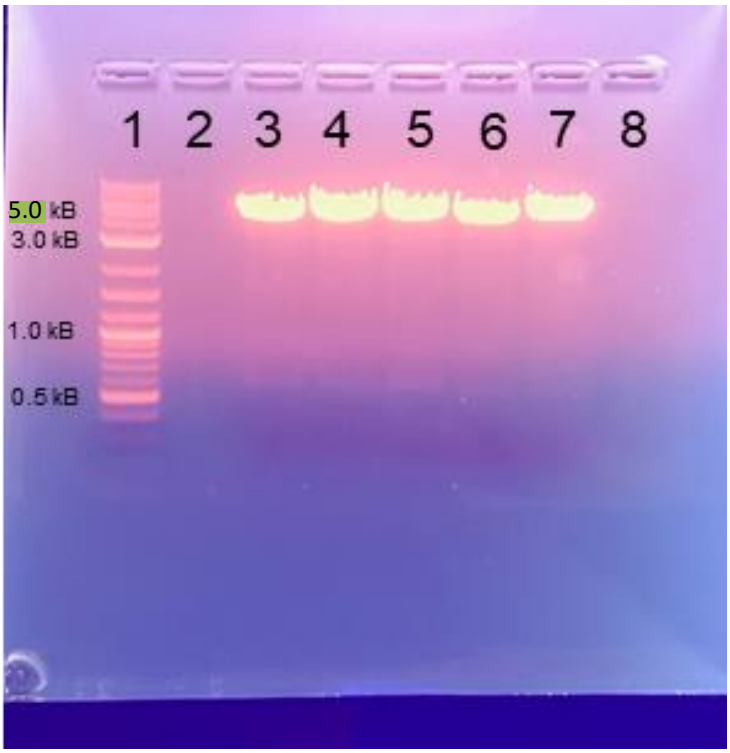

Figure 4: Checking potential pEGFP-C1 constructs by cutting with EcoRI. The lanes are as follows: lane 1-DNA ladder and lanes 3-7 are potential pEGFP-C1 constructs.

This gel was ran to simply check the potential constructs of pEGFP-C1 by cutting with XhoI or BamHI (Figure 5 – lanes 3 & 4). When cut with XhoI, the pEGFP-C1 construct did not produce one distinct band because it did not cut fully; while when cut with BamHI, it produced one band. As a comparison, the original plasmid, pEGFP-tubulin-6, was cut with XhoI or BamHI (Figure 5 – lanes 5 &6). The same results followed for the pEGFP-tubulin-6 construct, but the resulting DNA fragments were larger due to the presence of the tubulin insert. Uncut versions of both constructs were also run (Figure

5 – lanes 7 & 8). The uncut pEGFP-C1 and uncut pEGFP-tubulin-6 both had multiple bands because the DNA had different winding patterns and this also caused them to run at a lower molecular weight than expected.

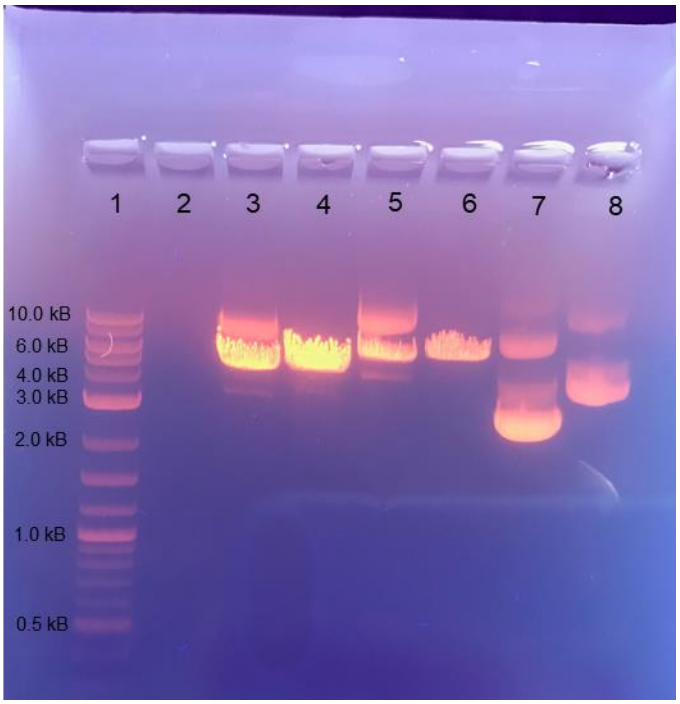

Figure 5: Additional check of potential pEGFP-C1 constructs. The lanes are as follows: in lane 1: DNA ladder, in lane 3: pEGFP-C1 cut with XhoI , in lane 4: pEGFP-C1 cut with BamHI, in lane 5: pEGFP-tubulin-6 cut with XhoI, in lane 6: pEGFP-tubulin-6 cut with BamHI, in lane 7: uncut pEGFP-C1, and in lane 8: uncut pEGFP-tubulin-6.

I have prepared the plasmid for students to use as a template for PCR of human alpha-tubulin cDNA and the EGFP expression plasmid for students to clone TUBA1B into. The next step was to test conditions for transfecting the pEGFP-tubulin-6 plasmid into cells. JEG-3 cells were transfected, fixed with formaldehyde, stained with DAPI and viewed using fluorescence microscopy (Figure 6).

The GFP failed to localize to the microtubules and instead localized to the cytoplasm. This could have been due to overexpression of GFP. It also could have been due to the type of fixation I performed. I used formaldehyde instead of methanol to fix the cells and this could have been the problem. I will

continue to trouble-shoot transfection of cells and fluorescence microscopy, as well as explore using Taxol to visualize microtubules at various stages of the cell cycle.

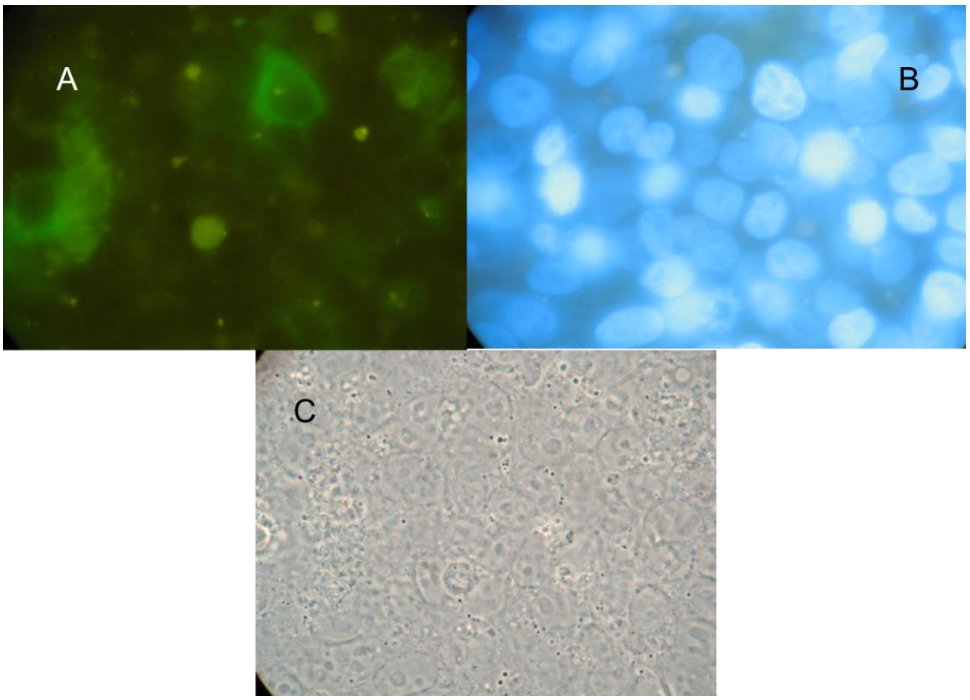

Figure 6: JEG3 cells expressing EGFP-TUBA1B were observed by A. EGFP fluorescence microscopy, B. DNA staining with DAPI, and C. phase contrast.

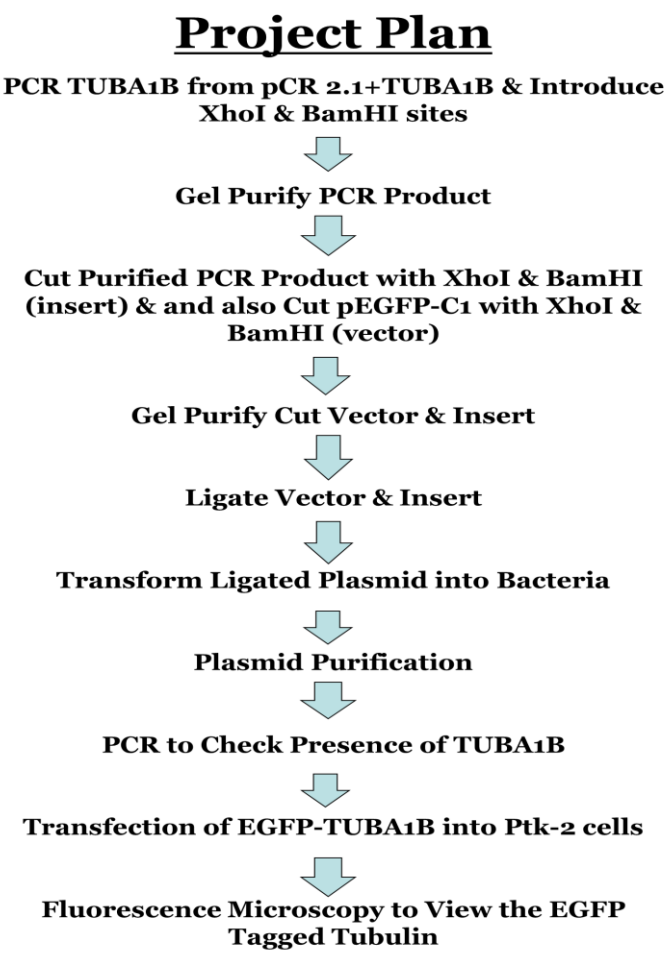

Figure 7: A flow chart depicting the steps the students will follow to create the original pEGFP-tubulin-6 construct.

I have successfully created the constructs that will be used by the students. In lab, the students will take the tubulin gene from pCR 2.1+TUBA1B and put it into the pEGFP-C1 vector. After doing this, the students will transform the ligated plasmid, now the original pEGFP-tubulin-6 plasmid that I was given, into bacteria. Once the bacteria accept the plasmid, the plasmid can be purified and the students will perform PCR to make sure the tubulin gene is present in the plasmid. Once this is confirmed, the students will transfect the pEGFP-tubulin-6 plasmid into Ptk-2 cells and view the microtubules using fluorescence microscopy. The steps involved in doing this will acquaint the students with PCR, cloning, and microscopy techniques as well as use of restriction enzymes. These are essential skills for students that may pursue research in the future as well as those interested in medicine. While the concepts

themselves may or may not be used directly in medicine, the ability to use a micropipette, microscope, knowing how to perform dilutions, running an agarose gel, and more importantly, knowing why each step in the process is performed is crucial for those pursuing a career in the medical field.

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Pacifism in Kurt Vonnegut

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Pacifism in Kurt Vonnegut

Kurt Vonnegut, one of the most prolific authors of the latter half of the last century, was an outspoken anti-war advocate and humanitarian during his career. He was the honorary head of the American Humanist Association for many years, and the book that propelled him into the public eye, *Slaughterhouse-Five*, holds many anti-war and pacifistic themes. Pacifism became a strong theme throughout most of his novels, in fact, but what exactly this pacifism looks like is not initially obvious. While Vonnegut would often argue against wars and violence, there are examples of violence as an at least semi-valid means in his novels. His first novel, *Player Piano*, features a violent revolution as its climax, one of the many religious practices of Bokonism in *Cat's Cradle* involves gruesome execution, and there are many small outburst of physical violence by characters in books like *Mother Night*, or to larger degree, *Breakfast of Champions*. While initially these may appear contradictory, it is important to remember what pacifism looks like to Vonnegut. Vonnegut portrays pacifism not as a hardline boundary that can never be crossed, but instead as a "rule of thumb" that should never be ignored.

This shows up as early as his first novel, *Piano Player*. The book revolves around a semi-fascist and very automatized society, where people are assigned their professions and many jobs have become redundant thanks to machines. The tension this creates eventually boils into a revolution towards the end of the book, and there is no real aversion to violence shown anywhere during the sequence. There are passages of chaos like, "'Stay at the wheel or I kill you!' said Khashdrahr savagely. He was shielding the Shah's sacred body with his own poor flesh, and he held the point of a golden dagger against the back of the driver's neck," (321). These descriptions of the violent revolution in Ilium never come with any pacifistic caveat.

There is no peaceful demonstration, no diplomacy, nor even a disparaging comment about the violence. The revolution in "the ruins of Ilium" (334) is mostly presented as the only possible option for the oppressed population. They must overthrow the machines that rule their lives, as Paul says, "The main business of humanity is to do a good job of being human beings, not to serve as appendages to machines, institutions, and systems," (314). There is no real means of expression or debate within the system, as anything or anyone anti-machine is banned or imprisoned for being a "saboteur." They autocratic society places machines at the top, and everything else is designed to only keep machines in power. There is no way to change the system from within, and so brute force and violent revolution are the only means left to anyone wanting society to change.

The only alternative is presented earlier in the novel, when Paul tries to buy an old farm so that he can abandon society. Paul starts to daydream of living a more rustic life, "developing an appetite for novels wherein the hero lived vigorously and out-of-doors, directly dealing with nature, dependent upon basic cunning and physical strength for survival," (137). These novels are the direct opposite of the mechanical, pseudo-fascist world Paul lives in. It is one where he lives secluded and independent from the world at large, in a pre-industrial lifestyle. These remain fantasies until he realizes a farm he has passed on the road is not part of the farming industry. It is as off the grid as possible, and that is what persuades Paul to buy the property. Because it is in no way part of the society he has grown to detest, he decides that is where he would rather be. Instead of fighting against the world he hates so much, Paul begins by trying to simply leave, not working for or against the society he detests.

However, trying to leave the society proves ineffective. Paul is taken to the Meadows as a captain and then is quickly swept away into the rebellion, becoming the face of the resistance almost overnight. Paul is unable to avoid the world around him, even by retreating into seclusion. But even if he was truly able to leave the society around him it would be the wrong way to handle the problems he is presented with. Player Piano's ending carries a sense of moral duty or obligation to actively try and fix any problems in a society. Failure or success do not matter, only the attempt, as Lasher says towards the end, "It doesn't matter if we win or lose, Doctor. The important thing is that we tried. For the record, we tried!" (334). They have an obligation to at least try to fix society, and since no other means is available to them within this oppressive system, they have to destroy the system from without and physical destroy its symbols, like the whole city of Ilium.

Violence, then, is not a wholly illegitimate practice. As opposed to true pacifism, Vonnegut does present some instances where violence is a useful practice, like in *Cat's Cradle*. The religion of San Lorenzo, Bokonism plays a huge role in *Cat's Cradle*, and one of its main practices is torture, or at least the threat of it. The preferred method of torture is a hook that is supposedly used to impale people and leave them dangling in the air. The narrator, Jonah, is told by Crosby on the way to San Lorenzo that people get, "the hook for stealing, for murder, for arson, for treason, for rape, for being a peeping Tom. Break a law – any damn law at all – and it's the hook," (Vonnegut 64). Every crime is meant to be punishable by gruesome, public death, and Crosby thinks the hook is why San Lorenzo is the best-behaved country in the world. Crosby views violence, and capital punishment especially, as a crime deterrent and as a way to keep the public obedient.

Castle reveals to Jonah the origin of the hook as a government tool. The hook was suggested to be a punishment for Bokonists, by none other than Bokonon himself. The original leader of San Lorenzo, McCabe, would circulate rumors about the hook being used on Bokonists at Bokonon's behest, until the rumors stopped being make believe. It was only when McCabe and Bokonon had started going insane that the hook was actually used. Castle says, "McCabe and Bokonon paid a terrible price in agony for the happiness of the people – McCabe knowing the agony of the tyrant and Bokonon knowing the agony of the saint… And then, people really did start dying on the *hy-u-o-ook-kuh*," (116). When McCabe and Bokonon started to put on this performance between government and religion, they had to deny part of who they were, and that self-denial is what drove them insane and brought the hook into reality. Originally the hook was part of a great performance, and it was the leader's insanity that made it real. Papa, the current leader of San Lorenzo, kills a Bokonist every so often just to, "keep the pot boiling," (117). The hook's gruesomeness is a result of fiction turned reality through insanity, and that insanity now sits at the heart of San Lorenzo's government along with the brutality of the hook.

However, the hook is not entirely insane. Jonah asks why Bokonon himself was never put on a hook, and Castle answers, "McCabe was always sane enough to realize that without the holy man to war against, he himself would become meaningless," (116). Without a villain and conflict, San Lorenzo's government would be exposed as meaningless. The standard of living in San Lorenzo was, "as short and brutish and mean as ever," (116), and so the façade needed to continue for as long as possible. Bokonon would continue to roam and write in the jungle, and the dictator of San Lorenzo would put someone on the hook every couple years to keep the drama going. In this way violence is being used as a tool of the government, but not in

the way Cosby thinks of it, nor is it exactly only the brutalizing of innocent people by a maniac. The executions are calculated and precise, to keep the drama between the government and Bokonism going for as long as possible, and ensure the San Lorenzo government can continue. In *Player Piano*, violence was the only way to overturn the government, and in *Cat's Cradle*, violence is the only way to keep the government running.

Slaughterhouse-Five has a mix between the institutional violence shown in *Cat's Cradle* and *Player Piano* and a more personalized, one-on-one kind of violence. The main backdrop for the novel (and much of Vonnegut's career) is the bombing of Dresden, which is described differently than any violence or mayhem in his other novels. When talking about the hook, the physical gruesomeness of it is emphasized, "they take somebody who's dumb enough to break the law, and they put the point of the hook in through one side of his belly and out the other and they let him go – and there he hangs, by God, one damn sorry law breaker," (65). When Billy Pilgrim ventures out to Dresden after the fire bombs have died down, the tone is different, "the sky was black with smoke. The sun was an angry little pinhead. Dresden was like the moon now, nothing but minerals. The stones were hot. Everybody else in the neighborhood was dead. So it goes," (465). There is a distinctly more somber and almost sterile tone in the description of bombed out Dresden, compared to the way the victims of the hook are described. Possibly this is because a character, Cosby, describes the hook while the bombing of Dresden is described by the narrator, or Dresden deserves more respect since it actually happened, or that maybe the difference in scale between bombings and individual torture plays some role.

There is, however, a certain coldness to the Dresden bombing that would warrant this different tone. Things like the hook or even the revolution in *Player Piano* have a kind of

motivation, for personal liberty or government survival. The bombing of Dresden, however, plays no real role in anything. There was no strategic reason to bomb the city, and no atrocities were being committed there. The entire city was turned to dust and smoke for no real reason. We get Air Marshall Saundby's foreword a little later that reads:

> *It was one of those terrible things that sometimes happen in wartime, brought about by an unfortunate combination of circumstances. Those who approved it were neither wicked nor cruel, though it may well be that they were too removed from the harsh realities of war to understand the appalling destructive power of air bombardment in the spring of 1945.* (471)

Saundby's explanation of Dresden is that it is just a tragedy that happened, and that maybe the people who approved the order did not truly understand what kind of atrocity they were ordering. It is tragic, but not an act of evil or good. The bombing of Dresden appears to be completely pointless to Saundby, an example of senseless violence that serves nobody's best interest.

General Eaker, however, disagrees. In his portion of the foreword, he writes, "*I deeply regret that British and U.S. bombers killed 135,000 people in the attack on Dresden, but I remember who started the last war and I regret even more the loss of more than 5,000,000 Allied lives in the necessary effort to completely defeat and utterly destroy Nazism,"* (471). General Eaker admits that the sadness of killing 135,000 non-combatants with fire bombs, but quickly undercuts that sentiment by saying the Nazis started it. It is a very childish, but emotionally appealing response. It is a natural response for someone to attack whatever attacked them first, both on the individual

and state level. General Eaker views the bombing of Dresden with little empathy, a coldness, because the atrocities of the Nazis were so much worse.

It is worth noting that Eaker, who is an American general, does not mention any of the Japanese's involvement when validating the bombing of Dresden. Dresden was a German city, and so he reaches for the Nazis, lumping all Germans together. This is an example of what Saundby was talking about, being, "*too removed from the harsh realities of war".* As a general, Eaker did not have to see the people on the ground like Billy Pilgrim did, nor did he have to drop the bombs like Saundby, so he views all Germans as Nazis and is not too broken up about 135,000 of them being turned to ash.

This reality of war, the human side that is impacted by the cruelty, is the main focus in Vonnegut's earlier novel *Mother Night*. Howard Campbell is in a unique position, since he is, "an American by birth, a Nazi by reputation," (Vonnegut 1). Campbell was a double agent for American during World War II and never saw any fighting himself, but delivered propaganda radio broadcasts that secretly contained intelfor the Americans. He helped the Americans and the Nazis at the same time, which is the source of his conflict. The book opens with an introduction by Vonnegut himself where he tells the reader, "This is the only story of mine whose moral I know… We are what we pretend to be, so we must be careful about what we pretend to be" (v). Although Campbell was not actually a Nazi and did help the Americans' fight against Nazism, he still feels the guilt and responsibility for empowering and inspiring Nazis in his broadcasts. In this way Campbell validates the views of Eaker later, since he is still guilty despite not even actually being a Nazi.

There is much more in *Mother Night* that goes against Eaker's generalized view, however. Through Campbell's memories, many actual Nazi families are shown in their natural habitat, as it were. As Russian forces are invading Germany, Campbell visits his father-in-law Werner North as he is moving things out of his house. One of the servant women almost drops a vase, but Noth is able to save it. For her negligence, "What was finally done with her was curious. She wasn't hurt. She was deprived of the honor of carrying any more of Noth's things… Her punishment was to be made to feel like a fool," (96). Werner does not show any of the stereotypical, Nazi cruelty, and instead punishes the woman through intellectual shame. In this way Werner's punishment goes against General Eaker's idea of the heartless German Nazi and shows more humanity in the German people during the war.

This is repeated when Werner tells Campbell what he thinks of Campbell's broadcasts, saying, "I realized that almost all the ideas I hold now, that make me unashamed of anything I may have felt or done as a Nazi, came not from Hitler, not from Goebbels, not from Himmler – but from you… You alone kept me from concluding that Germany had gone insane," (99). On one level this solidifies Campbell's sense of guilt, but on another level it reinforces the humanity of the Germans during the war. What Vonnegut presents are not stereotypical Nazis, but real people who are being actively convinced to either to part in horrible acts, or at least ignore just how horrible those acts are, with little distinction between the two. If Campbell had not been persuading some Germans and promoting the Nazi message, people like Werner might not have gone along with the Nazis. To support the cruelties of the Nazis, people like

Werner needed to be constantly convinced, not that what they were doing was right, but more simply that what they were doing was not wrong.

While Campbell views himself as being responsible for the awful things done by the Nazis, he never shows himself to be cruel or supportive of anything the Nazis did. He very often rebukes many of the things the Nazis believed, like racism. When he is interviewed by Dr. Jones for the white supremacist magazine, he says the only reason he had for giving a complete biography was, "to contrast with myself a race-baiter who is ignorant and insane. I am neither ignorant nor insane. Those whose orders I carried out in Germany were as ignorant and insane as Dr. Jones," (69). Campbell contrasts himself with racists like Dr. Jones and calls them insane, and then extends that to say that Nazi officers running the war are just as insane as Dr. Jones, and so Campbell is not like them either.

When it comes to the cruelty of the Nazis, Campbell's own philosophy runs counter to that as well. When O'Hare comes to finally kill Campbell, Campbell fights in self-defense and tells O'Hare, "There are plenty of good reasons for fighting, but no good reason ever to hate without reservation, to imagine that God Almighty Himself hates with you, too," (251). This is the cornerstone of Campbell's philosophy, and why he could never be a true Nazi. He is unable to muster any of the fervor or zeal needed to hate an entire group of people, the first step to genocide or any Nazi atrocity. That ability to feel completely validated in hating other people, whether it comes from religion or anything else, is what leads to evil, not nationality or race. Eaker, as a matter of fact, showcases this more than Campbell or Werner ever do, since he is able to

disregard empathy for anyone at Dresden simply because they were Germans during wartime.

These are all the different manifestations of violence in Vonnegut's novels, institutional or personal, and they all, at some point, have to deal with what Campbell says in *Mother Night*. In novels like *Player Piano*, the revolution is acceptable because it is not born out of hatred for other human beings. The hatred that ignites that revolution is born out of a desire for freedom, and the hatred shown is for machines and systems instead of the people themselves. In *Cat's Cradle*, the hook was only ever used after McCabe went insane, and even then it was part of a game and completely free of hatred. *Slaughterhouse-Five* paints the bombing of Dresden as the greatest tragedy of World War II, but not only because it was senseless destruction. Dresden's bombing is so terrible because of men like General Eaker, who validated the bombing because of their hatred for Nazis. It is the blind hatred that makes violence so despicable, and not the act of violence itself.

That is not to say there are not problems with violence as a means for change, like in *Player Piano*, but the morality of violence is never presented as a problem. The revolution ultimately fails because it chose violence as its method. This is why the leaders of the revolution, including Paul, all decide to turn themselves over after Ilium is destroyed. Before they all march out, Paul says makes a toast, prompting Von Neumann to tell him, "This isn't the end you know," (341). The men have ignited the revolution through violence, but they know that violence as a practice is not the way to make true change. Instead of brute forcing their way to a new world, they realize that change must

be gradual and mutually accepted before it can ever truly affect people. They give themselves up, entrusting the people to continue the revolution without resorting to makeshift tanks and explosives, because that is the only way to actually make a difference.

Cat's Cradle ends with an apocalypse brought about by ice-nine, which freezes all water it touches forever. Ice-nine was created by Felix Hoenikker, who was, "one of the so-called 'Fathers' of the first atomic bomb," (8). Felix's cold, scientific curiosity is what brought the atomic bomb into existence, and that same, inhumane curiosity is what makes a dangerous tool like ice-nine exist in the first place. Frank Hoenikker brought ice-nine to San Lorenzo as a bargaining chip, and it is accidentally released upon the world and effectively ends it. Here, the apocalypse is not brought about by hatred, but instead carelessness. Without any concern for human beings, the same destruction that is possible through hatred is possible through carelessness. It is not enough then, to simply not hate, but there must also be an element of concern and care for fellow human beings to prevent destruction and violence from over taking the world.

In "Happy Birthyday, Wanda June," the character Looseleaf says, "Wars would be a lot better if guys would say to themselves sometimes 'Jesus, I'm not going to do that to the enemy. That's too much.'" (64). This is another summation of how Vonnegut views pacifism. Vonnegut, on multiple occasions, voiced the complaint that wars would never end and there was no point in trying to stop them. In the introduction for *Slaughterhouse-Five*, Vonnegut says, "If wars stopped coming like glaciers, there would still be plain old death," (3). There is no stopping wars, and even if there were to

somehow be an end to all wars ever, people would still keep dying anyway from any of the awful things that kill people every day. This idea defeats the core of pacifism and renders it a sterile idea, and Vonnegut is not a true pacifist.

He does, however, take some things from the ideology. Vonnegut's novels do not show a clear disdain for violence, nor do they voice any idea that all violence should or ever will stop. Instead, Vonnegut's advice about violence is threefold: Sometimes violence is necessary, no one should ever partake in violence without a good reason, and there is never any reason to enjoy or be okay with hurting another person. The acceptance of violence as an inevitable part of the human experience is as much a part of Vonnegut's writings as anything else, and thus it is crucial to having a better understanding of his works, both individually and as a whole.

The current scholarship about Vonnegut is lacking a clear understanding of this. Many articles steer clear of Vonnegut and violence completely, which may be a kind of criminal negligence, and there still seems to be a bit of a misunderstanding about what Vonnegut is saying when this aspect of his work comes up at all. For instance, Racheal McCoppin's article, "War and Altruism in the Works of Kurt Vonnegut," she says, ""He revolts against war by teaching his readers to value altruism. His characters learn self-actualization by respecting and valuing others" (Simmons, 64). McCoppin is only half right here, as many characters in Vonnegut do find clarity and self-actualization by realizing how they should respect and treat others, but labeling this altruism is not exactly right. None of Vonnegut's characters do anything truly altruistic, and altruism in its pure form, much like pacifism, never shows up in Vonnegut's work.

In fact many of Vonnegut's characters operate in a very self-interested way for the entirety of their time on the page, even if they are doing good things. Paul in *Player Piano* has his motivations questioned explicitly during the trial, and is in a way found guilty. The lie detector clearly shows that Paul's hatred for the mechanized society comes from a resentment towards his father, who played a key role in society becoming the way it is in the novel. Paul replies to this accusation, "If my father were a petshop proprietor I suppose I would be a subconscious dog poisoner" (317). At this point Paul has accepted that his hatred for his father does not only fuel his hatred for machines, but is a fundamental part of who he is and shapes him into the person he is. It is just a fact to him that he would resent anything his father did, and would fight against it in his own ways. He continues to tell the court, however, "I expect all people are motivated by something pretty sordid… Sordid things, for the most part, are what make human beings, my father included, move. That's what it is to be human, I'm afraid" (317). Paul's statement here directly contradicts the idea of altruism. Paul does not believe that anyone is actually motivated by pure, disinterested hope for humanity, and that everyone is somehow motivated by the sordid things they have suffered themselves. Without these awful things propelling human beings, society would stagnate and nothing would ever change, and so terrible things need to happen before good things can. Paul thinks of this as the very essence of humanity and progress, and sees people selfishly retaliating against things they have suffered as the force that drives all good in the world. These awful things are not only necessary, but in a twisted way, good for people as long as they take those awful experiences as fuel for positive change.

This synthesis between horrible things, like violence or a neglectful parent in Paul's case, and positive or progressive change is a key method of self-actualization in Vonnegut's characters. It is not enough to just simply want better things, nor does it seem possible in Vonnegut's works for someone to simply change for the better. Vonnegut remains a cynic. There is always a conduit for progress, and most of the time that conduit is something awful.

In *Cat's Cradle*, Bokonism in many ways serves as a microcosm and critique of society, and more importantly the individual people within it. Almost all of the quotes given from the Books of Bokonon are centered around human beings. Concepts like the *karass* are defined as, "teams that do God's Will without ever discovering what they are doing," (5), and the emphasis throughout the book is placed on the people within Jonah's *karass* like the Hoenikker children and their lives. Many other Bokonist terms operate in the same way: *sinookas* are the tendrils of someone's life, a *granfalloon* is a false *karass* such as a "Hoosier" or a Communist, and a *duffle* is thousands of people whose destinies are all placed on one *stuppa*, which is an idiot. All of these terms are about different kinds of people and how their lives affect other people's lives. When Jonah is trying to write his first book, he tells Newt Hoenikker that book will, "emphasize the *human* rather than the *technical*" (9), and that is precisely what the book he does end up finishing accomplishes.

This Bokonism, which is so thoroughly concerned with human beings and the way they interact with each other, is what creates the horrific hook. The same religion that turned life in San Lorenzo into, "a work of art" (116), thought it would be valuable

to have something like the hook looming over Bokononists' heads, and it played a vital role in the drama that Bokonon and McCabe played for the people. It was only when Bokonon and McCabe went insane that the hook was actually put to use, and Castle explains this to Jonah. He says, "As young men, they had been pretty much alike, had both been half-angel, half-pirate. But the drama demanded that the pirate half of Bokonon and the angel half of McCabe wither away" (116). What the drama took from the two men was their sanity, because it made them deny the other half of themselves. Being unable to accept the pirate with the angel, or in other words the opposite sides of their natures, eventually took too much of a toll on them and drove them both over the edge. Having to be one extreme or the another taxes McCabe and Jonah so much that they lose who they really were in the first place, and that leads to gruesome torture like the hook as much as the two men's actual insanity.

One of *Slaughterhouse-Five'*s most notable stylistic choices is how exactly it jumps around Billy Pilgrim's life. Since he is unstuck in time, Billy experiences his life out or order in an endless loop, never really dying or ceasing to be, but always returns to Dresden in 1945. The book begins with Billy in the war and ends with Billy walking around Dresden two days after the bombing that turned it into the face of the moon and with World War II officially over. The imagery is a blend of postwar destruction and new life, reading, "The trees were leafing out. There was nothing going on out there, no traffic of any kind. There was only on vehicle, and abandoned wagon drawn by two horses. The wagon was green and coffin-shaped. Birds were talking" (490). The nice, spring like image of trees regaining their leaves and birds chirping is not undercut by the

coffin shaped wagon and abandoned, war-torn city, and instead the two mix together in a kind of harmony. Billy returns to the destroyed ruins of Dresden at a very picturesque time, one that synthesizes the atrocities of war with a reborn, natural life. Once again the results of violence have mixed perfectly well with the conventionally admirable, and neither is contradicted by the other.

Slaughterhouse-Five makes frequent use of the phrase the aliens use whenever someone dies, "So it goes." The phrase is when a plane crashes and almost kills Billy, when Dresden is destroyed, and when a fly is killed as Billy is abducted by aliens. Whenever some kind of violence happens, even on the smallest possible scale, the narrator's only comment is those three little words. This juxtaposition may initially appear jarring, but it creates a common thread between all violence or tragedy featured in the book, equating them all with one another. No amount of violence is too big nor too small to deserve the same amount of reverence, which is not very much. Tragedy and violence are presented as if they are perfectly natural and with not special attention payed to them. The phrase is attributed to the Tralfamadorian aliens that only think that, "the dead person is in a bad condition in that particular moment, but that the same person is just fine in plenty of other moments" (362). To them, death is a part of nature in such a way that it deserves no real recognition at all, as if it was indistinguishable from the rest of existence.

Vonnegut's general style shows this throughout his career. He is a frequent user of dark comedy, which makes fun of things that are conventionally tragic or taboo like death or murder. O'Hare shows the narrator a little book that says the world's

population will be seven billion before the turn of the millennium, and the narrator responds, “I suppose they will all want dignity” (488). The subject of that joke is the fact that each and every human being wants respect, but there are so many of them, as if dignity was a resource that had to be rationed out to people. It quickly tears down the concept of dignity to be just the butt of a joke, but that same joke works the other way around as well. It can be read as a satirical comment about people not treating people with respect, because of course dignity is not an exhaustible resource and every person deserves a basic form of it. That little joke works to both glorify the concept of dignity and reduce it at the same time, depending on how it is interpreted. Whether the joke is insulting people or complimenting them is up to the reader, and this can be extended to violence as well. Violence is not necessarily evil, and it can be used for good as much as it can be used for evil.

Vonnegut, however, is not arguing for any moral relativism. *Mother Night* struggles with the ideas of absolute good and evil throughout it, but does ultimately arrive at the conclusion that these absolutes exist in the world. As Campbell is exonerated by Frank’s affidavit, he says, “So I am about to be a free man again, to wander where I please. I find the prospect nauseating” (267), and he resolves to kill himself. The many awful things Campbell has done, and more importantly the awful things he has inspired other people to do, has worn down on him too much. He has placed himself in a category of true, irredeemable evil even more than the other Nazi officials he has met while imprisoned in Israel. Campbell offers a backhanded defense of men like Eichmann, who was an architect of Auschwitz, saying that he is unable to tell

right from wrong or beauty from ugliness on the most basic levels. Campbell views himself as different, saying, “I always know when I tell a lie, am capable of imaging the cruel consequences of anybody’s believing my lies, know cruelty is wrong. I could no more lie without noticing it than I could unknowingly pass a kidney stone” (166). The guilt Campbell feels, and what he thinks makes him evil, is that he is fully aware of the horrible things he has done. He is not ignorant or blind to the awful consequences of his Nazi propaganda, and that awareness is what makes his actions evil. Men like Eichmanns are afforded a kind of naivety that Campbell excuses before he makes any excuse for himself. Knowing the full negative impact of his actions is what makes him so despicable to himself, and makes his sins all the more unbearable.

Knowing that something is cruel but doing it anyway is Campbell’s definition of evil, but he gives it more explicitly in a different way after he breaks O’Hare’s arm in his apartment. He tells O’Hare, “Where’s evil? It’s that large part of every man that wants to hate without limit, that wants to hate with God on its side. It’s that part of every man that finds all kinds of ugliness so attractive” (251). Campbell uses some religious imagery here, but his point can be easily separated from it. God, in this case, is meant to represent some kind of false absolute that justifies doing horrible things to people, which can really be anything. Feeling justified and vindicated while doing malicious things is objectively evil, and often these things are validated through religious, pseudo-patriotic rhetoric, but what makes it pure evil is that part within men that does malicious things while fully knowing that what they are doing is wrong. The part of men that finds ugliness attractive, that is fully aware that what they are doing is ugly and is

doing it for the sake of ugliness, is pure evil to Campbell and why he finds himself deserving of death. While Campbell did help a lot of people by incorporating secret messages to Allied forces during the war, he knew full well that he was also inspiring Nazis to commit all of the heinous acts that Nazis commit. The good he did does not offset the purity of the evil he facilitated, and so he decides to kill himself when the Jewish courts exonerate him. As a being of pure evil, Campbell thinks the only suitable punishment for his crimes is death, and gives himself that "justice" by committing suicide.

With pure evil defined as a conscious, willingness to participate in cruelty, then pure good might logically be the inversion of that. Pure good might be a conscious, willfulness to participate in compassion or unity. Vonnegut often speaks very highly of sex in his books, and sex as a symbol of unity has a strong historical tradition. After Billy Pilgrim has been abducted by aliens, he and the other, female captive eventually have sex and have a baby. The description for this is very brief, saying, "After she had been on Tralfamadore for what would have been an Earthling week, she asked him shyly if he wouldn't sleep with her. Which he did. It was heavenly" (435). Although the description of the sex is anything but explicit, and only six words, it is entirely positive. There is no strings or sarcastic language attached to it. The description of sex is completely positive and, in a way, pure. Sex signifies a unison of two people, often in both mind and body, and is a primal symbol in the circle of life. Sex is, of course, the only way humanity can continue, and is part of the basic, biological human experience. While Vonnegut usually has some cranky anecdote or sarcastic quip to use about every other aspect of

humanity, he is only able to compliment the act of love making. There is an element of purity, and some innocence, to sex that is nowhere else in Vonnegut's works, and it serves as a symbol for pure good. If evil is known cruelty, then the consenting union between two people in mind as well as body is a pure good.

Violence in Vonnegut plays an important role in humanity's story. It can serve as a method of change or a force for good just as easily as it can lead to evil. Vonnegut never advocates for true pacifism, because violence is not inherently evil. People may do evil, violent things, but that evil comes from the people and not from the act of violence itself, and to deny violence outright would be to deny a crucial part of humanity. People are neither entirely good nor entirely evil, and each must be accepted on its own terms before a harmony between the two can be found. Harmonizing violence is difficult, as it can very easily become evil, but it cannot be refused or gotten rid of. People should be cautious and suspicious of violence, and never be entirely comfortable hurting another person, but violence must be accepted as a part of life. Vonnegut's works do not show anything as glamorous or sensational as true pacifism or altruism, but what they do show is just as definitive. Human beings are complicated and sometimes horrible to each other, but they must be accepted in their entirety before any progress as a species can be made. Violence is not going anywhere, and as abhorrent as it sometimes is, the pain it brings can sometimes become the conduit for better people and a better world for everyone to live in.

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Cloning Mutations of p53 for Cell Tissue Culture Expression

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Abstract:

The p53 protein acts within the cell as a tumor suppressor by regulating the rate of apoptosis, with the helps of its negative regulator MDM2. With the over-activation or inactivation of p53, severe damage can be caused to the body by allowing incorrectly divided cells to thrive and have the possibility of becoming cancerous or by causing perfectly working cell to kill themselves, resulting in loss of functioning cells. The objective of this experiment was to combine mutated inserts (Gly, Ala, Pro, Arg, and Asp/Glu) into a DNA plasmid containing p53 and observing how the overall function of the protein was affected by each mutation. A PCR reaction was done to create restriction enzyme binding sites into the vector and comparing the mutation sizes to the DNA ladder. The restriction enzymes, BAMH1 and Kpn 2.1, were used to cut the plasmids and make a gap for the inserts to be placed. Ligation and transformation were performed using *E.coli* cells and a final gel was run to see whether enough of the plasmids took up the mutant inserts. Upon final observation, the bands indicating enough mutated plasmids had been created were not visible within the gel. Thus, resulting in the creation of enough mutated plasmids for each mutation not working this trial.

Introduction:

The interaction between the p53 protein and MDM2 protein is a crucial part in tumor progression and bodily maintenance. These two work together by counter balancing the expression of each other to ensure the concentrations don't decrease/increase too dramatically. This balance of concentrations helps to activate certain cell cycle processes, as well as, apoptosis which helps to prevent the formation and evolution of malignant cells. However, the overexpression or under expression of the p53 protein or MDM2 gene can result in apoptosis defective pathways. Problems in these pathways prevent the body from removing faulty cells which can possibly become malignant and produce carcinogenic cells

p53 is a wild-type tumor suppressor protein made of 393 amino acids and is activated upon extracellular or intracellular stressors, like DNA damage, hypoxia, and dysfunctional telomeres (1 and 2). The protein is composed of five different domains: amino terminal domain, proline rich region, central core domain, oligomerization domain, and a carboxyl regulatory domain. The amino terminal and proline rich region combine to create the N-terminus which assists to regulate transactivation with the use of specific transcription factors, including MDM2 and acetyltransferases. The oligomerization and regulatory domains combine to create the C-terminus which regulates the induction into cell death. Lastly, the central core helps with the regulation of DNA binding which in turns controls the levels of specific DNA sequences; this location is the most commonly mutated in p53 protein's structure (1, 5, and 6).

The mutations that are produced by the p53 protein are nonsynonymous missense mutations, thus causing a single nucleotide change which results in a different amino acid sequence. This abnormality is what causes the commonality of p53 mutations in human cancer

cells due to the mutation disabling p53's ability to control the rate at which malignant cells are grown, as well as, repressing transcription of promoters at the specific DNA sequences (1 and 7). The protein also contains three amino acids, Leu-26, Trp-23, and Phe-19, which assist the protein in burrowing into the cleft of MDM2. This burrowing enables the interaction between to two to occur thus, resulting in the overall expression of p53 for it to function properly in the cell.

p53 works by using two separate pathways; an extrinsic and an intrinsic. The intrinsic pathway or the mitochondrial pathway produces pro-apoptotic products (Bax, Bid, Noxa, and p53A1P1) which assist in promoting the loss of membrane potential in the mitochondria while simultaneously releasing cytochrome c to form apoptosome complexes. Noxa, a proapoptotic gene, is selective for the BH-3 proteins that assist with DNA damage and glucose level deprivation (3). On the other hand, the extrinsic pathway or cell death pathway uses mainly p53 to activate death receptors (DR4, DR5, and Fas/CD95) to lead to IAP (inhibitor of apoptosis proteins that help to regulate cell death) production to eventually promote apoptosis. These pathways can be regulated and controlled through cell cycle arrest and the main functions of transcription factors c-Myc, ASPP, JMY, and other p53 family members (p63 and p73) (5).

p53 also works cooperatively with its' negative regulator MDM2. MDM2 is a 25 kilobase long protein that consists of 491 amino acids. Like p53, MDM2 also contains multiple domains that are conserved from species to species; specificity between species is what makes it so unique and gives it the ability to act as an oncogene in multiple animals. The protein contains eleven domains, however, some of them overlap functionally: amino-terminus, nuclear localization sequence (NLS), nuclear export sequence (NES), acidic region, zinc finger domain, caspase 3 cleavage site, three conserved putative DNA protein kinase phosphorylation sites, and two conserved zinc ring-finger conformations. The amino-terminus is what allows MDM2 to

bind to p53 thus inhibiting the transcription activators from functioning. The NLS and NES work together to mediate the movement between the cytoplasm and nucleus. This movement is what enables the MDM2 protein to move in either direction due to the formation of a ubiquitin-mediated degradation system, which downregulates p53 when too high of a concentration has been produced. The acidic region controls MDM2's relationship with the ribosomal protein L5. Lastly, the two zinc finger conformations regulate the ability to bind RNA sequences and structures while in vitro. All the protein's domains cooperatively work together to provide the necessary pathways for MDM2 to act as an oncogene (2). The protein also forms a cleft that is covered in hydrophobic aromatic amino acids, preventing any water containing substances from entering and binding. However, the cleft forms a perfect site for p53 to bind using its' amphipathic helix; this helix is only formed when interaction with MDM2 occurs (2).

p53 works with MDM2 to functionally regulate the rate of apoptosis of defected cells within the body. For this process to work, p53 must be tightly bound and highly regulated by the MDM2 oncoprotein through the amino terminus. The binding of the two results in the creation of a autoregulatory feedback loop. This loop causes the MDM2 is negatively regulating p53 levels and activity while p53 is positively regulating MDM2 levels. This decreased level of p53 causes messenger RNA levels to fall thus producing a chemical stressor within the cell in order to raise p53 levels (2). The p53 then begins working as a transcription factor by binding to specific DNA sequences and repressing large groups of target genes. This helps to promote cell growth by stopping the cells from going through interphase at either the G1-G2 or G2-Metaphase transitions. This allows time for the cells in that phase to correct any damages or genomic mistakes before moving on to the S or replication phase; where if damages are not corrected can result in the creation of many "bad" or faulty cells. These cells can then go on to produce benign

or malignant tumors within the human body (8). Once p53 has performed its' needed function, its' levels decrease resulting in MDM2 to work at inactivating the p53 until the cell requires its use again. For this process to occur, MDM2 uses nucleosome complexes to send transport signals through to the cytoplasm. These signals then activate transporters to move p53 to a different part or the cell, or a proteasome to degrade any excess p53 that had been previously expressed.

In conclusion, p53 and MDM2 are able to bind with the use of three hydrophobic amino acids and many different terminals that help to keep the gene and protein in their autoregulatory loop. p53 and MDM2 levels play many crucial roles to keep cells stable and correct while going throughout the cell cycle and inducing apoptosis if irreversible damage to a cell has been done. These processes are able to occur with the help of many other genes, transcription factors, and extracellular proteins.

Methods/Procedures:

PCR and Gel Electrophoresis:

A PCR reaction was performed using p53 Kpn 2.1as DNA template, reverse primers (designated mutations), GoTaq MasterMix, and a forward primer (BAMH1). Gel electrophoresis was performed using 1.5% agarose gels with ethidium bromide run at 100V.

Digestion and Mini Prep:

Gel extraction, PCR Cleanup, and DNA mini preps were performed using the Thermofisher kits. P53 Kpn 2.1 and PCR products were cut with the restriction enzymes, BamHI and Kpn2I and incubated at 37℃.

Ligation and Transformation:

Ligation was performed using DNA Ligase T4 (NEB). Transformation was done using NEB alpha-*E. coli* cells. The cultures were plated on ampicillin LB agar for selection.

Results/Discussion:

To generate the Gly, Arg, Ala, Pro, and Asp/Glu mutant products, a PCR mutagenesis was performed. These inserts were prepared into 50 microliter PCR reactions prior to running the gel and are being compared to the NEB Quick-Load 2-Log DNA Ladder. Running this gel helped to ensure the right size inserts would be used and placed into the vector during the last step of the experiment. The gel of the PCR product showed 100 bp band sizes in all lanes (Figure 1). However, the Gly and Pro lanes show bands larger than expected so a second gel, containing only the Gly and Pro residues, will need to be performed to determine each bands' size.

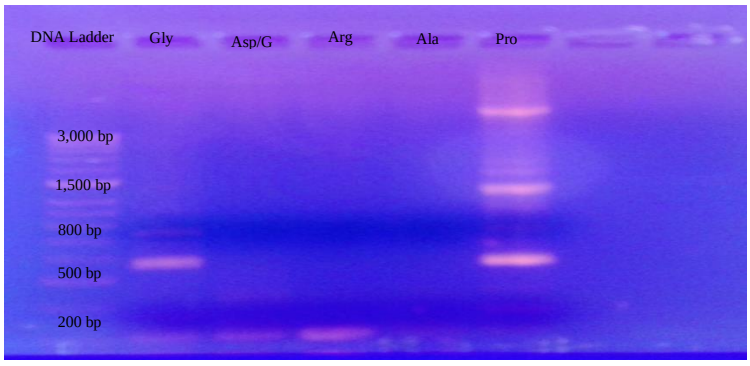

Figure 1: Electrophoresis of PCR Mutagenesis Products

A 1.5% agarose gel was run, and the product for the Gly and Pro residues were observed at multiple large band sizes. These larger band lanes were caused by an unknown reason.

Expected band sizes were located at 100 kbp for the remaining mutations (Arg, Ala, and Asp/Glu).

To determine the sizes of the unexpected bands, a second gel was ran containing only the Pro and Gly residues (Figure 2). The band sizes viewed were larger than expected at 200 bp, 300 bp, and 400 bp. These inserts were run in second gel to ensure that a mistake was not made in the first gel, causing the larger bands to appear, as well as, obtaining each band for gel extraction and purification. Upon cutting out each labeled band for the Gly and Pro mutants (Figure 2), a gel purification will be to done remove any access agar so that only the DNA inserts remain; the bands for Asp/Glu, Arg, and Ala (Figure 1) went through a standard PCR cleanup for purify the DNA for restriction enzyme digestion.

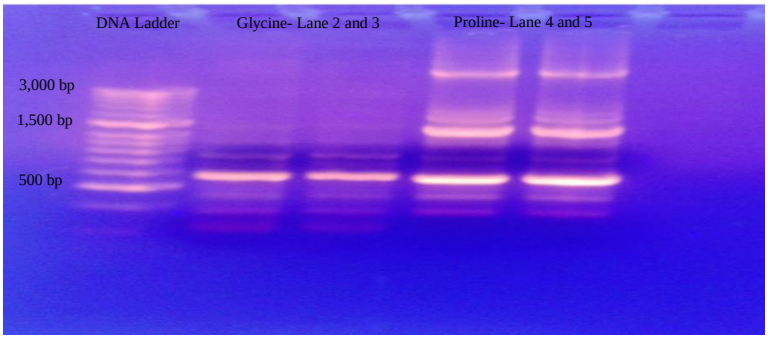

Figure 2: Glycine and Proline Gel Extraction

Another 1.5% agarose gel was ran containing only the Pro and Gly mutant residues. The bands were compared to the DNA ladder for determination of band sizes. Large, bright bands were visible at the 100 kbp, 200 kbp, 300 kbp, and 400 kbp markers

PCR cleanup procedures were performed on all cut bands to prepare them for digestion. Each vector was then cut with the restriction enzymes, BAMH1 and Kpn 2.1, to create binding sites for the inserts to attach to within the vector. The Kpn 2.1 was run against the mutant inserts in a gel for a size comparison between the mutants and DNA ladder (Figure 3). Each band is

approximately 100 bp, however, the Gly 100 bp was not visible on this gel. The second gel with proline and glycine inserts produced nothing of size visible to the human eye through the gel process. However, some trace bands were cut from the gel in case they included very small amounts of the mutant inserts.

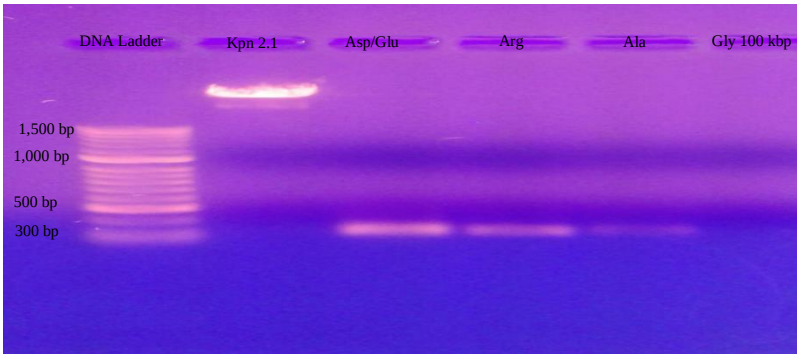

Figure 3: PCR Cleanup and Restriction Enzyme Cut of Viable Mutations

A 1.3% agarose gel was run against the Kpn 2.1 plasmid digestion. The initial digestion was done using the restriction enzymes BAMH1 and Kpn2.1. Bands were visible for the Arg, Ala, and Asp/Glu lanes, however, nothing appeared in the Gly 100 kbp lane. The reason behind it not appearing is unknown, but it can no longer be used in further processes due to its' absence.

In order to analyze the final product, colonies were collected from the ampicillin LB plates, DNA isolated from these colonies was run on a gel to visualize the products. As seen in figure 4, no bands were visible for any of the mutants, therefore, the experiment did not work as expected.

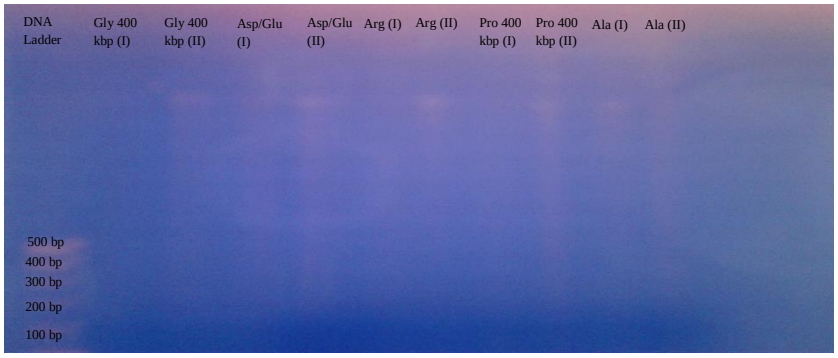

Figure 4: Gel Analysis of Plasmids Collected from Isolated Colonies

Purified digested mutants were mixed with digested p53 Kpn, ligated and transformed into DH5alpha cells. Colonies were chosen and grown overnight. DNA was isolated and run on a 1% agarose gel. They were run against the NEB DNA Ladder, as used previously. No visible bands were identified in any of the ten lanes.

Conclusion:

In conclusion, the recombinant plasmids were not created using a wild-type p53 DNA vector and different mutational inserts (Arg, Ala, Gly, Asp/Glu, and Pro). The experiment could have produced this result due to the experiment being completed in a larger time frame than the, possible life of the cells. Future experiments should be performed in a more realistic timeframe for better results.

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Engineering a Cellulosome: Increasing Synergy and Efficacy by using a Chimera

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Introduction

Cellulose, which is found in plant cell walls, is one of the most wasted products on earth. The potential use of cellulose as a source of energy is important and favorable because of the mass amounts available and it is rather renewable. Plant cell walls are not toxic and are not harmful but are taking up a mass amount of room in land-fills, which are filling up very quickly. Converting cellulose into a biofuel is extremely difficult because of the heterogeneous and recalcitrant structure of cell walls and conventional conversion is not realistic.[3] Even with the obstacles with the structure of cellulose, many bacteria have found ways to break down this molecule of almost pure sugar. They do so by using a multi-enzyme complex, cellulosomes, to break down the biomass into energy (ethanol).

Using cellulosomes as an alternative to fossil fuels, which have been drastically depleted and are not readily renewable, is attractive. However, there are other reasons to use cellulosomes to produce an alternative biofuel. The United States industrial and domestic population have generated 150 billion kilograms of waste, of that waste 100 billion kilograms are estimated to be biodegradable. The biodegradable products such as wood, paper, and cardboard are put into landfills in order for natural anaerobic processes to occur. These processes are slow and rather ineffective, which tends to lead to contamination of ground water and improper disposal.[3]

Biomass is one, if not the only known sustainable and renewable energy source that can be converted into a liquid transportable fuel. The U.S. has the potential right now to decrease fossil fuel, gas, consumption by 60% if they utilized ethanol from grain and biofuel. This percentage takes into account the numbers of food, feed, and fiber use and does not impede on current consumption numbers.[3] New technology could increase the efficiency of cellulosomes and utilize its natural capability to break down cellulose while decreasing input and increasing the output of energy.

The current methods of breaking down cellulose waste or lignocellulose include anaerobic hydrolysis of municipal solid waste (MSW) polymers and aerobic hydrolysis and fermentation processes.

Anaerobic hydrolysis of MSW polymers is the decomposition of organic molecules into methane and carbon dioxide by anaerobic digestion in MSW landfills. It is naturally occurring but has many mixed fermentations, which are hard to establish and maintain on a large scale. Another issue is the hydrolysis of complex polysaccharides into fermentable sugars because the lignin the cell contains that acts as a shield. Pretreatments to enhance the hydrolysis of cellulose such as size reduction of substrate particles, thermal chemical pretreatments, and treatment with specific enzyme cocktails have helped.[3]

Aerobic hydrolysis and fermentation processes use thermal chemical pretreatments followed by aerobic enzymatic hydrolysis of milled biomass. This process separates a small fraction of solution that is called the slurry. The slurry contains the insoluble sugars (cellulose). And cellulases over time break down the cellulose. Both of these processes are time-consuming and it is theorized that they can be completed on a larger and more efficient with the help of cellulosomes.

New focuses on designer cellulosomes have increased the probability of future use of cellulosomes to break down cellulose.

Cellulosomes are a relatively new concept. Cellulose was originally thought to be degraded by blends of simple free enzymes, cellulases, produced by cellulolytic fungi.[5] Eventually, researchers found that structures, called cellulosomes, contained theses enzymes. The enzyme would self-assemble on a scaffolding by using cohesion-dockerin interaction. The cohesion-dockerin interactions govern the cellulosomes' structure. Some researchers even refer to them as molecular Legos.[5]

In cellulosomes, the scaffolding serves as the dockerin backbone that contains a cellulose-specific carbohydrate-binding molecule that leads the molecule to the substrate. The cohesin molecules match up with specific dockerins and are essentially the enzymes that break down cellulose. So together the cohesin and dockerins make up a cellulosome. The cellulose can then be manipulated by incorporating different cohesin enzymes that will make a chimeric structure.[11] These chimeric structures can theoretically be made more efficient than the pre-existing cellulosomes.

Researchers began to "toy" with these newly founded molecules. They essentially wanted to take them apart piece by piece and put them back together in a more efficient fashion. These new cellulosomes would be of artificial man-made design. The cellulosome's processes occur in one cell, which makes the possibility of efficiency very plausible. These newly designed cellulosomes use a chimeric structural ideal by taking different scaffolding, which is the cohesin and matching dockerin bearing enzymes. Doing this allows us to control the structure of the cellulosome. However, recent chimeric structures have only given researchers two factors that affect degradation of cellulose, targeting to substrate by CBM and proximity of enzyme components. They learned that it is not about how efficient one enzyme is but more about how they work together as a whole when it comes to recombinant cellulosomes.[3]

When designing a cellulosome you must look at the arrangement of the cellulases in the cellulosome and the distance between enzymes, which can be monitored and changed with linker segments. An alignment of amino acids between the enzymes from the same glycoside hydrolase family is required as well. These can be used to estimate the limits of the catalytic module, linker, and CBM.[22]

After the cellulose is designed then you must clone, express, and purify it. You can clone a cellulosome by inserting a dockerin into the native CBM of the same species. This works well if the native CBM is noncellulosomal and the dockerin is cellulosomal. The DNA coding can be amplified with reverse and forward primers. You can then use normal purification methods to purify your chimera. After purification, you can then test your chimeric cellulosome.[22]

To degrade cellulose to glucose it takes synergy between three types of glycoside hydrolases, endoglucanases, and cellobiases.[13] In one study with minicellulosomes it showed to increase synergy you need complementary interaction between endo- and exo- celluloses. With this change, the cellulosomes could work in temperature over 60 degrees Celsius at an efficiency rate of 60% of the crystalline structure of cellulose.[13]

Current studies are also looking at using zinc fingers on DNA scaffolds to direct the structure of the cellulosome. This increases efficiency in designer cellulosomes depending on the amount of CBM each structure has. Using cellulase-xylanase has also shown improvement in efficiency. Close proximity between the two, xylanases and cellulases, is crucial for increasing degradation of cellulose.[16-17]

With increased interest in finding a substitute for fossil fuels, more and more research is being done on cellulose degradation. Current research is focusing on designer cellulosomes and equipping them with cellulases that can solely receive its carbon source from the fermentation of cellulose. These designs, if achieved, would allow cellulosomes to cost-efficiently produce ethanol or methanol from cellulose. Other research is looking at how to engineer cellulosomes with higher thermostability and activity to allow for efficient cellulose degradation.[14] Cellulose has the potential to be the next major biofuel, but it produces challenges. The recalcitrant nature of the substrate makes it hard to degrade into simple sugars, that is why carefully designed chimeric cellulosomes are crucial in finding an efficient way to break down cellulose.

Abstract

With the rise of cellulase waste in landfills and the amount of time it takes to naturally breakdown, engineered cellulosomes that can break down these waste products at higher and more efficient rates are important. Not only could chimeric cellulosomes breakdown waste products at higher rates, it could also be a potential energy source for the population and a replacement for burning fossil fuels. Combining a cellulose binding module, dockerins with cellulases (enzymes) attached, and cohesins we tried to create an efficient engineered cellulosome. We used natural cellulolytic bacterial cohesins and *T. Fusca* enzymes (TFU) for our construct. We successfully cloned and amplified all four cohesins and 1 of 4 dockerin enzymes. These cloned parts of the engineered cellulosome can be used later on as part of the chimera. Once the completed chimera is constructed it can be tested for efficiency.

Procedures

Freeze-dried whole bacterial cells were suspended in water then rapidly frozen in dry ice then thawed repeatedly with vortexing in order to ensure the breakdown of the bacterial cell wall and release of the genome. Then a PCR Master Mix solution was used. Due to the high GC content of the bacteria used, 10% DMSO was added to the PCR mixture to create a better solvent and allow proper separation of DNA strands. PCR was then completed in order to copy and amplify each dockerin and enzyme. The products were cleaned up and a small sample of each product was run on a gel to make sure they were correct. Next a short ligation was completed on the dockerins. Using TOPO and temperature shock the ligated dockerins were transformed into bacteria. Using SOC, the transformed bacteria was plated and grown on LB Amp plates overnight. The bacteria that grew have all taken up the dockerins, so a miniprep and digestion was done with Eco R1. A 1% Agarose gel was also done afterwards to make sure the dockerins were taken up and correct.

Results

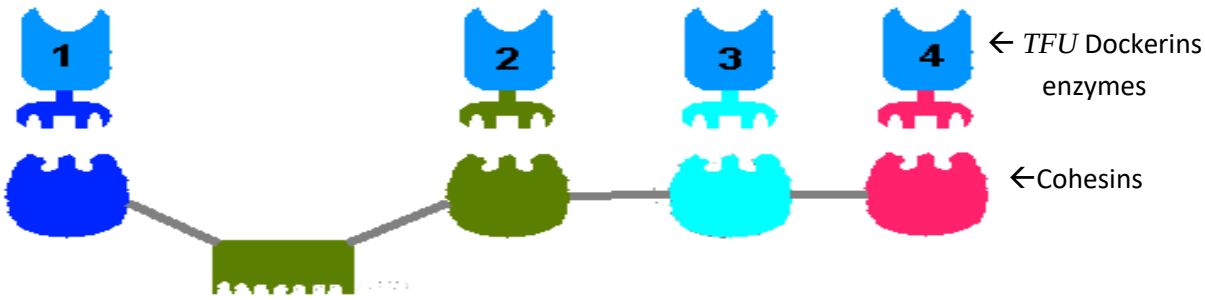

Figure 1. The Constructed Chimeric Cellulosome.

This is a simplified illustration of the Cellulosome we are trying to construct. Essentially the bottom colorful parts are the Cohesin enzymes; Blue: *Bacteriodes cellulosolvins*; Green: *Clostridium*

thermocellum; Cyan: *Ruminococcus flavefaciens*; Pink: *Acetovibrio cellulolyticus*. The cohesion enzymes come together with the cellulose binding module (green square) to form the scaffolding. The *TFU* dockerins labelled 1-4 are all from *Thermobifida fusca* (natural cellulolytic bacteria). Dockerin 1: *TFU* 0901, Dockerin 2: *TFU* 1213, Dockerins 3: *TFU* 0397, and Dockerin 4: *TFU* 1959.

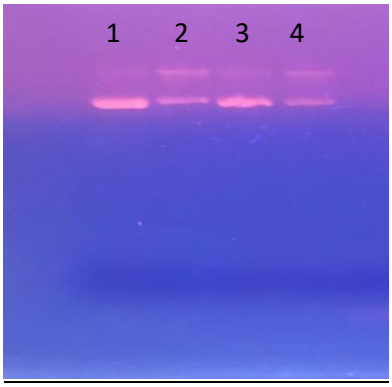

Figure 2. Gel of PET 21 and PET 28

PET 21 and PET 28 were grown on a plate and then a miniprep was run on each one to prepare them as plasmids. PET 21 and PET 28 DNA were ran on an agarose gel. Lane 1 and lane 3 contain PET 21 product and lane 2 and 4 contain PET 28. Because these lanes with corresponding PET plasmids match up, this indicates that the DNA was successfully isolated. PET 21 and PET 28 DNA is what we will use to insert isolated genes into so they can be expressed. The template from figure 1 is what we will try to insert into PET 21 and 28 bacterial plasmids. Restriction enzymes will be used to cut the plasmid so the cellulosome construct can be introduced into the vector.

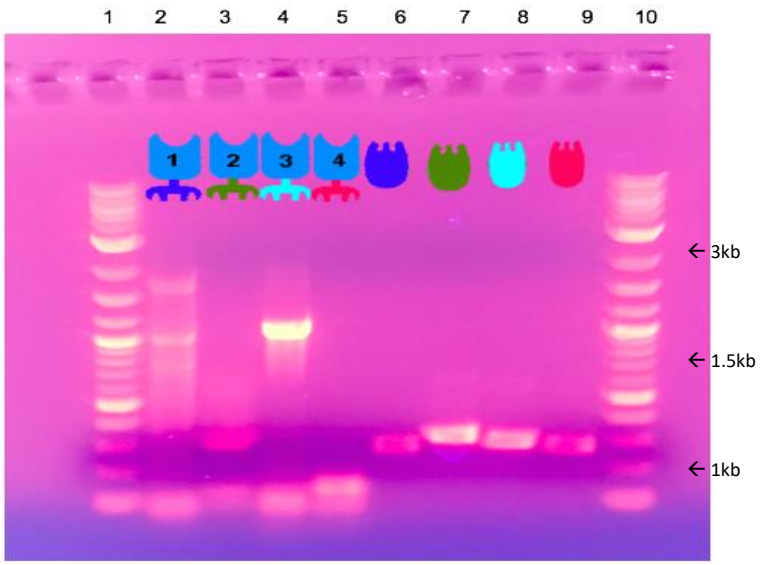

Figure 3. Gel of PCR of Dockerin and Enzymes (*TFU* products)

Lane 1 and lane 10 contain quick-load 2-log ladder. Lane 6, 7, 8, and 9 contain the cohesin PCR products. (blue, green, cyan and pink) All were successfully cloned correctly and corresponded with their correct weights. These are the same products as indicated in Figure 1. Lane 2, 3, 4 and 5 contain *TFU* (T. Fusca enzymes) PCR products. Lane 4 (*TFU* 0937) and lane 3 (*TFU* 1213) were successfully cloned but the other *TFU* enzymes (1959 and 0901) products were not successful. A new method will have to be tried to correctly prime the *TFU* PCR products. Potentially using DMSO instead of water will help because of the high G+C content when preparing the *TFU* enzyme DNA for PCR.

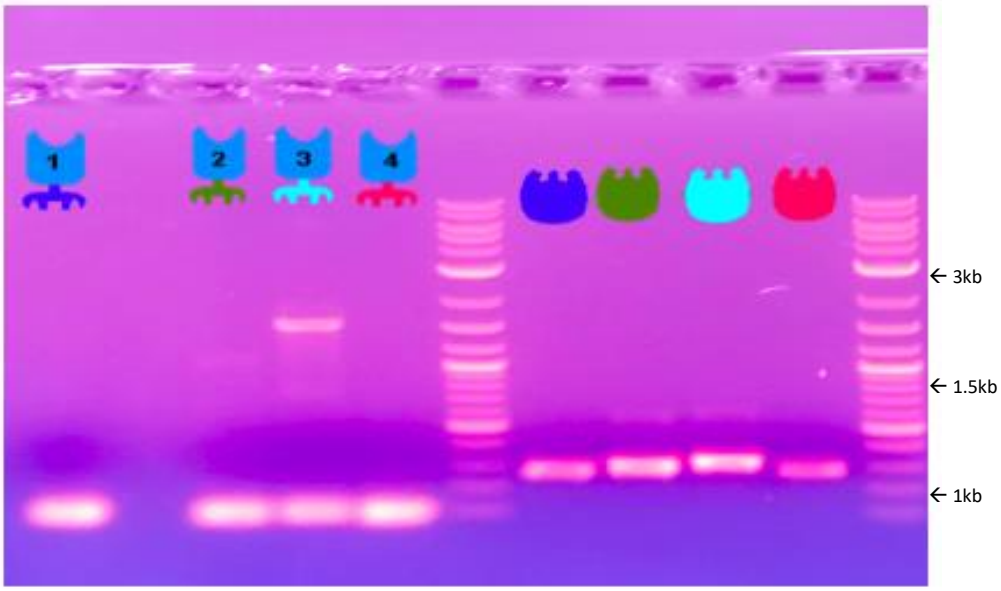

Figure 4. PCR results of third attempt to clone *TFU* products

All Cohesins were successful again. They matched each other and the corresponding weights, indicating that they are correct. Using DMSO did not help with the preparation of the enzymes for PCR. *TFU* enzymes (0901, 1213, and 1959) Dockerins 1, 2, and 4 were not successful. *TFU* 1213 was successful and matched with the corresponding weight. The products at the bottom of the enzyme lanes are primers, therefor the PCR was not successful. The cohesins (blue, green, cyan, and pink) were cloned successfully again.

Discussion

So far, PET 21 and PET 28 were isolated as potential plasmid vectors for the final constructed cellulosome. The bacteria were plated and grown in a lab, then the DNA plasmids were isolated with a miniprep. The products from the minprep were run on a 1% agarose gel. (Figure 2) When looking at figure two both lane 1 and lane 3 match (PET 21) and lane 2 and 4 (PET 28) match.. Next, we attempted to clone and amplify the *TFU* Dockerins enzymes and Cohesins depicted in Figure 1. This time the products were prepared for PCR. Corresponding primers, the enzyme or cohesin, and water were mixed in preparation. The cohesin were put into the thermocycler together because they were all equal or about

equal in length. Next the *TFU* Dockerins 0397, 1213, and 0901 were put in the thermocycler because they were close in base pair length. *TFU* 1959 was run separately because it is much longer. The products were then run on a 1% agarose gel (Figure 3). The PCR of the dockerins was succesful and matched the expected molecular weights. The *TFU* products were not all successful: *TFU* 1959, 1213, and 0901 (labelled 1,2, and 4 respectively). *TFU* 0937 was successfully amplified. In attempt to correctly prime the *TFU* enzymes 10% DMSO was added to the reaction. DMSO is often effective in aiding in amplification of DNA with a high G+C content. The rest of the preparation was kept consistent with the previous step. After PCR was completed, the products were run on a 1% agarose gel (Figure 4). Again all Cohesins were successfully amplified. *TFU* enzyme 0937 was successfully amplified with the addition of the DMSO. All other *TFU* enzymes were not successful. The gels indicate that either the preparation or PCR program used for *TFU* enzymes 0901 and 1959 needs to be modified. On the first gel we see products within the *TFU* 0901 lane, but it was not an isolated band.

In order to successfully preserve the Dockerins, we attempted to use short ligation and temperature shock to transform the products into bacteria. The bacteria were plated and grown overnight which resulted in plate growth. This suggested that the dockerins were successfully transformed into the bacteria.

Based on the work done, all the Cohesins; *Bacteriodes cellulosolvins*, *Clostridium thermocellum*, *Ruminococcus flavefaciens*, and *Acetovibrio cellulolyticus* have been successfully amplified with PCR and cloned into holding vectors. The *TFU* enzyme dockerins 0397 and 1213 have also been successfully cloned and amplified with PCR. The bacterial plasmids for purifying the completed cellulosome have also been isolated and amplified. Six of the eight components needed to construct the engineered cellulosome have been successfully cloned.

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The Efficacy and Toxicity of Synthetic Anti-Parasitic Drugs as Compared with Plant-Derived Treatments

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Abstract

With previous successes in anthelmintic and anti-parasitic drugs/repellants, new research in Veterinary Parasitology has declined drastically (Coles 31-39). As a natural response to encountering similar drugs throughout the decades, drug resistance has been proven to be on the rise. This increase in drug resistance has not only progressed through lack of research but also through the ease of access, lack of treatment options, elongated usage, frequency used, and lack of the requirement of a prescription to obtain anti-parasitic drugs (Coles 31-39).

Up until 2002, nematode drug resistance was only reported in small ruminants (Gasbarre et al. 281-285). Newer studies have shown anti-parasitic drug resistance has spread to various species including but not limited to cattle, equine, canines, and felines (Da Saliva 429-432; Coles 31-39). Parasitic infections in animals can result in a major decrease in productivity (Dyary 191-206). Parasitism in a host can lead to direct tissue damage, loss of nutrients and energy, loss of appetite, and eventually death (Dyary 191-206). Due to this plummet in productivity, farmers experience economic and financial losses as well. Not only can animal parasitism have an indirect effect on humans, but a direct impact can be introduced when zoonotic disease-causing parasites are transferred via an animal vector to a human host (Dyary 191-206).

To combat anti-parasitic drug resistance before it becomes uncontrollable, more people need to take interest in the development of new research in Veterinary Parasitology. Lice, mites, and ticks are also becoming resistant to insecticides (Ellse 233-243). Alternative methods for ectoparasite control are needed because of restrictions of certain insecticides that effect human health (Elsse 233-243). Due to an increase in population size and the demand for drug-free food production, the management and control of parasitic infections is important (Dyary 191-206).

In looking at the chemical defenses of plants, secondary metabolites are a promising option for parasite control. These organic plant compounds are not only environmentally safe, but strong enough to deter herbivory and predation. Through plant distillation, the secondary metabolites can be blended to form what many people know as an essential oil (Cloyd 1567-1579). There have been many studies to test the efficacy of essential oils as both a repellant, and a topical/oral anti-parasitic treatment option (Andrade et al. 2421-2429). Although many of these

studies have generated promising results, complications have occurred in in vivo experiments due to poor techniques and improper dosing (Rinaldi et al. 503-515). The goal of this experiment was to not only prove the efficacy of essential oils as a primary treatment option for parasites, but to also formulate accurate concentrations that are both safe and effective in vitro and in vivo trials.

Two essential oil blends showed significant results in limiting or decreasing the activity of the nematode, Caenorhabditis elegans. Both the 5% patchouli oil, chamomile oil, and cinnamon oil blend and the 5% bitter almond oil, mullein oil, and wormwood oil blend were more effective at limiting nematode activity compared to the over-the-counter Dewormer, Pro-sense. The 5% patchouli oil, chamomile oil, and cinnamon oil blend showed greater significance values when compared to the 5% bitter almond oil, mullein oil, and wormwood oil blend in the Krustal-Wallis and Mann-Whitney U tests. The 5% bitter almond oil, mullein oil, and wormwood oil blend displayed lower activity levels, however, when comparing mean activity levels of the nematodes. To determine which blend is both effective and safe for topical application or oral consumption, toxicity testing will be needed to be performed in later studies. More consistent and accurate protocols are also needed for future studies, due to the lack of so in this area of research. Efforts made during this experiment to improve techniques associated with the transfer of C. elegans from one media to another and the introduction of essential oils to the media itself were effective but were not unflawed. The major issue to address with the protocol used was the drying out of the media.

Literature Review

Research in veterinary parasitology has declined since pharmaceutical companies have generated a large variety of safe and effective anti-parasitic drugs (Coles 31-39). Economically advanced areas have developed a good means of parasitic control so the need for new drugs has not been a priority (Coles 31-39). Without the development of new anthelmintics, drug resistance began to appear; Ivermectin resistance in cattle and Benzimidazole in equine. In 2002, the first case of anti-parasitic drug resistance was reported in cattle (Gasbarre 281-285). Up until this point, nematode drug resistance had only been noted in small ruminants (Githiori 308-320; Gradé, 267-274). Studies have now shown that parasitic drug resistance has spread to various species including but not limited to equine, canines, and felines (Bowman 138). Multiple studies have shown entire classes of Dewormers are no longer working against nematode worms called Strongyles, which are found in the gastrointestinal tract of many mammals (Lynn). Nematodes have shown a higher resistance than Platyhelminthes when comparing helminth resistance (Fairweather 469-476). Many anti-parasitic drugs such as anthelmintics are cost effective and easy to access (Dyary 191-206). Various drugs such as these can be purchased in local supermarkets or pharmacies without a prescription from a veterinarian (Coles 31-39). Improper dosing, increased frequency, and the elongated time frame these drugs have been used has led to a rise in uncontrollable parasitic infections (Dyary 191-206).

Parasitic infections in animals can result in a major decrease in productivity (Seip 285-295). Parasitism in a host can lead to direct tissue damage, loss of nutrients and energy, loss of appetite, and eventually death (Seip 285-295). Due to this plummet in productivity, farmers experience economic and financial losses as well (Coles 31-39). It is estimated that a total of $77 million dollars was lost in 1999 in the United States alone due to a parasitic infection which caused coccidiosis (Coles 31-39). If the control of parasitic diseases could be made more economically friendly, the savings could be passed on to the consumer. Due to an increase in population size and the demand for drug-free food production, the management and control of parasitic infections is important (Dyary 191-206). Lice, mites, and ticks are also becoming resistant to insecticides (Ellse 233-243). Alternative methods for ectoparasite control are needed because of restrictions of certain insecticides that effect human health. Chemical medicaments create drug resistance in residues which have the capability of being passed on to animal-product consumers. Animal welfare constitutes as a vital component for human health and should be taken seriously.

Resistance occurs when an elevated number of organisms within a species are no longer affected by a regular dose or concentration of a drug; therefore, a greater concentration is required to reach a certain level of efficacy (Fairweather 469-476). Scientists are just now beginning to understand the mechanisms of resistance. Some known mechanisms are changes in a molecular target, changes in metabolism, changes in drug distribution throughout the body which prevents access to action site, and amplifications of target genes to overcome drug action (Coles 31-39). Parasites have proven to be very adaptable so alternative methods for control need to be formulated.

Plants not only harvest protein and energy but they also contain secondary plant substances which aid as anti-parasitic compounds (Seip 285-295). These substances are called secondary metabolites and serve as part of the plant's chemical defense system against herbivory and predation. Groups of these secondary plant substances are polyphenolic compounds which include lignin and condensed or hydrolysable tannins, flavonoids, alkaloids, glucosinolates, terpenoids, triterpenoid saponins, and other nitrogen-containing and Sulphur-containing compounds. These secondary plant metabolites make up what many people know as essential oils; which can be obtained through steam distillation of above-ground plant biomass. Essential oils are blends of approximately 20-80 different plant metabolites (Anthanasiadou 1392-1400; Githiori 308-320). Evidence shows that the combination of various oil components exhibits high anti-parasitic effects. Essential oils are efficient defense mechanisms due to their various modes of action (Cloyd 1567-1579). It is believed that because of the various modes of action essential oils exhibit, parasites have yet to develop resistance to them. Medicinal plants are a natural alternative to synthetic anti-parasitic drugs that are possibly nonresistant.

Previously, no rigorous testing had been conducted on plant-derived essential oil products yet they were still considered to be minimal risk pesticides (Cloyd 1567-1579). Now, a whole field of Veterinary Medicine called Ethnoveterinary Medicine has begun supporting these claims

(Rahmatullahet al. 386). Efficacies of 100% have been reported against flukes while efficacies against nematodes have varied. The efficacy of plant extracts can be compromised by host physiology, the site of parasitism, and secondary metabolite interactions (Anthanasiadou,et al. 1392-1400). Many researchers have concluded that the efficacy and toxicity of these essential oils is both time and concentration dependent (Singh et al). Some anti-nutritional complications have been reported while testing essential oils in vitro, as well as temperature and UV light degradation when applied topically (Krausea et al. 83-93). There have also been no studies to prove that adverse anti-nutritional side effects are linked to the use of essential oils (Githiori et al. 308-320). Aside from in vitro assays, most in vivo toxicity experiments have only been conducted on plants. Results from these experiments are debatably accurate based on differences in chemical composition between plants and human/animal skin (Githiori 308-320). There is a very limited collection of articles that assess microscopic parasites; most focus on macroparasites (Rinaldi 503-515). Overall, essential oils have proven to be promising acaricidal, anthelmintic, and insecticidal agents.

Methods

The essential oil blends were diluted using grapeseed oil as a carrier oil. Three containers of essential oils were blended to make a 30 mL solution containing 6 teaspoons of carrier oil. The first blend used 45 drops of essential oil to make a 5% dilution with 25 drops of bitter almond oil, 13 drops of mullein oil, and 7 drops of wormwood oil for the treatment of roundworms. The second blend used 45 drops of essential oil to make a 5% dilution with 25 drops of angelica oil, 13 drops of ginger oil, and 7 drops of bayleaf oil for the treatment of protozoas. The third blend used 45 drops of essential oil to make a 5% dilution with 25 drops of patchouli oil, 13 drops of chamomile oil, and 7 drops of cinnamon oil for the treatment of mites. The three same solutions were blended to create a 0.5% blend using the same essential oils in a 2:1.5:1 drop ratio. The containers were then left to sit for 24-48 hours to allow the essential oils to react to their full potential. The blends were stored in dark brown, plastic containers at room temperature during the entire experiment.

Once the essential oils were blended, a 1% essential oil (0.5 mL) to 50 mL nutrient agar mixture was generated by separating 200 mL of nutrient agar into 4 micropipet wells. Using a 0.200 uL micropipet, the 1% essential oil nutrient agar was transferred to a 96-well plate. To get a measurable sample size for each essential oil blend, the well plate was divided into 4 sections with every 3 out of the 12 rows containing a different diluted blend. Rows 1-3 contained the 0.5% roundworm blend, rows 4-6 contained the 5% roundworm blend, rows 7-9 contained the 5% protozoan blend, and rows 10-12 contained the 5% mite blend.

The 96-well plate was left to sit overnight to ensure penetration and blending of essential oil in agar solution. Each well was inoculated with E. coli and allowed to incubate for 24-48 hours. Small square sections containing C. elegans were cut out of the stock cultures using a scalpel and transferred into each of the 96 wells. The samples were left to incubate for 48 hours.

The activity levels of the C. elegans were then observed using a dissecting microscope. Each well was examined and the activity level of the C. elegans in each well were rated on a scale from 0 (no activity), 1 (little activity), 2 (normal activity), and 3 (high activity). This experiment was repeated using an over-the-counter Dewormer as a positive control and distilled water as a negative control. Both controls and the experimental well had two trials which gave a sample size of 48 for each factor being tested for treatment.

Results

Table 1. Data Table Key

Symbol	Meaning
0	**C. elegans in media exhibit no movement**
1	**Some C. elegans exhibit no movement while others exhibit a slight twitching movement**
2	**C. elegans in media exhibit normal sigmoidal movement as seen by healthy**
3	**C. elegans in media exhibit rapid thrashing movement**
MTL	**Media too lumpy to examine nematodes under microscope**
NM	**No media in well to examine**

Table 2. Positive Control Trial 1

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
A	1	0	3	MTL	0	0	3	MTL	0	2	3	3
B	2	0	2	3	3	1	3	0	MTL	0	1	2
C	MTL	2	2	2	2	MTL	3	3	1	3	2	MTL
D	3	1	3	3	3	2	1	1	2	1	2	1
E	3	0	1	2	2	0	2	3	MTL	2	3	0
F	2	3	0	1	1	0	0	1	0	3	0	2
G	3	3	1	2	2	2	0	0	2	1	2	MTL
H	MTL	2	1	0	1	1	3	3	2	3	1	3

Table 3. Positive Control Trial 2

	1	2	3	4	5	6	7	8	9	10	11	12
A	3	0	0	0	2	MTL	2	2	1	2	0	0
B	2	1	2	2	1	1	3	1	2	1	0	3
C	1	1	1	3	MTL	2	3	3	2	0	2	2
D	2	0	2	MTL	1	3	2	3	0	1	2	0
E	0	2	1	0	2	3	1	2	2	2	2	3
F	3	2	2	3	3	1	2	3	3	2	1	1
G	0	3	1	3	3	3	1	1	2	1	3	MTL
H	0	MTL	2	1	MTL	2	1	NM	1	2	3	1

Table 4. Essential Oils Trial 1

	1	2	3	4	5	6	7	8	9	10	11	12
A	NM	0	0	0	0	0	0	0	MTL	0	0	0
B	0	0	NM	0	1	0	0	1	1	0	0	0
C	NM	0	0	0	0	0	0	3	2	0	0	MTL
D	NM	0	0	0	3	0	3	0	1	MTL	0	3
E	0	0	0	0	0	0	1	0	1	0	0	MTL
F	0	0	0	0	0	0	0	0	0	0	0	0
G	0	0	0	0	0	0	0	0	0	0	0	0
H	0	0	1	0	2	0	0	0	MTL	MTL	NM	NM

Table 5. Essential Oils Trial 2

	1	2	3	4	5	6	7	8	9	10	11	12
A	0	0	1	0	1	0	0	0	0	0	MTL	2
B	0	1	0	0	MTL	0	0	1	2	1	0	2
C	1	1	1	0	0	1	0	0	0	2	0	0
D	3	0	2	0	0	0	2	0	1	0	0	0
E	2	1	3	MTL	MTL	0	0	1	0	0	0	1
F	3	0	1	0	0	0	1	1	MTL	0	3	1
G	2	0	0	0	0	0	0	0	0	0	2	2
H	1	0	0	1	0	3	MTL	MTL	0	1	0	NM

Table 6. Negative Control Trial 1

	1	2	3	4	5	6	7	8	9	10	11	12
A	0	1	0	0	0	3	MTL	0	0	0	0	0
B	0	0	2	0	2	3	0	3	0	2	1	0
C	0	1	0	0	2	0	0	2	1	0	2	2
D	0	0	0	3	0	0	1	MTL	1	0	0	1
E	0	0	0	0	2	1	0	2	0	1	0	0
F	1	0	0	0	1	0	1	2	3	1	1	0
G	1	0	3	1	2	1	3	0	1	0	0	0
H	0	2	2	2	2	1	1	0	1	0	3	0

Table 7. Negative Control Trial 2

	1	2	3	4	5	6	7	8	9	10	11	12
A	0	0	NM	0	0	MTL	0	0	2	1	0	MTL
B	1	1	0	0	0	0	1	3	1	0	0	0
C	0	0	1	0	0	1	2	0	1	2	0	0
D	1	0	3	0	0	0	0	0	MTL	1	2	0
E	0	0	0	0	0	0	1	0	2	0	0	0
F	0	2	0	1	2	3	1	2	2	1	1	0
G	0	0	1	0	1	1	0	1	1	3	0	0
H	2	0	0	0	2	2	1	0	0	MTL	2	0

Table 8. Krustal-Wallis Test Results Set 1

	Rows 1-3 & + Control	Rows 1-3 & -Control	Rows 4-6 & + Control	Rows 4-6 & - Control	Rows 7-9 & + Control	Rows 7-9 & - Control	Rows 10-12 & + Control
H-Value	54.5241	5.9704	50.9304	9.1555	27.4415	0.3581	33.8304
P-Value	<.0.00001	0.01455	<0.00001	0.00248	<0.00001	0.54958	<0.00001
Significance	Yes	Yes	Yes	Yes	Yes	No	Yes

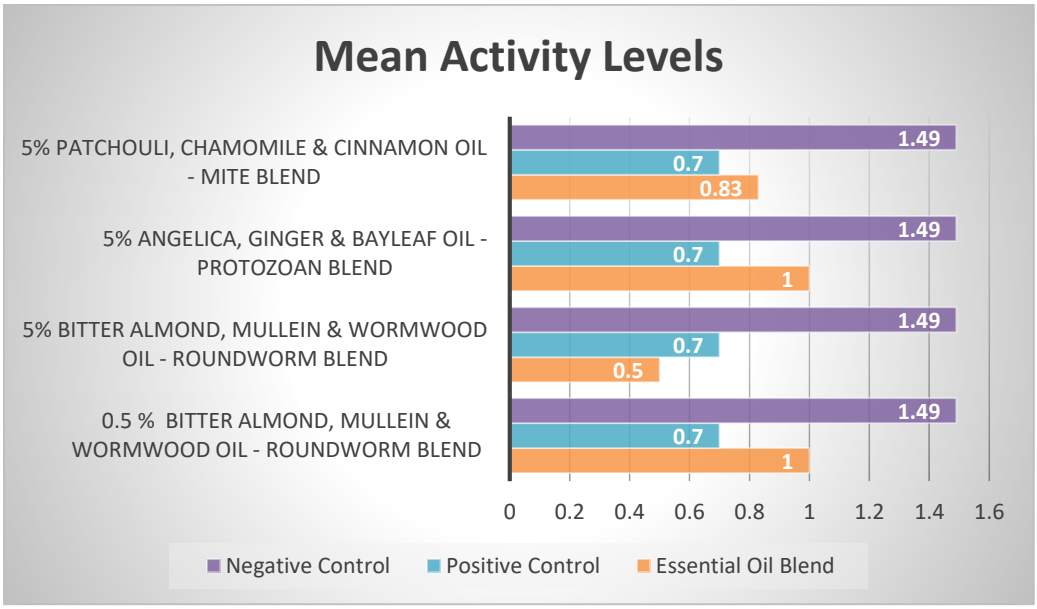
Table 9. Krustal-Wallis Test Results Set 2

	Rows 10-12 & - Control	+ Control & - Control	Rows 1-3 & Rows 7-9	Rows 1-3 & Rows 4-6	Rows 1-3 & Rows 10-12	Rows 4-6 & Rows 7-9	Rows 7-9 & Rows 10-12
H Value	0.1152	58.3846	1.5062	0.613	3.1304	2.9904	0.0612
P-Value	0.73436	<0.00001	0.21971	0.43367	0.07684	0.08376	0.8046
Significance	No	Yes	No	No	No	No	No

Table 10. Mann-Whitney U Test Results

	Rows 1-3 & + Control	Rows 1-3 & - Control	Rows 4-6 & + Control	Rows 4-6 & - Control	Rows 7-9 & + Control	Rows 10-12 & + Control	+ Control & - Control
U-Value	1738	3938.5	1297		3232	2822	8985
Z-Score	7.38293	2.44233	7.1353	3.02455	5.23744	5.81535	7.72555
P-Value	<0.00001	0.01468	<0.00001	0.00252	<0.00001	<0.00001	<0.00001
Significance	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 1. Mean Activity Levels



The highest mean activity levels were exhibited by the negative control group, distilled water while the lowest were exhibited by the 5% bitter almond, mullein, and wormwood essential oil blend (Figure 1). The over-the-counter Dewormer exhibited mean activity levels falling between both the negative control group and the 5% bitter almond, mullein, and wormwood essential oil blend (Figure 1). In performing the statistical analysis, the most significant p-value was shown by the 5% patchouli, chamomile, and cinnamon essential oil blend (Tables 8, 9, and 10). The 5% angelica, ginger, and bayleaf essential oil blend and the 0.5% bitter almond, mullein, and wormwood essential oil blend had higher mean activity levels than both the 5% bitter almond, mullein, and wormwood essential oil blend, the 5% patchouli, chamomile, and cinnamon essential oil blend, and the positive control group (Figure 1). The 5% angelica, ginger, and bayleaf essential oil blend and the 0.5% bitter almond, mullein, and

wormwood essential oil blend had lower mean activity levels than the negative control group (Figure 1).

Discussion and Conclusion

Based on the comparison of mean activity levels (Figure 1), all the essential oil blends proved to be effective in limiting, decreasing, or preventing the activity of the roundworm culture as compared to the negative control, which was water. Only one bend, the 5% bitter almond, mullein & wormwood oil, showed less activity than the positive control (Figure 1). Both a Krustal-Wallis and a Whitney-Mann U test were used as a basis for determining a significance between the groups (Tables 8, 9, and 10). Using the Krustal-Wallis test, seven groups produced a P-value that was significant (Tables 8 and 9), meaning that those groups were not from the same population and their medians were not equal. This test looked at whether the median were the same, shifted upward, or shifted downward from group to group. These groups being statistically significant suggests that the differences were too far apart to occur by chance. Since these samples were shown to be independent of each other, a Mann-Whitney U test was also done (Table 10). All the groups showed a small P-value meaning they were significant and the medians of the two groups were not equal (Table 10). Because the variances were not equal, looking at the means of the sample groups was helpful in determining the differences between groups.

Based on the significance tests and the distribution of the means, the two blends that displayed the most efficacy were the 5% bitter almond, mullein, and wormwood oil blend and the 5% patchouli, chamomile, and cinnamon oil blend. Although the 5% patchouli, chamomile, and cinnamon oil blend exhibited higher significance values in correlation with the control groups (Tables 8, 9, and 10), the 5% bitter almond, mullein, and wormwood oil blend decreased the mobility of the roundworms when measuring mean activity levels (Figure 1). All the essential oil blends were more efficient than the negative control (distilled water) at controlling/managing *C. elegan* activity.

Although the Krustal-Wallis and Whitney-Mann both showed specific groups were statistically significant, they may not be practically significant if the concentrations if the samples being tested are toxic in *in vivo*. Further toxicity testing would be needed to assess which concentrations of essential oil blends were both efficient in reducing the activity or growth of roundworms while remaining safe for topical or oral consumption in test subjects. Side effects to look for would be lesions, ulcers, nausea, vomiting, and changes in gut/skin microflora. Given the newly-observed resistance to major classes of Dewormers exhibited in Strongyles, alternative treatment methods need to be researched and put into effect before the parasitic infections become widespread and unmanageable. These results showed promising advancements in the replacement or cooperative use of over-the-counter Dewormers with essential oil blends.

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Sterne's Poststructuralist Hobby-Horse: The Flaws of Narrative in *Tristram Shandy*

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5 September 2017

Sterne's Poststructuralist Hobby-Horse: The Flaws of Narrative in *Tristram Shandy*

Upon Beginnings

The Bible states, "In the beginning God created the heaven and the earth" (KJV Genesis 1.1). Scientists, however, propose that the Big Bang theory is the most accurate cosmological model. Both theists and atheists like to present these "narratives of the beginning" as if they are the only options, but this is a false dichotomy. There is a third option: God (or any other divine hand) could be responsible for our creation, and His actions may be studied through science. The difficulty of choosing the "correct narrative of the beginning" is that science does not disprove that a divine figure had a hand in the creation of the earth, and so these two narratives of beginnings therefore overlap. This raises a significant question: if we cannot fully agree about our beginning, how do we tell the story of humanity? The question is not as simple as it seems because there are other events throughout history that we also do not understand entirely, and therefore a significant portion of reconstructed historic narratives have their gaps filled with probable speculation. There is, perhaps, one other question that is important to ask: why does it matter if we can tell an accurate, complete story of us? I argue that it is because we like linearity. Analyzing how events unfolded and how these events followed a now established trajectory shows how we have gotten where we are today. The difficulty, however, in constructing this trajectory is that we often mistake causation and correlation, and, because our knowledge of the past has its limits, there are things from the past that we will never be able to know. In a way, this suggests that there is a strained relationship between the present and the past. How can we fully understand the present, which was shaped by the past, if we cannot reconstruct the past in

its entirety? The true answer is that we cannot, and because we cannot understand the present, our likelihood of fully understanding the future, too, is improbable.

The idea that there are flaws in our narrative is one of the major themes of Laurence Sterne's novel *The Life and Opinions of Tristram Shandy*. The titular character, Tristram, attempts to recount the story of his life, but through numerous digressions we learn more about his uncle, Toby, than we do about the supposed main character. Tristram's inability to tell his own story stems from a few different sources: one, Tristram's favoring of minute details, which prevents his narrative from progressing beyond his birth for four of the nine volumes; second, Tristram's knack for revealing more about other characters than himself; and third, Tristram's incapability of telling a story that goes from point "A" to point "Z." Tristram claims that he is writing in what he implies is a digressive-progressive style (63), but can one really say that Tristram's digressions are progressive? He argues that he "constantly take[s] care to order affairs so, [sic] that [his] main business does not stand still in [his] absence" (63), but do they? The full title of this novel, *The Life and Opinions of Tristram Shandy, Gentleman*, suggests that the reader will be reading a biography about the titular character, but we only read about three major events in his life: his conception/birth, his circumcision, and his journey through Europe to avoid death. Considering that an account of a life implies a certain intimacy in handling and ordering the content to reveal an "overall" picture of the subject's life, it is remarkable that we learn so little about Tristram and that the novel is structured so strangely. This lack of ordering and intimacy, however, is likely used to emphasize the thematic intent of *Tristram Shandy*. By analyzing the content and the structure of the novel along with a few of the textual oddities, such as the black page, the marbled page, and the blank page, it seems that Sterne uses Tristram as a vehicle to

show that, because our language is flawed and because we have individual associations with actions and words, it is impossible to create a linear narrative, let alone a "complete" one.

Explicit Content

In the opening chapter of volume one, Mrs. Shandy asks, "Pray, my dear, [. . .] have you not forgotten to wind up the clock?" (6). Without knowing the context, this question would not strike someone as odd, but it is significant that it is asked during copulation. Mrs. Shandy asks this question because she associates "the act" with the winding of a clock. Like clockwork (see what I did there), Mr. Shandy winds up the clock on the first Sunday of every month, which is also the only day that he has sex with Mrs. Shandy each month. It's easy to see why Mrs. Shandy associates sex with the winding up of a clock because they are synonymous events in her world; however, Mr. Shandy does not think that this is an appropriate question to ask during intercourse, and he exclaims, "Good G—! [. . .] Did ever woman, since the creation of the world, interrupt a man with such a silly question?" (6). This reveals a disconnection between Mr. and Mrs. Shandy, which is caused by language and the different associations individuals have with words and events.

This isn't the only occurrence of a disconnection caused by language. In volume three, Trim tells Mr. Shandy that Dr. Slop is "busy in making a *bridge* [emphasis added]" (192). Readers are led to believe that "bridge" refers to the drawbridge that Trim and Bridget broke, which Trim is responsible for rebuilding. Toby assumes that Dr. Slop is helping rebuild this bridge and that he is making a model of the marquis d'Hôpital's bridge because Toby's hobby-horse (his obsession) is the military and his understanding of the world around him is limited due to this obsession. This idea regarding obsessions had been suggested by others in the 18th century; in fact, President James Madison once wrote that

> As long as the reason of man continues fallible, and he is at liberty to exercise it, different opinions will be formed. As long as the connection subsists between his reason and his self-love, his opinions and his passions [or hobby-horses] will have a reciprocal influence on each other; and the former will be objects to which the latter will attach themselves" (727)

Though I doubt Madison had *Tristram Shandy* in mind when he wrote this, the applicability to the text is clear: one's reason is intrinsically linked to their opinions and passions. Madison also writes that this causes a "division of the society into different interest and parties" (727), but he fails to mention that no man is like another—no man's hobby-horse shapes their understanding of the world the same way—which keeps one disconnected to some extent from everyone else in the world and also prevents us from agreeing on what is happening around us.

Trim finally reveals that the "bridge" is for Tristram's nose because Dr. Slop ended up crushing it with his "vile instruments" (193). Although the misunderstanding of "bridge" is a quite humorous example of equivocation, it reveals something more important about our language: context alone does not always help to prove which definition of a word is being used. Likewise, like Madison argues, our own biases and hobby-horses will shape our understanding of a word, which could also lead to a misunderstanding. Sterne seems to use Tristram's story to show that, even though we often use context to help us understand words, we can still be misled and have an incorrect understanding. We, as readers, are not aware that Dr. Slop has crushed Tristram's nose, and we only learn this fact after we are given a full account of how Trim and "Bridge"t (funny coincidence?) broke the drawbridge, and this account purposefully misleads us from the proper understanding of "bridge" in this context. By manipulating his audience to believe that "bridge" refers to "drawbridge," Sterne reveals just how easy it is for our language

to cause a disconnection between individuals because we could have separate understandings of a word that are all supported by the context.

Though equivocation is used throughout the novel, the most important (and most hilarious) occurrence is in volume nine. Toby tells Mrs. Wadman that, "You shall see the very place [where I was injured]" (567) and "You shall lay your finger upon the place" (568). Mrs. Wadman blushes because she assumes that she will see and be able to touch Toby's groin, but all that she is able to see and touch is the "place" on a map where Toby was injured. Again, Toby's obsession with the military and maps is being satirized; he has a myopic understanding of the world that prevents him from being able to connect with or understand others. Though this is an exaggerated instance of misunderstanding, how often do less severe forms of misunderstandings that stem from the use of our flawed language take place in the span of a day? How many misunderstandings are contained in our narrative? There is not a definite answer, but we can be certain that they exist and that they play a part in our inability to fully agree on what our narrative is.

The strange associations with words and the instances of equivocation that permeate the text reveal how, even though we use the same "words," it is almost as if we each have an individual language, which is one of the sources of the disconnection between us, and this becomes an even bigger problem when we move from individual words to complex conversations. In chapter eighteen of volume three, Toby and Mr. Shandy are discussing how slowly time has progressed while they were talking. Mr. Shandy begins to discourse on "the rapid succession of their ideas, and the eternal scampering of the discourse from one thing to another" (170), but Toby quickly asserts, "Tis owing, entirely, [. . .] to the succession of our ideas" (171). Mr. Shandy and Toby think that so much time has passed because they have talked

about so many different ideas, yet only two hours and ten minutes (170) have passed. This becomes more important when we discuss the structure of the novel, but it is also important to bring up now. This scene contains yet another instance of disconnection. Mr. Shandy was unable to say what he wanted when he wanted to because Toby chose to interrupt him, but this often happens in conversations. More importantly, the significance of this passage is that it reveals that we do not think in the linear patterns we love to advocate for. I could be telling a story about my trip to get pizza, mention that I met a close friend along the way, digress into a story about my friend's life, and forget that I never finished my story about going to get pizza. There is a chaotic element to conversations because it can be difficult to identify the segue between two very different topics, but, for the speaker, there was likely an element of connectedness, either in the use of a specific word or an association to a specific idea. This shows that there is an impracticality that plagues the way we think, and this impracticality effects the way we converse with each other, which, yet again, reveals itself as a source of the disconnection between us and suggests why we cannot agree on our narrative.

Perhaps the most important instance of disconnection is that between the reader and the author. In chapter nineteen of volume one, Tristram writes, "I should be born before I was christened" (51). Most (if not all) readers will think nothing of this line because we will read it literally and think, "Well, one has to be born before they can be christened, so what is the purpose of including this in the novel?" The answer to this question comes immediately in the next chapter when Tristram writes, "I told you [in the last chapter], *That my mother was not a papist"* (51). Tristram charges the reader to "read the whole chapter [preceding chapter twenty of volume one] over again" upon reaching the "next full stop" (52). Regardless, he assumes that his reader will not notice the clues and reveals that the most important word is "*necessary*" (52).

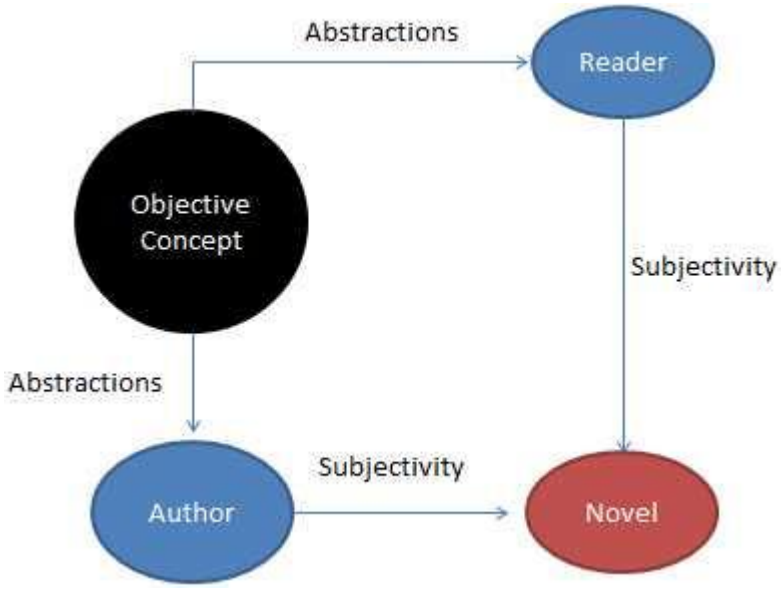
What follows is an essay in French about baptism via injection. There are several things wrong with this chapter: first, Tristram knows that the reader will not pick up on the obscure contextual clues and criticizes them for it; and secondly, it assumes that the reader, who was unable to notice the contextual clues, will be able to read the "Memoire presenté a Messieurs les Docteurs de Sorbonne," which is left untranslated. It is likely that Sterne is purposefully using Tristram and his writing of this chapter to reveal that, despite our best efforts, there is information that we will either fail to understand the subtleties of or fail to understand entirely because we do not have the same associations with words that others do. The main point of the chapter is actually hidden within the criticism of the reader. For example, Tristram writes,

> [The reason for pointing out this missed inference] 'Tis to rebuke a vicious taste which has crept into thousands besides herself,--of reading straight forwards, more in quest of the adventures, than of the deep erudition and knowledge which a book of this cast, if read over as it should be, would infallibly impart with them (52).

He then proceeds to say, "The subtle hints and sly communications of science fly off, like spirits, upwards [if one only reads for adventure];---the heavy moral escapes downwards; and both the one and the other are as lost to the world, as if they were still left in the bottom of the ink-horn" (53). What Tristram suggests here is that, if the reader does not pick up the "heavy moral" of the work, the writer could have left their work unwritten and received the same response; however, this is not an entirely accurate statement. Just because a reader does not pick up the exact meaning that an author intended does not mean that the author could have left the work unwritten and received the same response. A reader always responds to a work because even indifference is a response to something. This response is dependent upon the existence of the novel but does not

necessarily have to coincide with the author's response to their own work because the two have different subjective views of the world around them.

In his essay "Sexuality/Textuality in *Tristram Shandy*," Dennis W. Allan analyzes how the instability of our language is explored in *Tristram Shandy*, and he argues that Sterne uses phallic imagery to reveal the impotence of language and uses yonic imagery to show that meaning is birthed by the reader, which ties back into the idea that both the author and the reader have subjective perspectives. The following graph illustrates what Dennis. W. Allan and other poststructuralist critics argue:



The circle on the upper-left section of the graph, called "objective concept," refers to the concept which words refer to. For example, though we refer to cats as "cats," there is an objective concept that is suggested by the word "cat" that our language does not fully convey. When we use the word "cat," everyone abstracts something different from the objective concept, and their associations with the words will be different. I love cats, so I have positive associations with the word, but others may have negative associations with the word. This is where subjectivity comes into play. If I were to write a story about how great cats are, I would use positive language;

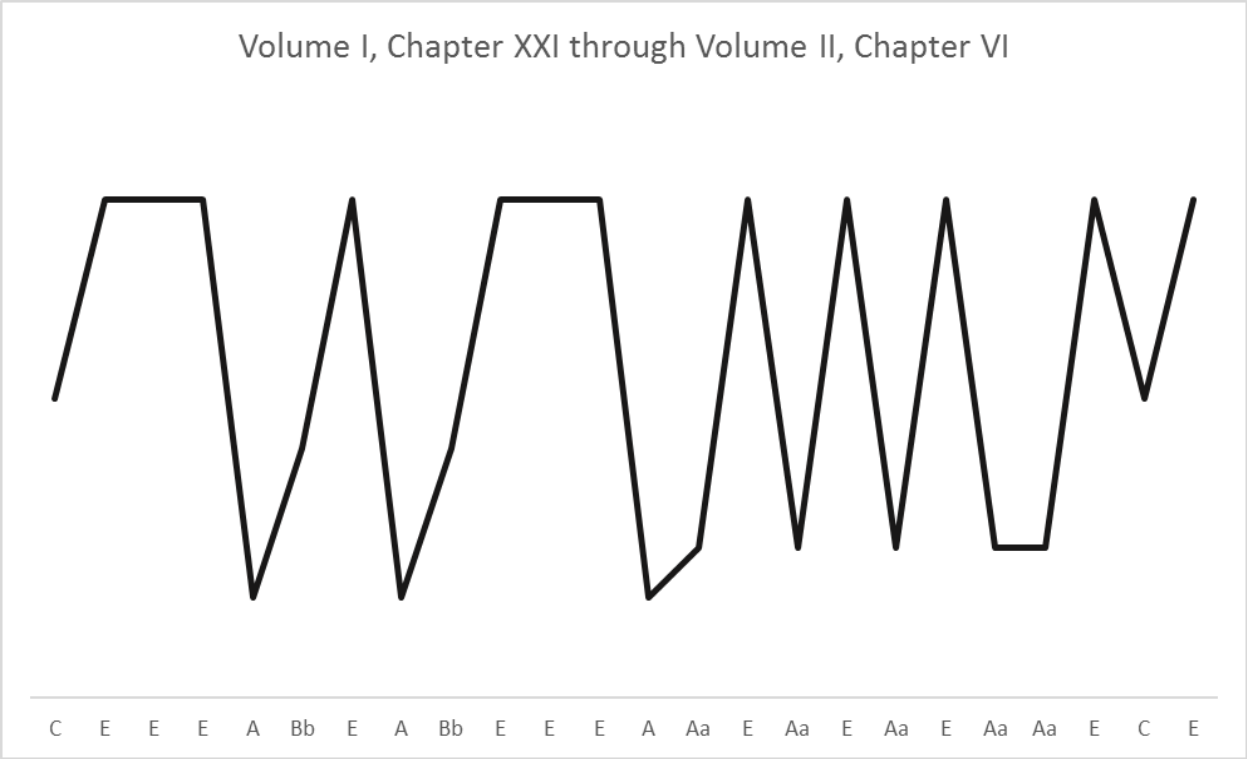
however, if someone who didn't like cats read my work, they may be cynical and find gaps within my narrative to reveal the "truth" about cats. Neither association is objectively correct, so this divide creates a disconnection between me, as the author of a work praising cats, and the reader who dislikes cats because we cannot agree on an objective interpretation of the word "cat." I did not fail as an author, however; I conveyed my truth through my work, but, implicitly, the reader read their own truth in the work. This idea is a matter of contention among schools of literary criticism, especially the structuralists, who argue that the "truth" of a work can be found within the work itself, but it is impossible to ignore the part the reader plays in birthing new meaning, even if it only serves to further disconnect individuals from others. Ultimately, because we cannot agree on the meaning of words, let alone content, we are unable to agree on an objective version of our narrative, though we continue to try in vain, and the content of *Tristram Shandy* can be interpreted as making this point clearly.

Structural Abnormalities

It is difficult to separate the content of a novel from the novel's structure because the two are intrinsically connected, but for the purposes of this essay we will initially isolate the two while also later proposing that both work together to reveal the fallibility of narratives. Critics have been divided on whether the structure of *Tristram Shandy* reveals a semblance of linearity or if it is nonlinear; however, much like the false dichotomy referred to at the beginning of this essay, the critical attention given to *Tristram Shandy* suggests that there is a correct answer (linear vs nonlinear) when, strangely enough, it can simultaneously be both. This seems like a paradoxical statement—that something can be both linear and nonlinear—but critics Jeffrey Williams, the author of the essay "Narrative of Narratives (Tristram Shandy),"and J. Hillis Miller, the author of the essay "Narrative Middles: a Preliminary Outline," inadvertently touched

upon this with their diametrically opposed essays, where the former supports linearity and the latter nonlinearity.

Williams uses shorthand to track and reveal that the narrative of *Tristram Shandy*, despite all of the digressions, always returns to the present, but his method is overly complicated, so I attach the following graph that illustrates Williams' point in a visual instead of textual way.



Williams argues that, because there is always a return to the peak ("E" on this graph—the present), *Tristram Shandy* is a narrative about writing a narrative, but this reading fails to acknowledge the numerous digressions along the way. Miller attempts to fill in this gap that Williams left, and he provides strong support for reading *Tristram Shandy* as a criticism of linear narratives, but he, too, fails because he does not acknowledge the linear aspect of *Tristram Shandy*.

Miller says something quite important, however; he writes that it is challenging to distinguish "irrelevance from relevance, digression from the straight and narrow" (170), and he

argues that "The human need for continuity is so strong that a man will find some principle of order in any random sequence" (169). If we are weaving a "complete" narrative, is there such a thing as "irrelevance"? Aren't all the minute details necessary in order to present a "complete" narrative? The answer is yes, and yet Tristram's inability to tell a story that goes from point "A" to point "Z" stems from his obsession with minute details and realizing that he must often work in a reverse chronology to explain details he hasn't explained throughout the novel. For example, in volume one, Tristram begins with the story of his conception, but, by chapter seven, he starts backtracking to provide the details about characters who are a part of Tristram's narrative, such as Yorick, who paid for the midwife's training to prevent the use of his horses to fetch a midwife in another town, and the midwife, who helps deliver Tristram.

In the large scheme of things, the inclusion ofYorick's and the midwife's stories are not necessarily significant inclusions in Tristram's narrative, but he chooses to include them to familiarize the reader with the people and events that played a part in shaping him into the man he has become. The problem with this is that Tristram forgets the "large scheme of things" and gets lost within these digressions, which prevents a big picture from forming. This touches upon what Miller mentioned about relevance. When we weave a narrative, we mutually agree that all the details are not necessary in order to paint the big picture, but, because we take those little details out, we are left to "find some principle of order in any random sequence" (Miller 169). This "random sequence" is caused by the gaps we leave in our own narratives. The simple narrative "I woke up early this morning, and I am now going to sleep" illustrates this point. Ignoring that this is not a significant narrative, there is a linear structure, which suggests that this isn't a "random sequence," but choosing to only include these two details from a span of time that is otherwise unaccounted for is, in a way, random when there were other points that could

have been chosen. We can raise the question, did nothing significant happen in between the provided "A" and "Z," but this is an improper question if our goal is to achieve a "complete" narrative: we must acknowledge that more was left out than was left in.

There are other problems with this narrative, however; the beginning and the end points are arbitrary because there are things that happened before and things that will happen after this relatively small span of time that are not even briefly mentioned here. This ties back into the structure of *Tristram Shandy* because Tristram realizes that, even though his conception is the proposed point "A" of his story, it is necessary to backtrack and show what happened before he was born because it plays a part in his birth. This explains the inclusion of the reverse chronology in the novel, but this means that point "A" is not a static position. Likewise, the novel ends with the account of Toby and Mrs. Wadman's relationship (which takes place before Tristram is born), but this is not the point "Z" we would expect from a novel. Most would argue that a narrative of a life begins with birth and ends with death, but this argument does not acknowledge the influence that the past has on the present, nor the present on the future (we must acknowledge that just because someone dies does not mean that their narrative/influence does not continue beyond the grave). By not ending the novel using a traditional ending, it is almost as if Sterne uses Tristram to parody the idea of there being such an ending.

Sterne may have also chosen to end the novel this way because of the "idea-to-idea conversation" topic mentioned previously. As I mentioned earlier, we often start telling one story, are reminded of something else (because of associations we have with specific words or events), begin a different story, and may forget to finish the story we initially started telling. If Sterne depicted Tristram writing a story that did not suffer from so many seemingly illogical digressions and an unexpected ending, any argument for reading *Tristram Shandy* as a

commentary on the flaws of narratives and our language would be less convincing, but, because the structure of the novel mimics the content, this reading is founded.

There are quite a few structural abnormalities that support this reading, too, which have until now not received the attention they deserve. For example, Tristram takes chapter twenty-four out of volume four because he did not want the other chapters to look bad; in the final volume, chapters eighteen and nineteen are removed and reinserted in chapter twenty-five; and volume seven is about Tristram's journey to avoid death (the traditional point "Z" in a life narrative), but volumes eight and nine are set before he is born. By having Tristram take out chapters, relocate chapters, and leave so many gaps in his own story, Sterne is implying that we are guilty of spinning narratives with erratic time schemes and that there is an illogical element to our narratives. The cause of this is simple: we subjectively understand and construct the world around us, and the rabbit holes that we wander down during conversation, which seem like logical segues to us, seem illogical at best to others. If the novel did not attempt to stimulate a disconnection between the reader and Tristram Shandy using both the content and the structure, the novel would fail to convince others that our language and our narratives are flawed at the foundational level, but Sterne effectively stimulates this disconnection by emphasizing Tristram's erratic time scheme filled to the brim with seemingly illogical digressions.

This still does not acknowledge the linear aspect of *Tristram Shandy*, though. As Miller mentions, mankind loves to construct linear narratives because we like cause-and-effect, "A" to "Z" narratives. These are the narratives that are the easiest to understand, even if they are not necessarily complete, because they map everything out on a straight line. If we are to accept that the linear aspect of *Tristram Shandy* is significant, we must quantify this statement while also regarding the numerous digressions. One interpretation for the inclusion of a semblance of

linearity is that, even though Tristram repetitively states that he takes "care to order affairs so, [sic] that [his] main business does not stand still in [his] absence" (63), he also acknowledges that he is "accidentally led into [digressions]" (63). This illustrates that Tristram's tendency to digress is not necessarily premeditated; digressions often happen in any attempt to weave a linear narrative because mankind does not think in a linear pattern. Our language and our subjective associations with words and events ultimately ensure that we will digress and be unable to capture the "A" to "Z" narrative that we wish to express. The linearity and nonlinearity of *Tristram Shandy*, when interpreted as echoing the thematic content of the novel, are so at odds with one another, yet they coexist because they universally plague the narratives mankind weaves. We will always attempt to recount stories in a linear way, but our minds do not favor linearity and stray into nonlinear territory remarkably quickly; therefore, we must acknowledge that nonlinearity exists as a byproduct of our thoughts—our associations with words and events—and that true linearity is a dream best left on the shelf.

Enjoy the (Literary) Silence

Though the content and structure of *Tristram Shandy* are quite strange compared to other novels, the quirkiest element of this novel is the textual oddities. We have already analyzed how the content and structure work to suggest the fallibility of our language and narratives, but the textual oddities reinforce this by being a sort of negative space within the text. The online Oxford Living Dictionary defines "negative space" as "An area of a painting, sculpture, etc., containing no contrasting shapes, figures, or colours itself, but framed by solid or positive forms, especially one that constitutes a particularly powerful or significant part of the whole composition," but when I use "negative space" I am providing a stipulative definition: these textual oddities do not explicitly reveal what the content and structure do, but they do

occasionally contain "contrasting shapes, figures, or colours"; I am implying that the content and structure are framed around these oddities, and, in being framed by the structure and the content, these oddities can be interpreted as implying that an attempt to construct a "complete" narrative is arbitrary because there will always be gaps in a narrative that individuals will try to fill.

The first textual oddity is the black page found at the end of chapter twelve in volume one. Preceding this page is the quote "Alas, poor Y O R I C K" (30), which is the phrase inscribed on Yorick's grave. Tristram does not mention that he is inserting a black page; he just does, and readers will likely be perplexed by its inclusion (I was). Considering that this page follows the epithet on Yorick's grave, one could argue that the black page is Tristram's silent handling of the situation, and this silence may stem from his inability to find the words to convey how he feels. If one interprets the black page as representing Tristram's inability to articulate his feelings, it is important to note that we try to understand this page as saying something. We recognize that, even if someone is silent, silence expresses something, and we feel a need to explain that "something" with our words, but this requires us to interpret and explain this silence using our flawed language. An author (usually—Tristram finds the loophole) cannot convey silence in a written narrative, and will likely provide a generic sentence like "the silence was oppressive and uncomforting." This generic statement proposes that the silence somehow conveys oppression and some source of discomfort, but this is the author's subjective understanding of the silence. Someone else who experienced this silence may write, "The silence was a welcome comfort from my friend's incessant talking." Again, this proposes that the silence expresses something comforting, so, in a way, this purports that silence speaks; however, the silence does not speak: we speak for the silence. Any attempt to find the "true" meaning of the black page will fail because it is an instance of literary silence. It means nothing in and of itself,

but we prescribe meaning to the page because we cannot accept that silence does not express something.

Tristram finally references the black page in volume three right before the marbled page, but he does so in an especially unrevealing way. He writes,

> [W]ithout *much reading*, by which your reverence knows, I mean *much knowledge*, you will no more be able to penetrate the moral of the next marbled page (motly emblem of my work!) than the world with all its sagacity has been able to unravel the many opinions, transactions, and truths which still lie mystically hid under the dark veil of the black one. (204)

This passage suggests that, if one continues to read, they will eventually learn the "moral" of the marbled page and the "opinions, transaction, and truths" that are hidden within the black page, but neither page is mentioned again. This is likely another instance of Sterne using Tristram to reveal his thematic intent; because these pages do not have their meanings spelled out, the reader is left to interpret the textual oddities using their own understanding of the work and associations with the things featured on these pages. For example, the marbled page, which used to be different in every volume of *Tristram Shandy*, contains color and abstract shapes (unfortunately, most modern editions of *Tristram Shandy* do not use color printing for the marbled page), and a reader's associations with colors or said shapes may affect their interpretation of the pages. These pages can be interpreted in a plethora of ways because they are so ambiguous, but Sterne likely knew this and included the oddities to further emphasize the role a reader plays in birthing meaning.

The inclusion of the blank page is no different. In chapter thirty-eight of volume six, Tristram includes a blank page and tells the reader, "Sit down, Sir, paint [a picture of Mrs.

Wadman] to your own mind—as like your mistress as you can—as unlike your wife as your conscience will let you" (422). One limitation of our language is the difficulty in conveying how something looks using only words so that someone can picture it the way we saw it; however, Tristram does not even attempt to draw a picture for the reader. He mischievously tells the reader that they are responsible for drawing Mrs. Wadman on the blank page and that they may model her after their own imaginations. This reveals that a portion of a reader's understanding of a novel derives from their own life—that they will fill in gaps left in by the author with details from their imagination or own life. If we accept that Sterne has methodically used Tristram's story to criticize our language and narrative structures, this is another figurative nail in the coffin: any attempt made by the reader to imagine Mrs. Wadman reveals that they are using outside material from their own lives to understand the * * * * *—

The *Entirely* Necessary and Seemingly Illogical Digression

The reason I have interpreted the odd pages the way I have is because they have been framed by the content and structure that strongly suggest that Laurence Sterne was criticizing the idea that there can be a "complete," linear narrative. The impression left by these textual oddities is equally difficult to express because I am hyperaware that, by proposing a reading for these pages, I must acknowledge my own fallibility and subjective understanding of the world around me. All this time I have proposed that the content and structure of *Tristram Shandy* mimic each other to reveal the fallibility of our language, the individual associations we have with words and events, and, subsequently, the idea that there can be a complete narrative when said individual associations give way to disputation, but it would be remiss of me to not acknowledge that, by these standards, even this essay is flawed. I will, however, mention that I never propose that my

interpretation of *Tristram Shandy* is objective or complete—I am guilty of attempting to convey the "truth" I saw within *Tristram Shandy*, though that "truth" may not be accepted by all.

The Arbitrary Ending

Go back to the beginning of this essay and read the first line. Notice that I quoted directly from the Bible, which I would only be able to do if I read or heard that passage before. In a lot of ways, this essay, too, has an arbitrary beginning and end because it was inspired by other projects that I have worked on, classes I have taken, and other works that I have read. These inspirations are not at the forefront of this essay because academia has mutually agreed that they are unnecessary for the writing of a strong essay if they are not pertinent to the topic, but their exclusion signifies that there are gaps within this suggested narrative of my reading of Tristram Shandy. In fact, there are many thoughts and ideas I had upon reading the novel which are absent from the confines of these pages. In an attempt to defend my thesis, I had to analyze the structure and content (which includes the textual oddities) separately, even though they are not disparate things; I had to reread the novel multiple times to see how my understanding evolved upon further analysis; and I read critical essays pertaining to a multitude of topics found within *Tristram Shandy*, some of which shaped my understanding of the novel, and several of these essays are not mentioned in this essay nor in my literature review. Likewise, though this is the "end" of this essay, what effect will it have on my future papers? The experience of having written this essay and getting these thoughts, however contrived the process may have been, on paper is not for naught; others will hopefully read this essay, question their own interpretations of *Tristram Shandy*, and engage in a never-ending conversation, which I am now an active participant in for a finite period of time.

Notice that I left a blank page before this section. One may have assumed that the inclusion of this blank page was an editorial mishap, but it has thematic significance. There are things that were left unsaid in this essay, and several angles and lenses were ignored in favor of

achieving a semblance of coherency. I still may have failed in that regard—it is *Tristram Shandy* that I am talking about, after all—but, ultimately, there is always more to be said, and in what way can readers of this essay or readers of Sterne's *Tristram Shandy* help fill in the gaps? We may never achieve an understanding of a work that is gapless, let alone an objective, "complete" narrative but the only way to get closer is to provide others with a chance to join the conversation. Sometimes there will be misunderstandings, disagreements, or contradictions, but this is to be expected from us, the users of our language that is flawed because of its limitations and inability to convey an overall truth for all people. Even though our language plays a part in keeping us disconnected from each other, this disconnection is paradoxically responsible for keeping us connected; our disagreements and our misunderstandings are flaws that affect all mankind, and, because we are equally flawed, we are connected because we are dependent upon one another for birthing new meaning and revealing new truths, even if we are never able to construct a monolithic narrative that withstands the sands of time.

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