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HE OVERCAME OBSTACLES.
Dr. Ronald Erwin McNair, Physicist & Astronaut, dared to dream. As an African-American growing up in a poor community in the South, he encountered discrimination early in his youth. Yet this did not stop him from pursuing his dream of becoming a scientist.

HE ACHIEVED ACADEMIC EXCELLENCE.
In 1971, he graduated magna cum laude from North Carolina AT&T State University with a B.S. degree in physics. Ronald McNair then enrolled in the Massachusetts Institute of Technology. In 1976, at the age of 26, he earned his Ph.D. degree in laser physics.

HE BECAME A LEADER IN HIS FIELD.
Dr. McNair soon became a recognized expert in laser physics while working as a staff physicist with Hughes Research Laboratory. He was selected by NASA for the space shuttle program in 1978 and was a mission specialist aboard the 1984 flight of the shuttle Challenger.

HE EXCELLED IN MANY ASPECTS OF LIFE.
Ronald McNair also held a fifth degree black belt in karate and was an accomplished jazz saxophonist. He was married and was the dedicated father of a daughter and a son.

After his death in the Challenger explosion in January 1986, members of Congress provided funding for the Ronald E. McNair Post-Baccalaureate Achievement Program to encourage college students with similar backgrounds to Dr. McNair to enroll in graduate studies. Thus, the program targets students of color and low-income, first-generation college students. This program is dedicated to the high standards of achievement inspired by Dr. McNair's life.

HE WAS RESPECTED AND COMMENDED.
For his achievements, Ronald McNair received three honorary doctorate degrees and many fellowships and commendations. These distinctions include: Presidential Scholar, 1967-71; Ford Foundation Fellow, 1971-74; National Fellowship Fund Fellow, 1974-75; Omega Psi Phi Scholar of the Year, 1975; Distinguished National Scientist, National Society of Black Professional Engineers, 1979; and the Friend of Freedom Award, 1981.
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I am delighted to share with you the seventh edition of the UNLV McNair Scholars Journal. It contains articles researched and written by our undergraduate students in the McNair Scholars program. The relevance of their work is truly impressive. The articles explore such timely topics as autism, big data, diabetes, the wage gap, and PTSD, to name just a few of the topics. The results exemplify both the rigor these students applied to their research and the commitment of the faculty who mentored them. Each article represents countless hours of study, experimentation, and analysis.

We anticipate our McNair Scholars will be at the top of their respective fields in the future. Students participating in the UNLV McNair Scholars Institute have gained an extraordinary opportunity to learn how to design, implement, and report research. These talented undergraduates now have the foundation to continue their education with graduate studies, which may one day put them on the path to being a university professor. We are honored to have such committed students and dedicated faculty at our university, and we are proud to share this publication as a testament to their outstanding work.

Cordially,

Len Jessup, Ph.D.
President
The UNLV McNair Scholars Program personifies the mission of our Division of Student Affairs. Our mission is to provide quality services and programs that create educational opportunities, foster collegiate success, enhance continuous learning and promote a just and inclusive campus.

Within a broader context, UNLV seeks to create a campus environment that promotes the performance of superior research and scholarly endeavors at all levels of study. A unique framework to engage under-represented undergraduate and graduate students in exciting and enriching research opportunities is provided by the McNair Scholars Program. This sixth publication of UNLV’s McNair Scholars Journal is an affirmation and amplification of those endeavors and accomplishments.

Perhaps the most important aspect of the McNair Scholars Program is that of relationship between the faculty mentor and scholar. For the scholar, the benefit of participating in the program depends to a large extent on this relationship. The relationship is designed to encourage, motivate and prepare McNair scholars for doctoral studies. Based on the research reported in this journal, the program has been a resounding success. It provides an undeniable testament to the hard work and commitment of the students and their faculty mentors.

I extend my sincere commendations and congratulations to the McNair scholars, faculty mentors, program staff, and the Center for Academic Enrichment and Outreach for a job well done. This edition of the UNLV McNair Scholars Journal is a fine tribute to their success.
This sixth publication of UNLV’s McNair Scholars Journal is the culmination of extremely hard work by many talented and dedicated individuals. The triumphs of the McNair Scholars and the commitment of their faculty mentors are highlighted within these pages and are exemplary examples of the academic excellence at UNLV.

Over 30 years ago I began my career in higher education, working with high school and college officials to attract young minority students towards postsecondary education. At the time, few universities employed faculty members who could personally identify with the economic and/or social backgrounds of disadvantaged students. There was an urgent need to diversify the ranks of college faculty in order to create academic environments where nontraditional and under-represented students could succeed.

To meet this need, the U.S. Department of Education established the Ronald E. McNair Post Baccalaureate Program. Named for one of the astronauts who perished in the 1986 Challenger explosion, the McNair Program sought to prepare a cadre of under-represented college students to become university professors and role models for others from similar backgrounds. Since its inception, McNair has become the most prestigious federal education program, helping to diversify the faculties at universities and colleges across the country. It is an honor for the Center for Academic Enrichment and Outreach to host UNLV’s McNair Program.

I commend the McNair scholars and their mentors for their hard work and dedication. These scholars displayed outstanding academic excellence in conducting their research; I have no doubt they will develop into top-notch educators. I also applaud President Neal Smatresk, Vice President Juanita Fain, Deputy Executive Director Keith Rogers, the Graduate College, and many other university units for their resolute support of the McNair Program. This journal, displaying the fruit of the McNair Scholars’ toil, reinforces our legacy and continues a tradition of excellence for future scholars.
It gives me immense pride to recognize the inimitable research profiled in the sixth UNLV McNair Scholars Institute Journal. Each year scholars are challenged to participate in research that is relevant, engaging, unique and consistent with their interests while under the careful watch of a faculty mentor. The broad scope of research topics and quality of articles always exceed expectations; this year’s journal publication is no exception.

UNLV operates one of 200 prestigious McNair programs designed to increase attainment of Ph.D. degrees by students from under-represented groups. Since receiving the Ronald E. McNair Post-Baccalaureate Achievement Program in 1999, UNLV has assisted over 250 talented undergraduate students who have demonstrated strong academic potential and has provided them an opportunity to conduct research and participate in other scholarly activities.

This publication reflects not only the dedication and hard work that resulted in the research journal presented here, but also the extraordinary support and expertise offered by the faculty mentors. I congratulate the McNair Scholars, applaud all participating faculty, and extend my sincere appreciation to the Graduate College and UNLV’s leadership for supporting and encouraging the outstanding accomplishments of our students.
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2013 McNAIR SCHOLAR ARTICLES
EFFECT OF FINASTERIDE ON STRESS AND AMPHETAMINE SENSITIVITY

by Kelly D. AbuAli

ABSTRACT

Major theories of addiction propose that stress plays an important role in the motivation to abuse substances. Research suggests that the likelihood of an individual to abuse a substance is higher for someone with previous exposure to a stressful event than one without that prior experience (Reed et al., 2007). 5-α reduced neurosteroids are endogenous regulators of stress and anxiety and may play an important role in stress-induced sensitization, such as drug abuse perpetuated by previous or current stressful events (Bortolato et al., 2011). Allopregnanolone (AP) is a neurosteroid and a potent modulator of the GABA_A receptors. In the present study, we examined the role of AP by using the 5-α reductase antagonist, finasteride.

On days 1-2, 30 male Long-Evans rats were pretreated with vehicle, 10 mg/kg, or 25 mg/kg of finasteride. On day 3, rats received either control treatment or restraint stress. On day 4, all rats were tested for behavioral responses to saline and 1.0 mg/kg of d-amphetamine. Hippocampal tissue was extracted on day 5. Hippocampal AP levels and plasma corticosterone were quantified using an enzyme-linked immunosorbent assay (ELISA). Two-way ANOVA confirmed significance of stress on amphetamine-induced stereotypies but not of finasteride dose. Unfortunately, this study did not demonstrate a relationship between neurosteroids, stress, and amphetamine responses as we hypothesized. More research will need to be performed to observe to what extent neurosteroids could be involved in addiction.

INTRODUCTION

The chronic, recurring nature of addiction remains a widespread problem in the United States. Even after successful treatment and long-term abstinence, individuals may still relapse several months or years later. Animal and human studies also suggest long term and acute stressors increase sensitivity to cocaine and amphetamine (Sinha et al., 2006, Robinson and Becker, 1986). 5-α reduced neurosteroids may play an important role in stress-induced sensitization as endogenous regulators of stress and anxiety (Bortolato et al., 2011). Therefore, the goal of this study was to determine what role 5α-reduced neurosteroids might play in the development of stress-induced sensitization to amphetamines.

This study is primarily based on another study performed by L.M Pritchard in 2005 titled Sex-
dependent effects of stress, but not finasteride, on amphetamine-induced stereotypos. In that study, the researchers looked at the effect of finasteride on stress-induced amphetamine sensitization in male and female rats. The results indicated a stress-induced sensitization of the locomotor response to amphetamine. In addition, male rats, but not females, exhibited stress-induced sensitization of amphetamine-induced stereotypies. Finasteride pretreatment did not alter amphetamine-induced locomotor activity. In this study, we modified our methods by adding more subjects since the last study may not have been large enough to detect a finasteride effect. In addition, we administered finasteride daily for two days before restraint stress, as opposed to one hour before to see how it affects amphetamine sensitization.

The implications of this study could mean more appropriate solutions for recovering addicts. Animal studies have indicated enriched environments and exercise may attenuate the effects of stress on sensitivity to cocaine and amphetamine (Thiel et al., 2009). However, better pharmacological treatment for relapse and drug sensitivity needs further consideration. If this study demonstrates an important role for AP in stress-induced sensitization, it could show physicians and researchers that AP might ameliorate the effects of stress in recovering addicts. Exogenous forms of AP could be synthesized and integrated into a treatment protocol to assist in drug abuse recovery. Ultimately, our goal is to assess the role of neurosteroids in regards to stress and amphetamine exposure. Observing significance will mean that we are one step closer to understanding the intricacies of addiction and how it can be treated. In addition, the information presented in this study will mean more refined studies questioning the role of neurosteroids and more focused questions.

**LITERATURE REVIEW**

Addiction is a life threatening disease that affects millions of Americans on a daily basis. Globally, 100 million adults are likely to be affected by their own or a relative’s addiction problems (Orford, 2013). Dysregulation of many pathways have been hypothesized to play a role in drug addiction and abuse. One of these is the mesolimbic dopamine system, which has been supported by evidence to become dramatically activated during limited self-administration of psychostimulants, such as cocaine and amphetamine (Koob, 2009). The mesolimbic dopamine pathway begins in the ventral tegmental area of the midbrain and connects to the limbic system which includes the amygdala, nucleus accumbens, the hippocampus and the prefrontal cortex. The VTA consists of dopaminergic, GABAergic, and glutamatergic neurons. Drugs of abuse, more specifically, psychostimulants act heavily on dopaminergic neurons by blocking the reuptake of the neurotransmitter, thus producing increased synaptic dopamine concentrations and contributing to euphoria as reported by many users.

Another system that has been shown to be involved in addiction is the hypothalamic pituitary adrenal axis, or HPA axis. The HPA axis is a connection between the hypothalamus, pituitary gland, and the adrenal. The main function of the HPA is to regulate stress and neuroendocrine activity. In the event of stress, corticotrophin releasing factor (CRF) is released from the hypothalamus, which triggers release of adrenocorticotropic hormone (ACTH) from the pituitary and eventually releases a glucocorticoid (cortisol in humans, corticosterone in rats) from the adrenals. Studies have shown that early life stress can predispose an individual to abuse drugs later in life (Koob, 2009). The HPA axis can be activated by drugs of abuse and can facilitate drug reward and the acquisition of drug seeking behavior (Piazza et al., 1993). Chronic unpredictable stress increases the rewarding properties and locomotor effects of cocaine and correlates positively with corticosterone levels (Haile et al., 2001). In addition, stress pre-treatment sensitizes psychostimulant-induced stereotypic behavior, which is demonstrated through repetitive head bobbing, paw licking, etc. This behavior is similar to what is seen in long time or heavy psychostimulant users. This increase in behavioral responses to psychostimulants is termed stress-induced sensitization (Robinson and Becker, 1986). Thus, stress is also a potent modulator of drug sensitivity.

Stress also leads to the increased production of several other hormones, including 3α, 5α tetrahydroprogesterone or allopregnanolone (Purdy et al., 1991). Allopregnanolone (AP) is a neurosteroid found in several brain circuits involving stress and reward. AP synthesis occurs from progesterone and corticosterone’s breakdown by the enzyme 5-α reductase I. AP modulates GABA receptor activity, which likely results in the anxiolytic effects of AP (Lambert et al., 2003; Reddy, 2003). Additionally, AP interacts with brain reward pathways. It has been demonstrated that AP can increase or decrease dopamine release in the rat nucleus accumbens and
prefrontal cortex, depending on the dose administered and can inhibit amphetamine-induced locomotor activity (Khisti et al., 2002). However, following cocaine administration, AP levels in plasma are higher in the hippocampus and striatum (Quinones-Jenab et al., 2008). Nonetheless, by inhibiting 5-α reductase I with finasteride, dopamine release in the rat prefrontal cortex from an acute stressor will increase (Dazzi et al., 2002). Therefore, AP plays a valuable role in the modulatory effects of dopamine and understanding that role is crucial in understanding the neurocircuitry involved in addiction.

**METHODS**

The objective of this study was to determine the role of 5-α reduced neurosteroids in stress-induced amphetamine sensitization. We hypothesized that by blocking the production of allopregnanolone, animals would be rendered more susceptible to the effects of restraint stress on amphetamine-induced behaviors. In addition, we expected to find lower levels of allopregnanolone and higher stereotyped behaviors in response to an acute amphetamine injection in animals that received finasteride, but especially those that received finasteride and underwent restraint stress.

**Subjects**: Subjects included thirty adult male Long-Evans rats. Rats were randomly assigned to a pretreatment group (vehicle, 10 mg/kg finasteride, or 25 mg/kg finasteride) followed by pseudo-random assignment to control or restraint stress. These procedures were approved by the UNLV Institutional Animal Care Committee.

**Drugs**: Finasteride (Steraloids, Inc., Newport, RI) was sonicated until dissolved in 20% 2-OH-propyl-β-cyclodextrin in a concentration of 10.0 mg/ml or 25.0 mg/ml. D-amphetamine (Sigma) was dissolved in saline in a concentration of 1.0 mg/ml.

**Pretreatment**: On days one and two, rats were pretreated once daily with vehicle, 10 mg/kg finasteride, or 25 mg/kg finasteride administered subcutaneously.

**Acute Stress**: On day three, rats either received restraint stress via a rodent restrainer tube (Harvard Apparatus) for 60 minutes or remained in their home cages. No injections were given on this day. Blood samples were collected from rats in the stress group by the tail-nick method (Fluttert et al., 2000) at three time points: immediately upon placement in the restrainer, 30 minutes after the onset of restraint, and 30 minutes after release from the restrainer. Blood samples were collected from control animals at the same time points. Samples were immediately centrifuged, and plasma was frozen at -20°C for later measurement of corticosterone.

**Amphetamine Administration**: On day four, all rats received a subcutaneous injection of saline and were placed in an open field chamber for 30 minutes, followed by a subcutaneous injection of 1.0 mg/kg of d-amphetamine, and placed in the open-field chamber for two hours. A video camera was assembled in the chambers to monitor the animals’ potential stereotyped behaviors.

**Tissue Collection**: On day five, animals were sacrificed by pentobarbital overdose, and hippocampal tissue was collected. The brain was dissected with the aid of a coronal brain matrix, and the hippocampus was removed as previously described (Hondo et al., 1999). Tissue samples were snap frozen on dry ice and stored at -80°C.

**Tissue Homogenization**: Tissue samples were immediately transferred from -80° freezer in an ice bucket to the UNLV core genomics lab. Tissue samples were weighed and transferred into Eppendorf tubes containing a mixture of 1:2 methanol and chloroform (respectively), and two beads were placed inside. Homogenization was performed via a bead homogenizer set at 30Hz for two minutes, repeated twice. Following completion of homogenization, tissue was centrifuged for five minutes at 10,000 rpm. Supernatant was then transferred into a new Eppendorf tube and samples were returned to -80° freezer.

**Allopregnanolone ELISA**: ELISA kit was supplied by Ucsn Life Science, Inc. A 96-well strip plate was precoated with allopregnanolone antibody. Reagent Preparation: Allopregnanolone standard was reconstituted using 1.0 ml of standard diluent. Five Eppendorf tubes were prepared containing 600ul of standard diluent, and a triple dilution was created with concentrations of 33.33 mg/ml, 11.11 ng/ml, 3.70 ng/ml, 1.23 ng/ml, and 0 ng/ml (respectively). Assay procedure: Five wells
were prepared for standard points, one well for blank. All samples were run in duplicates. 50 ul of standard, blank and samples were pipetted into appropriate wells. 50 ul of Detection Reagent A were pipetted into each well. The plate was gently shaken and incubated at 37°C for one hour. Following incubation, wells were aspirated and washed (3X) with 350ul of wash solution from the kit. 100ul of Detection Reagent B were pipetted into each well, and the plate was incubated for 30 minutes. The aspiration / wash process was repeated five times. 90 ul of substrate solution was added to each well, and the plate was incubated for 15 minutes. 50 ul of stop solution was added to wells, causing a color change from blue to yellow. The plate was read through microplate (Molecular Devices/Spectra Max M2, Sunnyvale, CA) reader at 450nm to detect absorbency.

Corticosterone ELISA: Plasma samples were collected at baseline, during stressor, and after stressor for a total of three samples per animal; albeit only nine out of 31 animals provided sufficient plasma on all three samples to qualify for the assay. ELISA kit was supplied by Enzo, Life Sciences. 96-well strip plate was precoated with corticosterone antibody. Reagent Preparation: Assay buffer 15 was prepared by a 1:10 ratio of assay buffer concentrate to deionized water for a total of 100 ml. Plasma samples were diluted in a 1:5 ratio of sample to assay buffer for a total of 100 ul. CORT standard was prepared by five-fold dilution. Five Eppendorf tubes were prepared to create concentrations of 20,000 pg/ml, 4,000 pg/ml, 800 pg/ml, 160 pg/ml, and 32 pg/ml respectively. Assay procedure: Duplicate wells were assigned for total activity (TA), bound activity (Bo), non-specific binding (NSB), standards, blank, and samples. 100 ul of assay buffer 15 were pipetted in NSB and Bo wells. 100 ul of standard and samples were pipetted into their respective wells. Additional 50 ul of assay buffer were pipetted into NSB wells. 50 ul of blue conjugate were pipetted into all wells, except TA and Blank wells. 50 ul of yellow antibody were pipetted into each well, except blank, TA, and NSB wells. The plate was incubated for 2 hours at room temperature on a plate shaker. Following incubation, the plate was washed/aspirated 3 times with kit-provided wash buffer. 5 ul of blue conjugate was added to TA wells. 200 ul of pNpp substrate solution was added to all wells, followed by hour incubation. 50 ul of stop solution was added to all wells and plate was read through microplate (Molecular Devices/Spectra Max M2, Sunnyvale, CA) reader at 405nm to detect absorbency.

Stereotypy: Data were collected during amphetamine open field chamber testing. Each video corresponds to one rat. Videos were edited to show the first minute of each of the 12 (10 minutes) segments. Stereotypy data were analyzed using a rating scale developed by Kelley (1998) that looks for certain stereotypes and requires the rater to determine whether the rat acted in any of the following behaviors: grooming, stillness, head-up sniff, head-down sniff, rearing, biting, mouth movement, or locomotion. In each segment, presence of the behavior was rated as “one point” whereas absence of the behavior was rated as “zero”. The values from all 12 segments were added together to generate the overall number of stereotypies for each animal.

In summary, benchwork was the main intention of this summer’s independent research. Prior examination was performed by looking through previous journal articles, inquiring into other researchers’ studies, and speaking with faculty to determine which method would assist best in helping us perform steroid extraction. That method included tissue homogenization/centrifugation, liquid phase extraction and ELISA. In addition, stereotypy was rated using a rating system.

RESULTS

Allopregnanolone concentration data were analyzed by a two-way ANOVA. There was no significant effect of dose or condition (both p > 0.05). However, values were averaged and plotted by concentration vs finasteride dose. This revealed a relationship between 10 mg/kg control rats and lower levels of allopregnanolone. In addition, 10 mg/kg stressed rats demonstrated a higher concentration of AP than their control counterparts (Figure 1). While these differences are not significant, it does show an expected direction that a low dose of finasteride can reduce allopregnanolone for control rats.

Stereotypy data were also analyzed by a two-way ANOVA. There was a significant effect of behavioral stress (F1, 28 = 4.936, p = 0.036), but not of dose (p > 0.05). Thus, all rats that received restraint stress,
regardless of finasteride dose, displayed greater stereotypy than control rats (Figure 2).

Data from the corticosterone ELISA showed no significance of time, dose, or condition (all p > 0.05). Interestingly, control rats exhibited higher baseline corticosterone than stressed rats regardless of dose. While we do see an increase of stress from baseline in stressed animals (sample 2), it is highest in animals that received vehicle, whereas only a slight increase in low and high dose finasteride stressed animals (Figure 3).

DISCUSSION

The main purpose of this study was to determine the role that 5-α reduced neurosteroids play in stress and amphetamine sensitivity. As expected, our study did show an effect of behavioral stress on amphetamine-induced stereotypies. While we didn’t see a significant effect of finasteride dose, we did see lower levels of allopregnanolone amongst rats that were pretreated with 10 mg/kg finasteride, and higher amphetamine stereotypies for all rats that were stressed vs. control rats.

The effect of stress from this study is concurrent with the results from Pritchard et al. (2005) and Piazza et al. (1990). Stressed rats exhibited higher levels of stereotypy than control rats. While the Pritchard et al. study focused on sex differences, it does follow our hypothesis that rats that underwent restraint stress would show pronounced stereotypies over control rats. In addition, Piazza et al. also demonstrated that previous repeated exposure to a stressful experience (tail-pinching) or to amphetamine, increase the locomotor response to this drug (behavioral sensitization) and enhance vulnerability to acquire amphetamine self-administration (Piazza et al. 1990).

Dazzi et al. (2002) performed a study where they found that finasteride pretreatment did inhibit allopregnanolone concentrations. While we did not show significance of finasteride pretreatment, we did see a relationship between 10 mg/kg finasteride pretreatment and allopregnanolone concentrations. Interestingly, Dazzi (2002) used the same dosage of finasteride (25 mg/kg) as we did, but they administered the drug 24 and one hour prior to stressor, whereas we administered it 48 and 24 hours prior. Had we administered finasteride closer to the stressor, perhaps we would have seen lower AP concentrations. In addition, our ELISA kit was intended for plasma and/or serum, and we had to modify the protocol for brain tissue. This could have played an important role in how efficiently we were able to extract steroid.

Our results did not show elevated corticosterone levels in response to stress. This is interesting, considering that corticosterone is a typical marker of the stress response. This could be due to timing of sample 1 in the stressed groups. Corticosterone levels may already have been increased from placement in the restrainer at the time of tail incision, thus not allowing us to detect an increase from baseline to sample 2. In addition, the hypothalamic pituitary axis (HPA axis) operates using a negative feedback loop. It is possible that finasteride inhibited 5-alpha reductase enough to cause a corticosterone build up (CORT is also metabolized by 5-α reductase). The build up would signal the hypothalamus to stop secreting CRF, leading to reduced release of CORT.

A main limitation in our study included determining how to most efficiently extract allopregnanolone from our samples. Brain tissue is highly lipid dense, so we wanted to ensure an effective transfer of steroid. We experimented with different buffers and concentrations, such as methanol/water and methanol/chloroform. We looked to current methods of steroid extraction and experimented with procedures such as solid phase extraction (SPE). Because lipids are hydrophobic, we encountered some challenges in implementing SPE. However, we homogenized scrub tissue in various solvents, ran practice assays, and determined through trial and error which methods proved most effective. In regards to this study, we have learned which methods will behoove us more than others and assist us in yielding useful results. Although our study did not confirm our hypothesis, previous research suggests...
that allopregnanolone does play a role in stress and behavioral sensitization (Quinones-Jenab et. al 2008; Khisti et. al 2002). That role will need to be further researched to fully grasp its scope. Ideas for future research could include altering finasteride timing and duration of stressor. Utilizing extraction methods such as solid phase extraction could be beneficial in yielding more steroid than with an ELISA alone.

REFERENCES


Orford, J., Velleman, R., Natera, G., et al. (2013). Addiction in the family is a major, but neglected contributor to the global burden of adult ill-health. Social Science and Medicine, 78, 70-77.


EMOTIONAL,
PSYCHOLOGICAL,
AND BEHAVIORAL
CHALLENGES OF
CHILDREN WITH
INCARCERATED
PARENTS

BY STARR BAILEY

ABSTRACT
Children of incarcerated mothers and fathers are at a high risk of developing emotional, psychological, and behavioral problems (Dallaire, 2000; Lotze, Ravindran, & Myers, 2010; Nurse, 2004). The literature review conducted for this study noted several problematic behaviors. Specific attention was given to consequences as the family unit deteriorated. Some children were at a high risk for delinquency and criminal activity. Others experienced several home displacements which led to foster care or grand parenting responsibilities (Belknap, 2006). Further, mental health issues and school behavior problems were directly linked to parental incarceration (Arditti, 2012). Four main problems in children were identified, which included aggression, anxiety, poor concentration, and social withdrawal. Some children of incarcerated parents demonstrated destructive attributes such as depression, predictive behaviors related to unsuccessful school achievement, and greater risk for intergenerational incarceration (Wildeman, 2010).

This paper examined a set of challenges faced by incarcerated parents and their children that caused a range of difficulties in the long term. The data for this research was gathered from case studies, personal viewpoints expressed by children having mothers or fathers incarcerated, and a comparative analysis study that explained the obstacles that children of incarcerated parents experienced.

INTRODUCTION AND PURPOSE OF THE STUDY
Over 10 million minor children in the United States have experienced parental incarceration, including at least 2.3 million children with a currently incarcerated parent (Johnson, 2012, p. 91). The purpose of this study was to identify the emotional, psychological, and behavioral difficulties that children have when their parents are incarcerated.

This research was based on several previous studies. Maternal Incarceration and Children’s Adolescent Outcomes: Timing and Dosage detailed a study of incarcerated mothers and their length and frequency of separation from their children. The author ana-
A common theme for children of incarcerated parents and fathers: A comparison of risks for children and families. A majority of the data came from a comparative analysis in the article, Incarceration and Reentry on Children, Families, and Community, laid the foundation for the effects of children's happiness, welfare, and development during and after incarceration. A majority of the data came from a comparative analysis in the article, Incarcerated Mothers and Fathers: A Comparison of Risks for Children and Families. A common theme for children of incarcerated parents was reactive attachment disorder. Reactive attachment disorder developed because the basic needs for comfort, affection, and nurturing were not met and loving, caring attachments with others were never established. This issue was difficult to change due to institutional policies. The literature proposed that 40% to 71% of children never saw their mothers during incarceration (Cullen, Johnson, & Stohr, 2015). As a result, it was difficult for them to form or maintain relationships with the parent or any other family member. It was disheartening for children to not be able to communicate with their mothers on a frequent basis (Belknap, 2006).

Although family and friends provided appropriate childcare, they usually only addressed the physical needs of the children. Consequently and more commonly, boys reacted to how often their mother was taken away from the household. Girls reacted to how long their mother was taken away from the household. However, both male and female children acted out in an unanticipated manner (Cho, 2010). Boys were prone to developing emotions that included aggression and girls exhibited social withdrawal (Arditti, 2012; Cho; Parke, & Clarke-Stewart, 2003).

Some sons and daughters suffered academic setbacks. The literature noted that the children with mothers in correctional facilities evidenced a greater risk for disruption in their school academic progress in comparison to their peer groups. However, the school dropout and suspension rates were lower when children had frequent contact with their incarcerated mothers. When mothers were not able to tangibly support and encourage their children by such acts as preparing a school lunch, ensuring available and appropriate school attire, or assisting in the morning school routine, it became evident that someone was missing in the children's lives (Dallaire, Ciccone, & Wilson, 2010).

From an educational perspective, one significant factor that affected IQ test scores and achievement in boys was the imprisonment of the father. Additionally, teachers observed that students of incarcerated parents often sought medical attention from the school nurse to reduce high levels of anxiety although the physical appearance seemed intact (Dallaire, Ciccone, & Wilson, 2010). Knowledge of a parent's incarceration led to antisocial behavior, which included poor interaction with teachers, peer hostility, and extended absences (Dallaire, Ciccone, & Wilson; Murray, Farrington, & Sckol, 2012). In relation to their peers, some children of incarcerated parents had a low desire to pursue higher education, demonstrated more antisocial, and developed habits leading to a higher risk for becoming future prisoners (Arditti, 2012).

The importance of this research proposal was to take a closer look at the harmful consequences to children as a result of parental incarceration. Through the research and development, the goal was to bring greater awareness to the behaviors that continue to promote an increase in the generational incarceration rate and the cycle of crime. This information is vital to promote the development of programs to give greater support to children of incarcerated parents, provide greater access and more meaningful contact during incarceration, and demonstrate the need for greater support services upon release and assist in a more effective family reunification.

LITERATURE REVIEW
The literature presented an updated statistical report of incarceration in the United States, the country the largest in the world (Arditti, 2012; Bosworth, 2010; Murray, Farrington, & Sckol, 2012; Wildeman, Wakefield & Turney, 2015). Parental incarceration was defined as any kind of custodial confinement of a parent by the criminal justice system except being held overnight in police cells (Murray, Farrington & Sckol, 2012, p. 176). The incarceration rate of the United States was recorded as seven times greater than Western European countries (Wildeman & Western, 2010). Of the 1.5 adult prisoners, about half had children under the age of 18 (Murray, Farrington, & Sckol). Further, according to the Nevada Department of Correction 2012, a comparison of African American and Latino incarcerations were reported as nine and three times greater respectively than those of the European American population.

Prior to reaching adulthood, these children have often felt as though they had lost their childhood from this emotionally damaging and confusing ordeal.
As early as 1959, studies have been reported supporting the negative behavioral effects of children with incarcerated parents. Reports facilitated by Robins, West, and Herjanic (1976) and Sack (1977) also linked a parental imprisonment to problems such as being absent or late for school, running away, stealing, and being hostile toward other children (Fritsch & Burkhead, 1981).

At this point, the criminal justice system was not accommodating adequate visitation for children and their imprisoned parents. Therefore, an influx of prison programs was established in the late 1970s and 80s to help parents and their children connect and enhance their relationships, reduce inmate stress, and lower the anxiety of the children. Other improvements to support children included agencies and service projects in the 1970s and community-based models in the 1980s.

During the 1990s decade, there was a dramatic increase in the prison population (Hanlon, Carswell, & Rose, 2007). The rate of men increased by 60% and the rate for women was even greater at 84%. Factors that contributed to this increase included stricter sentencing guidelines such as delayed release dates and longer sentences. With more parents in the prison system, more children were left without a parent role model; became at risk for emotional, psychological, and behavioral development; and lacked residential stability.

How children socialized with their mothers before incarceration, had a direct effect on how they interacted during the incarceration period. Exposure to adverse behavior increased the already strained mother-child relationship. Children wanted to follow in their parents’ footsteps. They adapted well to a “prison culture” of crime rather than college. This had the potential of multi-general families in jails or prisons (Dallaire, 2000).

Murray, Farrington, and Skol (2012) investigated the outcomes of the parental incarceration and the behavior of children who developed mental health issues such as antisocial behavior, low academic progress, and substance abuse. The results indicated that children reacted to parental incarceration in different ways due to a number of situations: parental relationships before the incarceration, the age of the children, the amount of time related to the parent’s absence, the circumstances and honest explanation surrounding the arrest. Other considerations included the change in housing and child care, the stress of parent-child visitations, and the dynamics impacting the extended family.

When family members continued to keep secrets from children about a parent’s incarceration, they thought they were providing comfort for the child, but in reality they were causing more damage that added to the conspiracy of deceit (Arditti, 2012). Through case studies and interviews, Arditti humanized the parental incarceration statistics by documenting personal stories of the entire family. The personal perspective she contributed from these interviews gave substance to what children were experiencing and the consequences of their parents’ criminal activities.

A 2005 study found that boys separated from either mother or father due to incarceration were at high risk for school delinquency later in life (Dallaire, 2000). School attendance was low because sons were expected to provide financial help for the family since the parent’s income was no longer available for the household (Cho, 2010). A meta-analysis in 2009 of previous studies established an association between antisocial behavior and poor mental health. Further analysis relevant to rehabilitation indicated that when a father had close ties with friends and a connection
to his family, he was less likely to participate in criminal activity as well as become a repeat offender (Modecki & Wilson, 2009).

The impact of fathers on their sons was vital to positive family relations and the sons’ access to a male role model. In the Cambridge Study in Delinquent Development, boys who lost a parent to incarceration manifested internal behaviors such as depression, anxiety, and antisocial behaviors during adolescence and adulthood (Murray & Murray, 2010; Parke & Clarke-Stewart, 2003; Shlafer & Poehlmann, 2010).

If there was a strong father-daughter bond at the beginning, the dynamics of the family deteriorated when the father was removed from the home. However, many fathers were grateful to have visits from their daughters. Daughters brought a comfort that was needed for their fathers to survive the mental anguish of prison. In the book, Freed to be Fathers: Lesson from Men Doing Time, Brutus and his daughter Amanda had a very strong relationship, which was very influential in his life. He gave a lot of attention to Amanda and got fully involved in her world. She had temper tantrums if she did not get a chance to make a phone call to him or she did poorly in school if she didn’t get to visit him (Smith, 2003). This was just one example of how the father-daughter relationship seemed to nourish both of them.

Research indicated that almost all incarcerated women have custody of their children prior to imprisonment in comparison to incarcerated men (Belknap, 2006). Mothers sentenced to prison often became emotionally distraught as Houck and Loper (2002) reported that stress from incarceration was directly linked to restricted parent-child contact. Signs of anxiety and depression were at higher levels when parents were prevented from seeing their children. They felt like a failure for their deteriorating family relationships, while they remained optimistic that their children would be resilient during this difficult time (Young & Smith, 2000). One young man recalled the day the police came and took his mother away. Although his mother bought his siblings anything they wanted, she did not have time to spend with them. He missed her very much, but he would not communicate with her. He was so angry that when she wrote to him about basketball, he stopped playing because he had no one in the stands to cheer for him (Gabel & Johnston, 1995).

When a mother was incarcerated, the daughter suffered. Behaviors identified were low self-esteem and aggression. We saw the example of how vital it was for a girl to have an example of her mother or an older woman to set the pattern for her growth and development into a woman who was productive in society. Girls who grow up without their mothers and knowing that their moms were incarcerated were at a double disadvantage because they had to live without their mothers and with the internal stigma of having a mother who was incarcerated.

The social stigma of having a parent who was incarcerated exacerbated the psychological and emotional difficulties that children naturally experience during separation. It was reported that children of incarcerated mothers were often teased at school, and many suffer from post-traumatic stress disorder (PTSD) (Arditti, 2010). Symptoms of PTSD include withdrawal, hyper-alertness, sleep disturbances, guilt, and impaired memory and concentration. Teenagers may be especially vulnerable to these stresses of having an incarcerated mother. A significant number of teenage girls, ages 13-14 years, became pregnant within a few months of their mothers’ incarceration. Furthermore, children of incarcerated mothers have been reported to experience serious depression, feelings of abandonment, shame, suicidal feelings, and worry about the incarcerated parent. These feelings may contribute to problems with eating, sleeping, and school performance (Young & Jefferson-Smith, 2000, p.152-153).

**SUMMARY OF LITERATURE REVIEW**

Findings from the literature stated that the United States has the largest incarceration rate of the world. Children of incarcerated parents seemed to be neglected because there was little help from the community and few resources to successfully handle this traumatic event. As more than 2.5 million American children will go to bed tonight with at least one of their parents confined within jail or prison walls, sixty percent of those children will become future inmates (Nevada Department of Corrections, 2012). Without this parental figure, there was an influx of emotional, psychological, behavioral problems in children. Gradually prison programs were introduced into correctional facilities to encourage and support families during incarceration.

Incarcerations distressed the parents and children in different ways. When children were separated from their parents, it impacted the family dynamics causing feelings of abandonment, anxiety, aggression, low
self-esteem, and withdrawing from social situations. Research studies discussed school delinquency, the deterioration of parent-child relationships, visitation concerns, and the social stigma of having a parent in prison.

**METHODOLOGY**

For the purpose of this research project, this study was selected to discuss the emotional, psychological, and behavioral issues in relation to parental imprisonment. Participants in the current study were inmates of state and federal correctional facilities who self-identified as a parent of at least one child. Of the 18,326 total participants who identified as being a parent, 7,249 participants were used in a survey. The total sample size in the current study consisted of 6,146 male and female inmates, where 1,014 (16%) were female and 5,132 (84%) were male. Only data from participants who were parents of either minor children (under 18) or adult children (over 18) was used in the current study. Of the female inmates, 690 (70%) were mothers of minor children and 324 were mothers of adult children. Of the male inmates, 4,029 (78%) were fathers of minor children and 1,103 were fathers of adult children. The research design was a comparative analysis of the similarities and differences of maternal and paternal incarceration, family incarceration, and living situation for the children of incarcerated parents. The author's hypothesis was that a mother's incarceration was a greater risk factor for children to also become incarcerated. Guiding questions for this research were as follows: Do mothers and fathers report a history of family incarceration and other risk factors? Do mothers and fathers report that their adult children have been through the penal system? Are there different predictors of risk for the mothers and for the fathers? Is there a link between high risk and high incarceration rates? How do minor children’s living situations differ?

Key terms and variables used by the author in this study included contextual risk factors, incarceration-related risk factors, and intergenerational incarceration patterns. Contextual risk factors included mother’s lack of education, being from a single parent home, being in a large family, being of an ethnic minority, and having a parent with mental issues. Incarceration-related risk factors included siblings being separated from each other due to parental incarceration and being placed in non-familial care. Intergenerational incarceration patterns included the parents’ history of incarceration, parental drug use, the family’s history of incarceration, and some neighborhood values that contributed to crime. The outcome variable was the incidence of incarceration for adult children of the incarcerated mothers and fathers. The contextual risk variables included the family size, the ethnicity, completed education, marital status, self-reported history of mental or emotional illness, and reported sexual or physical abuse. The incarceration-related risk variables included regular drug use, previous arrests, arrests for violent crimes and the arrest record of family members.

One limitation to the generalizability of the findings was the fact that accuracy of the reports could not be proven. Although the inmates were given a survey, there was not a way to verify if they were telling the truth. To resolve this issue, it was necessary to compare answers between the incarcerated parents and family members to increase accuracy, as well as use a smaller sample size and give the survey multiple times to determine consistency. Secondly, there was an insufficient amount of information on the children. To minimize limitations, more child demographic data information had to be collected. It would be beneficial to gain access to the child’s developmental status, the socialization process, and the family’s circumstances during the parent’s incarceration. Additionally, using a smaller sample size and examining the child, inmate, and caregiver relationship within the family would enhance this research.

To summarize, a large sample size was taken from both male and female parental inmates. Research study identified predictors of at-risk behavior for future incarceration of the children. Research also compared data to see if children with an incarcerated mother were at greater risk of future incarceration, than that of the father. It examined other risk factors that occurred in children of incarcerated parents, such as extended family incarceration, the children’s housing situation, and rate of the parent’s multiple incarcerations.

**DATA ANALYSIS**

For this study, 7,249 inmates from both state and federal correctional facilities, who self-identified as having at least one child, were given a survey developed through the US Department of Justice Survey of Inmates in State and Federal Correctional Facilities. The data was gathered by the US Department of Justice, Bureau of Justice Statistics, the Federal Bureau of Prisons, Department of Commerce, and Bureau of Census in collaboration with the College of William.
and Mary. After outliers were removed from the database, 7,245 participants remained. The total sample size in the current study consisted of 6,146 male and female inmates, including 1,014 (16%) female inmates and 5,132 (84%) male inmates. Only data from participants who were parents of either minor children (under 18) or adult children (over 18) were used in the current study. Of the female inmates, 690 (70%) were mothers of minor children and 324 were mothers of adult children. Of the male inmates, 4,029 (78%) were fathers of minor children and 1,103 were fathers of adult children. The research design compared and analyzed the similarities and differences in family and adult child incarceration.

This research study produced five major findings: 1) Incarcerated fathers of adult children reported that their sons and/or daughters were 2.5 times less likely to be incarcerated than adult sons and/or daughters of incarcerated mothers. 2) Sons and/or daughters of mothers who used drugs before becoming incarcerated were an elevated risk of becoming incarcerated also. 3) The more risk factors a son or daughter acquired throughout their life, the greater the chances that the mother reported her child’s incarceration. 4) In regards to family incarceration rates, fathers of adult and minor children were less likely than mothers of adult and minor children to report that their children had family members who had been incarcerated. 5) Incarcerated fathers of minor children were less likely than mothers of minor children to report that their minor children were living in the home, such as an orphanage and being cared for by someone other than family.

Contextual risk factors, such as the mother’s lack of education, a single parent home, mental illness of the parent, and being an ethnic minority may lead to incarceration, as well as failure in school and behavior problems. With four or more apparent risk factors, the chances for harmful outcomes increased. Throughout the study, mothers who were incarcerated reported more risk factors than fathers who were incarcerated. This conclusion supports the hypothesis that incarcerated mothers’ children are at a higher risk of incarceration than children of incarcerated fathers.

RESULTS

Intergenerational incarceration was another finding from this research. Incarceration had become a common part of families’ lives. There was a high probability that there will be generations of parent and child incarceration. In this study 8.5% of incarcerated fathers reported that their adult children were incarcerated, compared to the 21% of incarcerated mothers that reported their children were incarcerated. Four or more risk factors were identified for two-thirds of these mothers and three-fourths of the fathers. According to this chart, adult children of incarcerated mothers had a much higher percentage rate of adult children who were incarcerated.

However, the mothers in this study were least likely to make known the incarceration experience of their mothers. Another data result was that it was likely that if a mother had been taken to prison, other family members may have also been incarcerated, leaving fewer relatives to take responsibility for the children.

Other contributions that lead to her child’s incarceration were the mother’s consistent drug use. When there was a disruption within the mother-child relationship, it seemed to be extreme and could be a cause for more children of mothers to be incarcerated than the children of fathers.

Prevention factors were also included in the research study. Early intervention programs were encouraged as a way to enhance parenting skills, support groups were used to help the parents discontinue using alcohol or other nonprescription drugs. Another part of the intervention programs were assisting the parental inmates in finding and keeping a job once released from prison.
CONCLUSION OR FURTHER RESULTS
This study examined the emotional, psychological, and behavioral characteristics of the children with incarcerated parents to provide a better understanding of the family dynamics of children of incarcerated parents from a human service perspective. Although they are exposed to multiple risk factors, little attention has been given to this issue, yet it has affected many generations of people. Programs that address relationships between incarcerated parents and their children can increase a better understanding of the emotional, psychological, and behavioral issues and lessen the shame and stigma of being a child with an incarcerated parent.

More research is needed in the area of parent-child visitations to keep the lines of communication open, help reduce anxiety in children, and reduce stress in the mothers. Studies tend to be limited by small convenient samples, cross-sectional and short term designs. They may describe a sample of children whose parents who have been incarcerated but these analyses do not consistently distinguish between the challenges faced by children of incarcerated parents and the challenges faced by disadvantaged children.

REFERENCES


AN ACUTE INFLAMMATORY RESPONSE IN A DIABETIC MODEL OF ALZHEIMER’S DISEASE

BY KRYS TAL COURTNEY D. BELMONTE

ABSTRACT
Alzheimer’s disease (AD) is a neurodegenerative disorder, which displays progressive cognitive decline as well as several neuropathological hallmarks, including amyloid plaques and neurofibrillary tangles. Two of the greatest AD risk factors include Type 2 diabetes mellitus (DM) and neuroinflammation. Despite investigations of both of these risk factors no study has investigated an interaction between DM and neuroinflammation related to AD. We investigated if neuroinflammation induced by administration of lipopolysaccharide (LPS) would alter AD related behavioral and pathological features in a sterptozotocin (STZ) induced model of DM. Spatial learning and memory was investigated in the Morris water maze and biochemical markers for AD were analyzed by western blot analysis to determine if the inflammatory response had any effect. Data indicated that the administration of STZ induced AD-like deficits in learning and memory and pathological features of AD, such as increased Aβ oligomers and phosphorylated tau proteins. Data also indicated that an acute inflammatory response was capable of rescuing behavioral as well as some of the pathological AD-like changes in the STZ model. These results indicate an acute inflammatory response may be productive in potential therapeutic aspect of relieving AD-like characteristics.

INTRODUCTION
Alzheimer’s disease (AD) is the most common form of dementia, accounting for 50 to 80 percent of all dementia cases. This neurodegenerative disease leads to neuronal death and tissue loss in the brain, resulting in the slow deterioration of memory, thinking skills, and eventually even the ability to do daily tasks. While it is not a normal part of aging, AD is mostly diagnosed in people over the age of 65; thus, the main risk factor for Alzheimer’s disease is increased age, though it is most likely other additional factors also contribute (Heese & Akatsu, 2006). Neuropathological hallmarks of AD include neurofibrillary tangles (NFTs) formed by the aggregation of hyperphosphorylated tau proteins within neurons, and amyloid plaques formed by the accumulation of β-amyloid (Aβ) proteins in the extracellular space (Cvetkovic-Dozic et al.,

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To date, the etiology of AD remains unknown, but several models investigating multiple pathways have been used to better understand the disease.

Two specific AD risk factors in addition to age have been implicated in the onset and progression of the disorder. These include Type 2 diabetes mellitus (DM) and inflammation of the brain. Recent evidence has indicated a connection between Alzheimer's disease and Type 2 DM. In Type 2 DM, cells fail to use insulin properly, resulting in insulin resistance. This resistance consequently affects the metabolism of tau and beta-amyloid proteins, potentially leading to formation or acceleration of neurofibrillary tangles and amyloid plaques, both being neuropathological hallmarks characteristically seen in AD (Gasparini et al., 2002). Because of the similar characteristics seen in both Type 2 DM and AD, the use of a DM model to investigate AD represents a useful tool to examine AD pathologies.

Brain inflammation, commonly referred to as neuroinflammation, consists of activation microglia cells, which act as the immune response for the nervous system. Though useful in protection of the brain, the activation of microglia may also contribute to the progression of AD. Chronic brain inflammation induces a neurotoxic result by increasing the production of Aβ proteins, senile plaques, and neuronal damage; thus leading to exacerbated symptoms and a more rapid progression of AD. Alternatively, acute inflammatory responses have been suggested to serve a protective role in degenerative disorders by activating the microglia cells in a short-lived manner causing only an acute-phase response (Frank-Cannon et al., 2009). A critical question in AD research is what aspects of chronic neuroinflammation exacerbate pathological features, as well as if an acute inflammatory response may play a neuroprotective role by reducing the aggregation of Aβ, and thus lowering the likelihood of cell loss. The purpose of the present study was to investigate the effects of an acute brain inflammation in a diabetic model of AD. In order to examine this, we investigated if an acute immune response induced by lipopolysaccharide (LPS) would alter AD related behavioral or pathological features using the streptozotocin (STZ) diabetic model of AD.

MATERIALS AND METHODS

ANIMALS
Forty-four male Sprague-Dawley rats (~8 weeks old) were used throughout the studies. The animals were single-housed in a standard animal facility with a 12–12 hr light–dark cycle, with food and water available ad libitum. All procedures were performed during the light phase and in accordance with the University of Nevada, Las Vegas Animal Care and Use Committee and NIH guidelines for ethical treatment of research subjects.

DRUG ADMINISTRATION
Rats were randomly distributed into four groups. To induce DM, stereotaxic surgeries were performed under aseptic conditions and ketamine/dexmedetomidine anesthesia (Kinney et al., 2003; Sabbagh et al., 2012). In two of the groups, bilateral injection of streptozotocin (STZ; 25 mg/ml; 8 ml/ventricle) into the lateral ventricles was performed at stereotaxic coordinates: 0.7 mm posterior, 1.4 mm lateral to Bregma, and 3.5 mm ventral to the surface of the skull (Paxinos & Watson, 2009). The remaining two groups were infused with artificial cerebral spinal fluid (ACSF; 25 mg/ml; 8 ml/ventricle) to serve as controls. One week after the surgeries, a single intraperitoneal injection of either LPS (1.0 mg/ml/kg of body weight) or saline (1.0 ml/kg of body weight) were then administered, resulting in the four groups: ACSF/Saline, STZ/Saline, ACSF/LPS, and STZ/LPS (See Table 1).

TEMPERATURE AND WEIGHT RECORD
To ensure LPS induced an immune response, temperatures and weights were recorded prior to and after LPS injections. Rectal temperatures were monitored for the first 72 hours and then one week later. Body weights were recorded throughout the course of the experiment.

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### Table 1

<table>
<thead>
<tr>
<th>GROUP</th>
<th>SURGERY</th>
<th>IMMUNE ACTIVATION</th>
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<tr>
<td>ACSF/Saline</td>
<td>ACSF</td>
<td>Saline</td>
<td>&quot;Controls&quot;</td>
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<tr>
<td>STZ/Saline</td>
<td>STZ</td>
<td>Saline</td>
<td>&quot;Strep&quot; or &quot;Diabetic&quot;</td>
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<td>ACSF/LPS</td>
<td>ACSF</td>
<td>LPS</td>
<td>&quot;LPS alone&quot;</td>
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<td>STZ/LPS</td>
<td>STZ</td>
<td>LPS</td>
<td>&quot;Strep/LPS&quot; or &quot;Diabetic + inflammation&quot;</td>
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The resulting four groups’ drug administration during surgery, immune activation, and commonly referred names.
MORRIS WATER MAZE
Spatial learning and memory was tested using the Morris Water Maze spatial learning task two weeks after LPS or saline injection. The water maze was conducted using a white, circular polyethylene tank (1.5 m in diameter, 76 cm in height, 4.77 mm thick) filled with tap water made opaque with white, non-toxic paint, and divided into four quadrants. Four different large, colorful shapes and posters on the walls were used as distal spatial cues allowing the animals to orient themselves and learn the spatial location of the platform. Path length (the distance it takes for the animal to reach the platform), swim speed, perimeter time (thigmotaxis), and time to find the platform (latency) were recorded. During the probe trial, the time each animal spent in each quadrant was also recorded.

In the hidden/acquisition trials, rats were allowed to swim for 60 seconds to find the hidden platform (a 10 cm x 10 cm square clear plastic located 1.5 cm below the water’s surface) located in one of the four quadrants. If an animal failed to locate the platform after 60 seconds they were guided to the platform. Once on the platform the animal was given 20 seconds to orient and familiarize itself to the spatial cues. The trial was repeated in identical fashion three more times, with a 30 second interval between trials. Four consecutive trials were performed each day for each animal. A tracking system was used to collect latency to escape, distance traveled, speed of swimming, and perimeter time on all trials. After five days of training, a probe trial was done where the hidden platform was taken out and animals were allowed to search the maze for 60 seconds. The tracking system recorded the amount of time subjects spent in all 4 quadrants as well as the number of times the animals’ path crossed over the former platform location versus analogous locations in other quadrants. Visible platform training was then conducted wherein the platform was raised above water level to ensure motoric and visual function was equivalent between groups.

TISSUE COLLECTION
Immediately following the completion of the behavioral testing, rats were individually euthanized via CO2 asphyxiation, decapitated, and hippocampi and cortex were immediately dissected out and frozen. Hippocampi and cortex were homogenized using RIPA buffer (Bolton et al., 2012). Lysates were centrifuged at 15,000 x g for 15 minutes at 4°C, the supernatant was then collected and protein concentration determined using the bicinchoninic acid assay (BCA, Pierce). Samples were frozen and stored at -80°C.

SDS PAGE/WESTERN BLOT
Equal amount of total protein (20 μg per sample) from the tissue were separated via SDS-PAGE according to molecular weight with current being held at a constant 0.04A for 60min. Proteins were electrotransferred to nitrocellulose membranes and blocked for 2 hours in a blocking solution of 5% nonfat dry milk, 0.1% NaN₃, dissolved in 1x phosphate buffer saline. Membranes were then incubated overnight in primary antibody rabbit anti-ABO, 1:1,000 Cell Signaling; rabbit anti-pTau Ser404, 1:1,500, Cell Signaling; mouse anti-Tau, 1:10,000, Cell Signaling; rabbit anti-STEP, 1:1,000, Cell Signaling; rabbit anti-NMDAR2A, 1:500, Cell Signaling; rabbit anti-NMDAR2B, 1:1,000, Cell Signaling; AMPA GluR-4, 1:1000 Cell Signaling) at 4°C. Following incubation, membranes were brought to room temperature, washed three times with phosphate buffer saline and tween (PBSt) for 5 minutes each, and then placed in secondary antibody (IR dye rabbit 800, 1:5000, Bio-Rad; IR dye mouse 680, 1:10000, Bio-Rad) for 1 hour. Membranes were then rinsed again in PBSt three times for 5 minutes each and a final 10 minutes PBS wash prior to imaging. Membranes were imaged using Odyssey CLx Infrared Imaging System (LI-SOR).

STATISTICAL ANALYSIS
Hidden platform training data were analyzed using repeated measures analysis of variance (ANOVA) between and within groups. One-way ANOVA were utilized in the analyses of the probe trial data. Mean band densities for western blotting were analyzed using one-way ANOVA. Tukey post-hocs were performed following a significant ANOVA.

RESULTS
LPS EFFECTS
The body weights of the animals injected with LPS were lower than the control animals the two days following LPS injections (Figure 1A) and the rectal temperatures (Figure 1B) were significantly increased the first two days following the days of injection as well, indicating that an immune response was indeed induced. No differences in body weight or temperature were observed prior to or 1 week after the LPS injection.

MORRIS WATER MAZE
The analysis of the MWM indicated that the STZ/ Saline group exhibited learning deficits consistent
with AD (significant difference versus ACSF/Saline), whereas the STZ/LPS group did not exhibit these same deficits. STZ/Saline animals had significantly longer path lengths during hidden training than all other groups (Figure 2A; $F_{(1,3)} = 8.715, * p > 0.05$; Figure 2A). Interestingly, the STZ/LPS group’s path length was not significantly different compared to the control group of ACSF/Saline.

During the probe trial, the ACSF/Saline, ACSF/LPS, and STZ/LPS groups spent significantly more time in the target quadrants versus the other three quadrants (* $p > 0.05$, Figure 2B), exhibiting selective search. The STZ/Saline group was the only group that did not spend a significant time in the target quadrant versus the other quadrants.

**SDS PAGE/WESTERN BLOT**

**Aβ Oligomers**

Western blot analysis of oligomeric Aβ in the hippocampus indicated that the STZ/Saline group exhibited a significantly increased amount of total oligomeric species versus ACSF/Saline controls (Figure 3A; $F_{(3,516)} = 21.079, * p < 0.05$). Although STZ/LPS also exhibited a significant increase of Aβ total oligomers when compared to the control group of ACSF/Saline (Figure 3A; $F_{(3,516)} = 21.079, * p < 0.05$), the amount of total oligomers of STZ/LPS was significantly lower than that of STZ/Saline (Figure 3A; $F_{(3,516)} = 21.079, * p < 0.05$).

Specific Aβ oligomers were also analyzed (Figure 3C-F). Several Aβ oligomers were elevated in both the STZ/Saline and STZ/LPS groups (Figure 3D, 3F; $F_{(3,56)} = 4.121, * p < 0.05$), while other Aβ oligomers were only significantly increased in the STZ/Saline group alone (Figure 3C, 3E; $F_{(3,56)} = 3.16, * p < 0.05$), whereas some Aβ oligomers showed no difference across all groups (not shown).

**pβ/τ phosphorylases**

Western blot analysis of phosphorylated tau at Serine 404 in hippocampus indicated significantly higher levels for both the STZ/Saline and STZ/LPS groups versus controls (Figure 4A; $F_{(3,36)} = 4.992, * p < 0.05$ post hoc tests that demonstrate this??).
Western blot analysis of Aβ oligomers in hippocampus indicated that there was a significant increase in total Aβ oligomers as well as several specific oligomers in the STZ/Saline group (*p < 0.05; Figure 3A-D). The STZ/LPS group did exhibit a significant increase in total oligomeric versus the control group but significantly lower than the STZ/Saline group (#p < 0.05; Figure 3A). Several Aβ oligomers were elevated in both the STZ/Saline and STZ/LPS groups (Figure 3D, 3F), whereas other Aβ oligomers were only significantly increased in the STZ/Saline group alone (Figure 3C; 3E). Representative images can be seen in Figure 3B.

Figure 3 Western blot analysis of Aβ oligomers in hippocampus indicated that there was a significant increase in total Aβ oligomers as well as several specific oligomers in the STZ/Saline group (*p < 0.05; Figure 3A-D). The STZ/LPS group did exhibit a significant increase in total oligomeric versus the control group but significantly lower than the STZ/Saline group (#p < 0.05; Figure 3A). Several Aβ oligomers were elevated in both the STZ/Saline and STZ/LPS groups (Figure 3D, 3F), whereas other Aβ oligomers were only significantly increased in the STZ/Saline group alone (Figure 3C; 3E). Representative images can be seen in Figure 3B.

Figure 4 Western blot analysis of pTau at Serine 404 in hippocampus indicated significantly higher levels for both the STZ/Saline group and STZ/LPS groups (*p < 0.05; Figure 4A). Representative images can be seen in Figure 4B. Western blot analysis of striatal-enriched protein tyrosine phosphatase (STEP) in hippocampus shows no significant differences between groups (Figure 4C).

Western blot analysis of striatal-enriched protein tyrosine phosphatase (STEP) in hippocampus was analyzed to determine if changes in a protein phosphatase, a protein that dephosphorylates tau proteins, may have contributed to the increase in the STZ/Saline and STZ/LPS pTau levels. The analysis indicated no significant differences between groups (Figure 4C; F(3,36) = 0.275, *p < 0.05).

Learning and Memory Mechanisms
Protein levels for several receptors known to be responsible for learning and memory were analyzed to determine if changes may be associated with learning and memory impairments. Western blot analysis of NMDAR2B (Figure 5A; F(3,41) = 1.176) and AMPA GluR4 (Figure 5C; F(3,36) = 0.649) showed no significant differences between groups, indicating that the treatments did not alter the abundance of these receptor subunits. However, protein subunit NMDAR2A showed a significant decrease in the STZ/Saline group compared to the control group ACSF/Saline (Figure 5E; F(3,41) = 2.959, *p < 0.05). No significant differences were observed between ACSF/Saline and STZ/LPS group (Figure 5E; F(3,36) = 2.959, *p < 0.05).

DISCUSSION
MORRIS WATER MAZE
AtDuring the hidden training, STZ/Saline’s significantly longer path length indicates that this treatment group was impaired in spatial learning and memory. This deficit is consistent with numerous other animal models of AD, indicating a learning and memory impairment. Interestingly, the lack of a deficit in the STZ/LPS group ACSF/Saline indicates that the LPS was capable of rescuing the STZ induced deficits. This learning difference between the treatment groups STZ/Saline and STZ/LPS suggests that the induction of an acute immune response by LPS may relieve some aspects of learning deficits contributed by AD.
Data from the probe trial support the rescue of the STZ deficits by LPS. Treatment groups ACSF/Saline, ACSF/LPS, and STZ/LPS all exhibited selective search, as seen by the significantly prolonged time spent in the target quadrants versus the other three quadrants (Figure 2B). This indicates that these treatment groups learned where the hidden platform was located. The STZ/Saline animals were the only group that did not exhibit this selective search, supporting the fact that this treatment group did not learn where the hidden platform location. The probe trial further emphasizes that unlike the STZ/Saline group, the STZ/LPS group did learn where the hidden platform was which may be due to the acute inflammatory response induced by the LPS injection.

SDS PAGE/WESTERN BLOT
Aβ Oligomers
The increase of Aβ oligomers exhibited by the STZ/Saline group is consistent with AD characteristics since Aβ oligomers principally make up the hallmark Aβ plaques seen in the brain. Despite a significant increase in the STZ/LPS group versus ACSF/Saline, the STZ/LPS group exhibited significantly lower levels of Aβ total oligomers when compared to the STZ/Saline group. This difference in total oligomers may contribute to the difference seen in the learning deficits of the behavioral data and may indicate a beneficial effect of the acute immune response.

The analysis of specific Aβ oligomers also demonstrated that some oligomers differed in levels based on groups. The finding of some oligomers increased in both the STZ/Sal and STZ/LPS groups is interesting, however, for some of the oligomers levels were only increased in the STZ/Sal group. These data indicate that the acute inflammatory response by LPS may have rescued a subset of oligomers. Literature has suggested that specific Aβ oligomers may be the leading factor as to why there is learning deficits seen in AD. Rather than amyloid plaques contributing to the learning deficits seen in AD, it is thought that certain Aβ oligomers may be the primary toxin in AD. The quantity of amyloid plaques alone does not correlate well with clinical studies of AD, suggesting that the soluble non-plaque material, such as these Aβ oligomers may be a contributor (McDonald et al., 2010). Further experimentation on these Aβ oligomers may prove beneficial in seeing if, in fact, a specific oligomer is associated with deficits and if it is one of the oligomers LPS prevented being elevated.

pTau/phosphatases
An increase of pTau levels in the STZ/Saline group is consistent with AD pathologies (Figure 4A), as phosphorylated tau makes up neurofibrillary tangles seen in the brain. Though, the significant increase of pTau also seen in the STZ/LPS group suggests that the induction of an acute inflammatory response by LPS injection did not affect the phosphorylation of tau proteins as it did in the Aβ oligomers. Furthermore, the lack of significance in STEP (Figure 4C) further indicates that an alteration in STEP is not responsible for the hyperphosphorylation of tau. Though it must be stated that STEP is one of many phosphatases that dephosphorylates tau.

Learning and Memory Receptors
Examinations of protein for receptors known to be vital in spatial learning and memory also provide additional support for a role of LPS rescuing the STZ induced deficits. The findings of significantly decreased levels of the NMDAR2A subunit in only the STZ/Saline group indicates a potential mechanism for the learning impairments that STZ/Saline group exhibited. Interestingly, in the STZ/LPS group a similar reduction was not seen which may be a reason for the lack of learning deficit following administration of STZ and LPS. This presents a possible mechanism by which the administration of LPS reduces oligomeric Aβ, but does not result in reduction of NMDAR2A, and therefore, displays no learning deficits. The lack of difference in STZ/LPS for NMDAR2A and the exhibition of no learning deficits further strengthens this interpretation. Investigation of the NMDAR2B and AMPA GluR4 receptor protein levels showed no significant differences between groups (Figure 5A,C), indicating that the treatments did not alter the abundance of all these receptor subunits.

CONCLUSION
In the above studies, it is observed that the induction of STZ impaired learning and memory, consistent to that of AD, as seen in the Morris water maze behavioral data. The addition of an acute inflammatory response by LPS injection rescued the STZ-induced learning deficit. Western blot analysis indicated STZ increased the total Aβ oligomers consistent with AD. The reduction in total Aβ oligomers in STZ/LPS group compared to STZ/Saline group, indicates LPS may have reduced the Aβ increase. Contrastingly, phosphorylated tau levels were increased in both STZ/LPS and STZ/Saline groups, suggesting that LPS did not affect phosphorylated
tau proteins such like it did in the Aβ oligomers. Various receptors were then analyzed to observe if changes seen in the Aβ oligomers and phosphorylated tau proteins were mechanistically connected to receptors associated with learning and memory. A significant difference was observed for NMDAR2A that may be related to the learning impairments and possible LPS rescue.

It can be seen by both the Morris water maze behavioral data that an acute inflammatory response induced by LPS injection does rescue learning deficits. The lower levels of Aβ oligomers of the STZ/LPS compared to the STZ/LPS group as seen in the tissue analysis may have contributed to the rescue of learning deficits exhibited by the STZ/LPS group, but it is yet unclear mechanistically how the two might be connected.

Future investigation of this project includes looking into greater detail of the acute inflammation response to determine which particular aspect of the immune response is beneficial, creating a possible therapeutic aspect to the project. Moreover, further experimentation on the possibility of a specific Aβ oligomer being the main factor of toxicity would be of great interest.

REFERENCES


CORRELATES OF COMPULSIVE BUYING

BY BRITTANEY BENSON-TOWNSEND

ABSTRACT
Compulsive buying is a chronic issue for shoppers exacerbated by a nation obsessed with consumption. To predict compulsive buying behavior, a survey was administered to 283 college students in southern Nevada. The results suggested that the compulsive buyer exhibits an external consumer locus of control and purchases goods with the intent to increase social status or quell anxiety. Given that responsible financial behavior changes as a function of age, college students are particularly vulnerable to compulsive purchasing behavior, as it is exacerbated by irresponsible credit spending behaviors.

Keywords: compulsive buying, credit card, money attitudes, locus of control

INTRODUCTION
Faber and O’Guinn (1989) characterized compulsive buying as “chronic, repetitive purchasing that becomes a primary response to negative events or feelings” that can result in an “irresistible urge to repeatedly purchase unnecessary and unaffordable items” (Sang-Hee & Yun-Jung, 2012). Compulsive buying occurs as a reaction to reduce anxiety in the absence of cognitive evaluation. Shoppers are stimulated via a sale or appealing item and make a purchase on a whim instead of using a cognitive process intended to evaluate the necessity and price-worthiness of the item. Shoppers become compulsive buyers when purchasing behavior must occur regardless of financial consequence. Nonetheless, the intended consequence of a compulsive buyer is to quell anxiety which may stem from excessive environmental stimulation (e.g. a clearance sale) or as a mechanism to fill loneliness with a plethora of goods (Sang-Hee & Yun-Jung, 2012).

Compulsive buying is not a disorder characterized by the DSM, but an obsessive shopper may exhibit similar behavior to an individual with clinical anxiety issues. For example, obsessive-compulsive disorder is “an anxiety disorder in which obsessions or compulsions are a significant source of distress, that interfere with the individual’s ability to
function” (Goldenson, 1984). Although Obsessive-Compulsive Disorder (OCD) and compulsive buying individuals both exhibit excessive behaviors to quell anxiety, the OCD person will feel little to no relief after engaging in compulsive behavior and must continue the ritual with as many as 50 repetitions; whereas the compulsive shopper will feel relief after making a purchase (Workman, 2010). Granted, there exists a large comorbidity rate of 67% between compulsive shopping behavior and OCD. Despite the odds, compulsive buyers are more likely suffering from impulse-control disorder (ICD) with a 96% overlap. ICD refers to the “irresistible impulses to perform harmful behaviors” (Ridgway, Kukar-Kinney, & Monroe 2008). Thus, the essential difference between OCD and compulsive buying behavior, diagnostically, is that the OCD individual suffers from a subconscious issue that cannot be solved by any logical means. On the other hand, the compulsive buyer resolves an unstable mental state (an urge to shop) with a spontaneous, logical purchase to buy their way into a better mental state. Ridgway et al. (2008) included both obsessive-compulsive and impulsive-control dimensions in their Compulsive-Buying Scale and found that both perspectives are necessary to conceptualize the compulsive buyer. Although the debate to include compulsive buying in the DSM is ongoing, some academics have described the behavior as an “addictive disease” (Workman, 2010) that currently affects nearly 18 million Americans.

In order for a compulsive buyer to commence obsessive purchasing behavior, they must have an ample supply of money or the individual is devastated by financial ruin (Ridgway et al., 2008). Shopping budgets vary by an individual's income, but a person is said to be a compulsive buyer when shopping is prioritized before needs and consequences are neglected (Workman, 2010). For example, a compulsive buyer may overdraft their checking account to buy makeup and deny the fact that they needed that money to pay the mortgage. Once all cash has been consumed for wants and needs, credit cards may be utilized to pay for bills or other shopping binges. Eventually the compulsive buyer is left with no resources and may resort to illegal activity to maintain their lifestyle. In consequence, compulsive buyers overextend their credit cards, carry large amounts of debt, and neglect household expenses in an effort to pay for unnecessary items.

Compulsive shoppers have demonstrated predictable behavior in terms of what they buy and how they shop. Specifically, the compulsive shopper buys from certain product categories designed to enhance self-esteem or prestige. Female compulsive buyers purchase clothing, jewelry, makeup, and collectibles; whereas males gravitate towards electronics and collectibles (Workman, 2010). Although compulsive buyers often purchase flashy products and brag about their goods, 74 percent of them prefer to shop alone; perhaps due to their subconscious feelings of embarrassment for binge spending (Workman, 2010). Although compulsive buyers have not been quantified as a whole in terms of average shopping spree costs, percentage of spending as a function of net income, or financial devastation, the financial management research community has provided predictors for spending behavior that vary by maturity (Dew & Xiao, 2011).

Dew and Xiao (2011) developed the Financial Management Behavior Scale to measure a comprehensive, gradual succession of financial management behaviors. According to Dew and Xiao (2011), individuals perform spending behavior sequentially beginning with cash, followed by credit card use, then executing more savings behavior, and ending with investment in avenues such as stocks, bonds, and real estate. Thus, financial behavior occurs as a hierarchy with children and teens only having cash for means of purchasing. As young adults, college students are encouraged to transition from cash-spenders to credit-spenders by credit card solicitors. Given the inexperience with a new currency, college students are likely to mismanage credit card spending.

College students are vulnerable to mistakes caused by inexperienced personal financial management; however, credit card agencies target the 18-24 age demographic with excessive solicitation (Roberts & Jones, 2001). Mansfield and Pinto (2003) found that college students received an average of 5.1 credit card applications (with a maximum of 14) within a 6 week period. With marketers fighting for primary brand loyalty, college students received an average of 4.2 more applications per year than did older adults. Furthermore, approved credit card applications by means of excessive solicitation, give students an ample access to credit with 70% - 80% having at least one credit card, over 50% having an average of three credit cards, and an average monthly balance owed
of $2,327 (Mansfield & Pinto, 2005).

Recognizing that college students have considerable access to credit, their personality characteristics foster unhealthy spending. For example, college students reported more sensation-seeking behavior and impulsivity in comparison to older adults (Steinberg, Albert, Cauffman, Banich, Graham, & Woolard, 2008). Sensation-seeking is a general inclination toward novel, exciting experiences. An impulsive decision occurs in the absence of control, in an effort to seek a reward. Together, sensation-seeking and impulsivity facilitate risky behavior. Although adolescents are the most likely age group to engage in risk taking, sensation-seeking peaks at adolescence (age 10-15) by means of a bell curve, whereas impulsivity constantly declines from age 10 (Steinberg et al., 2008). Because the decline of risk behavior is a gradual process, college students exhibit heightened levels of sensation-seeking behavior and impulsivity more so than older adults. Thus, although college students are bestowed with new freedom and responsibility of adulthood, their state of mind is more susceptible to risky behavior compared to an older adult. Given the impulsive nature of young adults, the availability of credit card funds exacerbates the issue of compulsive buying.

Credit cards are conceptualized as a moderator variable between money attitudes and compulsive buying (Roberts & Jones, 2001). Individuals who engage in spending behavior to reduce anxiety or enhance social status are particularly susceptible to compulsive buying. Having a credit card provides a means for the desire to shop by making money more accessible and delaying financial repercussions. Individuals who buy goods via credit are more likely to purchase, purchase quickly, and purchase more than individuals paying with cash. Credit cards are tools for compulsive buyers to become less price conscious so that reckless spending may occur. Compulsive buyers not only carry more credit cards but also accumulate larger balances than average consumers (Roberts & Jones, 2001). Hence, these individuals may be more susceptible to impulsive purchasing in order to alleviate their anxiety.

Yamauchi and Templer (1982) determined money is both a source and solution to anxiety by means of their Money Attitude Scale. The scale is designed to categorize people’s attitudes towards money into four factors: power-prestige, retention-time, distrust, and anxiety (Yamauchi & Templer, 1982). An individual scoring high on the Money Attitude Scale with regard to the anxiety factor will associate money with angst. Thus, if money is in short supply, anxiety will be aroused. Furthermore, if an anxiety-provoking stimulus is eminent such as a clearance sale or a general feeling of loneliness, compulsive shopping behavior may be engaged to satisfy feelings of angst and return to a more desirable mental state. Thus, shopping effectively reduces cognitive tension for neurotic individuals especially during high stress periods such as the first semester of college. Overall, individuals scoring high on the anxiety factor of the Money Attitude Scale, exhibited high credit card use and high compulsive buying behavior (Roberts & Jones, 2001).

Another factor on the Money Attitude Scale that facilitated high credit card use and compulsive purchasing was power-prestige. Individuals scoring high on the power-prestige dimension consider money as a societal status enhancement. These individuals perceive money as influential, a symbol of success, and a means to obtain power. By enforcing the personal association with a power-prestige perception of money, individuals are less inclined to save and more inclined to spend. Hence, luxurious goods signify prestige, which thereby may lead to power within the community. Unfortunately, as this may be a form of overcompensation, there may be little cognitive satisfaction for the individual. Within the context of the Money Attitude Scale, individuals scoring high on anxiety and power-prestige factors are more likely to engage in compulsive buying and excessive credit card use (Roberts & Jones, 2001).

The third factor is distrust which can be utilized as a defense against compulsive buying. Those who are hesitant to make financial decisions or engage in spending behavior would score high on distrust, or price-sensitivity. Such individuals may have less product satisfaction and are also less likely to engage in compulsive buying and less likely to use a credit card for everyday purchases (Yamauchi & Templer, 1982). Such shoppers may also believe that the price of an extra good may be too high in most circumstances and will refuse to buy an unplanned product due to being frugal. Thus higher price-sensitivity in accordance with anticipated failure of product expectations or having frugal tendencies decreases compulsive buying (Roberts & Jones, 2001).
The fourth factor, retention-time, refers to how money is retained over long periods of one’s life (e.g. a retirement fund), and pertains to older-aged samples (Yamauchi & Templer, 1982). This was not pertinent to college students, and thus was not used for data collection in this study.

Similar to Yamauchi and Templer’s Money Attitude Scale (1982), Tang’s Short Money Ethic Scale (1995) was designed to measure people’s mental perceptions of money. The Short Money Ethic Scale factors money attitudes by success, budget, and evil. If an individual scores high on the success factor, the person cognitively associates money with achievement, respect, freedom, and power (Tang, 1995). If an individual scores high on the budget factor, the person is likely to exhibit budgeting behavior as opposed to spending behavior. Finally, if a person scores high on the evil factor; the individual affectively associates money with the root of evil obligation; money is a device that influences people to make bad decisions. The overall score of Tang’s Short Money Ethic Scale (1995) represents an individual’s overall attitudes regarding money (with a high score indicating a positive perspective towards money and a determination to get more money). Beyond an individual’s cognitive, behavioral, and affective associations with money; the placement of blame and triumph also influences spending behavior.

Another cognitive factor that influences compulsive buying is locus of control. Locus of control occurs via two orientations: internal and external. The “perception of personal control and responsibility for personal success and failures is described as one’s locus of control orientation” (Busseri, Lefcourt, & Kerton, 1998). Thus, if an individual is oriented towards an internal locus of control, they will attribute their personal success or failure to their own skill or shortcoming. However, if an individual is oriented towards an external locus of control, they will attribute their personal success or failure to environmental circumstances. For example, a student with an internal locus of control will claim they failed a test because they did not study. A student who performed equally as poorly, but has an external locus of control, will claim the test was too hard.

Based on Busseri, Lefcourt, and Kerton’s (1998) Consumer Locus of Control Scale (which measures locus of control orientation in the context of spending behaviors), an external consumer locus of control individual is more likely to make a bad purchase than an internally oriented individual. Having a consumer external locus of control is correlated with personal financial mismanagement, including compulsive buying behavior and poor use of credit. A consumer external locus of control allows an individual to shop while attributing fault to the environment as opposed to the self. Thus, externally oriented individuals feel less obligated to make informed decisions because they allow themselves to become a product of their environment more so than an internally oriented individual. Consumer external locus of control oriented individuals are more likely to act on impulse and shop more frequently with less strategy and effort.

Perhaps one of the best defenses against compulsive buying is strategic shopping. Internally oriented consumer locus of control individuals are more likely to consider shopping as a skill that occurs with a plan and purpose. They are more confident in purchases as they often engage in low risk shopping as opposed to high risk shopping. Furthermore, internally oriented individuals save money rather than spending money frivolously because shopping is a decision that reflects upon one’s self, not to one’s environment. Therefore, individuals who engaged in purposeful shopping were more likely to go home with a better product because an effort was made to purchase it. Because internal consumer locus of control oriented individuals attribute outcomes to personal decisions, they are more likely to engage in skillful shopping bound by price sensitivity.

Although compulsive buying has been researched in terms of locus of control (Busseri, Lefcourt, & Kerton, 1998), cognitive money attitudes (Tang, 1995; Furnham, Wilson, & Telford, 2012; Roberts & Jones, 2001), observable behaviors and moderator variables (Roberts & Jones, 2001), no studies have considered compulsive buying in the context of a sequential movement through financial behaviors as described by Hilgert, Hogarth, and Beverly (2003) in which consumers gain experience in money management first with cash-flow; then with credit cards, followed by savings, and ending with investment. Nevertheless, the purpose of this study is to predict compulsive buying behavior from of these aforementioned factors.
H1: AN INDIVIDUAL WITH AN INTERNAL CONSUMER LOCUS OF CONTROL ORIENTATION WILL SCORE HIGH ON THE FINANCIAL MANAGEMENT BEHAVIOR SCALE.
A person with an internal consumer locus of control will attribute success or failure to personal decisions. Thus, an internal locus of control orientation will prepare a person for disaster or retirement with savings behavior. A high score on the Financial Management Behavior Scale indicates a higher frequency of savings and investment behaviors, and a lower frequency of consumer debt.

A person with an external consumer locus of control will attribute success or failure to the environment. Thus, external consumer locus of control orientation will not predispose a person to save money for unfortunate events or old age. Rather, a person with an external locus of control will expect financial shortcomings to be handled by social security benefits or other means of financial rescue (e.g. welfare). A low score on the Financial Management and Behavior Scale indicates a low frequency of savings and a high frequency of consumer debt. For the purpose of this study, the frequency of credit card use can be measured with Roberts and Jones’ (2001) Credit Card Use Scale to estimate consumer debt.

H2: AN INDIVIDUAL WITH AN INTERNAL CONSUMER LOCUS OF CONTROL ORIENTATION WILL SCORE LOW ON THE CREDIT CARD USE SCALE.
If a person scores low on Roberts and Jones’ Credit Card Use Scale (2001), then they are considered responsible credit card holders and will be less likely to exhibit compulsive buying behavior. Internal consumer locus of control individuals will be less willing to spend all available funds because they attribute spending behavior to personal success or failure.

If a person scores high on Roberts and Jones’ Credit Card Use Scale (2001), then they are considered irresponsible credit card holders and will be more likely to exhibit compulsive buying behavior given the willingness to spend all available funds. External consumer locus of control individuals attribute fault to the environment as opposed to the self and will be more inclined to spend recklessly because of the lack of attributed personal cause; especially if they associate money with certain constructs as provided in Yamauchi and Templer’s (1982) Money Attitude Scale.

H3: AN INDIVIDUAL WITH AN INTERNAL CONSUMER LOCUS OF CONTROL ORIENTATION WILL SCORE HIGH ON THE DISTRUST FACTOR OF THE MONEY ATTITUDE SCALE.
Because internal consumer locus of control oriented individuals attribute outcomes to personal choices, they will engage in strategic shopping in order to minimize the chances of buying a bad product. Also, internally oriented individuals will likely attribute overall financial health to distinctive decisions. Thus, they are less likely to binge shop because consequences are carefully evaluated.

H4: AN INDIVIDUAL WITH AN EXTERNAL LOCUS OF CONTROL ORIENTATION WILL SCORE HIGH ON THE ANXIETY AND/OR POWER-PRESTIGE FACTORS OF THE MONEY ATTITUDE SCALE.
Because external locus of control oriented individuals attribute outcomes to the environment, they are more likely to engage in compulsive buying with the intention to reduce anxiety or increase social status.

METHOD
Participants
A sample of 283 undergraduate psychology students: 114 Caucasian, 26 African-American, 49 Hispanic, 52 Asian, 32 Other, and 10 who did not volunteer ethnicity (mean age = 20.83, SD = 5.85; range 16-55) from the University of Nevada, Las Vegas volunteered to complete a series of money oriented questionnaires as partial fulfillment toward their research participation requirement for their psychology course. The sample consisted of 81 males, 188 females, and 14 participants who did not volunteer their gender.

Materials
Although 13 scales were completed by the participants, for the purpose of the present study, only 7 scales were used. The Compulsive-Buying Scale (Ridgway et al., 2008) is a 6-item measure of both a compulsive buying and an impulsive buying factor with an overall Cronbach’s $\alpha$ of .84. Compulsive buying is represented by 5 items with a Cronbach’s $\alpha$ of .99, and impulsive buying consists of 3 items with a Cronbach’s $\alpha$ of .78.
The Consumer Locus of Control Scale (Busseri, Lefcourt, & Kerton, 1998) is a 14-item measure on a 5-point scale anchored with 1 = strongly disagree and 5 = strongly disagree. The scale is composed of a total score which is externally oriented. Six items pertain to the internal locus of control factor having a Cronbach’s α of .76, and the remaining 8 items pertain to external locus of control having a Cronbach’s α of .77.

The Short Money Ethic Scale (Tang, 1995) is a 12-item measure on a 7-point scale anchored at 1 = strongly disagree and 7 = strongly agree. The scale is divided among three factors with scores having an overall Cronbach’s α of .70. Success has 8 items with a Cronbach’s α of .76, budget has 2 items and a Cronbach’s α of .83, and evil has 2 items with a Cronbach’s α of .66.

Faber and O’Guinn’s (1992) Compulsive Buying Scale adapted by Roberts and Jones (2001) is a 7-item measure on a 5-point scale to identify compulsive buyers. Those who scored below -1.34 were considered compulsive buyers. The scores are highly reliable with a Cronbach’s α of .95. Because only 32 individuals were classified as a compulsive buyer, we used the scale as a continuum. Moreover, the scores were multiplied by -1 indicating that higher scores would be associated with higher compulsive buying.

Yamauchi and Templer’s (1982) Money Attitude Scale (adapted by Roberts and Jones (2001)) is a 20-item measure on a 7-point scale anchored with 1 = never and 7 = always. Although the original scale is composed of four factors, only the power-prestige, anxiety, and distrust dimensions were pertinent to this study. The Cronbach’s α of the original scores was .77 with factor scores of power-prestige, anxiety, and distrust having Cronbach’s α’s of .80, .69, and .73 respectively.

The Credit Card Use Scale (Roberts & Jones, 2001) is a 12-item measure on a 5-point scale anchored with 1 = strongly disagree and 5 = strongly agree. The scale places participants on a continuum ranging from irresponsible credit card holder (high score) to responsible credit card holder (low score). The scores from the overall measure had an α of .81.

The Financial Management and Behavior Scale (Dew & Xiao, 2011) is a 15-item measure on a 5-point scale anchored with 1 = never to 5 = always, with some questions providing an option indicating “not applicable”. The scale is composed of four factors: savings and investment behaviors, insurance behavior, cash management, and credit management. The savings factor had 5 items and a Cronbach’s α of .78. The insurance factor had 3 items and a Cronbach’s α of .73. The cash factor had 4 items and a Cronbach’s α of .63. Finally, the credit factor had 3 items and a Cronbach’s α of .57. Overall, scores on the total measure had a Cronbach’s α of .81.

PROCEDURE

All questionnaires were randomized to prevent user fatigue and general carry-over effects. The survey was administered online via Qualtrics and could be completed from any location via a computer so as to maximize student privacy and free response.

RESULTS

To predict compulsive buying behavior, a multiple regression analysis and correlations were performed to examine spending behavior. Although there was a slight amount of collinearity between power-prestige (Yamauchi & Templer, 1982) and success (Tang, 1995), and between the obsessive-compulsive and impulsive buying factors of the Richmond Compulsive Buying Scale (Ridgway et al., 1998), we opted to keep all variables in the equation. The independent variables for the multiple regression model consisted of the two factors: compulsive buying and impulsive buying from the Compulsive-Buying Scale (Ridgway et al., 2008), the external weight of locus of control (Busseri, Lefcourt, & Kerton, 1998), the three factors: success, budget, and evil from the Short Money Ethic Scale (Tang, 1995), the three factors: power-prestige, anxiety, and distrust from the Money Attitude Scale (Yamauchi and Templer, 1982), the extent of credit misuse measured by the Credit Card Use Scale (Roberts & Jones, 2001), and the four factors: savings and investment behavior, insurance behavior, cash management, and credit management from the Financial Management and Behavior Scale (Dew & Xiao, 2011). The overall model was statistically significant, $R = .688$, $R^2 = .475$, $F (14,195) = 12.485$, $p < .001$. Compulsive buying $t (195) = 4.012$, $p < .001$, budget $t (195) = -2.358$, $p < .05$. 
credit card misuse $t(195) = 3.115, p < .005$, and credit management $t(195) = -3.984, p < .001$ each contributed a statistically significant amount of the variance to the overall equation.

To address the hypotheses presented in the introduction, correlations were computed to confirm or disprove the experimental predictions. Hypothesis 1 was supported by statistically significant correlations $r = -.346, p < .001$ between external locus of control orientation (Busseri, Lefcourt, & Kerton, 1998) and the cash management behavior factor of the Financial Management and Behavior Scale (Dew & Xiao, 2011). Therefore, the greater the external locus of control, the lower the cash management behavior. Although the correlation between the savings and investment behavior factor of the Financial Management and Behavior Scale (Dew & Xiao, 2011) and external locus of control orientation (Busseri, Lefcourt, & Kerton, 1998) $r = -.156, p < .013$ was statistically significant, the purported variance accounted for was slightly over 2%. Hypothesis 2 was supported, $r = .280, p < .001$, demonstrating that external consumer locus of control orientation (Busseri, Lefcourt, & Kerton, 1998) is significantly correlated with higher credit card use (Roberts & Jones, 2001). Hypothesis 3 was not supported due to nonsignificant correlational results between internal locus of control orientation (Busseri, Lefcourt, & Kerton, 1998) and the distrust factor of the Money Attitude Scale (Yamauchi & Templar, 1982), $r = .104, p > .05$. There was an unexpected trend in the opposite direction. Finally, Hypothesis 4 was supported given a statistically significant correlation between the power-prestige and distrust factors of the Money Attitude Scale (Yamauchi & Templar, 1982) and the Consumer Locus of Control Scale (Busseri, Lefcourt, & Kerton, 1998) $r = .339, p < .001$ and $r = .190, p < .004$ respectively, indicating that higher external consumer locus of control individuals scored higher on power-prestige and anxiety dimensions.

**DISCUSSION**

Based on analysis of the results, compulsive buyers may hold cognitive predispositions to engage in binge shopping behavior, and are likely to act upon those predispositions if extra funds are available via credit. According to the multiple regression analyses, habitual spending behaviors, especially budgeting and credit card use, strongly influence the shopper. Frequent budgeting practice discourages compulsive buying behavior. Alternatively, inexperienced credit card holders are likely to mismanage their credit when shopping and engage in binge purchasing behavior. Additionally, obsessive compulsive buying, as opposed to impulsive buying elicits compulsive buying behavior to a more significant degree. Thus, the conceptualization of compulsive buyers as candidates of ICD was not supported by this study.

In terms of consumer locus of control, the correlations demonstrate a statistically significant relationship between perception of control and financial management. An externally oriented consumer locus of control individual is less likely to use good judgment when purchasing with cash or credit, thus acting as a predisposition to compulsive buying behavior. However, an internally oriented individual is more likely to execute responsible spending behavior when a credit card is in hand. Furthermore, an individual labeled as externally oriented will foster cognitive predispositions to compulsive buying by associating wealth with social status or by engaging in shopping behavior as a means to relieve anxiety.

Although the hypothesis concerning price-sensitivity and consumer locus of control orientation was not statistically significant, the nature of the distrust factor items reflect a large degree of consumer suspicion and may not resonate with the current American trend of consumption. Given that Americans typically visit the mall on three occasions per month and spend an average of $72 per trip (Fetto, 2002), questions such as “I hesitate to spend money, even on necessities” (Yamauchi & Templar, 1982) may be out-of-touch with typical American spending behaviors. When presented with a palpable good, a shopper will likely consider the convenience of buying the item over price-sensitivity. With so many variations, styles, and sizes of products, the right good can be hard to find. Also, given increasing gas prices, consumers may not be willing to travel from store to store to price-match the plethora of goods they must buy to sustain their daily lives. Perhaps to improve the American relativity with the distrust factor, a modern consideration of consumption may need to be implemented in the Money Attitude Scale with
regard to the distrust factor (Yamauchi & Templer, 1982).

Future research projects in the area of compulsive buying should focus on quantifying its severity. The general public has no estimation for acceptable spending budgets; that is, there is no dollar amount or income percentage that would constitute a binge shopping spree. Furthermore, the research community should investigate the cognitive and affective factors that turn compulsive shoppers into compulsive shoplifters when all available resources have been spent.

REFERENCES


THE EFFECT OF EXPERIENCE ON INFANTS’ VISUAL PREFERENCES

BY JENNIFER BOLICK

ABSTRACT
Research has shown that 3 to 4-month-olds with female primary caregivers show visual preferences for female relative to male faces (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002). Facial experience is likely an important influence on these preferences. From birth, infants’ experiences guide face processing skills. This processing ability influences the development of efficient face recognition later in life. The following study investigated (1) How visual preferences are influenced by real world experience with males and females, and (2) How experience affects older infants’ visual preferences (i.e., 10-month-olds). To answer these queries, we tested 10-month-old Swedish infants because Sweden’s public policy encourages male caregiving, therefore providing an ideal location to examine infants with a wide range of experience with male and female faces. We asked parents to assess detailed interactions between their infant and other individuals for a period of seven days and examined visual interest toward female and males faces in the lab setting. Results indicated that the more time infants spent with non-caregiver females, the less time infants spent looking at the female faces. This pattern of preferences indicates that as infants master processing details of the female face, their attention shifts to the male face, and so begins the process of mastery in that regard.

The Effect of Experience on Infants’ Visual Preferences
Research shows that 3-4-month-olds with female primary caregivers visually prefer female relative to male faces (Quinn et al., 2002; Quinn et al., 2008). Visual preferences may guide infant categorization of faces by sex (Rennels & Davis, 2008). This early pattern of categorization aids in deciphering people and may have long lasting implications regarding face processing. These categorization skills may be a precursor to stereotyping later in life, so understanding how these skills develop and influence an infant’s understanding of their social world is an important area of research. Keeping this in mind, the following inquiries are posed: (1) How are infants’ visual preferences influenced by real world experience with males and females?, and (2) How does experience affect older infants’ visual preferences (i.e., 10-month-olds) compared to
3-4-month-olds tested in previous research (Quinn et al., 2002)?

In their first year, most infants are inundated with female faces, as most primary caregivers are female (Rennels & Davis, 2008). As a result, infants acquire more experience with and show a preference for the female face (Quinn et al., 2002). As early as 3 to 4-months-old, infants can discriminate between familiar and novel female faces. This proficiency implies that familiarity leads to expert processing and that preference coincides with the sex of the primary caregiver (Quinn et al., 2002). The current study is most directly based on these notions. Quinn et al. (2002) sought to examine infants’ face processing as a function of sex of face in a set of six experiments, each building from the results of the last. Experiment 1 found that after habituation with male faces, infants preferred the female face, though after habituation with the female face, infants did not exhibit a preference for the male face. To test the notion that infants may have a spontaneous preference for female faces, Experiment 2 took place. This testing entailed a visual preference task with a male and female face paired together resulting in a spontaneous preference for female faces. Experiment 3 involved replicating Experiment 2, but with all external hair cues removed from the faces. The findings indicated that a female preference remained prevalent and could not be attributed to abstract, external features. Experiment 4 involved replicating Experiment 3, but with the internal features inverted. Results indicated that infants did not show a visual preference for the female faces, which suggests infants’ preferences for female faces are not due to a higher contrast of internal features (e.g., cosmetics). In Experiment 5, the process of Experiment 3 took place, but with infants who had male primary caregivers. Though a small sample, these infants displayed a clear preference for the male face. Finally, Experiment 6 familiarized infants to 8 male or 8 female faces, and then tested for recognition by pairing the familiar face with a novel face. Results indicated that infants familiarized with female faces displayed a preference for the novel female face (i.e., they recognized the familiar female faces and therefore looked longer at something more novel). Conversely, infants familiarized with male faces displayed no preference for the novel or familiar male face (i.e., they did not seem to recognize the familiar male faces). This finding reinforces that infants exhibit more skill at processing the intricacies that define particular female faces compared to male faces. Quinn et al. (2002) found differences in visual preferences based on the sex of the primary caregiver.

The visual preferences Quinn et al. (2002) found are important to investigate further because infants need to become as efficient as possible when deciphering the world and people around them. These preferences can lead to expertise in processing the most socially relevant faces. Studying visual preferences may help to define what influence the sex of the primary caregiver versus real world male and female experience has on infants. The changes that occur between 3-4 months and 10-months may offer insight into these changes. Subsequently visual preferences may be a precursor to the development of bias and stereotypes as adults.

**LITERATURE REVIEW**

Much of the literature about infants’ perception is subject to interpretation. We, as researchers, make the best assessments and conclusions possible with the information we study. Most infants have female primary caregivers, and therefore most infants have substantial experiences with females relative to males (i.e., both strangers and familiar individuals) (Rennels & Davis, 2008). This predominantly female facial experience lends credence to the notion that most infants prefer looking at the female face (Quinn et al., 2002). Moreover, infants with female primary caregivers get more face time with their mothers and thus begin the journey of acquiring skills for mastering female facial processing. It appears 3-4-month-old infants prefer girl to boy representations of faces in lab testing, and that adult female faces are the mediating reason. As infants have more experience with female faces, this raises the possibility that these preferences would extend across age (Quinn, Conforto, Lee, O’Toole, Pascalis, & Slater, 2010). As infants progress, every moment is an opportunity to absorb information, though it is restricted to what moves in and out of their field of view.

As infants develop, they form a representation or prototype of the female face, but not the male face (Ramsey-Rennels & Langlois, 2006). We cannot master that with which we have limited information. A representation becomes crucial because the prototype can aid in the processing of new faces and may help foster interest toward faces, as infants prefer faces that emulate their newly formed representation. When infants view male and female faces
paired together, infants look longer at female faces. However, when viewing either male or female faces alone, infants spend more time looking at the male face (Ramsey, Langlois, & Marti, 2005). A possible explanation is that infants need more time with this task because of less overall experience with male faces. From this, we may conclude that (1) infants have a preference for female over male faces, (2) infants struggle when attempting to process male faces, and (3) infants differential processing of male versus female faces directly corresponds to their formed categories (Ramsey-Rennels & Langlois, 2006).

Findings show that at 3-months, female preferences seem to be limited to familiar race faces, yet such a preference is not present in newborns (Quinn et al., 2008). If 3- to 4-month-olds’ preferences for females are limited to familiar race faces, it suggests that not only is female/male facial experience important for guiding preferences, but so is experience with various racial groups. Moreover, although 3- to 4-month-olds’ preference for the female face is prevalent, newborns show no spontaneous preference for their own or other ethnic groups, although they may be able to discriminate between faces from different ethnic groups (Kelly, Quinn, Slater, Lee, Gibson, Smith, Ge, & Pascalis, 2005). From this, we may conclude that experience is necessary for the visual preference to develop because babies are not born with the preference. When testing 3- to 4-month-olds for a same-race preference, they displayed a preference for their own race over other ethnic groups. The revelation is that within that three-month period, the information they are absorbing is beginning to guide their preferences for same-race faces and the role that experience plays is important in developing these preferences. What this implies is that perceptions of ethnic differences are learned and are a direct consequence of exposure to own versus other-race faces during development. From this, we can infer that poor other-race face recognition is caused by early exposure to one’s own race, which aids in honing the facial representation, and leads to a preference toward familiar own-race faces (Kelly et al., 2005). Thus, not only is experience important for guiding preferences for females, it is important for guiding preferences for particular racial groups.

As infants develop, not only does experience affect visual preferences, it also seems to influence face-recognition abilities. For example, when being familiarized to one of four racial groups (African, Asian, Caucasian, and Middle Eastern), then tested with that face paired with a novel face, 3-month-old infants showed a significant novelty preference in all four groups, 6-month-old infants displayed a novelty preference for two of the four, and 9-month-olds demonstrated a significant novelty preference in the Caucasian condition only. These findings imply that 3-month-old infants have the ability to discriminate faces from all types of racial groups, but by 9-months they can discriminate only faces from their own racial group. Facial experience with familiar race faces and the emergence of facial preferences may result in mastery and recognition of familiar race faces. These findings affirm (1) exposure to faces from one’s own race creates a familiarity and visual preference for such, (2) this preference is maintained even with the presence of other-race faces, and (3) when inundated with one’s own racial group, the capability of recognition increases (Kelly, Quinn, Slater, Lee, Ge, & Pascalis, 2007).

Evidence that experience is important for guiding infant face processing, such as visual preferences, comes from a study that tested 3-month-olds in three conditions: Caucasian infants living in a Caucasian environment, African infants living in an African environment, and African infants living in a predominantly Caucasian environment. Visual preference (VP) testing illustrated that the Caucasian infants preferred the Caucasian stimuli, African infants preferred the African stimuli, and the last group showed no preference. Acknowledging that looking behaviors are experience dependent, 3-month-old infants are showing the capability to not only decipher between own and other races, but are showing a preference for the most commonly experienced racial group. Overall, these preferences are evident in infants living in homogeneous own-race societies, but not in infants who had cross race exposure (Bar-Haim, Ziv, Lamy, & Hodes, 2006). These findings provide valuable insight because many infants being raised in the United States are bi-racial, as evidenced by the need to change the U.S. census survey to allow for classification of two races (United States Census Bureau, 2010).

At this time, I have established that newborns display no visual preferences, but quickly and methodically develop female and same-race preferences, but not male and other-race preferences due to experience (Kelly et al., 2005). Upon acquiring expertise in processing familiar face types, a decline in face processing ability occurs for unfamiliar face types (Kelly et
al., 2007), though this decline can be prevented with training. Individualization is a necessary process in maintaining recognition of familiar faces (Scott & Monesson, 2009).

Summary of Literature Review
Because infants generally interact with females, they typically show a preference for female faces (Quinn et al., 2002). This exposure leads to expert processing of female faces relative to male faces (Ramsey-Rennels & Langlois, 2006). Some research suggests visual preferences may guide infant categorization of faces by gender (Quinn et al., 2002). This early pattern of grouping aids in categorizing people and may have long lasting implications regarding face processing. Newborns display no preferences, but by 3 months, infants develop a female preference, and between 6 and 9 months, infants’ ability declines (Kelly et al., 2005). This decline can be avoided with familiarization to less familiar face types (Scott & Monesson, 2009).

METHOD
Participants
Participants included infants aged 10-months-old in Uppsala, Sweden (N = 60); recruited via email from a database of eligible infants at Uppsala Universitet.

Stimuli
Stimuli included digitized, color, static images of 16 pairs of female-male faces. Faces within each pair were similar in attractiveness, age, hair color, and emotional expression allowing the main difference between the faces to be sex. Sheets hid clothing cues, and photos were taken from the shoulder up. Research assistants standardized photos for brightness, contrast, and size, and modified and/or extracted any distracting make-up, haircuts, jewelry, glasses, or facial hair.

Apparatus
E-Prime Professional 2.0 with Tobii Extentions presented stimuli. Tobii T120 near infrared eye tracker measured gaze; precision 0.15°, accuracy 0.4°, and sampling rate 60 Hz. Infants were seated on their parents’ lap approximately 60 cm from the monitor (0.022 x 0.023 visual degrees per pixel). The monitor measured 35.7 x 27 (1280 x 1024 resolution). A standard 5-point infant calibration procedure was used. A research assistant sat behind a curtain and observed the infants’ looking behavior via a monitor.

Measures
To accurately gauge interaction with others, parents used the Infant-Individual Interaction Scale (IIIS) (see figure I), and the Infant-Caregiver and Family
Member Interaction Scale (ICFMIS) (see figure II) (Rennels & Davis, 2008). Rennels & Davis (2008) found that parent use of the ICFMIS and IIIS appears reliable and results provided convergent validity. Visual preference tasks consisted of four pairs of female and male faces selected randomly for each participant from the 16 pairs and were counterbalanced across infants.

Procedure
Upon agreement to participate in the study, an experimenter mailed the ICFMIS and IIIS forms to families. Parents received enough ICFMIS forms for a period of eight days and 50 IIIS forms. Once received, an experimenter instructed parents via phone or Skype on how to properly use the ICFMIS and IIIS scales and record the infants’ interaction over the course of one week. The experimenter explained that for the ICFMIS, each familiar individual’s interaction with the infant should be recorded on separate forms. For less familiar individuals or strangers, the researcher noted to use the IIIS. Next, the researcher gave sample scenarios to explain how to use the forms during different types of interactions. Also, the experimenter provided tips to estimate distances, length of interactions, and the infant’s level of attention toward an individual. The experimenter asked about the typicality of the upcoming week, and if deemed out of the realm of normal, urged parents to delay using surveys until a normal week would occur. Two days after training, an experimenter contacted parents by phone to address concerns or questions. After a week of using the surveys, families came to the lab for testing and the researcher conducted a post survey interview to address accuracy and ease of using the scales. The experimenter explained the study and obtained demographic information and parental consent. Prior to testing, the experimenter calibrated infants’ eye movements and once calibrated, presented the visual preference task. The visual task consisted of four 10-sec trials, during which a female-male pair was presented.

RESULTS
Using data from the ICFMIS and IIIS, we calculated infants’ percentage of real-world experience with female faces. We determined if real-world experience
was predictive of the visual preferences infants display in the lab by conducting a repeated measures analysis of variance (ANOVA) with the percentage of total looking time toward the female face (FPTLT) as the dependent variable and infants’ percent of experience with non-caregiver females (as reported by parents) as the independent variable in one analysis and infants’ percentage of experience with females (PFEXP) as the independent variable in another analysis. FPTLT was determined by calculating looking time toward the internal features of the female face during the visual preference trials divided by total looking time toward the internal features of both the female and male faces. Four infants had missing data from one of the visual preference trials, so they provided visual preference data for only three of the four trials.

Results indicated that PFEXP was a marginally significant predictor of FPTLT, $F(1, 18) = 3.02, p < .10$, when used as the independent variable. When non-caregiver female experience was used as the independent variable, it was significantly predictive of FPTLT, $F(1, 40) = 4.02, p = .05$. When examining the correlation between FPTLT and non-caregiver female experience, results indicated it was negative ($r = -0.292, p = .058$).

These findings incorporate what parents reported, as at the time of data entry, we did not have complete data. Even so, it appears that the more time infants are spending with non-caregiver females, the less time infants spend looking at the female face. See Figure III.

**Figure III**

**DISCUSSION**

These findings may indicate that once 10-month-olds master the ability to discriminate female faces from male faces, their attention and curiosity shifts to male faces. Although this finding seems contradictory to Quinn et al.’s (2002) study, other research shows that during the first year infants transitioned from visually preferring familiar to unfamiliar race faces (Troller-Renfree, Righi, Westerlund, & Nelson, 2015). This research illustrates similar findings, where with mastery of female faces, infants begin to attend more to male faces.

**CONCLUSIONS/FURTHER STUDY**

Our investigation sought to determine (1) How are visual preferences influenced by real world experience with males and females? and (2) How does experience affect older infants’ visual preferences? Results revealed that the more interactions that parents reported their infants had with non-caregiver females, the less time infants spent looking at the female face during the visual preference task. This result may indicate that once infants become well versed in their experience with female faces, they seek out the novel experience (i.e. male faces). This shift in visual attention appears to be a logical progression in learning, to master one thing and then seek out the next experience until mastered, and so on. The 3- to 4-month-olds in Quinn et al.’s (2002) study may have shown visual preferences for female faces compared to male faces because those appeared to be the most socially relevant faces in their environment (i.e. the same sex as their primary caregivers). More experience with female faces may aid in developing a strong female face representation and as infants get older (i.e. like the 10-month-olds in this study) this representation may become mastered as a result of female facial experience.

Subsequently, by 10-months-old, infants may no longer display visual preferences for female faces, if they have had enough experience to master their representation of the female face, and have acquired a strong representation for female faces. With such a representation established, the opportunity to transition their focus toward male faces is possible.

Limitations of this study may include the possibility of skewed or embellished feedback on IIIS and ICMFS surveys, as it is impossible to have experimenters collect this information. Future researchers may consider using participants with more experience and interaction with males to further investigate if and how those real-world experiences affect visual preferences. Also, it may be interesting to
study how infants would respond to actual people as the stimuli, as opposed to only static and dynamic stimuli.

REFERENCES


RELATIONSHIP OF GLOBAL DNA METHYLATION WITH CARDIOVASCULAR FITNESS AND BODY COMPOSITION

BY MIHAELA CIULEI

ABSTRACT
Global DNA Methylation (GDM), an epigenomic modification has been linked to the development of Cardiovascular Disease and its risk factors. The research focus is to identify the relationship between cardiovascular fitness measurements and epigenetic alterations specific to chronic disease states in adult subjects. Thirty-six adult human subjects were required to complete a physical activity and diet questionnaire. Each individual donated a small blood sample (600 μL) in order for us to analyze the Global DNA Methylation (GMD). Then, their body composition was evaluated by using the Dual-Energy X-ray Absorptiometry (DEXA Scan) machinery. The level of physical activity was assessed by the completion of a maximal exertion, graded exercise test (VO2max) on a treadmill. The Pearson’s “r” value was used to reveal the correlation between GDM and various variables, while t-tests were used to assess if any differences exists between high and low value groups for each variable. The Body Mass Index was significantly correlated (p-value, r value; 0.031, -0.556) with GDM while there was a significant difference between high and low levels of folate groups (p=0.034) as determined by the diet questionnaire. No significant correlations or differences were found in males. The results conclude that as BMI increases, GDM decreases in females. In attempts to further investigate the relationships between GDM and these variables, auxiliary research needs to be conducted with larger subject pools containing additional sedentary participants.

INTRODUCTION AND PURPOSE OF THE STUDY
This project’s purpose is to identify if there is a relationship between cardiovascular fitness level and the level of global DNA methylation. The indicator for the cardiovascular fitness level used is the maximal oxygen consumption. The project also examines the relationship between percent body fat via DEXA scanning and Global DNA methylation.

The field that studies the 3 billion base pair long chain of genetic information is known as genomics. The human genome has been elucidated
in 2003 and since then this field has expanded tremendously. Through research it has been understood that other external factors that humans choose to do affect the great variety in the human genome. This field of study is known as epigenomics (Ordovas & Smith, 2010).

Epigenomics is the field of study of heritable alterations in gene expression potential that are not caused by changes in the actual DNA sequence (Waterland, R. A., 2009). These alterations to the genome result in differences to the future outcome or expression of the genetic information. Today there are three main mechanisms that contribute to epigenomic alterations: 1) DNA methylation, considered the primary measure, 2) histone modification, and 3) autoregulatory proteins that add in modification (Waterland, R. A., 2009).

A great deal of research has been conducted on the effects of DNA methylation on health issues and its effects since the early 2000’s, however, most of this research has been focused on the links to cancer (Choi et al., 2009), (Das and Singal, 2004). The more up to date research such as Kim et al. (2010) is trying to find a biomarker such as the DNA methylation to identify the cardiovascular disease (CVD). So far the CVD risks, obesity, smoking, and nutritional status have been shown to link with DNA methylation (Ordovas and Smith, 2010). Furthermore, Breton et al. (2009) observed that children who were exposed to smoking prenatally, had significantly (p=0.03) lower methylation levels at the AluYb8 gene, which is not desirable.

Not all risk factors for CVD have been investigated thoroughly so far. The least investigated is the relationship between physical inactivity and/or exercise and DNA methylation. A simple search on PubMed revealed that research conducted on DNA methylation and exercise came out to be in 1,235 articles whereas research concerning DNA methylation and obesity, or DNA methylation and nutrition are two to four times more. Considering this, it is a good approach to research the relationship between obesity, smoking, and nutritional status. The results of this analysis would provide evidence that the DNA methylation biomarker can be considered for CVD and its risk factors.

This study could contribute to the field of genomics if it will reveal a connection between cardiovascular fitness level, body mass composition, and the biomarker global DNA methylation. If significant results will come out between the variables chosen, then the global DNA methylation biomarker would be a valuable identifier of the quantitative risk factor for cardiovascular diseases.

LITERATURE REVIEW
As the available research database shows the publications in regards to DNA methylation and cardiovascular disease is very limited. However, there is some evidence in regards to the relationships between the epigenomic markers. The rest of the literature review will emphasize on the available evidence such as the different types of epigenomic markers, the correlation between DNA methylation and CVD, the relationship between DNA methylation and obesity, and the influence of exercise on DNA methylation.

Epigenomic Markers
DNA methylation, as the primary measure, histone modification, and autoregulatory proteins that add in modification are the three mechanisms responsible for epigenetic and epigenomic (Waterland, R. A., 2009). DNA methylation has been utilized as an indicator in the most up to date literature. The reason for using it is because DNA methylation is the tool that can test both at the genetic and genomic level, and secondly because DNA methylation is effected by histone modification and autoregulation. The following information illustrates briefly how these epigenomic mechanisms work.

DNA Methylation
As the figure below illustrates, the process of DNA methylation involves the addition of a methyl group to a CpG dinucleotide within the genome.

Figure 2.1: DNA Methylation at CpG Dinucleotide (Kim et al., 2011)
The source Baccarelli & Ghosh (2012) explain the whole DNA methylation process, which begins with the action of four enzymes collectively known as DNA methyl transferase. One of the DNA methyl transferase enzymes interacts with S-adenosylethionine (SAM) and swaps a single methyl group for it, converting SAM into S-adenosylhomocysteine (SAH) (see Figure 2.2). Next, the free methyl group is attached to the 5th position on a CpG dinucleotide (CpG island).

![CpG Methylation](image)

**Figure 2.2 CpG Methylation**
**Courtesy of Dr. Amr Sawlha, University of Michigan**

The position where the process of methylation occurs in the genome is very important because it can occur anywhere within the CpG island. The position indicates the effect of the methyl group in the genome. For instance, the transcription of a gene can be repressed if the CpG island is located within the coding or promoter region. However, this process occurs very rarely; only 10% of all methylated CpG islands are found within a coding region (Baccarelli & Ghosh, 2012).

The available research is not very clearly understood in regards to why the process of methylation occurs, however some papers have shown a correlation between methylation levels and health complications including atherosclerosis and some sorts of cancer (Stauffer & DeSouza, 2010). Diet and exercise habits have been correlated with levels outside the normal range such as hyper or hypo levels of methylation (Stauffer & DeSouza, 2010). The following information discusses the trends and relationships of hyper and hypo levels of methylation.

**Histone Modification**

Another epigenetic marker used is the histone modification. Histones are proteins that are surrounded by 146 base pairs of DNA. Four main proteins make up the histone (H2A, H2B, H3, and H4) and an unstructured N-terminal tail (Mazzio and Soliman, 2012). Histones help DNA package into chromosomes to form a nucleosome. In order for the histone to be modified one of the following processes needs to occur at the N-terminal tail: methylation, acetylation, phosphorylation, ubiquitination, biotinylation, sumoylation, and proline isomerization. These alterations at the N-terminal tail is known as the histone mark which leads to gene repression or silencing by adjusting how ‘tightly’ the DNA strand is wound around the histone (see Figure 2.3).

**DNA Methylation and Cardiovascular Disease**

As it can be noted the DNA methylation is important, especially when correlated with diseases. Historically, DNA methylation was primarily used in cancer and tumor development, but recently it has been used in cardiovascular diseases to indicate the risks and the stages of development. These relationships were firstly identified in the animal studies. Lundi et al. conducted a study in mice in 2004 to prove the DNA methylation patterns in mice without apolipoprotein E (apoE) versus a control group (Lundi et al., 2004). The results showed that the apoE group was more likely to develop atherosclerosis whereas the control group contained the unaffected/normal mice. These two groups were observed for a period of six months. DNA fingerprinting procedure was used to analyze the level of DNA methylation in these two groups. At the four week time point, blood analysis did not show any significant difference in DNA methylation patterns between the two groups. However, aorta tissue sample in the apoE- mice were found to have
significantly different (p<0.04) methylation patterns compared to the control group. These patterns consisted of both hyper and hypomethylation. However, when samples were collected after 6 months, both the blood and aorta tissue samples indicated a significant difference between the apoE and control group: (p<0.02, p<0.003 respectively). These patterns were the hyper and hypomethylation levels in the apoE group. Furthermore, in the apoE group it was the fibrocellular lesions which indicate the development of atherosclerosis. Although the results were somewhat inconclusive in how atherosclerosis causes a modification in global DNA methylation, they do offer the conclusion that global DNA methylation is significantly altered with the development of atherosclerosis (Lundi et al., 2004).

In 2007, Stevinkel et al. came up with a similar approach as Lund et al. (2004) but their work was done on human subjects. Stevinkel et al. identified the link between DNA methylation and cardiovascular disease development in chronic kidney disease (CKD) patients who have a higher risk of cardiovascular disease, and a control group. The control and the CKD group were monitored for the elevated global DNA methylation levels (by collecting blood samples) and the symptoms of cardiovascular diseases (by analyzing the inflammation and oxidative stress biomarkers) for a period of 36 months. The results revealed that the patients with CKD and inflammation had higher levels of methylation (p<0.001) and those who did not have inflammation had results similar to those in the control group. This study helps in concluding that patients that were developing cardiovascular diseases presented elevated levels of methylation or hypermethylation (Stenvinkel et al., 2007).

Another study came out three years later showing important aspects in regards to the levels of methylation in a population based study. Kim et al. (2010) used a similar approach as Stevinkel. The levels of DNA methylation and the cardiovascular disease level were assessed in 286 males and females out of a 65257 population based cohort in Singapore over a five year period. At the beginning of the study, 101 subjects were identified with cardiovascular disease. Then, at the second meeting, another 52 subjects of the remaining 185 were identified with cardiovascular disease. All the subjects with cardiovascular disease (n=153) and the ones without it (n=133) from the beginning of the observation had their DNA methylation levels analyzed. Although, the results obtained did not indicate significant difference for this population, the results were further analyzed after the samples were divided by gender. A higher level of global DNA methylation (p<0.05) was identified in the males with cardiovascular diseases versus those who did not have cardiovascular diseases. However, in females the results were not significantly different. These results were consistent with Stenvinkel et al. (2007). The Table 2.1 below shows the results.

<table>
<thead>
<tr>
<th>Article</th>
<th>Subjects</th>
<th>Dependent Variable</th>
<th>Independent Variable/s</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lundi et al. (2004)</td>
<td>n=27 mice</td>
<td>GDM</td>
<td>Prevalence of atherosclerosis</td>
<td>↑ GDM</td>
</tr>
<tr>
<td>Stenvinkel et al. (2007)</td>
<td>n=191 males &amp; females</td>
<td>GDM</td>
<td>Inflammation measured by IL-6 and C</td>
<td>↑ GDM in patients with inflammation</td>
</tr>
<tr>
<td>Kim et al. (2010)</td>
<td>n=286 males &amp; females</td>
<td>GDM</td>
<td>CVD</td>
<td>↑ GDM in CVD patients</td>
</tr>
</tbody>
</table>

**DNA Methylation and Obesity**

Recently, it has been shown that global DNA methylation may be closely correlated with obesity via the body mass index indicator (Kim et al., 2010). The researchers looked at 286 men and women from Singapore and discovered that those with a BMI value of 24 kg/m2 or higher had significantly (p = 0.007) elevated levels of global DNA methylation than those with a BMI value lower than 24 kg/m2. Furthermore, Wang et al. (2010) and Milagro et al. (2012) found consistent results with Kim et al. (2010) in which the methylation status of individual genes were examined. Similarly, Milagro et al. (2012) found that overweight/obese individuals had elevated methylation levels of the circadian clock system (internal clock) gene, CLOCK 1, compared to lean individuals (17.4% compared to 12.4% respectively).
The previous evidence uses the BMI as a marker for obesity and the levels of DNA methylation, however, it does not take into account the percent body fat for each subject and it does not differentiate between the body fat mass or fat-free mass. One study that looked if the methylation levels could be used to indicate weight loss and body composition to a hypocaloric diet measured body composition with the bioelectric impedance analysis and not by BMI (Fermin et al 2011). Fermin et al. (2011) set out to determine whether or not methylation levels of nine obesity-related genes (AQP9, ATP10A, CD44, IFNG, MEG3, NTF3, POR, TNFRS9, and WT1) in order to determine the weight loss and body composition responses to a hypocaloric diet. The study applied on twenty-five (n=25) overweight or obese (BMI M (SD): 30.5 (0.45) kg/m2)) men. The height, weight, age, percent body fat, waist girth, and blood samples were taken prior to and following an eight week hypocaloric diet. Again, the DNA methylation levels were assessed by obtaining blood samples and looking at peripheral blood mononuclear cells. Their results help us consider two relative concepts: 1) DNA methylation at a genetic level is significantly correlated with changes in fat mass, over-all weight, and changes in waist girth, and 2) DNA methylation (ATP10A and CD44 genes specifically) could be used to predict an individual’s degree of response to a hypocaloric diet.

Although Fermin et al (2011) did not investigate the GDM alteration with weight or fat loss, their data is illustrates the correlation between DNA methylation and obesity and it is consistent with the other sources mentioned above (Kim et al., (2010); Wang et al., (2010); and Milagro et al., (2012)). Moreover, it provides evidence of using DNA methylation as an indicator of CVD risk factors and responses to lifestyle changes.

SUMMARY OF LITERATURE REVIEW

METHODOLOGY

Participant characteristics
Based on what the participants have reported in the Modified American College of Sports Medicine Health/Fitness Facility Pre-participation Screening Questionnaire the subjects appeared to be healthy. The sample size consisted of 35 male and female subjects with their ages ranging from 18 to 44.

Collection of the Data
Preliminary Data
Each subject was informed to come appropriately dressed with fitness gear for the VO2max testing and DEXA. They also were instructed to come very well hydrated and not eat two hours before the test, no alcohol or caffeine nor exercising for at least 6-24 hours prior to being tested.

Before the testing procedure, each individual was given an informative consent document that explains individuals about the purpose, requirements, procedures, risks, and benefits of the study. This document has been approved by the UNLV Institutional Review Board (Protocol #: 1209-4268). 

After, the subjects filled out the Modified American College of Sports Medicine Health/Fitness Facility Pre-participation Screening Questionnaire. Only those who passed the health questionnaire entered the study. Next, each subject was assigned an identification number and the height, weight, and age were taken. Then, by using the dual energy x-ray absorptiometry (DEXA) the body composition was identified. Each subject completed a food frequency questionnaire dealing with folate-rich foods and a physical activity questionnaire in order to control for the effects of diet and lifestyle choices on methylation levels.

Blood Sample Collection
After each subject has completed the informed consent and health screening questionnaire, they donated a sample of blood (600 μl) via finger-sick using antiseptic technique into an anticoagulant tube (Multivette 600 LH, Sarstedt, Fisher Scientific, Pittsburgh, PA). The blood draw site was cleaned with an alcohol swab prior to all blood draws. Samples were labeled with corresponding subject identification numbers before being placed in a sealed and labeled biohazard bag (primary container) inside of a sealed and labeled biohazard cooler (secondary container). Samples were kept in an ice bath until they were analyzed in accordance with the University of Nevada, Las Vegas Institutional Biosafety Manual (Section VIII, page 19). Standard biological personal safety barriers including latex-free gloves, laboratory coat, and eye safety goggles were worn at all times by the research team members. All sharps and biological materials were disposed of in a labeled and sealed sharps container and decontamination was conducted in accordance with the University of Nevada, Las Vegas Institutional Biosafety Manual (Section IX, page 23).

Blood Sample Analysis
Each sample was transported to the Exercise
Biochemistry Laboratory for DNA isolation and storage. Whole blood (approximately 300 μl) was added to 900 μl of Cell Lysis Solution, thoroughly mixed, and incubated for 10 minutes at room temperature. The sample was then centrifuged, and the supernatant was discarded without disturbing the white blood cell pellet. The cells were then re-suspended via vigorous vortexing and 300 μl Nuclei Lysis Solution was added and it was pipetted 5-6 times to lyse the white blood cells. Now the solution should start appearing very viscous. Next, 100 μl of Protein Precipitation Solution was added, vortexed, and then centrifuged. A dark brown protein pellet was visible at the bottom of the tube, and the remaining supernatant was transferred to a new microcentrifuge tube containing 300 μl room temperature isopropanol. This tube was gently mixed and then centrifuged to pellet the DNA. The supernatant was discarded in a biohazard waste container, and equal volume of 70% ethanol was added in a wash step before centrifugation. The tube was inverted over absorbent paper and allowed to air-dry for 15 minutes. DNA Rehydration Solution (20-100 mL) was added to the tube and allowed to incubate overnight at room temperature before being stored at 2-8 °C for subsequent epigenetic analysis. DNA concentration (ng/mL) was determined using an Epoch microplate reader with the Take3 System (Biotek U.S., Winooski, VT).

After the 36 samples have been collected via the method explained above, the global DNA methylation was examined. This was done by using the commercially available assay kit (MethyFlash Methylation DNA Quantitation Kit, Epigentek Group Inc., Farmingdale, NY). A binding solution, followed by the samples was added to an antibody-infused 96 well plate. Negative and positive controls, as well as diluted positive values were added alongside the samples and tested in order to produce a standard curve for quantification proposes. Then, the samples were incubated for 90 minutes inside the wells. Next, the samples were removed and the wells were washed with a wash buffer and a capture antibody was added to each well. The plate was again incubated for 60 minutes. The removal of the solution and the washing procedure with the buffer was repeated for cleaning purposes. After this second wash, a detection antibody was added and the wells were incubated for 30 minutes. An enhancer solution was then added to each well and a final 30 minute incubation phase was followed. The wells were washed for the last time and the developer solution was added giving the sample a bluish color based on the methylation level. Finally, a stop solution was added before the 96 well plate was placed in a plate reader and read at 450 nm. All samples were processed at the same time and global DNA methylation levels were expressed as an absolute percentage based on the determined standard curve. The formulas used are given below:

\[
GDM(ng) = \frac{\text{Sample OD} - \text{Negative OD}}{\text{Slope} \times 2}
\]

\[
GDM \% = \frac{GDM(ng)}{S} \times 100
\]

S is the concentration of sample DNA used in nano grams.

**DATA ANALYSIS**

The statistical Pearson product-moment correlation coefficient “r” was used to assess the links between the body composition, fitness measurements, and GDM percentage. Also, the t-test were used to asses any differences. High and low value groups from each variable were constructed and compared with the median for each variable. For this study the significance level alpha (α) was set at α = 0.05. The SPSS Version 20 was used to calculate all the statistical analyses (IBM Corporation, Armonk, NY).

**RESULTS**

The purpose of this investigation was to determine whether a relationship exists between the percentage of global DNA methylation and measures of aerobic fitness, as well as measures of body composition. It was hypothesized that a significant correlation existed between GDM% and measures of aerobic fitness and body composition. Regarding the association between VO\textsubscript{2max} and GDM%, we retain the null hypothesis as no significant correlation was determined. It was found that a significant relationship between the global DNA methylation and the body composition measure of Body Mass Index only in the female group.

Our results show a negative correlation with BMI and GDM percentage in females (as BMI increases, the GDM percentage decreases). These findings are not in agreement with the findings of Kim et al. (2010) which are opposite. Also, Kim et al’s (2010) sample revealed a significant correlation for both males and females, whereas our sample showed this result only on the females group. These
inconsistencies are because Kim et al’s sample is from Singapore where the obesity rates are much lower than in the U.S. (12% versus 36%) and that our sample is much smaller than Kim et al’s (56 vs 286 subjects). This study was also unique in that it took an actual measurement of body composition (DEXA scan), as well as calculating BMI values.

Next, since it is known that the physical activity level and the aerobic capacity are related with cardiovascular disease risks (Dencker et al., 2012; Shortreed, Peeters, & Forbes, 2013), then it was rationalized that the measure of the aerobic capacity VO2max to be associated with the global DNA methylation marker. However, we did not find any significant relationship between the two variables (r ≤ -0.253, p>0.452) in males or females, neither a significant difference between the high or low VO2max groups. These results may be due to the other aspects that are known to negatively affect the cardiovascular system in an individual such as smoking, dietary habits, family genetics, and our sample size and variation. However, as far as we know, this is the first investigation to report that there is no association between VO2max and GDM%. Further research is necessary to determine whether other measures of aerobic fitness are more sensitive correlates with DNA methylation.

Although this project did not focus on the patterns between dietary habits and DNA methylation, it was found that subjects who consumed higher levels of folate tend to have GDM percentages higher than those with low intakes of folate by 36.6%. These results support the conclusions presented by Ong, Moreno, & Ross (2012) in that higher folate intake can influence methylation levels. High folate foods are considered in methylation tests because they donate the methyl group. Although this aspect was not part of our hypothesis, the influence of folate rich foods on GDM levels is important and should be considered in future studies to limit confounding variables.

CONCLUSION OR FURTHER STUDY

As our data reveals, a more diverse sample such as sedentary or less physically fit subjects would be necessary for more conclusive results. 2.7% GDM was obtained from this study which is similar to the findings shown by McGuinness et al. (2012). The GDM ranges from 0.85 to 91% (Bromberg, Bersudsky, & Agam, 2009). As this range shows there is not much consistency between the DNA isolation and GDM quantification, which makes the comparison between studies very misleading. There is a need of standardization for future research.

As of today, this study appears to be the first one to look at the direct measures of body composition and GDM. Although the sample size was small, a few important aspects were found. It was found that an inverse relationship between GDM and BMI is present in females, but not in males; also, subjects who reported higher levels of folate in their diets have increased levels of GDM than those who do not. However, we could not find a relationship between cardiovascular fitness via VO2max measurement, and GDM. As a result, there is a need of more studies and for our case there is a need of a larger sample size because DNA methylation is an important biomarker in detecting the cardiovascular disease risk and its prevention.

REFERENCES


AN EXAMINATION OF ATTITUDES TOWARD SEXUALIZED ADVERTISING IN LAS VEGAS

BY ASHLEY CRISP

ABSTRACT
This study explores the attitudes of college-level criminal justice students as to their perception of sexualized advertising in Las Vegas, and if these attitudes have any correlation with the participant’s length of residency. The study also correlated college-level student’s attitudes toward sexualized advertising and how religious they rate themselves. The results for the female participants who lived in Las Vegas for 5 to 10 years or more on average agreed advertisements in Las Vegas are too sexualized. In contrast, female participants who were either born in Las Vegas or lived there less than 5 years, neither agreed nor disagreed that advertising was too sexualized. As for the males, only those who lived in Las Vegas for 5 to 9 years on average agreed that advertisements in Las Vegas are too sexualized. Those participants who considered themselves very religious on average agreed that advertising in Las Vegas were too sexualized.

INTRODUCTION
No other city in America uses sex to sell as boldly as Las Vegas (McCarthy, 2013). Sexualized advertising has been a part of the Las Vegas community for some time now. Over recent years, sexualized advertising in Las Vegas has gained interest from many researchers and those that are a part of the community. In 2004, the Hard Rock Hotel and Casino paid a settlement along with the Nevada Gaming Commission for their advertising deemed as “inappropriate” (Engstrom, 2007). Sexual advertising has been studied in many different forms from television shows to billboards in communities with researchers providing data on the effects of this type of advertisement.

Las Vegas is one of the places where anyone visiting the tourist area (the strip) is persistently flooded with advertising that contains sexual content. “Visitors walking along the Strip are constantly bombarded with adult-themed handbills distributed by off-premises canvassers. The majority of this material depicts graphic advertisement for referral services, that provide erotic dancers directly to visitor’s hotel rooms” (Engstrom, pg. 4). Handbills along with billboards,
headliners on taxi cabs, and advertising vehicles include a few of the many ways Las Vegas is known for its overtly sexual advertising.

This study examines the attitudes of college-level students on their perception of sexualized advertising in Las Vegas and the potential role of length of residency in Las Vegas on these attitudes.

**LITERATURE REVIEW**

As sexual advertising has caught the interest of researchers a common definition has been used to study its effects on individuals. Sexual advertising is defined as drawing a response to an item of consumption while using persuasion of sexual interest (Hultin & Lundh, 2004). The adult sex industry is defined as the purchase or selling of sexual services, anything from pornography to individual prostitution. Las Vegas is a one-stop shop for anyone interested in sexual advertising or the adult sex industry (McGraw-Hill, 2002).

Sexual advertising of women dates back to the rebirth of the women’s movement in the 1960’s with the strongest critics being young, wealthy, educated women. Critics constantly ranted of the negative effects this type of advertising had on women. While in recent times, people who were born during the 1980s and later feel that sexual advertising of women is a normal part of our everyday media. Younger women today are more sympathetic to companies who portray females as sex objects than previous generations. At this point, sexual content advertising makes up 75 percent of primetime television commercial content (Zimmerman & Dahlberg, 2008).

The study by Zimmerman and Dahlberg correlated attitudes of today’s young women toward advertising with the evolution of feminism. The third wave feminist movement places emphases on moving away from the old fashioned view of women and promoting the idea that women are becoming more dynamic, confident, and embracing sexuality. It focuses on seeing women as a dominant sex and not a piece of property. Although, women’s sexual portrayals in advertising have an effect on views of sexual behavior, younger women don’t perceive it as insulting or damaging (2008).

Among the many themes in adolescent popular television shows the most common sexual theme is that women are constantly judged by their physical attributes (Aubrey, 2006). The physical attributes portrayed are nearly impossible to replicate, but the media producers are still making these advertisements because they sell (Furnham & Paltzer, 2010). Exposure to these “ideal” physical attributes has led to increased body disengagement and anxiety in young adults (Monro & Huon, 2005).

One’s self-objectification (treating one’s self as an object) became amplified through more exposure to sexual media. As women increased their viewing of sexual television shows they began focusing on themselves in terms of external qualities rather than internal qualities. The prevalence of sexual television shows/ advertising in today’s society has increased young adults self-objectification, which affects their attitudes toward sex and sexual behavior (Aubrey, 2006). The additional exposure to television and magazines that objectify women’s bodies increase self-consciousness and the monitoring of one’s body (Aubrey, 2007). Taking these facts into consideration, the heightened amount of sexual advertising done in Las Vegas may lead women to look at themselves more critically with unrealistic expectations promoted in the advertising.

Are women just sex objects? Stankiewicz and Rosselli studied the popularity of women as sex objects and victims in print advertisements. They concluded that the media continue to indulge in images of highly sexualized women in advertisement to sustain male authority (2008). Las Vegas designates women’s bodies as property by advertising them for sell while promoting whatever happens here stays here.

In contrast, a study done in Belgium found that women preferred sexual advertisements to traditional stereotypical advertisements (women cleaning the house). Respondents were more concerned with advertisements that expressed traditional stereotypical roles more than obscene nudity. They viewed sexual advertising as a breakthrough of gender stereotypes (Hellemont & Bulck, 2012). This study shows the cultural differences and views of a European country with more liberal sexual attitudes toward advertising in comparison to America.

Women and men tend to actively engage in sexism. Women were found to engage in sexism at a similar degree with men, although the origins of these
feelings differed. Neither men nor women were interested in seeing women portrayed in a communal role, both preferred seeing them portrayed as free agents to choose as they wish (Infanger, Bosak, & Sczesny, 2012). Similar to the study done in Belgium by Hellemont and Bulck, the respondents in this study were not interested in seeing women portrayed in a traditional stereotypical way (2012).

A couple of factors that many researchers analyzed when exploring the effects of advertising on participants is religious background and individual self-perception. Religion has an overwhelming influence on many aspects of sex from masturbation to marriage (Mackay, 2001). Additionally, a woman's perception of herself intensely affects the extent to which she internalizes sexual advertising. Tiggermann and Boundy found that women who had a positive perception of themselves didn't perceive sexualized advertising as offensive as those who had much more of a negative view of themselves (2008).

Overall, sexualized advertising thus far has been found to have a negative effect on an individual’s self-perception, however; sexual advertising is better-recalled than non-sexual advertising. Participants of a study viewed two television shows, one of which contained sexual content while the other was a nonsexual program; they then completed a free and cued-recall questionnaire to test their memory of the television shows. The show that contained sexual content was recalled more often than the show with no sexual content (Furnham and Mainaud, 2011). This study leads us to believe that sexualized advertising in Las Vegas could be beneficial because visitors will have a memorable experience and will want to return.

Adult advertising can have a lasting effect on children and adolescents who are constantly exposed to it (Zubairi, Zubairi, & Waqas, 2012). Exposure to such advertising is considered “premature exposure” and can create undesirable consequences. Media and ads have an intense effect on children/adolescent’s health, physical and mental, beliefs and actions. When exposed to adult behavior children tend to follow in the footsteps of what they see. If children/adolescents find the advertising they are being exposed to pleasurable, they will be more likely to seek whatever is being advertised (Zubairi, Zubairi, & Waqas, 2012).

It is feasible that sexualized advertising has some effect on individuals and their self-perceptions. Las Vegans are constantly bombarded with sexualized advertisement because it is one of the most flourishing promotions in Las Vegas. Native and non-native attitudes toward sexualized advertising in Las Vegas can be affected by many factors, some of which will be explored in this study.

THE CONTEXT: Las Vegas
Las Vegas is very unique compared to any other city in America; Las Vegas is one of the most popular travel destinations and attracts millions of travelers and visitors per year. Although, it has become such a common travel destination for many all over the world, the city has made a name for itself similar to no other. Las Vegas has managed to become an adult’s playground where no rules apply and whatever one does is tolerated by the city. Advertising and activities imply tourists who visit Las Vegas can behave however (usually sexually related) and go back home to their “normal” lives and not be affected by those behaviors.

What about the residents who stay here? It is plausible to assume these types of behaviors have some lasting effect on the locals of the city. Therefore, the attitude of locals has become an interest for many researchers.

PURPOSE OF THE STUDY
This study explores the attitudes of college-level criminal justice students as to their perception of sexualized advertising in Las Vegas, and if these attitudes have any correlation with the participant’s length of residency. This study will correlate college-level student’s attitudes toward sexualized advertising and how religious they rate themselves.

METHODOLOGY
Participants
The sample included responses from 861 college students at the University of Nevada, Las Vegas. Just over 56% of respondents were female, 43% were male. The amount of time each participant lived in Las Vegas are presented in Table 1. The largest group lived in Las Vegas ten years or more, 31.9%. The remaining portion of the participants varied, as presented in the table 1 below.
Participants rated themselves on a scale one to five of how religious they considered themselves. The scale ranged from 1 representing not at all, while 5 represented very much so. The majority of participants, 28.6% considered themselves somewhat religious. The other portion of the group varied, 20.6% stated they were quite a bit religious, 19.3% considered themselves a little religious, 15.6% rated themselves not at all religious, and lastly 13.8% measured at very much so religious.

PROCEDURES
The UNLV data was collected through Criminal Justice Student Subject pool. The data collected at UNLV followed all procedures required by the Institutional Review Board of UNLV (protocol #1001-3335M) including informed consent and debriefing of subjects.

MEASURES
Attitudes Toward Las Vegas Environment
Dr. Alexis Kennedy and the Legal and Social Issues Research lab at UNLV developed the survey questions that were designed to measure students’ perceptions of sexual behavior and high-risk activity related to sexual behavior in Las Vegas. These questions were measured on a Likert-type agreement scale with 1 representing strong agreement and 5 representing strong disagreement. Three items were written to measure perceptions of tourist, locals, and personal attitudes toward sexualized advertising in Las Vegas. These items were exploratory and were compared by gender, length of residency in Las Vegas, and how religious participants rated themselves to explore any differences in response rates.

<table>
<thead>
<tr>
<th>Number of years living in Las Vegas</th>
<th>% of Sample</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Born in Las Vegas</td>
<td>29.8%</td>
<td>256</td>
</tr>
<tr>
<td>Over 10 years</td>
<td>31.9%</td>
<td>274</td>
</tr>
<tr>
<td>5-10 years</td>
<td>16.3%</td>
<td>140</td>
</tr>
<tr>
<td>4 years or less</td>
<td>18.9%</td>
<td>162</td>
</tr>
</tbody>
</table>

Note: Percents may not add up to 100% as it was optional for participants to respond to the question.

FINDINGS
Gender Comparisons
An independent-samples t test was conducted to compare male and female attitudes toward sexualized advertising in Las Vegas. There was a significant difference in scores for males and females.

Means Plot
Note: Las Vegas- Most Las Vegas think advertising in Las Vegas is too sexualized, Participants- I think advertising in Las Vegas is too sexualized, Tourists- Most tourists in Las Vegas think advertising in Las Vegas is too sexualized, 1 represents a strong agreement, 5 strong disagreement.

Attitudes toward Las Vegas Environment
Male and female participants varied significantly from each other on a number of attitudes, so the data analyzed was split by gender. A one-way between group analysis of variance was conducted to explore the impact of how long the participants lived in Las Vegas on their attitudes toward sexualized advertising in Las Vegas and how they viewed tourist and locals’ attitudes toward sexualized advertising. Each participant was grouped by how many years they lived in Las Vegas and their gender (male or female). Looking first at females’ attitudes toward locals and whether they felt as if most Las Vegas think advertising in Las Vegas is too sexualized. Women who were born in Las Vegas and those who lived there less than 5 years felt ambiguous about local’s attitudes toward sexualized advertising in Las Vegas. While, women who lived in Las Vegas 5-10 or more years had significantly lower means (indicating greater agreement) that locals thought the ads were too sexualized as presented in
Table 1. The analysis showed there was a significant difference between the groups, with (F= 5.950 (3, 459), p<.001).

<table>
<thead>
<tr>
<th></th>
<th>&lt;5 years</th>
<th>5 to 9</th>
<th>10+</th>
<th>Born in Las Vegas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Las Vegans</td>
<td><img src="Image1.png" alt="Bar Chart" /></td>
<td><img src="Image2.png" alt="Bar Chart" /></td>
<td><img src="Image3.png" alt="Bar Chart" /></td>
<td><img src="Image4.png" alt="Bar Chart" /></td>
</tr>
</tbody>
</table>

Post hoc analyses (LSD) indicated that the middle two groups differed from the shortest residency and those born in Las Vegas but not from each other. Similarly, the longest and shortest groups did not vary significantly from each other.

Secondly, looking at females’ individual attitudes toward sexualized advertising in Las Vegas. As presented in Table 2 on average all the women felt as if advertising in Las Vegas was too sexualized. Although, women who lived in Las Vegas less than 5 years differed significantly in their responses to those who lived in Las Vegas 5-9 years. Post hoc (LSD) indicated that those participants with the shortest residency differed from those who lived in Las Vegas for 5 to 9 years and 10 years or more, (F= 4.737 (3, 461), p<.003).

<table>
<thead>
<tr>
<th></th>
<th>&lt;5 years</th>
<th>5 to 9</th>
<th>10+</th>
<th>Born in Las Vegas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td><img src="Image5.png" alt="Bar Chart" /></td>
<td><img src="Image6.png" alt="Bar Chart" /></td>
<td><img src="Image7.png" alt="Bar Chart" /></td>
<td><img src="Image8.png" alt="Bar Chart" /></td>
</tr>
</tbody>
</table>

As mentioned before male and female responses were split for analysis, so now taking a look at male participants and their attitudes toward sexualized advertisements in Las Vegas. A one-way between group analyses was performed for both male and female participants. Males indicated they felt ambiguous about locals thinking advertising in Las Vegas was too sexualized. There was no statistically significant difference in the mean scores of the responses, as presented in Table 4.

The second question looked at the males individual attitudes toward sexualized advertising in Las Vegas. Interestingly, men’s responses varied significantly from those born in Las Vegas or living there 10 years or more and those who lived in the city 9 years or less. Those who were born in Las Vegas or lived...
there 10 years or more took a more modest stance on their thoughts about sexualized advertising in Las Vegas as presented in table 5. While the other group of men who lived in Las Vegas 9 years or less overall agreed advertising in Las Vegas was too sexualized. Post hoc (LSD) described that those males who were residents 9 years or less differed from those who were born in Las Vegas or lived there 10 years or longer with, (F= 3.104 (3, 357), p<.027). Participant’s who have been a resident the least amount of time agreed with one another. Similarly, those who have been a resident longer agreed with one another.

On average, most male participants didn’t agree or disagree that tourists felt advertising in Las Vegas was too sexualized. There was a statistically significant difference in the between group analyses with, (F= 2.821 (3, 355), p<.039). The post has (LSD) reported only statistically significant difference lay between those who were born in Las Vegas and those who lived in Las Vegas 5 to 9 years. Although, the mean scores still indicated most responded moderately as presented in table 6.

Lastly, how religious the participants rated themselves was compared to their attitudes toward sexualized advertising in Las Vegas. Through the one-way between group analysis, it was found that those who considered themselves very religious differed significantly from those who considered themselves not at all religious. The mean scores that reflect whether the participant’s felt that advertising was too sexualized due to their level of religiosity are as follows; those who considered themselves not at all religious mean score was 2.67, a little religious scored 2.58, somewhat religious scored 2.51, quite a bit religious scored 2.20, and very much so religious scored 2.05 with, (F=8.842 (4,832), p< .000). Those who considered themselves very religious personally agreed advertising in Las Vegas was too sexualized, while those who stated they were not religious at all didn’t agree or disagree. There was no significant difference between how religious the participants considered themselves and whether they felt locals and/or tourists thought advertising in Las Vegas was too sexualized.

**DISCUSSION AND CONCLUSIONS**

The culture of Las Vegas is unlike any other city, from the sexual advertising to the adult sex industry. Previous research indicated that sexualized advertisements had a negative effect on an individual’s self-perception and a positive effect on recall memory. The problem residents of Las Vegas face are whether the sexual advertisements the city displays are harmful or helpful to the community. From an individual’s perspective the advertisements may seem harmful, but on the other hand the financial gain the city receives from being such an overly sexual city may be helpful.

This study sought to explore resident’s attitudes toward sexualized advertising in Las Vegas and whether gender or the amount of time the participant has been a resident has an effect on their perception. Although, previous research has examined the effects of sexualized advertisements and advertisements on individuals. There isn’t much research on Las Vegas the city famous for its overly sexual ways. This study found that gender had an effect on whether the participants personally thought advertising in Las Vegas was too sexualized; men on average felt ambiguous about the advertisements while women tended to agree that the advertising was too sexualized.
After splitting the analysis by gender and looking for differences between how long each participant lived in Las Vegas the results varied. For the female participants who lived in Las Vegas for 5 to 10 years or more on average agreed advertisements in Las Vegas are too sexualized. In contrast, female participants who were either born in Las Vegas or lived there less than 5 years, neither agreed nor disagreed that advertising was too sexualized. The curvilinear relationship makes interpretation of the trends hard to analyze. As for the males, only those who lived in Las Vegas for 5 to 9 years on average agreed that advertisements in Las Vegas are too sexualized. Those participants who considered themselves very religious on average agreed that advertising in Las Vegas were too sexualized. The current research suggests there may be some effect of length of residency and how religious the participants consider themselves on attitudes toward sexualized advertising in Las Vegas.

**Limitations**

While the findings from the current study are helpful, this population may not be representative of all those that live in Las Vegas thereby limiting the generalizability of these findings. Due to time constraints, looking at other demographic information was not possible. Since Las Vegas is recognized as one of the locations where visitors are constantly bombarded with sexual, adult themed material, further research would provide opinions regarding the degree of the negative impact to women as well as the actual relationship between the monetary benefits of the advertisements themselves (Engstrom, 2007). Additionally, the absence of response from some of the participants limits the scope of the data.

**REFERENCES**


EVALUATING THE DISCRIMINANT VALIDITY OF THE METAPHORS TEST

BY DANIEL N. EROSA

ABSTRACT
The Metaphors Test (Barchard, Hensley, Anderson, & Walker, 2013) is a new test of emotion perception in which test takers indicate the extent to which various emotions are conveyed by metaphors. In order for the Metaphors Test to be considered a valid test of emotion perception, it must have discriminant validity. Discriminant validity occurs when a test has small or zero correlations with tests of different constructs. The Five-Factor Model (McCrae & John, 1992), also known as the Big Five Model, is one of the most well-known frameworks for personality. The Five-Factor Model contains five dimensions: Openness, Conscientiousness, Extroversion, Agreeableness, and Neuroticism. Based upon theory and previous research, the Metaphors Test should have low correlations with results generated by the Big Five Model. In this study, the scores from the Metaphors Test were correlated with scales from the Five-Factor Test (Goldberg, 1992). Conscientiousness had a moderate correlation with the Metaphors Test, suggesting that some participants were not taking this study seriously. Future research should take steps to ensure that all of the data that are analyzed are based upon participants who attended to the study materials—for example, by throwing out data from respondents that did not take sufficient time or by using a pre-screened participant panel. Agreeableness had a moderate-to-high correlation with the Metaphors Test. This might suggest that the proportion consensus scoring (of any attribute) is influenced by the tendency to care about what other people think. Future research on emotion perception might benefit from focusing on tests with veridical scoring keys, such as the new Measure of Emotional Connotations (Barchard, Kirsch, Anderson, Grob, & Anderson, 2012).

Introducing and Purpose of the Study
The ability to perceive emotion in written materials is becoming more and more important as society develops new forms of communication. Technology and social media are two examples of these changes. Without the normal social cues that generally tell us how someone is feeling, such as body language and tone of voice, we must rely on information generated through written language.
Thus, verbal tests of emotion perception have become critical to our continued development. The Metaphors Test is a new test of emotion perception. The test includes ten metaphors with three emotions for each item. Participants are asked to rate the extent to which the metaphor conveys each of the emotions. The Metaphors Test is unique in that the item stems do not include any explicit emotion words. For example, the Metaphors Test contains the item stem, "His face is like a ray of sunshine", which does not include any explicit emotional words (e.g., happy, sad) but still conveys emotions. The Metaphors Test is designed to measure the ability to perceive the emotional connotations of written language, without simply being a vocabulary test.

Personality traits consist of multiple styles of thinking, feeling and acting (McCrae & Costa, 1997). One of the most well-known frameworks for personality is the Big Five Model, also known as the Five Factor Model. The Five Factor Model is a hierarchical organization of personality traits. Each of the five dimensions is used to describe individual differences in personality ranging from emotional and interpersonal styles to attitudinal and motivational styles. The five dimensions are Openness, Conscientiousness, Extroversion, Agreeableness, and Neuroticism (McCrae & John, 1992).

The Big Five (Five Factor Model) was developed as a means to establish a list of personality traits and the Metaphors Test was designed to measure a cognitive ability. For the Metaphors Test to be considered a valid test, it needs to have discriminant validity. Discriminant validity is achieved when measurements between different constructs have low correlations (Reitsma, Scheepers & Janssen, 2007). Given that cognitive abilities and personality usually have low to moderate correlations, the Metaphors Test should have low to moderate correlations with the Big Five in order to have discriminant validity.

LITERATURE REVIEW

Emotion perception is the ability to identify and interpret emotional stimuli, which alters an individual’s emotional state in response to the stimuli (Phillips, Drevets, Rauch, & Lane, 2003). The Emotional Accuracy Research Scale (Mayer & Geher, 1996), the Stories task from the Multifactor Emotional Intelligence Scale (Mayer, Caruso, & Salovey, 2000), and Gregory and Waggoner’s (1996) test all ask respondents to identify the emotions conveyed in written language.

VERBAL EMOTION PERCEPTION TESTS

Emotional Accuracy Research Scale (EARS)

The Emotional Accuracy Research Scale (EARS; Mayer & Geher, 1996) was created to measure how perceptive an individual is of another individual’s emotion. The items on EARS are descriptions of specific situations experienced by eight individuals. Respondents are asked to estimate the emotional state (feelings) of the eight individuals. The thoughts in regards to the situation were then placed in a scale and were followed by twelve pairs of dichotomous mood items. Respondents choose between pairs that they felt more strongly towards after reading the thought sample.

EARS can be scored using both target and consensus scores (Mayer & Geher, 1996). Target scores are calculated by comparing the number of times a participant’s answers coincided with the answers given by the original target’s response over the 96 items. Consensus scores are calculated as the proportion of the norm group who gave the same response (Mayer & Geher, 1996). This is referred to as proportion consensus scoring. For example, if 40% of participants select option D, then option D receives a score of .40 (Barchard et al., 2013).

Stories Task

The Stories task is one part of the Multifactor Emotional Intelligence Scale (Mayer et al., 2000). Like the EARS, the stimuli consist of descriptions that were provided by real people. However, on the Stories task, respondents provide ratings on seven emotion scales.

Many of the items on the EARS and the Stories Test contain explicit emotion words (e.g., jealous). Thus, these tests measure both denotative and connotative knowledge. Denotative knowledge is knowledge of dictionary meanings (e.g., “sad” is similar in meaning to “unhappy”). Connotative knowledge is knowledge of meanings that are not in a dictionary (e.g., “home” has more positive connotations than “house”). Thus, the EARS and the Stories Test do not provide pure measures of the ability to perceive the emotional connotations of written language.

Gregory and Waggoner’s (1996) Test

Gregory and Waggoner’s (1996) test contains 12
metaphors. For example, the metaphor “Joe was crashing thunder” means that he was angry. Metaphors require the individuals interpreting the metaphor to go beyond the literal meaning and examine its connotations (Lakeoff, 1993). Thus, metaphors can convey meaning without explicitly stating emotion words directly. For example, the metaphor “He is the apple of my eye” would have a literal expression of someone being an apple in someone’s eye. The figurative interpretation allows the metaphor to be an expression of love or admiration.

In this test, respondents needed to indicate which of two emotions was conveyed by the metaphor. This item format was deliberately selected to make the items easy, and the high means for adults on all items indicate that this goal was reached. Easy items were desired so that the test could be used to distinguish between children and adults (Gregory & Waggoner, 1996). However, this makes the test of limited use for use in adult-only populations.

The Metaphors Test
The Metaphors Test was designed to measure an individual’s ability to perceive the emotional connotation of written language (Barchard et al., 2011), while avoiding the limitations of previous tests. Specifically, the item stems do not include any explicit emotion words, and items were designed to be relatively difficult. See Figure 1 for an example item.

Expected Discriminant Validity
The ability to perceive emotions is one aspect of emotional intelligence. To demonstrate that emotional intelligence is a new and useful construct, it is important that it is distinct from well-known constructs such as the Big Five personality traits (Joseph & Newman, 2010). The Big Five traits are Openness, Conscientiousness, Extroversion, Agreeableness, and Neuroticism (McCrae & John, 1992). The Metaphors Test is expected to have low to moderate correlations with each of these dimensions, because it should be measuring different constructs.

Barchard et al. (2013) examined the relationship between the Metaphors Test and the Big Five personality dimensions using a sample of university students. Only the correlations for openness and agreeableness were statistically significant, and both of these were small. The purpose of the current study is to replicate those results using a non-student sample.

SUMMARY OF LITERATURE REVIEW
Emotion perception is the ability to identify and interpret emotional stimuli, which alters an individual’s emotional state in response to the stimuli. The Metaphors Test is a new test of emotion perception that measures the ability to perceive the emotional connotations of written language. This test was designed to avoid limitations of previous tests of this construct, so that item stems do not include explicit emotion words and so that items are moderately difficult. To further investigate the validity of the Metaphors Test, this study examined discriminant validity with respect to the Big Five factors of personality. Small to moderate correlations were expected with each of the Big Five dimensions.

METHODOLOGY
Participants
A total of 181 individuals participated in this study. Participants were recruited through Amazon’s Mechanical Turk (mTurk) system. mTurk is a crowdsourcing website that allows requesters (such as researchers), to create Human Intelligence Tasks (HITs). HITs can be used to promote and advertise studies posted on mTurk. Workers are individuals that complete the HITs. In a research study, the workers are the participants. In general, mTurk HITs provide low monetary compensation. Participants in this study were paid 10 cents.

Participants ranged in age from 20 to 68 years old (mean 31.05, standard deviation 10.83). Of these, 44.8% were female and 55.2% were male. Participants lived in the following countries: 86.2% India, 9.9% United States, 0.6% Russia, and 3.5% other. Participants had a variety of first languages: 29.3% Tamil, 27.1% English, 22.7% Malayalam, 8.3% Hindi, and 12.7% other. Ethnically, participants identified themselves as follows: 78.8% Asian, 11.7% White, 4.5% Indian, 3.4% American Indian or Alaska Native, and 2.8% other.

Procedures
The study was completed online. It took approximately 15 minutes to complete. The online materials for this study were created using Qualtics. Qualtrics is a type of computer software that has been created for researchers to use when conducting their research. It allows researchers to design online survey instruments and to administer
them. At the end of the study, participants received a validation code that was generated in Qualtrics. Participants entered the validation code into mTurk in order to receive payment.

**MEASURES**

*Demographics Questionnaire*
Participants answered a series of demographic questions. These included sex, age, ethnicity, first language, how long they have spoken English, and how comfortable they are reading and writing in English (using a scale of 1 to 10).

*The Metaphors Test*
The Metaphors Test (Barchard et al., 2011) was designed to measure the ability to perceive emotion in written language. The test contains ten metaphors, with three emotions each, for a total of 30 items. Participants are instructed to indicate the extent to which each metaphor conveys the given emotions. An example item is given in Figure 1. The test is scored using proportion consensus scoring. As explained earlier, proportion consensus scoring assigns scores based on the proportion of the norm group who selected the same response.

The Metaphors Test has strong reliability and validity (Barchard et al., 2011). The test has high internal consistency (coefficient alpha = 0.84). The test contains a single factor and all items have large salient loadings on that factor. Total scores have strong positive correlations with tests of emotional intelligence, emotional awareness, and social intelligence. Finally, confirmatory factor analysis demonstrated that the Metaphors Test measures emotion perception (rather than some other dimension of emotional intelligence).

Barchard and colleagues (2011) also examined the relationship between the Metaphors Test and the Big Five personality traits. All correlations were small and only two of the correlations were statistically significant: openness ($r = .26, p < .05$) and agreeableness ($r = .24, p < .05$).

*International Personality Item Pool*
The International Personality Item Pool (IPIP) was developed as a measure of personality that could be accessed at no cost (Ehrhart, Roesch, Ehrhart, & Kilian, 2008). The IPIP is an international effort to develop and refine a set of personality scales for scientific and personal use (Goldberg, Johnson, Eber, Hogan, Ashton, Cloninger, & Gough, 2006). The IPIP Big Five Personality Test (Goldberg, 1992) is a 50-item questionnaire in which the participants are asked how accurately each item describes them at the time of study completion. The test contains ten items for each of the Big Five traits. Participants respond to each item using a five-point scale (1 = Very Inaccurate, 5 = Very Accurate).

**RESULTS**
The Metaphors Test correlated significantly with four of the five scales of the Five-Factor Test. The only exception was extraversion. The results are shown in Table 1. Most of these correlations are small to moderate. However, the correlation with agreeableness ($r = .58, p < .01$) might be interpreted as large.

**CONCLUSION**
The Metaphors Test (Barchard et al., 2011) is a new test of the ability to perceive the emotional connotations of written language. The original study on the Metaphors Test showed that it had small correlations with each of the Big Five personality traits. Only two dimensions had significant correlations and both of these correlations were small. They were openness ($r = .26, p < .05$) and agreeableness ($r = .24, p < .05$). The remaining correlations were all .10 or less.

Two of the five correlations were similar in the current study: the correlation for extraversion was still very small and the correlation for openness was still small but significant. However, the other correlations were larger in this study than in the previous one. First, there was a small significant correlation with neuroticism. This might be explained by arguing that people with high levels of neuroticism experience their emotions more intensely. It is notable that this relationship was not found in the original student sample. Perhaps there is more variability in reported neuroticism in a world-wide study than in a sample from one corner of the United States. Restriction of range in the student sample might account for the difference in the size of the correlations.

Second, this study found a moderate correlation between the Metaphors Test and conscientiousness. This correlation was unexpected. This correlation might be due to the sample that was used in the current study. Participants for this study were recruited through mTurk. These participants were paid a small amount in return for completing the
study. It could be that some participants did not attend carefully to the study materials. They may have even answered randomly. If they did, they would be likely to put answers that were different from other people's and get a low score on the Metaphors Test. These people might be described as low on conscientiousness. If so, this could account for the correlation between these two tests. Future research should ensure that all participants attend to the study materials. This could be done in several ways. First, the study could be supervised. Second, even if the study is still done online, a researcher might screen the data to eliminate participants who did not spend enough time on the items. Third, online participants could be solicited from a panel that has been carefully screened to ensure that they give high quality results.

Third, this study found a much higher correlation with agreeableness (r = .58) than the original study. It is unclear if the difference in the size of the correlation is meaningful or if this is simply the degree of variation that would be expected from one sample to another. Regardless, this size of correlation was unexpected, given that the two tests are designed to measure quite different constructs. Perhaps the correlation is due to the way the Metaphors Test is scored. It uses proportion consensus scoring, where one's score on an item is equal to the proportion of the norm group who gave the same response. People who obtain high proportion consensus scores are ones who are sensitive to the people around them and understand how other people think. This may be an essential component of emotion perception. After all, there isn't actually any emotion in the black ink on the page (or the black characters on the white screen). Our attributions of emotion are based upon how we think other people feel; which we learn by observing other people. It therefore makes sense that the Metaphors Test would have a moderate-to-high correlation with agreeableness. People who score high on agreeableness care about others opinions.

On the other hand, the test designers were not trying to create a test that would be influenced by agreeableness; they were trying to create a test of emotion perception. Moreover, sometimes perceiving emotions is difficult and it would be good if a test was able to include some difficult items. Proportion consensus scoring cannot be used effectively with difficult items (Barchard, Hensley, & Anderson, 2013). A new test has been designed to attempt to address these problems: the Measure of Emotional Connotations (MEC; Barchard, Kirsch, Anderson, Grob, & Anderson, 2012). On this test, the stimuli were carefully designed so that the correct answers were known for each item, regardless of the responses of the norm group. A study of the relationship of the MEC to personality (Hensley, Craun, Grob, & Barchard, 2012) found significant but small correlations with openness (r = .28, p < .01) and agreeableness (r = .28, p < .01). This therefore appears to be a promising direction for future research.

REFERENCES:


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Table 1

<table>
<thead>
<tr>
<th>Personality Dimension</th>
<th>Correlation</th>
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<tr>
<td>Neuroticism</td>
<td>.30**</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>.58**</td>
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<tr>
<td>Extraversion</td>
<td>-.01**</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>.46**</td>
</tr>
<tr>
<td>Openness</td>
<td>.33</td>
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</table>

** p < .01.
ABSTRACT
How society and the legal system should respond to youth crime is a volatile issue. Much research exists on this topic broadly. A largely overlooked subset exists regarding the rights of juveniles in the United States who face pretrial confinement, specifically how juveniles accused of delinquency are treated by the courts. Delinquency or a delinquent act, in the context of this study, is "an act that would be considered a crime if committed by an adult." Adults and children are processed by the courts differently, each with their own rights and court mandated procedures to follow. This report analyzes juvenile detention with specific focus on the U.S. Supreme Court case Schall v. Martin 467 U.S. 253 (1984) and how this case affects juveniles in the court system today.

The primary sources for this research include documentation from various court cases, including legal briefs, pleadings, and court decisions from multiple levels of the justice system up to and including the United States Supreme Court. Secondary sources included a number of books published by subject matter experts in juvenile justice.

INTRODUCTION AND PURPOSE OF THE STUDY
The purpose of this study is to examine “due process” within the juvenile justice system, with a focus on juvenile pretrial detention. The United States Constitution, the Bill of Rights, Amendments to the Constitution, and various legislative actions over the last two hundred years, all ensure that adults in America, when charged with a crime, regardless of citizenship status, are guaranteed basic civil rights of “due process.” Juveniles, however, even those charged with minor

infractions, do not currently enjoy the same protection. This project analyzes the issue of juvenile pretrial detention by revisiting Schall v. Martin 467 U.S. 253 (1984), which has shaped the debate of juvenile detention practices for the last three decades.

The basis of this study comes from a combination of both subject matter books and records from pertinent court cases. The books selected establish the formative years of the American juvenile justice system. Information from these books provides a clear understanding of the general underlying issues and how the juvenile system has developed. To better understand the effects on laws today and how courts use these laws to rule on juvenile detention, it was also necessary to conduct in-depth analysis of various legal briefs, judicial decisions, and case records from various levels of the court system, including the United States Supreme Court. Through this combination of books and court records, it is possible to analyze how Schall v. Martin affected the determination of the rights of juveniles held in pretrial confinement and how these rules have evolved into their current form.

The concept of individual liberties, such as freedom of speech, religion, and the right to assemble are all set forth in the Bill of Rights. Pretrial detention, regardless of one’s age, is an important issue as it affects the individual liberties most Americans take for granted. When determining a juvenile’s detention status, their treatment is guided by a combination of the U.S. Constitution, a number of legislative actions, and various court decisions. When examining the issue of pretrial confinement within the concept of “due process,” both the Fifth and Fourteenth Amendments to the Constitution are relevant. One problem is the ambiguity of rights defined in the Constitution and how current laws are in potential conflict regarding juvenile pretrial confinement.

Due to various High Court decisions including Schall v. Martin, the rights of adults and those of juveniles have taken separate paths. Figure 1 shows the paths of adults and juveniles through the justice system; there are many differences, including the limitations to punishments imposed upon adjudication. While the paths through the system are different, it is important to understand that a denial of a basic right, such as bail to any citizen, regardless of age, implies the State could simply detain any member of society, effectively giving punishment without a need to prove a case against that individual first.

In order to formulate an understanding of the problem of juvenile detention, it is first necessary to look back at the general history of juvenile justice in its formative stages and how the system used by the courts today was created. In order to obtain this understanding, numerous books written by subject matter experts were reviewed, a sample of these books includes The Constitutional Rights of Children and Juvenile Justice in the Making by David Tanenhaus, Transforming Juvenile Justice Reform Ideals and Institutional Realities, 1825-1920 by Steven L. Schossmen, and American Juvenile Justice by Franklin E. Zimring.

Once a basic foundational understanding of juvenile justice was established, it was next necessary to examine official court records. These records document how basic civil rights for juveniles have reached their current form. The four most significant cases reviewed were: Kent v. United States 383 U.S. 541 (1966) – a case involving the waiver of juvenile court jurisdiction to transfer an adolescent to the adult court for adjudication; In re Gault, 387 U.S. 1 (1967) – a case that challenged the procedural rights of juveniles in the process of adjudication of delinquency; McKeiver v. Pennsylvania, 403 US 528 (1970) - a case that addressed whether juveniles had a right to a jury trial in the adjudicative stage of juvenile hearings; Schall v. Martin 467 U.S. 253 (1984) – a case that challenged the rights of the State to hold juveniles in pretrial confinement.

Before one can understand the current court system, the basic structure of the laws regarding the rights of

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3 Juveniles are no longer subject to the death penalty. Roper v. Simmons, 543 U.S. 551 (2005).
individuals must be understood. These rights are the basis of “due process” which, regardless of an offender’s age classification, form the foundation of the entire justice system. This study will add to general knowledge in this area by examining disparate views of state detention policies and prior court rulings, to form a historically informed view of the problems today specifically focusing on juvenile pretrial detention.

While most effort regarding the study of juvenile rights has focused on the case of Gault, Schall v. Martin has been given only passing attention and then used only as support for other cases. Schall v. Martin has been largely overlooked for review on its own merits, or held to scrutiny for its effects on juveniles. This report will focus primarily on how Schall v. Martin has affected rulings within the juvenile justice system over the last three decades.

**LITERATURE REVIEW**

On November 6, 1976, the New York Police arrested 15-year-old Tyrone Parson for dealing a game of Three-Card-Monte; later, Parson was cited and released to his parents, and given a future court date. Nearly a month later, on December 1, 1976, Tyrone honored the requirement to return to court to face the allegations. As part of the hearing on this date, the judge ordered Tyrone taken back into custody to be detained in a juvenile facility pending trial. He was returned to court on December 6, 1976, but “because the offense alleged did not come within the provisions of the penal law,” the delinquency petition was dismissed and he was released.4 Parson had been held in secure confinement for five days even though the court did not have the required jurisdiction to proceed with the case. The Parson case was just one of thirty-six examples presented to the U.S. Supreme Court in Schall v. Martin to demonstrate alleged abuse of detention authority by New York Family Court.

Responding to juvenile crime is a challenge for society, and is a subject that today continues to spark passionate debate. Juvenile crime is riddled with challenges and conflicts that child advocates against those desiring to curb criminal activities of juveniles. Questions debated include:

- At what point do juveniles need to be treated as adults?
- Do juveniles always deserve different treatment than adults?
- Does a juvenile have the cognitive ability to know right from wrong or to understand?
- Are juveniles competent to understand the consequences of their actions? If so, at what age?
- If a juvenile breaks the law, should he/she be detained?
  - If so, where should he/she be held?
  - Is there a [distinction] between placing youth in “detention” and in “shelter care”?
- Most importantly, do juveniles have the same civil rights as granted to adults, especially regarding the subject of pretrial confinement?

These questions will be examined by the study within the context of history and within the current juvenile justice system.

Prior to the turn of the 20th century, juveniles were treated as common criminals. In most cases, juvenile offenders were placed in holding locations including local jails and prisons until their cases were later adjudicated. While in these facilities, these juveniles were exposed to all forms of abuse, both physical and sexual, not to mention being exposed to criminals who effectively acted as mentors, teaching these children to be better criminals.

Over the years, children’s advocates contended that juveniles accused of crimes needed to be protected while being processed. Protecting juveniles is nothing new – English law originated the concept of “parens patriae,” a “medieval English doctrine of nebulous origin and meaning that was sanctioned by the crown to intervene into natural family relations whenever a child’s welfare was threatened.”

4 Schall v. Martin. 347 U.S. 483 (United States Supreme Court, June 4, 1984), 295.
8 Schlossman, S.
to protect their children, the people (the State) should step in and assume the role of the parent, guiding and protecting said children.

The process of protecting a child, however, can be a double-edged sword. On one side is the protection from harm: taking a child, or children, out of an abusive situation to place them into a protective state, “foster care” or “protective custody,” thus protecting them from further harm. Most would agree this is a good thing. The problem lies on the other side when the rules used to protect children become an excuse to detain them when no other legal options are available – thus the issue of unconstitutional pretrial detention begins.

In the early 1800s, for the betterment of the child, the rule of “parens patriae” was often used by the courts in order to detain children in reform schools. One of the earliest American reform schools was the House of Refuge for Juvenile Offenders. This facility, located in New York, first opened in 1825.9 The House of Refuge was designed to be “a full-time residence for dependent, delinquent, and the collected youth;” however, it turned out to be a brutal blend of a strict educational setting and a reform setting that more closely resembled a prison.10 The perceived advantage to the House of Refuge was that it “promised judges, juries, police, and disgusted and overwhelmed parents an alternative to committing children to local jails or prisons.” Unfortunately for the incarcerated juveniles, this “promise” was not kept. The wealthy had resources to prevent their children from being housed here; unfortunately the poor, with a lack of resources, became the primary clientele served by this new facility. Hence, the overwhelming demographic of this prison were the underprivileged.12

During the nineteenth century, child savers advocated for additional protections for children.13 For example, in 1869 the Illinois General Assembly created the Board of State Commissioners of Public Charities. The purpose of this new board was “to consider new questions arising out of the experience as to the best modes of treatment and improvement of various classes of patients and inmates in our several benevolent institutions.”14 This was a huge step forward. Even though the board members were unpaid, the state recognized a need for advocates who would be “responsible to investigate charitable and correction institutions within the state and does the century concluded responsible for Chargers for any charity that wanted to care for dependent or neglected children.”15 This is one of the earliest stages in which the State acknowledged that proper pretrial detention required more than a child simply being stuck in a jail cell.

The current court process is a complex one, with many opportunities for the court to hold or release a child (see Figure 2). Due to this complexity, it is necessary to understand how today’s juvenile courts got their start. On July 3, 1899, Lucy Flower’s “Parental Court” in Chicago adjudicated its first case. The case of 11-year-old Henry Campbell was heard by the Hon. Richard Tuthill. Vital to this particular

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9 Ibid., 22.
10 Ibid., 23.
11 Ibid., 25.
12 Ibid., 27.
13 Platt, Chapters 1 and 2.
14 Ibid., 117.
15 Ibid., 118.
case was the concept “that a child should be treated as a child.”\textsuperscript{16} Finally, court officials had recognized that children should be treated differently than adults. Now there was a basis for looking at children in a different light. While this did not address the issue of pretrial confinement, it was a first step in changing the overall treatment of children within the justice system.

Many experts perceive that for the better part of a century, under the excuse of protecting either the child or society, pretrial confinement of juveniles was used by the courts as punishment. This is in stark contrast to the idea of Timothy Hurley, the first chief probation officer of Chicago juvenile courts, who said, “No child should be punished for the purpose of making an example of, and he certainly [cannot] be reformed by punishing him. The parental authority of the state should be exercised instead of the criminal power.”\textsuperscript{17} While this was great in concept, in practice over the following decades this turned out to be a hollow ideal. Adults and juveniles are treated differently, as there are distinct and different end goals. For adults, the process is a formal one designed to determine if they will return for trial; for juveniles, the goal is to protect the welfare of the child.\textsuperscript{18}

From the early 1960s to the mid-1980s, America saw a wave of civil rights challenges, (see Figure 3). Battles were fought on many fronts – from the rights of African-Americans to attend the same schools as whites in \textit{Brown v. the Board of Education}, 347 U.S. 483 (1954), to the rights of women with the Equal Rights Amendment.\textsuperscript{19} Similarly, many battles were fought to change the way that juveniles were protected under the constitution. The first of these juvenile cases, \textit{Kent v. United States} 383 U.S. 541 (1966), challenged the juvenile court’s authority to transfer a juvenile case to adult court for adjudication without following “due process.” Although this case did not deal with pretrial confinement per se, it was a pivotal moment in the arena of juvenile civil rights.\textsuperscript{20} In this case, the Supreme Court maintained that juveniles had rights and “due process” had to be followed. No longer could juvenile courts act on a whim; they now had to follow a standard procedure.

Commonly studied as the most pivotal case regarding juvenile civil rights to date is \textit{In re Gault}, 387 U.S. 1 (1967), which affirmed some basic civil rights for all juveniles within the justice system.\textsuperscript{21} Most poignant of these affirmations stated that juveniles have the right to an attorney during the adjudication of delinquency stages. The High Court ruled juveniles needed to be informed of their rights against self-incrimination – in other words, \textit{Miranda} stood.\textsuperscript{22}

The next significant case of the period, \textit{McKeiver v. Pennsylvania}, 403 US 528 (1970), raised the question of juvenile’s right to demand a trial by jury while in the adjudicative state of a juvenile hearing. The Appellants argued that the State of Pennsylvania was violating the constitution by refusing to allow juveniles to request a jury to decide their cases. While Justice Blackmun, writing for the majority, admitted that the juvenile courts had “disappointments, failures, and shortcomings in the juvenile court procedure,” he wrote that the Constitution did not require a trial by jury for all cases, especially in the cases of juveniles.\textsuperscript{23}

Justice Blackmun expressed concern that by allowing a jury trial, that the juvenile system would lose its informality and become instead “a fully adversarial process.”\textsuperscript{24} He further wrote that the courts would become backlogged if the adversarial process was followed. In a dissenting opinion, Justice Douglas called into question the concept of the adversarial nature of the jury trial system, and noted the potential possible delays it would cause. Pointing to a survey of twenty-six courts, Justice Douglas argued that while this state allowed juveniles to request juries, they seldom did and the delays feared by the majority were unfounded.\textsuperscript{25} This case was a turning point, in an action by the High Court that signaled the end of a civil rights winning streak for juvenile rights during this period (see Figure 3).

\textsuperscript{17} Ibid.
\textsuperscript{18} Manfredi, 328.
\textsuperscript{20} Schlossman, 53.
\textsuperscript{22} Miranda 384 U.S. 436 (1966), the case that decided individuals being questioned regarding a crime had a right to be notified of their Fifth Amendment rights against self-incrimination stood, even for juveniles.
\textsuperscript{24} Ibid., 545.
\textsuperscript{25} Ibid., 563.
Finally, in June of 1984, the U.S. Supreme Court ruled on Schall v. Martin 467 U.S. 253 (1984) regarding the constitutionality of pretrial confinement of juveniles while adjudicating delinquency. This ruling raised more questions than it answered. The case was built on the concept that the courts did not have a right to the unlimited and arbitrary pretrial confinement of juveniles. At the heart of the case, was the accusation that the City of New York’s juvenile courts routinely detained juveniles without regard to “due process.” Schall v. Martin started as a Habeas Corpus action brought against the New York Family Courts, as juveniles were being detained under section 320.5 (3)(b). It was argued that this section of New York law violated the “due process clause” of the Fourteenth Amendment, and that the statute was flawed because it allowed for justices of the juvenile court to be able to hold juveniles without probable cause, even though the child, if adjudicated delinquent, would not likely serve any jail time. The Appellants further argued the fact that juveniles were being held only on the merit that they “might” commit another delinquent act was an additional violation of “due process.”

Schall v. Martin worked its way up through the court system. The first stop was the United States District Court, which certified the class action of “all juveniles who [were then] or [would] be held before [the proceedings were concluded], in pretrial detention” under the New York Family Court statute, as it did violate the protections of “due process” under the Fourteenth Amendment. The State of New York appealed this decision to the United States Court of Appeals for the Second Circuit, which upheld the findings of the lower court. The court agreed the statute was a violation of the juvenile’s constitutional rights. The State of New York next appealed to the United States Supreme Court. The behavior of the New York Family Court, seen as an egregious violation by many groups (including the American Bar Association, Attorneys’ Generals, and representatives of multiple states), caused them to file amicus briefs urging this statute be struck down. The case was heard on January 24, 1983, when the law was allowed to stand and the lower court’s rulings were overturned.

In the majority opinion delivered by Justice William Rehnquist, the court determined that the State of New York had not violated the “due process” protection of the Fourteenth amendment. The majority opinion affirmed that the statute of New York calling for preventative detention was constitutional. Rehnquist expressed that the statute was compatible with “fundamental fairness” as required by the “due process clause,” and that they served to protect both juveniles and society. The majority wrote that just because a juvenile was held in detention, even if they were subsequently placed on probation or adjudicated not delinquent, did not in itself constitute punishment.

This decision was in stark contrast to that of the lower District Court, which decided that since the vast majority of juveniles held under the statute were released after adjudication with their cases either outright dismissed or simply given probation, that the New York statute violated “due process” as

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28 Guggenheim, Martin – Counsel of Record, American Civil Liberties Union, New York – New York, Lexis Nexis – Appeal from United States Court of Appeals for the Second Circuit, October 14, 1983 [*1].
30 Schall v. Martin, 253.
31 Ibid., 264.
guaranteed under the Fourteenth Amendment. In fact, both the U. S. District Court and U.S. Court of Appeals had ruled that this pattern of pretrial confinement was serving solely as punishment, especially for cases that had not yet been adjudicated. In contrast, the majority on the High Court went so far as to say that because juveniles had both the ability to pursue Habeas Corpus and had access to appeals, that even though there were “challenges to its constitutionality,” these challenges could be “heard on a case-by-case basis” rather than fixing the law as a whole.

While the High Court acknowledged that the “Due Process Clause [was] applicable in juvenile proceedings . . . The problem . . . [was] to ascertain the precise impact of the “due process” requirement upon such proceedings.” The question for the Court was not whether the right of “due process” extended to children, but whether the constitution required equal treatment for children by the elimination of all differences between adults and children within the criminal justice system. Rehnquist explained that preventative detention was “designed to protect the child and society from the potential consequences of his criminal acts.” According to Rehnquist, it was necessary to consider not just the needs of the child, but also those of society when determining the appropriateness of pretrial detention for children. In this decision Rehnquist held that the liberty of the child was subordinate to the State’s responsibilities of “parens patriae” by “preserving and promoting the welfare of the child.”

When examining the question of pretrial detention used as a punishment, or “protection” according to the State of New York, Rehnquist wrote that it was the court’s responsibility to “decide whether the disability [was] imposed for the purpose of punishment or whether it [was] but an incident of some other legitimate governmental purpose;” in other words, the fact that the State was protecting both society and the child did not necessarily make the child’s incarceration punishment. It was not clear to Rehnquist that the statute, as written, was designed to create punishment. Further, Rehnquist noted that because juveniles were entitled to expedited hearings, and were only held for short periods of time (typically less than 14 days), the “conditions of confinement also appear to reflect the regulatory purposes relied upon by the State.” This supported Rehnquist’s view that this particular confinement was not creating a condition of punishment.

In continuing to address the argument of pretrial confinement being used as punishment, even after large majority of cases were being dismissed without adjudication, Rehnquist defended this concept by saying that there are numerous reasons why cases are dismissed. Rehnquist pointed out the court could not foresee all outcomes: “a Family Court judge cannot be expected to anticipate such development[s] at an initial hearing. He makes his decisions based on the information available to him at the time, so the propriety of the decision must be judged in that light. Consequently, the final disposition of a case is “largely irrelevant” to the legality of a pretrial detention.”

Writing in dissent, Justice Marshall argued the New York Family Court statute, as written, was far too broad. Marshall wrote that the statute allowed for pretrial detention without the consideration of probable cause, without regard to prior criminal acts or delinquent history, and was not limited to the prevention of serious crimes. Justice Marshall explained that the District Court’s findings regarding the application of the statute should stand, saying, that “unless clearly erroneous” the findings were binding upon the High Court and that these same findings should guide the analysis of the constitutionality of the statute.

32 Schwarz, Jr., Frederick A. O. − . Counsel of Record, Corporation Counsel of the City of New York, Attorney for the Appellant, Brief for Appellant Schall, August 15, 1983, 11.
33 Schall v. Martin, 274-281.
34 Ibid., 264.
35 Ibid.
36 Ibid.
37 Ibid., 264-267.
38 Ibid.
39 Ibid., 270.
40 Ibid., 271.
41 Ibid., 271-274.
42 Ibid., 299.
43 Ibid., 284.
The minority opinion in Schall v. Martin also expressed concerns over multiple procedural issues. Of foremost concern was the fact that a family court judge, moments before a hearing, would appoint counsel for juveniles charged with crimes. The newly appointed attorney would then be expected to present a competent defense, without appropriate time to adequately review the case, or to thoroughly examine the child’s background before having to answer the charges in open court.

Another major failure expressed by the minority opinion was that the New York statute failed to give judges any guidance as there were no limitations, and no procedures to follow, thus the actions of the juvenile judges were discretionary. Marshall also addressed concern that due to these procedural problems, juveniles with no criminal past or those with no adjudicated criminal history were being detained with little or no “due process.”

Of further serious concern to the minority was the issue of the family court judge taking a child into pretrial confinement even after he or she had been released post arrest. This change in liberty status occurred sometimes within just a few days. Marshall wrote that the sample class, “despite the absence of any evidence of misconduct during the time between their arrests and initial [court] appearances,” were being confined, thus supporting the suspicion that pretrial detention was being used as a punishment.

Another major concern expressed by Marshall was that pretrial detention occurred within secure detention facilities. Marshall said that this brought new troubles to the juveniles and expressed concern that by being held in these facilities, juveniles were being subjected to strip searches and the requirement of wearing institutional uniforms. Marshall wrote of concern regarding the potential for the emotional trauma inflicted on juveniles having to follow prison-like regiments.

Justice Marshall expressed concern over the overwhelming percentage of juveniles held in pretrial confinement and then released either before or immediately after adjudication. Marshall wrote because a large percentage of juvenile cases were either dismissed without adjudication or the defendant was released on parole immediately after adjudication that this supported the position that the City of New York was using pretrial confinement as punishment.

Reflecting on the fact that the majority agreed that the Fourteenth Amendment applied to both children as well as adults, Justice Marshall again raised the question of “fundamental fairness” as required by the Due Process Clause. Justice Marshall questioned the majority and their “grudgingly and incompletely [acknowledging] the applicability” of the need to ensure a compelling State interest. Marshall pointed out in the dissent that liberty, above all else, meant freedom from physical restraint. In doing so, Justice Marshall called into question the fact that preventative detention is not merely a transfer of guardianship, but in fact a form of imprisonment. It was the feeling of the minority that considering a minor’s “impressibility,” that this period of confinement could cause additional injury. The concern here was that holding juveniles in detention could actually encourage delinquency, as the child might then see society as a whole as being “hostile and oppressive.”

In addressing the majority’s argument of pretrial confinement preventing future juvenile crime, Marshall pointed out that this reduction happens only “occasionally and accidentally.” Justice Marshall commented on the lack of evidence that the New York detention statute substantially prevented crime. Marshall pointed out that there was no statistical difference between the number of children committing crimes between their arrest and initial appearance, and the number of children committing crimes between their initial appearance and their trial date. The minority made it clear in their opinion that the argument that the New York statute protected society was reduced, thus also reducing the argument that pretrial confinement was a compelling State interest.

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44 Ibid., 303.
45 Ibid.
46 Ibid., 288.
47 Ibid., 287-291.
48 Ibid.
49 Ibid., 289.
50 Ibid., 292.
51 Ibid., 294.
While the High Court ruled that juveniles can be treated differently from adults, it is clear that this ruling is not the end of the story. The issue of pretrial confinement is a critical subject for continued research. As society changes, so do attitudes regarding issues, such as juvenile justice. Currently, there is a push to change the entire concept of juvenile confinement. As shown in the *Comeback States* report, a number of states are seeing promising results by decreasing detention in both pretrial and post-adjudication settings.52 The next logical step to this report is to analyze this evolution in juvenile justice, and study how the changes being applied to juvenile cases in all fifty states.

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SUMMARY OF LITERATURE REVIEW

Based on the findings of this report the system of American juvenile justice is at a crossroads. What started as a bold social experiment in Chicago has, as is the case of most political issues, followed an ebb-and-flow as pressures from the public have demanded. The effect of the case of Gault was almost immediate; within a few short years, the public was screaming for harsher punishments and better control of juvenile offenders. By the 1970s, the trend of “friendly” juvenile court rulings had turned.53 In 1970, the U.S. Supreme Court denied juveniles their constitutional right to trial by jury.54 In 1984, the court denied that juveniles should be treated the same as adults during the adjudication stage of delinquency hearings regarding pretrial detention.55

Today, the system of juvenile justice is at a turning point. Does the system continue “as-is,” with all parties knowing there are flaws, or do policy makers need to step in and examine new visions and concepts to amend the system?

53 Tanenhaus, 111.
54 McKeiver v. Pennsylvania.
55 Schall v. Martin.
METHODOLOGY
Due to the subject matter and working within the confines of both the length of project and availability of resources, this project presented no need for quantitative research. It did, however, require extensive qualitative efforts.

In order to complete this study, it was necessary to conduct an extensive analysis of the official court records of multiple cases and subject matter experts within the area of juvenile justice. The project included a need to research the following:
• Establish a basis for understanding the underlying history of juvenile justice as a whole
• Examine the progress of juvenile justice parallel to that of the adult justice system
  › Identify a need for different treatment
  › Identify critical differences in process
• Analyze the effects of the U.S. Supreme Court of the rights of Juveniles
• Consider the future of Juvenile justice within the State of Nevada

Each of these key issues was examined extensively and the findings reported in detail within the body of the report.

The terms used in this research are of a primarily non-technical nature. All of the technical terms used were explained within the body of the report; therefore, there is no need for additional explanation.

All information collected was taken from historical court records and supported with books by subject matter experts. While court records were used to establish a factual record, subject matter books helped establish and relay a basic background to facilitate understanding of the context of the juvenile justice issues.

DATA ANALYSIS
• No data collection was preformed; see Literature Review for project analysis.

RESULTS
• No testing was conducted

CONCLUSION / FURTHER STUDY
Currently, juvenile justice experts are examining the change in public attitudes and evaluating new methods of dealing with juveniles, especially where the issue of detention, both pre and post adjudication, is involved. In a report titled The Comeback States, the National Juvenile Justice Network & Texas Public Policy Foundation examined the trends of juvenile justice since 1985 and found a correlation between detention, even as punishment, and its effect on long term juvenile crime statistics.56

The results for this report indicate a need for change regarding the use of confinement in juvenile cases. It is clear to this researcher that the people of the State of Nevada will be greatly affected by this question in the future, and it should be further explored.

53 Comeback States Report - Final.
ABSTRACT
‘Aigarchaeota’ is a candidate phylum of Archaea known only by 16S rRNA gene fragments from cultivation-independent microbial surveys and a single composite genome from Candidatus ‘Caldiarchaeum subterraneum’, an inhabitant of a subterranean gold mine in Japan. Gene sequences reported in various publications were found almost exclusively in geothermal settings, but a comprehensive assessment has not yet been performed. Public databases were mined for 16S rRNA gene sequences related to known ‘Aigarchaeota’ and a combination of approaches were used to rigorously define the phylogenetic boundaries of the phylum. The analyses supported the proposed relationship between ‘Aigarchaeota’, Thaumarchaeota, Crenarchaeota, and Korarchaeota in the so-called ‘TACK’ superphylum, and identified ~300 16S rRNA genes and gene fragments affiliated with ‘Aigarchaeota’, including those recovered from terrestrial geothermal systems on several continents (North America, Asia, Africa, Europe, and Oceania) and marine geothermal and subsurface samples in both the Atlantic and Pacific. ‘Aigarchaeota’ belonged to at least three family- to order-level groups and at least 13 genus-level groups. All genus-level groups were recovered from geographically distant locations, suggesting a global distribution within amenable habitats. ‘Aigarchaeota’-specific primers for the polymerase chain reaction (PCR) amplification of 16S rRNA genes were designed using SP-Designer, ARB, and AlleleID, and reviewed using the Ribosomal Database Project Probe Match tool. Primer template gene sequences were aligned in ClustalW in order to locate regions that are suitable for targeting genus-level groups. The primers will be used to determine the presence and abundance of ‘Aigarchaeota’ in a wide variety of samples from terrestrial geothermal systems in the western U.S. and Asia using quantitative real-time PCR (qRT-PCR).

INTRODUCTION
A primary objective of microbial ecology is to determine how physicochemical factors, such as pH, temperature, and dissolved oxygen, influence the distribution and abundance of microorganisms in their unique habitats (Brock, 1966). Terrestrial geothermal springs around the world have been
studied for decades due to the presence of microorganisms that thrive at high temperatures. However, our knowledge of terrestrial geothermal ecosystems remains limited because some microorganisms detected in cultivation-independent censuses of microbial communities fail to grow in laboratory culture (Hugenholtz et al., 1998; Rappé and Giovannoni, 2003). One important discovery in microbiology in recent years is the existence of major lineages of microorganisms in nature that have never been studied. These lineages have recently been referred to as "biological dark matter" or "microbial dark matter" to emphasize the unknown nature of these microbes (Marcy et al., 2007; Rinke, et al., 2013). One of these so-called "microbial dark matter" groups was originally described as pSL4 during a phylogenetic analysis of 16S rRNA genes representing the microbial community in Obsidian Pool (74-93 °C) in Yellowstone National Park (Barns et al., 1996). Subsequently, Marteinsson et al. (2001) detected pSL4 sequences in subterranean hot springs in Iceland (71.8 °C). Gene sequences related to pSL4 were also found in an unusual microbial mat formation at a depth of 320 metres in a subsurface gold mine in Japan (Nunoura et al., 2005), and grouped under the name Hot Water Crenarchaeotic Group 1 (HWCG 1). A metagenomics study of that same Japanese deep subsurface mine microbial mat community led to the construction of a complete composite genome for a member of the pSL4/HWCG 1 lineage (Nunoura et al., 2005; Nunoura et al., 2011), proposed as Candidatus 'Caldiaarchaeum subterraneum' as the first proposed taxonomic epithet for the phylum 'Aigarchaeota'. Analyses of the Ca. 'Caldiaarchaeum subterraneum' genome reported the presence of one Ni-Fe NADP-reducing hydrogenase and an aerobic type carbon monoxide dehydrogenase. Those genes, along with those predicted to encode a membrane-bound nitrate reductase, a periplasmic nitrite reductase, and a respiratory chain including a cytochrome c oxidase suggest potential for chemolithotrophic growth using hydrogen or carbon monoxide as electron donors, and oxygen, nitrate, or nitrite as electron acceptors. In contrast, 'Aigarchaeota' representatives were found to co-occur in anaerobic hydrothermal environments with strict anaerobes (Nunoura et al., 2010), which may suggest a strictly anaerobic metabolism for some marine 'Aigarchaeota'. As a result, it's likely that a diverse physiological potential exists within the phylum.

The Ca. 'Caldiaarchaeum subterraneum' genome not only provides insight into the biology of this novel phylum but also expands our understanding of the evolution of Archaea, since genomic analyses also revealed several eukaryote-type features not documented previously in Archaea. (Nunoura et al., 2011). These results led to proposal of a superphylum level relationship called the 'TACK' (Thaumarchaeota, Aigarchaeota, Crenarchaeota, Korarchaeota) superphylum. The 'TACK' superphylum contains genomic features exclusively shared with eukaryotes and is thought to have given rise to the 'archaeal parent' of the eukaryotic cell (Guy and Ettema, 2011).

The cultivation-independent studies available to date suggest a world-wide distribution of 'Aigarchaeota' in terrestrial and marine geothermal environments, and some studies have also shown evidence that 'Aigarchaeota' dominates some of these habitats. For example, an investigation of a deep sea hydrothermal vent in Okinawa Trough reported that HWCG 1 was one of the dominant groups in the rRNA gene clone libraries from hydrothermal sediment samples at 2 m (55-60 °C) from the sea floor vent with source temperature at 90°C (Nunoura et al., 2010). Similarly, Cole et al., 2012 reported that 'Aigarchaeota' was one of the dominant lineages in Great Boiling Spring (GBS) in northern Nevada, including 80-87 °C sediments (Site A) and 79 °C sediments (Site B). 'Aigarchaeota' 16S rRNA gene sequences had the highest relative abundance at Site A (~54% of total 16S rRNA genes), with a general trend of decreasing relative abundance down to ~5% of total 16S rRNA genes at 62 °C (Site E). That study also showed different composition and relative abundance of 'Aigarchaeota' along a temperature gradient, suggesting 'Aigarchaeota' niche differentiation along a thermal gradient.

While these studies provide insight into the potential physiology and evolution of 'Aigarchaeota', a comprehensive synthesis of the environmental distribution and phylogenetic structure of 'Aigarchaeota' is still lacking. The purpose of this study was to gather 16S rRNA gene sequences potentially belonging to 'Aigarchaeota', and to use those sequences to address several goals: (i) to rigorously define the phylum; (ii) to gain insight into the phylogenetic and potential taxonomic structure of the phylum; (iii) to assess the distribution of 'Aigarchaeota' as a whole, along with individual groups of 'Aigarchaeota' in nature; and (iv) to design
'Aigarchaeota' specific 16S rRNA gene primers that combined, will target all potential genus-level groups.

**METHODODOLOGY**

**DATABASE MINING**

The 16S rRNA gene sequence of Ca. 'Caldarchaeum subterraneum' was submitted to BLAST, and the accession numbers of all gene sequences with greater than 80% identity were recorded. 80% identity is commonly used to circumscribe microbial phyla (Cole et al., 2013; Peacock et al., 2013; Schmitt et al., 2012; Webster et al., 2010). Iterative BLAST searches were performed on each individual accession number representing potential 'Aigarchaeota', and the process of capturing new accession numbers with greater than 80% identity was repeated. The resulting product of database mining was a spreadsheet with the gene sequences, accession numbers, sample locations, and publication source for each BLAST result that showed possible phylum-level evolutionary relationships, according to the BLAST algorithm.

**ITERATIVE PHYLOGENETIC TREE CONSTRUCTION TO DEFINE THE MEMBERS OF THE PHYLUM ‘AIGARCHAEOTA’**

Gene sequences mined from GenBank were organized into FASTA format and aligned in mothur using a 50,000 character SILVA reference alignment capable of aligning sequences from all three domains of life (Schloss et al., 2009). Sequences associated with a wide variety of out-groups, including Bacteria, Crenarchaeota, Euryarchaeota, Thaumarchaeota, Korarchaeota, Nanoarchaeota, and the Miscellaneous Crenarchaeotic Group (MCG) were added to the FASTA file, in addition to the gene sequences representing possible 'Aigarchaeota'. Alignments were manually curated in BioEdit version 7.1.3.0 (Hall, 1999). Finally, the alignment was trimmed from 50,000 characters to the length of the shortest sequence in the alignment, making it easier to review the individual nucleotide positions on a manageable scale for creating the best alignment. The final alignment was saved as a Phylogenetic Inference Package (PHYLIP) version 4-compatible file for processing in various programs contained within PHYLIP. First, a distance matrix was computed using 'Dnadist' according to the F84 nucleotide substitution model (Kishino and Hasegawa, 1989; Felsenstein and Churchill, 1996). The resulting distance matrix was used in the "Neighbor" program, which clusters lineages and constructs a tree according to the neighbor-joining method (Saitou and Nei, 1987). Due to the variable size of sequences published in GenBank that BLAST associated with 'Aigarchaeota', from 200 to 1,500 nucleotides, it was necessary to produce over a dozen different trees because the alignments are based on the shortest sequence length. The Miscellaneous Crenarchaeotic Group is closely related to 'Aigarchaeota', so each individual neighbor tree allowed for the determination of a sequence to be either 'Aigarchaeota' or MCG. The "Seqboot" program was used to generate 100 bootstrapped datasets, and the bootstrap tree was submitted to the "Consense" program, which uses consensus tree methods (Margush and McMorris, 1981) and provides a bootstrap value at each node. After compiling several neighbor-joining trees and strictly defining the sequences that are representative of 'Aigarchaeota', a final phylogenetic tree was constructed with all 'Aigarchaeota' sequences and out-groups greater than 1200 nt using the "Neighbor" program, which produced a newick file that was viewed in Dendroscope version 2.7.4 (http://ab.inf.uni-tuebingen.de/software/dendroscope/). The trees were rooted at the node separating bacterial out-groups from all archaea. The original PHYLIP-formatted distance matrix was processed in mothur using the cluster command to organize sequences into OTUs with the average neighbor algorithm. The resulting outfile grouped sequences into OTUs from 99% to 31% identity, and sequences were subsequently evaluated at the species (>97%), genus (>95%), family (>90%), order (>85%), and phylum (>80%) level visually in Dendroscope.

**PRIMER EVALUATION**

Three different programs were used to design 'Aigarchaeota' specific qRT-PCR primers: SP-Designer, ARB, and AlleleID. SP-Designer is a recently released, free and open source program that was created specifically to provide a user-friendly application for the design of species-specific primers (Villard and Malausa, 2013). ARB (ARBor, latin: tree) software (http://www.arb-home.de) is an older, UNIX-based tool that has been widely used to design PCR primers. AlleleID is a PREMIER Biosoft program (http://www.premierebiosoft.com/bacterial-identification/) that locates species-specific regions in alignments. SP-Designer was unique in that it required the manual curation of an alignment of 'Aigarchaeota' and out-groups in BioEdit prior to uploading the file to the program. ARB and AlleleID have built-in sequence alignment tools, which raises the possibility of inaccurate alignments. Each program provides an output file with 'Aigarchaeota'
specific primers, but each primer must be carefully evaluated to determine if the primer will also hybridize with non-‘Aigarchaeota’ sequences. Each primer was submitted to the Ribosomal Database Project (RDP) Probe Match tool (http://rdp.cme.msu.edu/probematch/search.jsp), which is hosted and maintained by the Center for Microbial Ecology at Michigan State University. Depending on the location of the target sequence, the primer was selected as either a forward or reverse primer, and then searched in RDP as targeting either the positive or negative DNA strand, accordingly. The RDP search results provide a comprehensive list of all sequences that match that primer, sorted by taxonomy. The first indication of a good primer was a match with a low number of Archaea and zero Bacteria. In some instances, all of the matches were to sequences that had been identified phylogenetically in this study as ‘Aigarchaeota’, although the taxonomic structure in RDP is not currently updated to reflect that phylogeny. Screening in RDP allowed for primers matching to non-‘Aigarchaeota’ to be eliminated from consideration. Primers that did match well with ‘Aigarchaeota’ were reviewed in RDP to determine which genus-level groups were associated with each of the individual primers. OligoCalc (http://www.basic.northwestern.edu/biotools/OligoCalc.html) was used to review potential primers to ensure that the GC content was approximately 50%, the melting temperature was around 60°C, and that there was no self-complementarity, no hairpin formation, and to screen for potential self-annealing sites.

RESULTS
AIGARCHAEOTA POSITION IN ‘TACK’ SUPERPHYLUM DEFINED AND GENUS-LEVEL GROUPS Delineated GenBank database mining and iterative phylogenetic evaluation of the phylum resulted in a total of 341 16S rRNA gene sequences of varying lengths that represent the phylum ‘Aigarchaeota’. Sequences >1,200 nucleotides in length were grouped at a level of 95% identity, roughly corresponding to a microbial genus (Cole et al., 2013; Peacock et al., 2013; Schmitt et al., 2012; Webster et al., 2010), resulting in 13 genus-level groups within the ‘Aigarchaeota’. Due to their common ancestry, Groups 1A, 1B, 1C, 1D and 1E, as well as Groups 2A and 2B have a naming convention that implies a relationship, possibly at a the family level, but they are likely separate genera. To our knowledge, this is the first attempt to delineate taxonomic groups within this phylum.

AIGARCHAEOTA ARE GLOBALLY DISTRIBUTED AND SHOW CLEAR DIFFERENCE BETWEEN TERRESTRIAL AND MARINE ECOLOGY
All ‘Aigarchaeota’ sequences greater than 1200 nt were assigned to 1 of 13 genus-level groups based on average neighbor OTU clustering of sequences at greater than 95% identity. Figure 2 shows all 341 sequences organized into 1 of 6 habitat categories: Terrestrial, Terrestrial Subsurface, Marine, Marine Subsurface, Hypersaline, and Bioreactor. Locations where samples were collected are shown on the map, and the common color scheme associated with the map and the tables corresponds to temperatures, as defined in the legend. The numbers next to each circle on the map represent the total number of ‘Aigarchaeota’ gene sequences that are associated with that sampling site. Figure 3 demonstrates a color coded representation of the global distribution of ‘Aigarchaeota’ genus-level groups, which isn’t clear from Figure 2, but provides an additional way to assess the shift in type of groups dominant in either terrestrial or marine samples.

PRIMER SELECTION
SP-Designer found 16 unique ‘Aigarchaeota’-specific PCR primers, but analyses with the RDP showed that only 8 were specific enough to ‘Aigarchaeota’ thus, eligible for further investigation. The benchmark chosen for judging if a primer was specific enough to ‘Aigarchaeota’ in the RDP results was if the total number of ‘Aigarchaeota’ sequences matching was greater than one half of the total number of Archaea matching. ARB found 51 potential primers, but none were specific enough because most matched ‘Aigarchaeota’ in wide range between 1/100 and 1/5.
Errors" column. The "1 Error" and "2 Errors" columns show the ratio of total 'Aigarchaeota' to total Archaea matching the primer if one or two nucleotides are mismatching. Primers can still hybridize to templates with mismatches, so the number of errors, and subsequent matches with increasing numbers of non-'Aigarchaeota' provide insights into the overall fitness of these primers.

**DISCUSSION**

The structure of the phylogenetic tree in Figure 1, with Euryarchaeota branched separately from the 'TACK' superphylum, and with *Thaumarchaeota* and 'Aigarchaeota' sharing a common ancestor, is the exact same structure published previously (Nunoura et al., 2011; Guy and Ettema, 2011; Rinke et al., 2013), supporting the general accuracy of the phylogenetic tree itself, and lending credibility to the subsequent grouping of 'Aigarchaeota' genus-level groups. In contrast to the results in Figure 1, the Guy and Ettema (2011) 'TACK' superphylum clusters the Miscellaneous Cren Group within 'Aigarchaeota', whereas Figure 1 suggests MCG is a unique phylum that branched prior to the divergence of *Thaumarchaeota* and 'Aigarchaeota'.

A small number of trends can be observed from Figure 2. First, 'Aigarchaeota' has been found on several continents and displays a global distribution, as shown in Figure 3. There is no evidence that any suggested genus-level group is endemic to one particular region of the world. Second, the results strongly suggest that 'Aigarchaeota' are mostly thermophilic or hyperthermophilic since they are predominantly found in habitats >50°C, with only a small number of 'Aigarchaeota' sequences recovered from cooler temperature samples, such as the sequences were found in a study of a subzero hypersaline spring in Canada. Alignments were performed with 16S rRNA sequences to compare Ca. *Calidibacterium subterraneum*, a known representative of 'Aigarchaeota', and the Arctic hypersaline...
representatives. The Ca. ‘Caldiarchaeum subterraneum’ gene is full-length, approximately 1500 nt, and the Arctic hypersaline gene is about 300 nt, or about 20% of the gene. The alignment produces 86% identity across 20% of the gene, so issues with gene length might be contributing to inaccurate classification as ‘Aigarchaeota’. Additional studies will be needed to confirm the taxonomy of these hypersaline communities. Third, there isn’t enough temperature data on marine samples to imply anything significant. Finally, it appears that Groups 1A, 2B, 3, 4 & 5 are predominantly found in terrestrial habitats, Groups 6-8 are predominantly found in marine habitats, Group 2A is found in both habitats, Groups 1B and 1C are only found in terrestrial habitats, and Group 1D is only found in marine habitats. Out of 99 detected full-length 16S gene sequences, 22 belonged to group 1A followed by 19 and 18 from groups 2A and 3 respectively. This could suggest that some specific groups of ‘Aigarchaeota’ may be more abundant than others. On the other hand, this abundance could be due to a greater number of terrestrial studies (54) than marine studies (17). Group 2A showed the most geographical versatility, but this group still appears to prefer terrestrial habitats because twice as many representatives were detected in terrestrial sites than marine. Although there were not many ‘Aigarchaeota’ gene sequences from marine and terrestrial subsurface samples available for analyses, it appears that they follow the same general trends as their surface-level counterparts. It’s important to note that there were fewer gene sequences available from marine habitats than terrestrial environments, making it difficult to make solid comparisons.

The 15 potential primers must be further investigated prior to submitting a primer for synthesis and using it in qRT-PCR studies. Alignments in ClustalW must be performed in order to identify highly conserved nucleotide positions that are unique to ‘Aigarchaeota’ genus-level groups, and do not match with all other archaeal and bacterial outgroups. If the primer sequence is shifted to anchor the 3’ free hydroxyl end of the primer on this “signature nucleotide”, it can help ensure that primers will not hybridize to non-‘Aigarchaeota’ 16S rRNA genes. The primers designed in this study using SP-Designer, ARB, and AlleleID, and screened in RDP for effectiveness in binding only to ‘Aigarchaeota’ give the first hints at the selection of the best primer. The list of 15 suitable primers will likely be paired down to 4 to 6 primers that will be chosen and subsequently synthesized for use in further studies.

CONCLUSIONS

This study revealed, for the first time, the phylogenetic diversity of the novel phylum ‘Aigarchaeota’. Currently available 16S rRNA gene sequences from global studies suggest that the phylum consists of at least 13 genus-level groups, and that ‘Aigarchaeota’ is situated firmly in the ‘TACK’ superphylum, but exists as a separate, unique phylum that does not possess a phylum-level relationship with the MCG. Samples obtained around the world from terrestrial and marine sites were analyzed with regards to sample temperature and taxonomy, and it was discovered that fundamental ecological differences exist between terrestrial and marine ‘Aigarchaeota’. Genus-level Groups 1A, 2B, 3, 4 & 5 are predominant in terrestrial samples, and are not predominant in marine samples. In contrast, Groups 6-8 are predominant in marine samples, and totally absent in terrestrial samples. Group 2A is found in both terrestrial and marine habitats, and Groups 1B and 1C are found only in terrestrial habitats. In addition, Group 1D was found only in marine habitats. There are no ‘Aigarchaeota’-specific primers published in any online public database, so for the first time, this study designed and screened potential primers to develop a list of 15 strong primer candidates that can be further analyzed and optimized to select a small number of primers suitable for synthesis. Later analyses that will result from this work will allow for measuring abundance of ‘Aigarchaeota’ genus-level groups in terrestrial geothermal systems in the western U.S. and Asia using these primers in qRT-PCR.

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KETAMINE INDUCED DEFICITS IN WORKING MEMORY WITH RELEVANCE TO SCHIZOPHRENIA

BY MICHAEL A. LANGHARDT

ABSTRACT
Schizophrenia is a chronic, debilitating brain disorder, which affects approximately one percent of the adult population worldwide. Several models have been proposed as to the etiology of schizophrenia, one of which proposes the hypofunction of a discrete class of excitatory receptors (NMDA) on primarily inhibitory circuits in the brain. This change in signaling is argued to give rise to a loss of coordinated network activity throughout the brain resulting in deficits observed in schizophrenia. Data for this model is based on postmortem alterations in inhibitory circuits and the ability of drugs that block the function of the NMDA receptor to produce deficits similar to those seen in schizophrenia populations. Previous studies in our laboratory have demonstrated the ability of ketamine, an NMDA receptor antagonist, to produce deficits in rodent’s spatial and emotional learning and memory consistent with observations in schizophrenia populations. In these investigations, it was also shown that ketamine administration was sufficient to induce alterations in inhibitory circuits in the brain that are commonly implicated in schizophrenia. In the present study, we examined the extent to which the same administration of ketamine produced deficits in rodent’s spatial reference and working memory performance in the radial arm maze task. As working memory deficits are a core pathological feature of schizophrenia, these investigations seek to further the validity of the ketamine model as it relates to the etiological origin of schizophrenia.

INTRODUCTION
Schizophrenia is a severe neuropsychiatric disorder that is ranked among the leading causes of disability worldwide. The symptoms of schizophrenia are commonly divided into three broad classes: positive symptoms, negative symptoms, and cognitive disturbances (Kay et al., 1987). The positive symptoms of schizophrenia include hallucinations, delusions, and disorganized thinking, while the negative symptoms include affective flattening, social withdrawal, and an inability to plan and carry out future activities. The cognitive disturbances exhibited in schizophrenia include deficits in spatial reference and working memory.
memory as well as difficulties with focus and attention (Lewis et. al., 2007). While the effects of schizophrenia are severe, the etiology of the disorder remains relatively unknown. In recent years, research into the etiology of schizophrenia has focused on a few key lines of convergence among several models. One of these lines of convergence has been the neurotransmitter glutamate (Katrowitz et al., 2010).

The glutamate hypothesis proposes that alterations in the signaling of the excitatory neurotransmitter glutamate may give rise to key aspects of the symptoms associated with schizophrenia (Olney et al., 1995). Early evidence for this model was based on postmortem findings in schizophrenia populations showing an alteration in the overall abundance of markers for the excitatory neurotransmitter glutamate. This alteration has been suggested to manifest in the reduced expression and function of the N-methyl-D-aspartate (NMDA) type glutamate receptor. In addition, separate postmortem examinations of schizophrenia populations have found alterations in the abundance of inhibitory (GABAergic) cell markers (Coyle, 2012). The combination of these post-mortem data has given rise to the glutamate model of schizophrenia, which proposes that a decrease, or hypofunction, of the NMDA type glutamate receptor, principally on inhibitory GABAergic cells, may give rise to specific deficits associated with schizophrenia.

Further evidence for the glutamate model has come from the characterization of the psychotomimetic properties of drugs that act to block the function of the NMDA type glutamate receptor. These drugs, known as NMDA antagonists, include phencyclidine (PCP), ketamine, and MK-801, among many others (Coyle, 2012). Previous studies have shown the ability of these NMDA antagonists to induce periods of psychosis in healthy human populations, similar to those seen in schizophrenia. In addition, when administered to patients diagnosed with schizophrenia, these drugs have been shown to worsen the negative side effects associated with the disorder (Adler et al., 1998). The ability of these drugs to produce symptoms similar to those seen in schizophrenia, as well as the above post-mortem data showing alterations in NMDA signaling, has led to the extensive use of NMDA antagonists in elucidating possible mechanistic features of schizophrenia.

Previous investigations in our laboratory have demonstrated the ability of a low sub-anesthetic 8mg/ml dose of the NMDA receptor antagonist ketamine to produce deficits in spatial reference learning and memory in the Morris water maze task, sensorimotor gating deficits (commonly observed deficit in schizophrenia populations) in rodents (Sabbagh et al., 2012), and emotional learning and memory (Bolton et al., 2012). These findings are consistent with a large number of studies showing that ketamine may impair learning and memory acquisition when administered at sub-anesthetic doses to rodents examined in a variety of spatial learning and memory behavioral tasks. These investigations utilize drugs such as ketamine that act to reduce the function of the NMDA receptor to model in rodents what is being proposed to take place in the glutamate model of schizophrenia. In addition, separate studies have examined the effects of ketamine in human populations and have demonstrated the ability of ketamine to produce deficits in human spatial learning acquisition in a virtual water maze task (Rowland, 2005). These investigations utilizing NMDA antagonists provided the basis for early experimental models of schizophrenia suggesting that the signaling of the NMDA type receptor may be implicated in the pathophysiology of the disorder.

One core aspect of the pathology of schizophrenia is deficits in working memory performance. Working memory is defined as the ability to guide behavior by in the moment representations (Goldman-Rakic et al., 1994). The loss of this ability in schizophrenia has been extensively characterized in human psychiatric populations. It has been suggested that deficits in working memory performance may be the fundamental impairment which leads to schizophrenic thought disorder; that is, the cognitive disturbances exhibited in the disorder (Goldman-Rakic et al., 1994). The ability of ketamine to produce deficits in human working memory performance has been well characterized (Adler et al., 1998). However, there exists a need to evaluate the effects of sub-anesthetic ketamine administration on rodents working memory as it relates to schizophrenia.

In the present study we examined the extent to which the same sub-anesthetic dose of ketamine utilized by previous experiments in our laboratory produced deficits in rodent’s working and reference
memory in a radial arm maze behavioral task. The radial arm maze task allows the separate examination of rodent’s reference memory performance, which is defined as long-term memory across days, and working memory, previously defined as “memory in the moment.” In this experiment, animals were divided into two groups: those administered 8mg/ml ketamine and those administered saline (control). The effects of ketamine on performance in the radial arm maze were measured against the saline group performance. The investigation of the effects of the NMDA antagonist ketamine on working memory performance provides vital insights into the use of the ketamine model to study the mechanisms associated with schizophrenia. In addition, these investigations may also provide further support for the glutamate model of schizophrenia, by studying the behavioral consequences of NMDA hypofunction (proposed to take place in the glutamate model) and behavioral deficits consistent with the disorder.

METHODS

Subjects

Twenty male Sprague-Dawley rodents (n=20) weighing between 250 and 275g from Taconic Farms (Albany, NY) were used in this project. Animals were pair-housed in a standard animal facility with a 12-12 hour light-dark cycle with food and water ad libitum prior to food restriction. To avoid aggressiveness and unequal competition for rations, animals were individually housed at the start of food restriction and during behavioral training (Rowland, 2007). Food restriction and individual housing began six days prior to the radial arm maze task. The highest weight achieved during acclimatization was assigned as 100% free feeding weight. All animals were given 5 grams of rat chow daily until reaching their 85% target. Once reaching this target weight, they were fed the difference in grams between their current weight and the 85% free feeding weight plus 5 grams of normal rat chow. During radial arm maze training, animals were fed after the completion of their daily session. Water was available ad libitum throughout the course of the experiment. All procedures were performed in accordance with the institutional Animal Care and Use Committee and NIH guidelines for ethical treatment of research subjects.

Drugs

Ketamine HCl (Henry Schein, Indianapolis, IN) was diluted in pharmaceutical grade physiological saline in order to achieve a final concentration of 8 mg/ml. This dosage is consistent with previous studies in our laboratory demonstrating that 8 mg/ml was sufficient to induce a spatial learning and memory deficit in the Morris water maze (Sabbagh et al, 2012). All drugs were administered subcutaneously (SC) once daily at a volume of 1 ml/kg, 30 minutes prior to the start of behavioral testing.

Radial Arm Maze

The radial arm maze (Med Associates Inc., St. Albans, VT) consisted of a clear center platform with a white base, 35.6 cm in diameter; 35.6 cm in height, with a width of 40.6 cm. Eight arms, 45.7 cm in length, extended radially outwards from the center platform, with metal food trays at the end of the arms for food pellet baiting. The arms consisted of a white base with clear plastic walls allowing the animal to visualize distal spatial cues on the walls. Four spatial cues were placed along the walls of the testing room to help orient the animal.

Trials were recorded using a video tracking system (Smart, San Diego Instruments, San Diego, CA) recorded from a Sony Handycam camera connected to a Cobalt Instruments computer. For each trial, the animal’s latency to complete and speed were tracked and recorded using the video tracking system. For each animal, arm entries were tracked and recorded by a trained experimenter.

Behavioral Testing – Radial Arm Maze

After an acclimatization period of four days, subjects were handled by experimenters for two days in order to habituate the animals to experimental handling. Animals were randomly assigned to receive injections of either ketamine (n = 10) or saline (control; n = 10) throughout the course of the experiment. Daily injections began nine days prior to the start of the radial arm maze and continued throughout completion of the experiment. All injections were administered SC at 1 mL/kg, 30 minutes prior to the start of behavioral testing.

For the radial arm maze task, animals were taken individually from the colony room and brought into a room containing the radial arm maze, and large geometric shapes positioned along the four walls of the room serving as distal spatial cues to orient the animal within the maze. Experimenters and
computer equipment were concealed behind curtains.

The radial arm maze task began with two days of acclimatization. During these sessions, reward sugar pellets were scattered throughout the maze. The animal was placed into the center platform by an experimenter and given five minutes to freely explore the maze and collect sugar pellets. These days served to acclimate the animal to the radial arm maze environment and the sugar pellet food rewards.

After acclimatization, ten days of training began. Four of the eight arms of the radial arm maze were randomly selected for each animal and baited with a sugar pellet food reward in the metal tray at the end of the radial arm. The arms that were baited remained consistent for each animal throughout the course of the experiment. Animals were placed into the center platform and allowed to freely explore the maze until all four food rewards were collected. If the animal did not collect all four food rewards within five minutes, the animal was removed from the apparatus by the experimenter, returned to their home cage, and fed. Throughout the experiment, total arm entries were tracked and recorded by experimenters and working and reference memory errors were scored. Reference memory errors were defined as the first time during any trial that an animal entered an un-baited arm. Working memory errors were defined as any time an animal re-entered an arm during the course of a single trial. Reference memory errors were used to quantify animal’s long term learning across sessions while working memory errors were used to examine animals learning within a single session.

Statistical Analysis
The effect of treatment on performance in the radial arm maze was analyzed using a repeated measures analysis of variance (RM-ANOVA). A repeated measures analysis of variance was performed for animal’s latency and speed as well as total number of working and reference memory errors across days.
RESULTS
A significant difference was found for total working memory errors between ketamine and saline groups across the ten days of training with the ketamine group showing an increase in total number of working memory errors relative to control (F$_{1,18}$=38.343, p<.001). The ketamine group displayed a significant increase in latency across days compared to the control group (F$_{1,18}$=13.554, p=0.02). No significant differences were found for reference memory errors (F$_{1,18}$=3.37, p=0.083) or speed (F$_{1,18}$=1.12, p=0.304) between the groups.

DISCUSSION
The above data demonstrate the ability of sub-anesthetic administration of ketamine to produce a specific deficit in working memory in a radial arm maze task. These data are consistent with reports of schizophrenia populations of which working memory deficits are a core pathological finding. Interestingly however, no deficits were seen in reference memory performance for those animals administered ketamine. The lack of a reference memory deficit indicates that animals receiving ketamine were still able to learn and recall where food was located in the radial arm maze. As four of the eight total arms in the maze are baited, this is a relatively simple learning task. The fact that animals administered ketamine were still able to exhibit a simple form of learning may provide further validity to the deficits observed in their working memory, which is a more complicated form memory performance. The ability of sub-anesthetic ketamine administration to produce behavioral deficits similar to those seen in schizophrenia further supports the use of the ketamine model in examining mechanisms associated with the etiology of the disorder.

Further support for the use of the ketamine model would come with examining tissue collected from animals used in this experiment for pathological alterations consistent with those seen in post-mortem examinations of schizophrenia populations. These include alterations in a specific subclass of inhibitory GABAergic cells that co-localize with the calcium binding protein parvalbumin (PV). Previous studies in our laboratory have demonstrated the ability of sub-anesthetic administration of ketamine to induce changes in the overall abundance as well as location of these PV+ GABAergic cells in the hippocampus of adult rats (Sabbagh et al., 2013). This altered distribution may be the result of abnormal neuronal migration and could give rise to altered network connectivity in the brains of those animals administered ketamine. In addition to the alterations in the distribution of these PV+ cells, deficits in spatial learning and memory in the Morris water maze were also reported. While the functional consequence of these PV alterations is still unknown, the fact that these alterations were specific to the hippocampus, a region of the brain highly involved in learning memory, has led to the hypothesis that these alterations in PV+ GABAergic cells may give rise to the learning and memory deficits seen in the Morris water maze.

The examination of PV+ GABAergic cells in the hippocampus of animals used in this experiment would provide an interesting comparison to those alterations seen in previous studies. A task specific change would provide compelling insight into the mechanisms associated with the alteration of these PV+ neurons. Further insight into the mechanisms behind alterations in these cell types may provide a vital insight to the etiology and functional pathogenesis of the observed deficits in learning and memory as well as schizophrenia in general. In addition, the examination of markers for NMDA type receptors in the tissue collected from animals used in this experiment may provide further evidence for the role of NMDA signaling in the disorder.

The behavioral characterizations of NMDA antagonists, as well as the histopathological alterations observed in tissue collected from these animals, provide compelling support for the use of the ketamine model in studying the mechanisms associated with the etiology of schizophrenia. Further study into the role of glutamate signaling in schizophrenia would provide vital information in identifying key risk factors associated with the disorder. In addition, the glutamate model of schizophrenia offers a variety of novel therapeutic targets for pharmacological treatment of the disorder. These targets vastly differ from those currently utilized in the treatment of schizophrenia. As current treatments for schizophrenia have shown little to no efficacy in treating the negative symptoms of the disorder (Cioffi, 2013), the insight provided from these investigations into the glutamate model could lead to the development of a novel comprehensive treatment for schizophrenia.

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EVOLUTION OF THE HUMAN DIET: WHAT WE CAN LEARN FROM HUNTERS AND GATHERERS

BY KARA OSBORNE

ABSTRACT
The study of hunter-gatherer populations around the world can greatly inform our understanding of the evolution of the human diet. Ethnographic research of modern hunter-gatherers has been used to infer the possible food consumption and acquisition patterns of our ancestors. Hunter-gatherers provide the information necessary for the understanding of the past human diet, due to these populations living similar lifestyles in similar environments, therefore procuring similar foods.

The Hadza, a group of nomadic hunters and gatherers living in Tanzania, East Africa, are one of the primary populations that nutritional anthropologists study to infer what possible foods our ancestors acquired and consumed. My project explores the diet composition of the Hadza, in combination with reviews of previous research, to provide a broader perspective on the possibilities that shaped early hominid dietary patterns.

INTRODUCTION
There have been many different viewpoints and perspectives throughout the years when attempting to understand the evolution of the human diet. Some researchers are adamant that meat eating and hunting is responsible for our larger brain size in relation to our body size, a phenomenon known as encephalization (Aiello and Wheeler 1995). Others argue that cooking, honey and/or tuber consumption, and even scavenging (extracting the calorically dense marrow from the bones left by carnivorous predators on the African savanna) are what made us human. While eating meat has historically been the primary explanation of how hominids came to develop such large brains, other researchers are exploring alternative possibilities that may have contributed to the expansion of our uniquely large brain (Crittenden 2011; Gremillion 2011; Larsen 1995; Lee 1969, Milton 1999; Wrangham 2009). We can infer about our past diets based on a number of different factors. Our present anatomical and biological makeup can give us clues into our past dietary habits. In addition to the evaluation of archaeological evidence, ethnographic research on the diet of modern hunter-gatherers can also
provide us with the information necessary for understanding how past hominids possibly obtained their nutritional requirements. Through studying modern hunter-gatherer populations we can interpret what people in similar ecological environments would have eaten, how they would have procured it, and even how they might have prepared and processed it (Gremillion 2011; Wrangham 2009; Crittenden 2009; Crittenden 2011; Aiello and Wheeler 1995; Marlowe 2009).

The Hadza of Tanzania epitomize the human foraging behavior that has been practiced throughout most of our history – nomadic hunting and gathering - and live in an area similar to that of our hominin ancestors (Marlowe 2010). This project analyzes original diet and foraging data collected among the Hadza foragers of Tanzania, by my adviser, Dr. Alyssa Crittenden. This study evaluates their diet composition, allowing us to infer what a hunting and gathering lifestyle may have meant to the diet of our ancestors. Researching diet composition of modern hunter-gatherers can help us better place diet in the context of human evolution (Cordain et al. 2002).

LITERATURE REVIEW

One of the most prevalent theories, which many have thought to be the fundamental basis on the evolution of the hominid diet, was meat consumption. It was thought that men brought home the bulk of the daily calories after a long day of hunting (Lee and Devore 1969). This has led many to debate about whether the primary importance of our ancestral diet relied upon hunting, typically provided by men, or gathering, which is usually carried out by women (Gremillion 2011; Ungar et al. 2006). The meat-eating hypothesis was based on the notion that hominids began to incorporate more meat into their diet due to the increasing resources of the savanna, as the forest resources began to deplete, forcing early Homo to adapt to these changes. Although debatable, this shifting climate seems to be the logical explanation for this changing diet (Ungar et al. 2006; Gremillion 2011; Teaford and Ungar 2000).

Archeological evidence suggests that the earliest signs of our meat consumption date to around 2.5 million years ago, but this too is debatable (Luca et al. 2010). This early evidence of animal bones found at sites like Olduvai Gorge, in Tanzania, with cut marks and patterns of fracturing, are indicative of butchering and meat eating among early Homo (Gremillion 2011). It has also been suggested that early Homo populations were scavengers. Remains left at carnivore kill sites, which include brain, bone marrow, and other scraps of meat, would have been necessary in supporting early brain growth (Speth 1989, Gremillion 2011). Essential fatty acids, like Docosahexaenoic acid or DHA, found in these remains would have assisted in this neural development (Cordain et al. 2001). This view supports the notion of meat playing a very important factor in our evolution, whether its bone marrow from scavenging or meat from hunting (Speth 1989).

We can gain insight to past dietary practices by researching our closest living relatives, chimpanzees and bonobos. Chimpanzees are also known to consume small primates and other small mammals, although this is only a small portion of their diet (Luca et al. 2010). The chimpanzee diet is mostly frugivorous (fruit based); meat does not make up a significant portion of their diet.

In addition to forager data and analysis of the diet of non-human primates, we can also learn a lot about the evolution of the human diet from the analysis of carbon isotopes from fossil remains. The fossil evidence tells us that it is likely that the earliest hominids were possibly dependent on a more plant based diet, rather than a primarily meat dependent one. The diet of Australopithecus afarensis is thought to have consisted of around 75% of fruit and leaves, while the other 25% was meat (Krebs 2009). Upon the appearance of Homo Erectus there is more indication for an even greater reliance upon game animals, and this becomes ever more prominent around 150,000 years ago with the arrival of the modern human (Ungar et al. 2006).

Anatomical evidence also suggests that when we compare the gut biology between great apes and hominids, our gut has evolved to accommodate this increased consumption of meat or more easily digestible foods (Milton 1999; Gremillion 2011). The guts of orangutans and gorillas are more suitable for diets consisting of bark, foliage and unripe fruits, while chimpanzees dine regularly on ripe fruits (Milton 1999). The reduction in the size of our gut is indicative to a shift from this diet primarily based on leaves, roots or fruit. Due to the small size of the gut it would not be beneficial for humans to consume low quality or bulky foods like those the great apes
consume. It is thought that eating these foods would require more time for feeding and digestion that would ultimately take away from other more productive activities such as socializing (Gremillion 2011; Milton 1999; Aiello and Wheeler 1995). It is argued that what led to our encephalized brain was this trade off in our reduced gut size. This change in diet ultimately led to a chain reaction that has left us able to maintain a large brain (Aiello and Wheeler 1995, Wrangham 2009).

Though some evidence may seem to suggest that meat eating would have been primarily responsible for our changing bodies, ethnographic data shows us this may not be the case. While in some outliers, such as artic populations, these people consume great amounts of animal foods, they are merely an exception to the rule. These populations, per capita, consume the greatest amounts of animal protein (Speth 1989). Among the !Kung, a population from Botswana, who live in the Kalahari desert, 16% of their diet consists of protein and only 6% of the overall diet consists of animal protein (Lee and DeVore 1969; Speth 1989). Lee and DeVore, in the late 60’s discovered that 60-80% of the !Kung diet, by weight, was comprised of vegetable foods. In fact, the majority of the !Kung protein intake come from mongongo nuts.

Most hunter-gatherers enjoy a rather diverse diet, not primarily based on meat, but a rather variable season to season diet (Lee and DeVore 1969; Wrangham 2009; Speth 1989; Marlowe 2009). Other than the hypothesis that a diet based primarily on meat was the Paleolithic dietary model, there are other quite provocative theories that can explain these changes just as well.

While we give so much attention to meat consumption we must evaluate the importance of underground storage organs (USOs), tubers and bulbs, and other variable possibilities, in the evolution of the human diet (Gremillion 2011; Wrangham 2009; Pennisi 1999). There are some significant questions that come to light when determining our ancestral diet. Many mammals eat meat and have not spawned a significantly larger brain, or do modern hunter-gatherers rely entirely on meat consumption. The tools used today, by modern hunter-gatherer populations, are a bit more complex than that which were used by ancestral hominids (Pennisi 1999) yet it was thought that hunting and meat consumption was the predominate source of energy and calories (Wrangham 2009). These questions have caused researchers to reevaluate the model commonly relied upon for understanding the evolution of the human diet.

Underground storage organs, USOs, are often underrepresented when reconstructing early Homo diet. They are high in starch, and may have been sought after as far back as 2 million years ago by Homo ergaster and other early hominids (Gremillion 2011). Tubers are considered a fallback food among the Hadza, as they are not a preferred food, but are continuously available throughout the year. Although, they may not have been a preferred food through human history, we can safely assume that they would be exploited to keep from starvation or be implemented as a sort of staple food at some point in our evolution (Marlowe 2009). Not only are humans known for digging these energy rich foods out of the ground, but researchers have observed chimps in the Congo digging in the ground for tubers. Hunter-gatherer populations of today rely heavily on USOs, and supply a large percentage of the caloric intake within these populations (Wrangham 2009; Gremillion 2011; Marlowe 2009).

Fossil evidence shows that it is possible some hominids developed thicker enamel on their teeth by adapting to an increased intake of tubers and other fibrous USOs. Some edible tubers are toxic to humans, so it is thought that the introduction of these foods into our diet coincides with the time when we began to cook (Wrangham 2009). We now have robust evidence to suggest that roots and bulbs were present in the early Homo diet (Ungar & Teaford 2002).

Tubers are thought to have been responsible for many of the biological changes already described. The hard work in retrieving them is paid off especially when cooked. Dr. Richard Wrangham, of Harvard University, suggests that the evidence points to cooking being responsible for some of these changes in our bodies. Cooking our food is a method of predigestion. It allows for our bodies to more easily digest foods, extracting more nutrients from cooked foods than their raw counterparts. It does not only allow for easier nutritional intake of tubers and other USOs, but of most things that we eat. Cooking does ultimately change the overall nutritional content of food, but it is argued that cooking increases our energy intake. Some archaeological evidence of cooking earlier than
previously thought has been found, which could corroborate Wrangham’s theory and would coincide with our reduced gut size, which, in turn, has eventually led to fueling our metabolically expensive brains (Wrangham 2009).

Others argue that honey played a major role in our evolutionary history. Foods rich in energy would have played a significant role in feeding our metabolically expensive and expanding brains (Crittenden 2011, Wrangham 2009). The expansion of the brain coincides with smaller dentition, as well as the production of early stone tools. This reduced dentition would have indicated “less mechanical breakdown” of food. Foods that were easier to digest and consume could have led to this shift, as even small amounts of honey would have been greatly beneficial. (Crittenden 2011)

Diets of our early ancestors varied with season, latitude, and their environment, just as they do with modern hunter-gatherers. Based on the variability between certain niche ecological areas, there is no one universal pattern of subsistence (Eaton et al. 1988). Diet varied from one region to another. The Paleolithic diet consisted of a variety of different wild resources. While foraging populations of today are not entirely representative of Paleolithic populations, because no indigenous foraging population has been purely uninfluenced by industrialized societies, nonetheless one can still make reasonable inferences from these contemporary populations. (Marlowe 2010; Ungar et al. 2006)

STUDY POPULATION

The Hadza are a hunter-gatherer population who live in Northern Tanzania. With a population of around 1000, only approximately 300 individuals are practicing a hunter-gatherer subsistence strategy. The Hadza are nomadic and live in camps that are made up of about 30 individuals per camp. Camp members frequently move in and out, and camps are described as being very fluid in their makeup. Fluidity of the Hadza camps is highly dependent upon seasonality in the region. The Hadza have recently begun residing in larger camps because other tribes have imposed upon the area in which they reside. Many of the areas within their region have been intruded upon, since around the 1950’s (Crittenden 2009; Marlowe 2010).

The Hadza are an ideal population to study in terms of the evolution of the human diet because they live in an area similar to that of our hominid ancestors and likely eat the same types of foods (Marlowe 2010). Archaeological evidence shows that three different species of hominids lived nearby at Olduvai Gorge, and the famous Laetoli footprints were found only 40 km to the north. Along with these findings of early hominids, a number of fossils belonging to archaic Homo sapiens have been found nearby, as well. The evidence of long time occupation in this region is plentiful, complete with lithic artifacts and rock art (Marlowe 2010).

There is a sexual division of labor amongst the Hadza. Men hunt different mammals and birds, as well as collect baobab fruit and honey. Women typically gather tubers, berries and baobab fruit. Children also play a significant role in acquiring foods. Hadza children will collect foods that are near camp and easily accessible. They spend a large amount of time collecting food throughout the day. It is thought that the children collect enough foodstuffs, to maintain their own nutritional requirements when they reach their teens (Crittenden 2009).

The diet of the Hadza can be divided into five different categories: tubers, berries, meat, baobab, and honey (Marlowe 2009). Seasonality in this region greatly determines the foods acquired and consumed by the Hadza. Wet season diet composition and dry season diet composition vary in the amount of different foods accessible to the Hadza. Among the Hadza, honey is the highest ranking food and the most sought after (Crittenden 2011). Although their diet consists of a large amount of animal meat, they heavily rely on honey and plant foods.

LITERATURE SUMMARY

There is mounting evidence that suggests a number of theories are responsible for the development of our brain and the reduction of our gut. Meat consumption, in combination with cooking and/or the consumption of honey and tubers played a significant role in the evolution of human diet and may have caused the biological shifts we see the end results of in our own bodies today. The reduction in gut size, brain growth, change in dentition, are all evident of this dietary change. There are many different theories that are being researched regarding the early hominid diet, but what seems to be agreed upon, is that food played such a significant role in the development of phenotypic, genetic, and
physiological traits in our early evolutionary history. Much of the evidence of our ancestral diet is said to be difficult to interpret and controversial (Ungar and Teaford 2002). Although modern hunter-gatherers are not living fossils and they do not live exactly as early Homo lived, we can definitely gain insight into the possibilities. Whether it was honey, tubers, cooking or meat that caused the expansion of the brain, or whether early hominids were primarily hunters, gatherers, foragers, or scavengers, there seems to be a general consensus that diet played a major role in our evolution and that adaptation to our food sources was a significant factor.

**METHODOLOGY**

The current study analyzes the foods collected in four different Hadza camps by Dr. Alyssa Crittenden over a three-year period; summer 2001, summer 2004, spring 2005, and fall 2005. Small samples were collected from the foods brought back to camp. Eighty-five samples, from twenty-four food types were collected in the field and then prepared for lab analysis (Crittenden 2009). The foods were collected and then dried on an open-air rack. Consumed and unconsumed portions, as well as different segments of the fruit, like the pulp, seed, husks, etc. were individually dried. The drying rack was raised two feet off of the ground, was made out of wood, and had a wire mesh top for air-drying. The temperatures never went above 38 degrees Celsius, and during dust or rain storms the sample would be relocated indoors so as not to contaminate the samples (Crittenden 2009). Some food was subject to mold more than others due to their high sugar content. This happened more often with berries and figs and during the rainy seasons. These types of samples were watched carefully and would be relocated to drier areas of the rack or possibly indoors. Once the samples were entirely dried, they would then be placed and stored in manila envelopes and mailed back to the lab at Harvard (Crittenden 2009).

**Plant Foods**

There are two berry species that are reported in this analysis, Undushibi (*Cordia senesis*) and Tafabe (*Salvadora persica*). These two berries have large seeds with little pulp. Every berry is eaten raw, being freshly picked from the plant or dried and stored for a few days. The seeds are extracted for processing, and the pulp is dried and stored for analysis (Crittenden 2009).

Baobab (*Adansonia digitata*), is a fruit with an outer capsule that is very hard and green. Because the outer capsule is fifty percent of the weight of a baobab, and inedible, it is weighed and discarded. The inner portion of the baobab contains about 12-20 seeds that are covered in a dry, chalky, white pulp. The seeds and the pulp were dried and then analyzed (Crittenden 2009).

Additional plant foods analyzed included; one species of drupe, Mashalobe (unknown *Genus species*), figs (*Ficus sycomorus*), a legume species (*Acacia nilotica*), and a number of tubers (Crittenden 2009). Mashalobe cannot be eaten without first being boiled, as this drupe contains a hard dense pulp. Only the pulp, and after boiling, was analyzed (Crittenden 2009).

Hadza tubers are sometimes peeled and then eaten raw. Tubers are also roasted, unpeeled. All portions of each tuber species were collected. The portions were separated and dried on site, in the field. Later, only the inside pith (the edible fraction) was analyzed (Crittenden 2009).

**DATA ANALYSIS**

Chemical analyses were undertaken by Dr. Alyssa Crittenden, in the Nutritional Ecology Laboratory at the Anthropology Department in Harvard University. The collected samples were analyzed to determine fat contents (lipids), crude protein, free mono- and disaccharides, fiber (neutral detergent fiber), ash, and non-structural carbohydrates were determined by difference (Crittenden 2009).

Lipid content was found by using a petroleum ether extraction for four days at room temperature under a chemical hood. Crude protein was then determined using Kjeldahl procedure. Total nitrogen was determined and then multiplied by 6.25. A phenol/sulfuric acid calorimetric assay was used in evaluating free mono- and disaccharides. Fiber was then measured using a neutral-detergent fiber analysis, which determined insoluble fibers: cellulose, hemicellulose and lignin. By measuring a drying subsample the amount of ash was assessed (Crittenden 2009).

In order to determine energy values for all of the plant foods collected including berries, tubers, baobab, and other fruits, inedible portions of the food was subtracted from the wet weight and the value left over were analyzed. The energy values of
honey were determined by using values from Murray et al. 2001 by analyzing moisture content. Published values were then used to calculate energy values for game meat. The energy values, or total kilocalories, were analyzed by determining the potential energy contributions of each listed nutrients (Crittenden 2009).

We used the energy contributions for each food type to calculate the percent contribution of that food type to the Hadza diet. We accounted for the weight of the container, water weight, indigestible fractions, and calculated the digestion coefficients for each foods in order to determine the most reasonable figures for energy contribution (kilocalories per 100 grams) for each Hadza food type.

RESULTS
The Hadza diet is highly variable. There are many factors that contribute to this variability. The demographic group procuring the food, the season it is collected in, and preference and abundance of the food, all play important factors in the complete spectrum of the Hadza diet. Dry season food procurement (Figure 1) is dominated by big game meat consisting of around 31% of the total kilocalories consumed by the Hadza. The remaining 69% consists of mainly baobab, fruits, nuts and legumes (Crittenden 2009). During the wet season (Figure 2), the bulk of the kilocalories contributed to the diet consists of berries at 43%. Only 17% percent consists of animal based foods. In all, the total caloric intake (Figure 3) of the Hadza foraging diet is highly variable between wet and dry seasons (Crittenden 2009). This leaves us to infer the possibility of a high variable Paleolithic diet that was possibly consumed by our ancestors.

The Hadza data supports the notion that the Paleolithic diet was one of omnivory. Although they do consume a significant amount of animal based resources, the bulk of their diet is from plant materials. This supports data from other foraging populations (Cordain et al. 2000) and recent trends in research on the evolution of human nutrition (Ungar and Sponheimer 2011).

CONCLUSION
There are many different pathways to understanding lifeways and diet composition of early hominids. There are clear anatomical markers, such as dentition and gut reduction, and brain growth, that indicate these shifts in diet throughout hominin history.

Using inference from researching the dietary patterns of modern hunter-gatherers, we can get a broader perspective of what the diets of early Homo would have been like. These preliminary results show that modern hunter-gatherer diets are highly varied. This implies that our ancestors, who lived a similar lifestyle possibly, had this type of highly varied diet. With this information, we can increase our understanding of the diets of foragers and the evolution of human nutrition.
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ARE INCOMPLETE DENITRIFICATION PATHWAYS A COMMON TRAIT IN THERMUS SPECIES FROM GEOTHERMAL SPRINGS IN CHINA?

BY Juliene JoChel Paraiso

ABSTRACT
Temperature has strong impacts on ecosystem function and biogeochemical cycles, particularly within extreme environments such as geothermal springs above 60 °C. The primary focus of this study was to investigate the denitrification pathways of Thermus (Bacteria) isolates from geothermal springs from Tengchong, China. This study tested the hypothesis that incomplete denitrification is a common characteristic of the genus Thermus, regardless of geographic origin or species affiliation, which would implicate them in the efflux of nitrous oxide (a strong greenhouse gas) to the atmosphere. In this study, we cultivated 25 isolates, including six known Thermus species, and measured the stoichiometry of nitrogenous products of nitrate respiration using gas chromatography and colorimetric assays. We also designed custom primers for polymerase chain reaction (PCR) amplification of denitrification genes including narG, nirS, nirK, and norB to screen for the genetic capacity for each step in denitrification. Experimental results show that all Thermus strains tested display incomplete denitrification pathways terminating at nitrite (NO2-) or nitrous oxide (N2O), and possibly nitric oxide (NO).

INTRODUCTION
Nitrogen plays an integral role in our environment, and is an essential component of DNA, RNA, and proteins. Dinitrogen gas (N2) is highly abundant in the atmosphere which can be fixed by certain bacteria and archaea and becomes converted into important biologically-available intermediates for uptake by living organisms (Canfield et al., 2010). While nitrogen cycling in mesic environments has been studied in detail, the nitrogen cycle at high-temperature environments above 60 °C is poorly understood. Nevertheless, many thermophilic microorganisms that inhabit geothermal environments carry out important steps in the nitrogen cycle, such as denitrification. Denitrification occurs when microorganisms use oxidized nitrogen as terminal electron acceptors for anaerobic respiration. This process involves the stepwise reduction of nitrate (NO3-) to nitrite (NO2-), nitric oxide (NO), nitrous oxide (N2O), and...
dinitrogen (N₂), with nitric oxide, nitrous oxide, and dinitrogen being lost to the atmosphere as gases. The genes involved in denitrification include: narG (nitrate reductase), nirK/S (nitrite reductase), norB (nitric oxide reductase), and nosZ (nitrous oxide reductase) (Murugapiran et al., 2013).

Several studies on terrestrial geothermal environments have shown that many thermophiles and hyperthermophiles, such as Thermoprotei and Thermales, have the capability to reduce nitrate (Dodsworth et al., 2011). To date, only one study has indicated that some Thermus thermophilus isolates can denitrify completely to dinitrogen (Cava et al., 2008). In contrast, Hedlund et al. (2011) investigated several isolates of T. thermophilus and T. oshimai from the U.S. Great Basin and found that these strains demonstrated an incomplete denitrification pathway due to the absence of the nosZ (nitrous oxide reductase) gene (Murugapiran et al., 2013). T. scotoductus SA-01 is the only other nitrate-reducing Thermus strain, for which a genome is present and it also lacks a gene encoding the nitrous oxide reductase (Gounder et al., 2011). A previous genomic study (Murugapiran et al., 2013) showed that nitrate-reducing genes are present on megaplasmids in T. thermophilus JL-2 and T. oshimai JL-18. A truncated denitrification pathway terminating at nitrous oxide has been observed in other organisms, such as Corynebacterium nephridii (Hart et al., 1965; Renner et al., 1970). In addition to a complete loss of the nosZ gene, other studies have shown that induced mutations within the nosZ gene can alternatively lead to an altered phenotype (Zumft et al., 1985; Zumft et al., 2007).

A previous study observed a positive relationship between temperature and nitrous oxide flux from a natural geothermal spring, suggesting complete denitrification may be impeded at high temperatures (Hedlund et al., 2011). Hot spring environments have thus been identified as possible sources of nitrous oxide, which is a strong greenhouse gas and atmospheric ozone reactant (Ussiri et al., 2013). Globally, approximately 40% of nitrous oxide emissions may be contributed to human activities including: agriculture, transportation, and industrial use. Although many activities may produce nitrous, other denitrifying microorganisms and some plants remove atmospheric nitrous oxide (Kroeze, 1994; EPA, 2010).

Here, we sought to test the hypothesis that incomplete denitrification pathways are common among members of the genus Thermus. Specifically, we are examining whether truncated denitrification pathways are present in Thermus strains from Tengchong, China. We cultivated 25 bacterial isolates, representing six Thermus species, and measured the products of denitrification using gas chromatography and colorimetric assays. In addition, we designed primers to examine the presence of denitrification genes, including narG, nirS, nirK, and norB, within these strains. These results will help us understand whether incomplete denitrification pathways are common both geographically and phylogenetically in the genus Thermus, and understand the possible role of Thermus in the flux of biogenic nitrous oxide from geothermal environments.

**METHODOLOGY**

**Cultivation and physiological experiments:**

For endpoint nitrate reduction experiments, Thermus strains originally isolated from hot springs in Tengchong, China (Table 1) were streaked from freezer stocks onto aerobic agar plates containing 9 mM nitrate-amended Castenholz medium D (CMD) (Castenholz, 1969) containing 0.1 % yeast extract and 0.1 % tryptone. Isolated colonies from second set of streak plates were then introduced into 0.8 ml volume of anaerobic medium, followed by inoculating 125 ml serum bottles with 2 atm of 100% He. In addition, a defined medium was prepared using 1 mM nitrate-amended CMD with 0.1 % starch and 0.1 % sodium pyruvate as carbon sources.

After inoculation, serum bottles were oriented horizontally to maximize surface area for growth and gas equilibrium. These cultures were then incubated at 60 °C and shaking at 100 RPM. Cultures for the end point experiment were allowed to grow
for 96 hours, while cultures for the time course were sampled every 12 to 24 hours and allowed to grow for 287 hours.

**Measurement of denitrification products:**
Nitrate, nitrite, and ammonia concentrations were measured in liquid samples colorimetrically using commercial kits (LaMotte, Chestertown, MD) and a Spectronic 20D spectrophotometer (Milton Roy). Nitrate concentrations were measured based on the nitration of 2-hydroxy-benzoic acid (2-HB) that occurs when a nitrate-containing solution is added to the 2-HB solution. A colorimetric change is directly proportional to the nitrate concentration present in the solution (Bhandari & Simlot, 1986). Nitrite concentrations were measured based on the diazotization of sulfanilamide. Ammonia concentrations were measured based on the nesslerization method.

The composition of gas headspace samples was measured using gas chromatography. Headspace N₂O concentration was measured by GC-Thermal Conductivity Detector (GC-TCD) with an injection of 0.5 mL sample into the GC-2014 gas chromatograph (Shimadzu) using 99.99% argon at 40 mL/min as the carrier gas and a Supelco 80/100 mesh Molecular Sieve column (Sigma-Aldrich, St. Louis, MO, USA). Temperatures for GC analyses were the following: injector at 120°C, column at 80°C, and detector at 210°C.

**DNA extraction and PCR amplification for denitrification genes:**
DNA extractions were performed on cell pellets using the FastDNA SPIN Kit for Soil (MP-Biomedicals, Solon, OH) using the manufacturer’s instructions. DNA was precipitated with 70% ethanol, eluted in 300 μL 1x TE and stored at -20°C.

Denitrification genes were screened using the polymerase chain reaction (PCR). To determine if sufficient DNA was present, 16S rRNA genes were PCR-amplified using bacterial primers: 9bf (Eder et al., 1999) and 1512uR (Eder et al., 2001). Each 25 μL mixture contained 1 μL of DNA extract, 200 μM of dNTP (Promega, Madison, WI, USA), 0.65 U of GoTaq polymerase (Promega), and 1x GoTaq buffer (Promega). Cycling conditions included: 35 cycles of denaturation (30 s at 94 °C), primer annealing (30 s at 55 °C), and elongation (1.5 min at 72 °C), followed with a final step of elongation (7 min at 72 °C) (Dodsworth et al., 2011). PCR amplification for nitrate-reducing genes was carried out using primers specifically chosen and custom-designed for this study, seen in Table 2.

Gel electrophoresis was prepared using 40 mL of 1x TAE buffer solution, 0.4 mg agarose and 0.4 μL of ethidium bromide dye. Power source was set at 120 V, 50 mA which ran for approximately 10 to 25 minutes. The gel was then examined using an ultraviolet transilluminator.

**RESULTS/DISCUSSION**

**Physiological Experiments:**
Initial results from endpoint physiological experiments indicate three distinct denitrification phenotypes, which have been defined as Group A,
products through time, wherein strains were grown with 1 mM nitrate in a defined medium with sodium pyruvate and starch as carbon sources. Strains 410 and 412 (Figures 5a and 5b), which were defined in Group A from endpoint experiments, also show production of nitrite during the time course experiments. During the time course, the concentration of nitrate declines concomitantly as nitrite increases, which indicates a stoichiometric conversion of nitrate into nitrite. After 287 hours, all of the added nitrogen was accounted for as nitrite, inferring that these strains and other members of Group A lack the enzyme nitrite reductase.

Strain 428 (Figure 5c) illustrates a different phenotype associated with Group B strains, in which nitrous oxide is inferred to be the final denitrification product. Time course data show that between 13 to 25 hours, strain 428 was consuming nitrate and converting it into nitrite. The nitrite concentrations steadily increased up until after 200 hours as nitrous oxide concentrations increased. Since essentially all the added nitrogen was accounted for as nitrite and nitrous oxide, strain 428 and other members of Group B may lack the enzyme nitrous oxide reductase.

Time course results from strains 318 and 574 (Figures 3d and 3e) differed from results obtained from endpoint experiments. Strain 318, which was defined as Group C from the endpoint experiment, produced negligible nitrous oxide and all added nitrogen could be accounted for as nitrite, consistent with phenotype seen in Group A. Strain 374, which were defined as Group B in the endpoint experiment, produced nitrite and no other detectable denitrification products. It is possible that missing nitrogen is nitric oxide.

Results from time course experiments (Figures 3a – 3e), generally confirm the three distinct phenotypes observed in the endpoint experiments. These experiments examined changes in denitrification nitrate into nitrite, but a large amount of nitrogen could not be accounted for. It is hypothesized that the missing nitrogen may be nitric oxide, which was not accounted for in our study.

Group B and Group C (Figure 2). Group A is comprised of *Thermus* strains that are inferred to reduce nitrate to nitrite as the final denitrification product. Group B includes *Thermus* strains that are inferred to reduce nitrate into nitrous oxide as the final denitrification product. Group C reduces

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### Table 2. Selected primers used for amplification for nitrate-reducing genes

<table>
<thead>
<tr>
<th>Primer&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Primer sequence (5'-3')&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Reference</th>
</tr>
</thead>
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<tr>
<td>narG1960f</td>
<td>TAY GTS GGS CAR GAR AA</td>
<td>Phillipot et al. 2002</td>
</tr>
<tr>
<td>narG2669r</td>
<td>TTY TCR TAC CAB GTB GC</td>
<td>Phillipot et al. 2002</td>
</tr>
<tr>
<td>nirKF1</td>
<td>TGY GCN CCN GGN GGN CA</td>
<td>This study</td>
</tr>
<tr>
<td>nirKF2</td>
<td>TGC GCS CCS GGS GGS CA</td>
<td>This study</td>
</tr>
<tr>
<td>nirKR1</td>
<td>TTN GGR AAN WSR TTN CC</td>
<td>This study</td>
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<tr>
<td>nirKR2</td>
<td>TTW GGG AAW WSG TTW CC</td>
<td>This study</td>
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<td>nirSF1</td>
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<td>CAG ACS TGG CTS GTSGAC TA</td>
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</tr>
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</tr>
<tr>
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<td>This study</td>
</tr>
<tr>
<td>cnorB6R</td>
<td>GAA NCC CCA NAC NCC NGC</td>
<td>Braker &amp; Tiedje. 2003</td>
</tr>
</tbody>
</table>

<sup>a</sup> Primers are named according to corresponding nitrate-reducing gene; forward and reverse primers are indicated by F and R.

<sup>b</sup> N = A, C, G, or T; Y = C or T; R = A or G; D = G, A, or T; B = C, G, or T; S = C or G

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Group B, and Group C (Figure 2). Group A is comprised of *Thermus* strains that are inferred to reduce nitrate to nitrite as the final denitrification product. Group B includes *Thermus* strains that are inferred to reduce nitrate into nitrous oxide as the final denitrification product. Group C reduces

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**Figure 2.** Results from endpoint experiments show final products of nitrate reduction. Nitrate has been corrected for interference with nitrite. Blue bar indicates starting concentration of 9 mM nitrate.
This study identifies more diverse denitrification phenotypes than those previously described for the genus *Thermus*. In the study by Hedlund et al. (2011), all of the isolates of *T. thermophilus* and *T. oshimai* tested from the U.S. Great Basin displayed incomplete denitrification pathways, which all terminated with the production of gaseous nitrous oxide (Hedlund et al., 2011). Our results indicate that while incomplete denitrification is a common trait among *Thermus* species, denitrification capabilities within the genus *Thermus* are much more variable than previously described.

The three observed denitrification phenotypes seen among the *Thermus* strains could be the result of the presence or absence of specific denitrification genes. For example, *Thermus* strains categorized under Group A produced nitrite as the final product of nitrate reduction. These likely possess a gene cluster encoding the nitrate reductase, but these strains likely lack or have a mutated nitrate reduction. These likely possess a gene cluster encoding the nitrate reductase, but these strains likely lack or have a mutated nitrate reductase (nitric oxide reductase) gene. In comparison, *Thermus* strains defined in Group B produce nitrous oxide as a final denitrification product. We speculate that these strains possess *narG*, *nirK* and/or S, and *norB* (nitric oxide reductase) genes, but the *nosZ* (nitrous oxide reductase) gene may be missing or mutated. Based on results from the endpoint experiment, strain 318 (*T. thermophilus*) was classified as the third phenotype labeled in Group C, with nitrite as final denitrification product.
product, but 3.0 mM of nitrogen was unaccounted for in the expected total nitrogen output. We speculate that this missing nitrogen observed for strain 318, as well as the missing nitrogen observed for strains in Group B (Figure 2), could be nitric oxide. Nitric oxide was not measured, because it is very unstable in liquid cultures and difficult to quantify. We are currently exploring the feasibility of nitric oxide assays that could be used to determine if the missing nitrogen seen in these experiments is nitric oxide. Based on our interpretation of endpoint results and our inferences regarding the production of nitric oxide, we infer that the narG gene, nirK gene and/or nirS gene are present and that the norB gene may be absent or mutated in strain 318.

Our current results and our interpretations of Thermus physiology suggest that the denitrification capabilities of this genus are highly variable, which may reflect high susceptibility to changes to the denitrification gene island. Murugapiran et al. (2013) investigated the whole genome sequences of two Thermus strains. This study reported the first complete genome sequence for T. oshimai JL-2 is and only the fourth complete genome sequence for T. thermophilus JL-18. Their results showed that the denitrification gene cluster in these strains has a high degree of synteny. The denitrification genes of JL-2 and JL-18 are both located on the megaplasmid (Murugapiran, 2013), which is more susceptible to mutations or deletions than the genome (Brüggemann & Chen, 2006). The variability in denitrification phenotypes may further indicate that denitrification genes of Thermus are actually part of the dispensable-genome, which evolves much faster than the core genome (Medini et al., 2005).

Molecular analyses:
Based on the physiological experiments, the three phenotypes seen among the Thermus strains are expected to have variable genotypes. Existing Thermus genomes provided a valuable resource for the design of custom primers (Table 2). Currently, PCR optimization is underway to determine the optimum annealing temperature for each primer set along a gradient of 50 °C to 66 °C. DNA from T. oshimai JL-2 is being amplified in this gradient PCR, and the annealing temperature that yields the greatest PCR product is identified as the optimum. Initial results from the molecular analyses show some indication of the expected genotypes described above, but further optimization is needed to determine if incomplete denitrification is the result of the absence or mutation of the denitrification genes.

CONCLUSION/FUTURE WORK:
Although nitrogen is highly abundant in our environment, the nitrogen cycle, particularly the denitrification process, is poorly understood at high temperature. Initial results from this study show that Thermus isolates from Tengchong hot springs display diverse phenotypes of incomplete denitrification, wherein strains produce one of three final denitrification products - nitrite, nitric oxide, or nitrous oxide. Ongoing molecular analyses are needed to determine whether an incomplete denitrification pathway is due to the absence or mutation of the corresponding genes. Incomplete denitrification pathways slow the removal of nitrogen within these terrestrial geothermal environments, providing more biologically-available nitrogen for uptake by other organisms in the ecosystem. This study supports the suggestion that hot spring environments serve as emission sources of nitrous oxide (Hedlund et al., 2011), which is an important greenhouse gas and atmospheric reactant (Kroeze, 1994).

ACKNOWLEDGEMENTS:
I thank Gisele Goertz for assistance with DNA extraction and Namritha Manoharan and Jeremy Dodsworth for guidance on PCR amplification work. I also thank the UNLV McNair Scholars Summer Research Institute and the National Science Foundation (OISE-0968421 and EPS-0814372) for funding. I thank Dr. Wen-Jun Li and Enmin Zhou for providing Thermus isolates isolated from China for this study.

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AMERICAN INFLUENCE IN THE INTERNATIONAL FINANCIAL INSTITUTIONS

BY SHAWN ROSEN

ABSTRACT
As the world becomes more globalized and the prosperity of new, rising powers begins to challenge that of long-standing powers, many scholars and policy-makers have begun to examine America’s place in the global political economy. Ongoing changes in the world’s political economy, such as the flourishing economies in the BRICS countries (Brazil, Russia, India, China, and South Africa), continued integration in Europe, as well as questions about economic policies derived from American dominated neoliberal ideology, have raised many doubts regarding how long the United States can remain the world’s leader. The conventional wisdom holds that the United States has enough influence in these international organizations to both pass items the U.S. supports and block items that it opposes. This broader context of influence within international financial institutions leads to the more specific research question addressed in this study: is the United States able to block loans and other items that it does not support?

In order to answer this question, various data were collected on U.S. positions regarding decisions that came before the multilateral development banks (MDBs). Additional data were assembled from the World Bank website and its different lending windows, as well as development bank websites, to address the issues determining what percentage of items the U.S. does not vote for pass. Once the data were coded to indicate if an item the U.S. passed or opposed, descriptive data analysis was performed to determine what percentage of items the U.S. did not support, yet nevertheless still passed. This empirical analysis raises doubts about the prevailing ideas about American influence in these important MDBs. Through this combined data and analysis, the study is able to address where the U.S. stands with its influence in the MDBs and the World Bank.

INTRODUCTION
Since the end of the World War II, the United States has held great influence over the rules and norms by which the world is governed. These rules and norms are embodied in the international
organizations, which the United States was fundamental in helping to establish and manage (Luck 1999; Sanford 1982; Schoultz 1982). Many observers of international organizations assume American influence in the international financial institutions is almost absolute. The United States has been very influential in international organizations, such as the World Bank (WB) and its various lending windows that include the International Development Agency (IDA), International Bank for Reconstruction and Development (IBRD), Multilateral Investment Guarantee Agency (MIGA), and the International Financial Corporation (IFC). The U.S. also is a key actor in the regional development banks, including the European Bank for Reconstruction and Development (EBRD), Asian Development Bank (ADB), the African Development Bank (AfDB), and Inter-American Development Bank (IADB) (Babb 2009; Strand 1999).

Given the superpower status of the U.S., one would expect its influence to be very far-reaching in the MDBs. As this study demonstrates, however, many items that the U.S. did not support still passed. This empirical result runs counter to much of the literature and suggests that new theories are needed to understand America’s contemporary influence in the MDBs. The study concludes that in the contexts of the MDBs, American influence is much lower than the conventional wisdom assumes and further research is needed.

**PURPOSE OF STUDY**

The purpose of this study is to determine if the United States is able to block loans and other items it does not support in the WB and MDBs, which ultimately deal with American influence in international organizations. The research focuses on the theoretical models developed by Randall Stone in his book *Controlling Institutions*. The study also relies on recent research on the determinants of American support for loans in the MDBs (Strand and Zappile 2013).

Stone (2008) explains how the U.S. is able to control the IMF even though the U.S. only holds 17 percent of the votes in the IMF’s weighted voting system. Stone also addresses how the rules of the global economy are made and how a combination of formal and informal rules explicate how international organizations (IO) operate. He goes into great detail on “formal” and “informal” rules in which formal rules only apply during ordinary times where the risk is low within international organizations; while informal rules are used by leading states in order to exert control when the risk is high. He claims that international organizations are best understood as the balance of power and interests between the leading states and member countries to ensure legitimacy of the very organization itself.

Strand and Zappile (2013) detail the motivations for the U.S. to cast votes in international organizations. They test several hypotheses regarding positions that the U.S. takes concerning loan decisions in the MDBs. Such retrieved information was found through U.S. Treasury data that was recently released on loan decisions made by the U.S. from 2004 to 2011. They conclude that bilateral trade relations, regime type, and recipient need are directly related to attaining U.S. support.

Even though the U.S. is viewed as very influential in the international community, preliminary evidence suggests a large number of loans and other items pass in the MDBs without U.S. support. This study is the first to systematically examine and measure the level of items not supported by the U.S. that still pass in the MDBs. This is an important contribution to ongoing debates about America’s role in the world, as well as the theories scholars use to understand IOs. The analysis presented here provides evidence regarding U.S. international influence.

**LITERATURE REVIEW**

Stone (2008) addresses how international organizations function through different sets of formal and informal rules. He first sets the stage of his book by stating the general argument: IOs are best understood as equilibrium outcomes that balance the power and interests of the leading state and the member countries (Stone 2008: 33). With this in mind, he created a model to better explain this argument. The model specifies how three particular forms of power interact. The first power is structural power and it represents the externalities the leading state generates for other members, as well as its own outside options. The second power is formal voting rights, which set the policy of the organization and creates a medium in which informal influence can be exercised. The third power is informal influence that allows special access to information, participation in significant decision making, and gives the leading state the ability to override the common policy when its core interests are involved (Stone 2008:32).
With much of this model’s emphasis falling on the power of informal influence, Stone (2008: 33) defends his model by arguing that,

Informal governance can be legitimate because the degree of conflict of interest between the leading state and the membership varies within the range of issues or cases that fall under an organization’s competence, so the member countries tolerate a degree of informal influence in cases of special concern to the leading power in return for a larger share of decision-making authority in ordinary times.

He then counter argues that the legitimacy and credibility of the IO can be eroded if informal influence is used too often. This model focuses particularly on the reciprocity of the leading state, the U.S. in this case, with all other member states in which cooperation is important and the results usually end up in a zero-sum game, where one country’s gain is another country’s loss. Stone develops a sophisticated game theoretical model to demonstrate this logic.

Stone’s model is laid out formally in order to define terms, precisely such as power and legitimacy, and to discover and to attend to any implications of the arguments. Stone points to game theory as being an ideal tool for exploring the effects of complex strategic interactions but not useful for explaining the origins of preferences or worldviews, both important factors pertaining to the research question addressed here. For the sake of parsimony, his model contains no incomplete information and no dynamically evolving state variables, but contains a lot of configuring parts.

There are four key features to Stone’s model. First, the U.S. has the power of informal influence, which gives it the ability to override a policy that an international organization imposes that is determined by weighted voting. The weighted voting systems used by IOs are complicated and the percentage of votes held by a country often differs from its ability to influence outcomes (Leech and Leech 2005; Strand 2003). Temptation to override that policy may or may not be an attractive option for the U.S. Thus voting represents formal control and the U.S.’ ability to override represents informal influence. Second, since there is a cost associated with overriding the common policy, the member countries vote to determine that cost, so informal influence depends on the consent of the membership. Third, the U.S. does not have to depend on multilateral cooperation among the member states and may choose an outside option that involves some sort of level of investment in the IO, which may provide greater benefits to other member countries. The U.S., in turn, may impose costs of its own if any member decides to leave the organization. This denotes U.S. structural power, and deters the member countries from setting the cost of informal influence at a prohibitive level. Finally, with the U.S. being the leading state, it may propose the distribution of vote shares in the IO, where the member states decide whether to participate under those terms. Having the advantage of being the leading state represents its unique role in designing any organization in which it participates. This is similar to building a house however one likes and then subletting it to X amount of tenants for Y amount of rent a month, and the tenants may decide to agree to those terms or simply not be tenants. Because the person who built the house is the leading state, one has the bargaining advantage of running participation, or in this context, tenancy. A fundamental aspect of this model that ties it all together is that the institutional design is endogenous (Stone 2008: 35).

Stone argues that “power and legitimacy are related in a particular way, which relies on organizations that combine elements of formal and informal governance” (Stone 2008: 11). This correlates to the key insight of this model which is capturing how formal and informal governances interact with structural power and formal control. This equilibrium that he states in his general argument is what his model strives to explain. Each of the three powers coincides with one another and keeps each in check. Formal voting rights determine to what extent powerful countries are allowed to exercise their informal influence with each leading state having the power to override common policy. It is only under a certain cost determined by the member countries that they may choose that option. Instead of paying that cost to override policy, a member may choose to instead revert to attractive outside options in lieu of multilateral cooperation, and, in turn, create positive externalities for other participants. This ability of having outside options gives that state structural power. Without any informal influence, there will not be a need to revert to any outside options, because there will not be any policy to override. Without structural power, there will be little positive consequences for any of the participating members within the IO. When there is
no benefit to being in IOs, then there is no point of being a part of it and thus membership declines. If membership declines, there will be less formal voting rights, resulting in less informal influence, and so on.

In order for Stone’s model to be used in this sense, power and legitimacy must be properly and clearly defined. According to Stone, “Power is defined as the ability to suspend formal rules that allow powerful actors to safeguard their core interests” (Stone 2008: 13). Basically, having the authority to suspend any kind of restrictions to protect one’s vital interests is defined as power in terms of IOs. Legitimacy, on the other hand, is defined as “the monopoly of the legitimate use of force” (Stone 2008: 16). Stone goes more in depth in which he explains that “in order for international institutions to serve anyone’s interests, therefore, they must enjoy some minimal legitimacy, because they must elicit voluntary participation” (Stone 2008: 16). As long as there is voluntary involvement between member states, the leading state can ensure a monopoly of the legitimate use of force. With the U.S. being the leading state in a majority of these IOs, it has the ability to suspend rules to safeguard its vital interests, which would be informal influences in this case. It can also use force legitimately, which would be its structural power in order to ensure that it not only satisfies its own interests, but also other members’ interests. The U.S. must be careful when exerting its power because if it exercises its power to override institutional policy too often, it will undermine the value of the IO for the other members.

Stone explains that usually within an IO, each state chooses strategies that maximize its short-run interests but, throughout a prolonged period of time, the powerful states are willing to exercise restraint in order to sustain cooperation in the future. Weaker states nurture that restraint by reducing the costs that they impose on those powerful states when they exert their informal influence and override common policies, as long as the powerful only do so when the temptation exceeds a particular threshold (Stone 2008: 44). The benefits of cooperation can erode if it is expected that the leading state will override an institutional policy; member states respond by increasing the cost of overriding, and then the U.S. responds by reducing its investment in the IO. This points to a very significant danger to IOs: the temptations of the leading power can lead to their gradual marginalization. If the U.S. consistently decided to override institutional policy it would erode the cooperativeness of institutions, which would lead to members restricting informal influence, and ultimately resulting in low levels of U.S. investment.

Stone came up with a solution to this key danger and that is to include multiple leading states. The main understanding to be gained from long periods of cooperation is the potential to generate restraint on the multiple leading states. He explains that a fundamental key for successful cooperation is to maintain mutual restraint: powerful states refrain from exercising informal influence outside of a recognized zone of legitimate deviations from the formal rules, and in turn weak states refrain from imposing formal rules that would curtail their privileges (Stone 2008: 45). This mutual restraint basically shifts the essential threshold needed in order for the leading states to exert their informal influences at the appropriate level mandated by the member states.

In his formal model, Stone states that the objective of his model is “to incorporate the features that appear to be substantively most important to the subject at hand while retaining as much generality and tractability as possible.” (Stone 2008: 41) He refers to simplicity within his model when it can capture the key intuition of an argument, which would be much more preferable to a model that may contain many unneeded features. This allows for better understanding for anyone analyzing the influence the U.S. has on the different IOs.

**SUMMARY OF LITERATURE REVIEW**

Over the years IOs have become significant actors in international politics and states remain the fundamental actors in IOs. Stone’s model of informal governance explains why weaker states participate in IOs even if the policies simply reflect the preferences of the powerful. Through informal governance, weak and powerful states mutually cooperate with both parties benefitting.

The weak states have ample authority within the formal governance structure to provide them meaningful voices within the IOs and benefit from their policies enacted by the leading states. Powerful states, on the other hand, realize that IOs are only useful to them when they elicit voluntary participation; hence, they are willing to share power. Unfortunately, the most powerful states participate only when they are assured that they can assume
control when they deem that their core interests are affected. Informal governance itself continues to struggle constantly because of the leading states’ ability to override policy. This makes power sharing tolerable initially, but tends to undermine the legitimacy and credibility of IOs. Nonetheless, IOs are legitimate because, in equilibrium, the leading state chooses not to override institutional policy under ordinary circumstances. The member countries implicitly consent to leading states’ informal influence, because they understand that it is the price for their participation. Stone’s model is a cycle of balance and it helps to better explain the reason why weak and powerful states cooperatively exist within IOs, which ultimately helps explain the U.S.’ dominant influence within IOs like the MDBs and the IMF.

METHODOLOGY

This study uses descriptive statistics to test whether the United States is able to use its formal and informal influence in the manner Stone suggests. The first task was to gather data on all items the United States did not support in the MDBs. Data were obtained from Strand and Zappile’s (2013) study. Strand and Zappile used U.S. Department of Treasury data to create a dataset with over 12,000 positions taken by the U.S. in the MDBs. A dataset of those items the U.S. did not support was created, resulting in over 1,300 individual positions taken by the U.S. over the period of 2004 to 2011. Using empirical data analysis to examine the outcome of loans not supported by the U.S., the study tracks loan information from several different IOs.

Information was gathered by searching project databases for the MDBs examined in this study. For the World Bank, its project database included both the IBRD and the IDA. Data on other MDBs loan projects were gathered from individual sites for MIGA, the IFC, and the various regional development banks.

The dataset contains several columns of data needed for this study. The first column in the file is the date the item was considered. The second column is the IO and the third column is the specific lending window. Then the country, project title, and project number, if available, are listed. The key data for this study is the status of loan and other items considered by the MDBs. If an item opposed by the U.S. ultimately passed, the variable was coded “1” and if the item did not pass the variable was coded “0.” To determine if an item passed or not, an attempt was made to match up the exact dates, amount, and country. If it was unsure, the study’s mentor looked into it. In total, there were 1,217 items that have been coded and verified.

Since the main question guiding this research is what percentage of items that the U.S. does not support is approved by IOs, Stone’s argument supports that IOs are best understood as equilibrium outcomes that balance the power and interests of the leading state and the member countries was consistently used. He created a model to support this argument called the model of informal governance, which specifies how three particular forms of power interact. It includes the following: structural power, formal voting rights, and informal influence. Structural power represents alternatives to the leading state and the options it produces for other members involved. Formal voting rights set the stage for the organization regarding how it will be run and are a direct medium for informal influence. Informal influence, the most essential form of power that provides substance for this model, consists of participation in decision making, allows special access to information, and allows the leading state to override the common policy when its core interests are affected. This model proposes that the concept of power is significantly more crucial in informal governance or what Stone calls “outside options.” Although the U.S. only controls a minority of the votes in these IOs, its informal governance allows it even more control through its power and legitimacy.

In addition to using Stone’s model, this study relies on Strand and Zappile’s (2013) research. They used several different variables in their paper that help to better understand why the U.S. would support some loans over others and vice-versa. One variable is called the U.S. Loan Support Ratio which is the ratio of loans receiving U.S. support. It is a dependent variable that relies solely on the U.S.’ positions on items whether it be loan proposals or grant-in-aids. This was the prime variable used for the core of this research, because it allows us to see which loans had the support of the U.S. This helped with calculating an estimated percentage of items that the U.S. does not support are approved by IOs. Another variable used is per capita national product (GDP/capita), which helped determine whether or not U.S. votes on loans were driven by assessments of recipient need. Strand and Zappile have mentioned that “it is expected that the U.S. is more likely to vote in favor
of loans to countries that have lower per capita GDP” (Strand and Zappile 2013: 10). Data were collected from the following sites: The WB at http://www.worldbank.org/projects, the IFC at http://www.ifc.org/projects, and MIGA at http://www.miga.org/projects/advsearchresults.cfm. Data was also from both Stone (2008) and Strand and Zappile (2015) and some data were collected from Dr. Strand to better help analyze the data. The data have been assembled in a dataset (in the form of an Excel spreadsheet) allowing for empirical data analysis to examine the outcome of loans not supported by the U.S. from the aforementioned websites stated above.

DATA ANALYSIS

Stone’s theory and the conventional wisdom indicate that if the U.S. does not support a loan or other item that we would expect that item to not be approved. Preliminary analysis of items coded to date reveals that more than 50% of the items not supported by the United States still passed. The way this statistic was produced was by creating an Excel spreadsheet of all compiled data from the list of the 1,217 items that did not have U.S. support, either through an abstention or complete unsupportive vote of the loan request, and calculating the percentage of loans that still passed each year from each international lending window. This involved counting how many total votes, passed items, and failed items each year for each lending window by using the data in the list of loan request items. In this Excel spreadsheet there are five columns for each lending window. The first column shows the total votes that lending window made within that particular year, the second column portrays the amount of items that passed, the third column portrays items that failed, the fourth column contains a percentage of items that passed, and the last column is the year in which the loan requests were brought forth.

Beginning with all the WB lending windows in total, the seven years with available data show shockingly high numbers of loan and grant requests that have passed without any U.S. support whatsoever. In 2004, there were 77 items that were brought up to the World Bank and out of them 67 had passed. For that year, it had an 87.01% passing rate for loans that did not have any U.S. support. The following years had similarly high percentages as well: 2005 had 74.26%, 2006 79.01%, 2007 76.34%, 2008 65.91%, 2009 86.56%, 2010 77.27%, and in 2011 had the lowest pass percentage of 59.74%. Overall, from the total 583 items brought forth, 441 passed giving it the average pass percentage of 75.64%.

The next lending window is the IBRD with 12 out of 12 loan requests being approved in 2004; a 100% pass rate. The IBRD shows rather higher pass percentages than its larger counterpart: an 85.71% for 2005, 100% for 2006, 2007, and 2010, 91.67% for 2008, 86.67% for 2009, and an all-time low of 45% for 2011. Overall pass percentage is 85.19% out of 108 loans, almost ten points higher than the World Bank. The other componential lending window of the IDA shows similar results: 100% for 2004, 2007, 2009, 84% for 2005, 85.33% for 2006, 50% for 2008, 66.66% for 2010, and the lowest of 40% for 2011. The overall pass percentage is 81.25% out of 128 loans, which is higher than the World Bank but slightly lower than the IBRD. The IFC follows suit with these seven annual pass percentages: 85.71% for 2004, 77.36% for 2005, 80.36% for 2006, 80.59% for 2007, 62.50% for 2008, 86.56% for 2009, 82.05% for 2010, and 82.86% for 2011. Overall pass percentage out of 301 loan requests is 79.75%. The final lending component of the World Bank is MIGA with the following annual pass percentages: 0.00% for 2004, 2006, 2007, 2009, 2010, and 2011, and 11.11% for 2005. Overall annual pass percentage out of 36 total loan requests is 2.78%.

Across the regional development banks, the passing rates vary widely. First, the EBRD results show the following pass percentages: 27.78% for 2004, 51.16% for 2005, 35.42% for 2006, 38.81% for 2007, 31.82% for 2008, 45.45% for 2009, 62.96% for 2010, and 59.09% for 2011. The overall pass percentage is 41.75% out of 309 loan requests. Second is the IDB with the following pass percentages: 100.00% for 2004, 2007, 2008 and 2010, 90.91% for 2005, 77.78% for 2006, 88.89% for 2009, and 63.16% for 2011. The overall pass percentage is 89.66% of 87 loan requests. Last is the AsDB with the following pass percentages: 34.48% for 2004, 14.29% for 2005, 50.00% for 2006 and 2009, 67.74% for 2007, 63.16% for 2008, 70.00% for 2010, and 61.76% for 2011. Overall pass percentage out of 188 loan requests is 52.13%.

To better provide a more accurate analysis of the overall loans that were passed without U.S. support on a year-to-year basis, the total pass percentage

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1 The African Development Bank (AfDB) was excluded from the analysis due to the difficulty of getting loan approval data; there were 141 loan requests from this lending window that were excluded.
rates of each lending window by each year together were added. By combining the pass percentages of the WB, IBRD, IDA, IFC, MIGA, EBRD, IDB, and AsDB, the following average totals were produced: 54.57% for 2004, 61.1% for 2005, 63.23% for 2006, 70.41% for 2007, 58.13% for 2008, 67.97% for 2009, 69.87% for 2010, and 54.04% for 2011. As seen by these statistics, more than half of the loan requests brought forth to these IOs are passed with either the U.S. abstaining or voting against them. The pass rate seemed to only increase for four consecutive years until it hit another low in 2008 and then rose back up for two years until it dropped again in 2011.

Using pass rate to assess U.S. influence where lower pass rates reflect more influence, it can be seen that the U.S. has the strongest influence over MIGA but has the least amount of influence in the IBRD. When adding together the final pass percentages of each year starting in 2004 and ending in 2011, the total pass rate for loans and other items that the U.S. did not support was 62.39%, more than half of the items brought forth.

CONCLUSION

Using the pass percentages for the year-by-year statistics from the data analysis, the following research question can now be answered: Is the United States able to block loans and other items that it does not support? Clearly the results are mixed across the various lending windows, but, given these results, the U.S. has not been able to block unsupported items. This conclusion runs counter to much of the conventional wisdom. Moreover, as the data shows, the U.S.’ informal influence may be declining. More than half of unsupported loans and other items passed within the World Bank and the regional development banks in 2004, the first year that loan data became available from the U.S. Treasury. It is interesting to note that the loan passing rate within these IOs continued to gradually rise until 2008 where it dipped from 70.41% to 58.13%. This could have been caused by the Great Recession in the U.S. and the European Debt Crisis, both of which had dramatically weakened the world’s economy. Other indicators behind these annual passing rates are bilateral trade relations, recipient need, and regime type in which the U.S. strongly supported. If the host country requesting the loan did not align with any of these categories then there was much lower support from the U.S, if any.

Stone’s model of informal governance plays a key role in explaining how the U.S. has been dominating these IOs. But the evidence in this research project suggests that Stone’s model may need to be revised to account for the passage of unsupported items. My analysis demonstrates that more than half of the loans the U.S does not support still get passed. Future research should look into how much international influence the U.S truly has within the world’s international lending windows. Future studies should also extend this analysis to other IOs, such as the IMF and the United Nations.

REFERENCES


ABSTRACT
This essay combats elitist academic attitudes assuming that all online content is not reputable and that online communication, specifically txtspk, defiles English. By exploring the tenants of open source and open access, particularly the benefits of free redistribution, online editions of Shakespeare’s plays prove to promote intellectual excellence and transparency, benefitting academics most. Similarly, the belief that txtspk is destroying the English language is a myth because modernizing and shortening words exist in all languages, including the first printed editions of Shakespeare’s canon. Finally, this essay addresses future concerns for online editions such as the copyright barriers over intellectual and artistic material, the need to recognize privilege and value identity, and the necessity of universal design, and the need to recognize privilege and value identity. Terence Eden’s open source project, SHKSPR.mobi, is this essay’s example for discussing academic attitudes toward these concerns. Ultimately, this online txtspk edition of Shakespeare’s canon advances rather than redacts academic scholarship.

INTRODUCTION
Academia has a natural aversion to scholarly work produced by non-academics, particularly when posted on the internet. A 2010 textbook on theatrical history, Theatre Histories: An Introduction, bluntly voices the concern that ‘Anybody can put up a website with data and opinions that represent no special expertise. Unlike the data and opinion in scholarly books and articles, those on many websites are not subjected to review by experts in the field before being disseminated to millions of possible users’ (McConachie, et all xxv). While this is a valid concern, stating that these sources are uninformed generalizes that all online content posted by non-academics misleads readers or lacks peer review. Sharon O’Dair, of the University of Alabama, shares similar concerns from personal experience: in her essay in Shakespeare Survey, she complains that internet users wrongly interpreted a presentation she delivered at the International Shakespeare Conference, which then led to distorted versions of the aforementioned presentation appearing online, accompanied by criticism combatting statements she did not make. The essay, aptly titled, “Pretty Much How the Internet Works”; Or, Aiding and Abetting the Deprofessionalization of Shakespeare Studies,”
attacks non-academic scholarship on the internet, which, as the title suggests, “deprofessionalizes” academic work.

There is hardly any room for a reputable, non-institutional online edition of Shakespeare’s canon when there is not a safe space for intellectual critique. Michael Best lists further barriers to online academic material in his essay “Shakespeare and the Electronic Text,” describing the stigmas against online editions of Shakespeare’s plays as “economic, political, technical, academic, legal, political-academic, economic-political-academic, and, no doubt, economic-political-technical-legal-academic” (146). Several arguments leveled against all online editions include one or a combination of the following concerns: lack of economic revenue, political implications of challenging traditional scholarship, technical difficulties of creating adequate online databases, academic insecurities of online publishing, and legality concerns of copyright ownership over published or artistic media. These barriers exist because academia fears that audiences will consume faulty information or that what academia produces will be digested incorrectly and redistributed in a flawed format. Other scholars find these concerns minimal.

Compared to the many complaints, there are only a few supporters of online editions – fewer when multimedia are no longer justification for making the edition digital. Jerome McGanne’s “Rationale of Hypertext” praises the multimodal benefits of electronic editions, but these editions have more advantages than easily incorporating media. It has long been overlooked that online editions supply intellectual and authoritative material standard of academic work, progressing rather than diluting academic scholarship. Leading open access advocate and scholar Peter Suber summarizes that, contrary to popular belief, these open access material is “compatible with copyright, peer review, revenue (even profit), print, preservation, prestige, quality, career-advancement, indexing, and other features and supportive services associated with conventional scholarly literature” (Suber). In other words, online scholarship can rival printed scholarship in every way, and access to posting this material hastens participation in academic discussions.

Using Terrence Eden’s SHKSPR.mobi, a txtspk online edition of Shakespeare’s canon, as a basis for conversation, this essay analyzes academia’s criticism toward two online concerns: open access and online literacy. It shall prove that Eden’s edition advances rather than “deprofessionalizes” Shakespearean studies.

**MYTH 1: ANYBODY CAN UPLOAD ANYTHING ONTO THE INTERNET**

For an open access and non-institutional project like SHKSPR.mobi, the immediate objection is that non-academics can publish scholarship on the internet without having to undergo peer review. However, this completely overlooks the purpose of open source and open access, which make high quality online material free of costs and rights.

Terrence Eden launched SHKSPR.mobi in 2007 under a Creative Commons license, inspired by the Free Software Movement which believes that all users should have free access and rights to software. A subset of this movement is the Open Source Initiative. The Open Source Initiative (OSI) describes its mission in part: “Open source is a development method for software that harnesses the power of distributed peer review and transparency of process. The promise of open source is better quality, higher reliability, more flexibility, lower cost, and an end to predatory vendor lock-in” (“About the Open Source Initiative”). In other words, the aim of open source (OS) software is to create excellent and professional software that is available to all and, above all, unbiased from monetary gain. OS combats “vendor lock-in” akin to academia’s efforts to provide a multimodal critical edition of Shakespeare’s canon in 1997: the Arden Shakespeare CD-ROM offered a package of the canon and supplemental material, priced at $3,995USD, which few could afford, academics and institutions included (Murphy 401). OS projects are also cheaper because online content easily accommodates color images that grayscale printed editions often cannot afford (Galey and Siemens 204). Costs for academic material have been a constant frustration, leading critics such as Charles Ross’ to complain that printed editions “restrict, not expand, readers’ resources” (225). The tenants of OS provide greater access to academic scholarship by making content free.

The first foundation of OS has a movement of its own: open access. “Free redistribution,” otherwise known as open access, is the first of the OSI’s ten tenants, all of which require transparency for derivative works and equal opportunity for and inclusivity of all groups (“The Open Source
Definition”). Scholarly open access (OA) comes in four forms: journals (gold OA) or repositories (green OA) and free access to cost (gratis OA) or permissions (libre OA). These groups of OA can also describe other online material, such as editions. Suber describes OA literature as, “digital, online, free of charge, and free of most copyright and licensing restrictions” (Suber). Combined with the mission and definition criteria of the OSI, this definition describes the ideal online edition of Shakespeare’s canon: professional, accessible, and redistributable. Thus, one of the many positive outcomes SHKSPR.mobi delivers to the academic community is translation: OA projects have the advantage of being translated without securing rights or permissions of the author, allowing for global dialogue. Eden’s other online edition, 莎士比亚.org, is an open source project of Shakespeare’s canon’s translated into Mandarin. Eden relies on users accessing and correcting the scripts in order to improve the translations.

Suber lists a number of parties OA academic scholarship benefits, but ultimately academics benefit most. He acknowledges that nonacademics have “access to peer-reviewed research . . . But even those with no interest in reading this literature for themselves will benefit indirectly because researchers will benefit directly” (Suber). It is easy to assume that only digital laymen benefit from online material, but they are not the targeted audience and profit incidentally compared to academics. In fact Suber would argue that OS editions promote intellectual collaboration not intended for digital laymen, instead resisting discrimination against primary and secondary readers (Suber 25). OS projects and, in particular, Eden’s translation project, have the added benefit of inviting the reader to become an active agent. Ross would say that this “offers the reader a hitherto unavailable opportunity, not simply to check an editor’s decisions in cases of emendation, but actually to rewrite a whole text or version on the screen of his or her personal computer” (226). Free access to content and free right to translate is an example of how OA primarily benefits the academic community, immediately allowing academics to immediately participate in contributing to the body of knowledge.

While it is true that anybody can upload content online, the parties uploading material are not the ones academia fears. Though unaffiliated with an academic institution, Eden is a graduate of the University of East Anglia. He has a minor in Mandarin and participated in the Drama Society at his university, making him knowledgeable in Shakespeare and Mandarin. While he may not be an academic in literature, Eden is obviously well informed on the subjects of his websites. As a self-proclaimed “Imaginer of Wondrous Things” at the O2 UK Lab and a team member of QRpedia, Eden is a credible source aware of the positive effects of OS and OA (“Terence Eden”).

MYTH 2: TXTSPEAK IS KILLING THE ENGLISH LANGUAGE
What separates Eden’s SHKSPR.mobi from other online editions is that Eden optimized it for mobile literacy. Labeled txtspk for its lack of vowels and origin in SMS texting, society has viewed this written form as a desecration of the English language. However, Shakespeare’s texts have been revised for modernized spelling since his plays were first printed. Shortening language, akin to txtspk, is a natural evolution for all languages, tracing back to Latin.

It is reigning popular opinion and a common myth that txtspk perverts English and the educational system. In the UK, Nick Seaton of the Campaign for Real Education and a local West London English teacher responded negatively toward a 2008 campaign by the London Grid for Learning because the advertisements were written in txtspk. Daniel Boffey reports that Seaton believes “This is a complete waste of money. Posters that go up in schools should be written in standard English and encourage children to read and write standard English. To use text language is to pass on entirely the wrong message and encourage lower standards” and that the teacher was frustrated because “These posters go up on the corridors of the English department, as well as everywhere else, and it undermines everything that we [the teachers] do” (qtd in Boffey). These viewpoints assume that txtspk is not standard English and that txtspk operates counterproductively to academic literacy. Such beliefs are shared by many credible figures in academia, as txtspk analysts Naomi Baron and David Crystal find, but txtspk practices have existed since antiquity.

David Crystal looks to historical literacy to prove that these practices that existed before modern literacy. Crystal acknowledges that txtspk is often yet wrongly attributed to the 21st Century, but it is actually one of the “oldest techniques in the [English] language” (7). For example, English texts have
replaced and with an ampersand since the invention of the printing press (Crystal 70). Further history of shortening words can be traced to cum, the Latin word for and, which was reduced to c in Roman texts by authors such as Tiros (Baron 176). Even Stanley Wells, renowned Shakespearean editor, admits that “The practice of modernizing the spelling of Shakespeare and his contemporaries is an ancient one” (4). It is not that modernizing spelling has never been done; it is that txtspk practices are historically overlooked.

Analyzing these practices would account for the differences between early editions of Shakespeare’s plays. Editors have modernized spelling as early as the first printed editions. MIT’s Hamlet on the Ramparts explains that “In addition to variant readings of this kind, all English books of Shakespeare’s time exhibit variation within a single edition, due to the practice of correcting proof pages while the presses continued to run” (“Hamlet on the Ramparts”). This explains the variations in the First Folio and the Second Quarto. Using Horatio’s speech from 1.4, the differences are obvious. The First Folio appears as, “What if it tempt you toward the Floud my Lord? / Or to the dreadfull Sonnet of the Cliffe” (Shakespeare, The Tragicall Historie of Hamlet). However the Second Quarto appears as, “What if it tempt you toward the flood my Lord, / Or to the dreadful Sonnet of the Cliffe” (Shakespeare, The Tragicall Historie of Hamlet). In these two lines alone, there are three variations in spelling, two in capitalization, and one in punctuation. The evolution from Second Quarto in 1604 to the First Folio in 1623 exemplifies modernizing language.

It is especially tricky because the Folios and Quartos include spellings that might be misunderstood by contemporary readers. In his essay “Modernizing Shakespeare’s Spelling,” Wells attacks the spelling conservatism of the 1950s because it has “the practical disadvantage of creating a need for many more glosses than normal in a modern spelling edition” (5). He lists examples where the contemporary reader would be more confused by Shakespeare’s spelling than a modern spelling, txtspk or otherwise: “fadm (fathom), burthen (burden), bile (boil, sb.), asprey (osprey), arrand (errand), accompt (account), venter (venture), and tottered (tattered)” (6). Especially in the case of words that are similar to modern homophones like bile and tottered, Shakespeare’s texts challenge the modern reader. Horatio’s speech in the First Folio refers to the “Sonnet of the Cliffe” which a contemporary reader might misunderstand to be a poem of the cliff rather than the summit of the cliff. Modernizing spelling clarifies language nuances like this, making Eden’s edition easier for a 21st Century reader to understand than the First Folio, which is considered to be Shakespeare’s most sophisticated source text.

This is partly because txtspk spelling is only an aesthetic change, as W.W Greg writes in his essay, “The Rationale of Copy-Text.” Greg asserts that any aesthetic change, insofar as accidentals are concerned, can be changed as long as the meaning of the text remains intact. Ultimately the purpose of the text is not to be read, but to be performed. In fact the txtspk spellings represent phonetic pronunciation, making performing Eden’s edition easier. SHKPR.mobi would be performed in the same manner as any other Moby edition of the text, such as the Massachusetts Institute of Technology’s The Complete Works of William Shakespeare, would be. To illustrate, the only difference in the first two lines of Horatio’s speech in 1.4 are aesthetic spellings. In the MIT text, these lines appear as, “What if it tempt you toward the flood, my lord, / Or to the dreadful summit of the cliff” (“SCENE IV”). In Eden’s edition, it appears as, “wot if it tempt U toward d flood, my lord, / Or 2 d dreadful summit of d cliff” (Eden). Unlike the printed sources, the words are identical, and punctuation and capitalization remain the same (except for the substitute of you for U), making the spelling changes purely stylistic. This alters the appearance of the text, but it does not change the meaning.

Modernizing spelling to the standards of temporality has always presented a challenge for Shakespearean editions because it might be thought of “vulgarizing” the text. Wells maintains that the “Modernization of spelling, responsibly undertaken, may thus be seen not, as some would have it, as a work of popularization, even of vulgarization, but as a means of exploring Shakespeare’s text that can make a real contribution to scholarship” (54). The definition of “popularization” and “vulgarization” is subjective. Txtspk certainly popularizes spelling, but so too does modernizing archaic spellings, such as Shakespeare’s last name, which appears on the title of Hamlet in the First Quarto as Shake-fpeare. Similarly, txtspk might be viewed as a vulgarization to an academic, but not to somebody who uses mobile literacy on a daily basis.
In *Always On: Language in an Online and Mobile World*, Naomi Baron explains that there are also cultural pressures that encourage txtspk. Particularly in American culture, informal communication networks and new pedagogy approaches, such as “increasingly encouraging students to write what is on their minds, with the objective of self-expression taking precedence over ‘proper’ writing style,” reinforce informality in written literacy (166). It is further acceptable because English is already corrupted in a variety of socially – and academically – acceptable ways, like talking about a singular subject in the plural for gender neutrality (Baron 168). Socially and literately, txtspk is easier to process, and according to Crystal, this is why it “helps rather than hinders literacy” (9). While any Shakespearean scholar would be well acquainted with the language of the Folios and Quarters, it is hard to deny that modernized spelling does not make reading his plays easier and quicker. Few scholars would acknowledge that the same goes for txtspk, but it achieves the same effects as modernized spelling.

Txtspk is not a new practice that coincided with the advent of the internet; it is actually an age-old practice that came into existence simultaneously to the invention of language. The “vulgarizing” practice of condensing language can be seen in early printings of Shakespeare’s plays and subsequent editions that modernize his language. Institutional figures complain that txtspk corrupts English, but txtspk spellings are as valuable as “standard” spellings because they clarify the archaic spelling Shakespeare used.

**MYTH 5: NOTHING IS IMPOSSIBLE FOR THE INTERNET**

While access advocates describe the endless possibilities of how online material will revolutionize the academic community, there are barriers to coders and critics alike. Electronic OS editions, including Eden’s *SHKSPR.mobi*, still have an uncertain future with plenty of room for improvement in editorial and artistic rights, physical access, and identity politics. Academia has voiced these concerns repeatedly as doubts against online scholarship, but academia in print also struggles with these concerns.

Ownership of the author and the artist are two critical copyright concerns at the present time. Copyright laws make important texts and editions impossible to publish online, limiting access to knowledge. Moby Shakespeare is the most prevalent edition of the canon found online because it is in the public domain and therefore free of copyright. However, it is hardly an ideal edition, deriving from the 1866 Globe Edition. A superior academic edition has yet to be made specifically for free or internet use. Creator of *Open Source Shakespeare*, Eric Johnson speculates that “such a free edition [a modern, scholarly, free alternative to edition], while superior to Moby Shakespeare, would not necessarily be that much of an improvement. All of the ‘competitive’ modern collections have annotations, glossaries, detailed introductions to the play, etc” (Johnson). Johnson contends that a competitive edition requires supplemental material, something that is time-consuming and unappealing to compile when there is no monetary incentive.

The more complicated copyright challenge is access to multimedia. Although the internet is a prime tool for linking and embedding media, few sites are able to offer this due to expensive and complicated copyright over artistic creations. Until there are better channels for incorporating this material, copyright will continue to be a barrier, especially in the case of free editions which often cannot afford royalties. In “The Internet Shakespeare Editions: Scholarly Shakespeare on the Web,” Michael Best admits that “When it comes to the many artefacts of theatre performance, however, there are relatively few material objects that are capable of digitization, and even for these there are often significant difficulties in obtaining permission to make them public” (227). In Best’s explanation, OS is not even possible because access to the source is restricted. Unfortunately, this is not a concern that OA can handle because “OA isn’t an attempt to deprive royalty-earning authors of income. The OA movement focuses on research articles precisely because they don’t pay royalties” (Suber 21). Best suggests performance archives, although he is quick to add that archives are sometimes neglected and smaller troupes cannot afford them (“The Internet Shakespeare Editions” 228). It is a twofold problem: access to performance is limited and publishing that material when it is available is costly.

Even if *SHKSPR.mobi* had the funding to accommodate multimedia, this would present concerns for physical access for ability and hardware. Critic George Williams points out that “What has remained neglected for the most part, however, are the needs of people with disabilities,” citing “deaf or hard of hearing, as well as for people who are blind, have low vision, or have difficulty distinguishing particular
colors” as especially important populations in need (Williams). Multimedia raises a number of concerns: video and audio must include comprehensible closed captions or transcripts for deaf or hard of hearing users; blind users may require screen reading or Braille reading technology for all media, especially text; and aesthetic delivery of the material should avoid triggering migraines, epilepsy, and other concerns. Williams recognizes that these populations can be small and inconvenient to serve, which is why he advocates for universal design. Originally coined by Ronald Mace, universal design refers to principles that better accommodate all users, not just users with ability concerns. To Williams, design for ability and universal design differs because “Devoting efforts to accessibility might improve the built environment for disabled people, but devoting efforts to universal design improves the built environment for all people” (Williams). Like the tenants of OS and OA, universal design benefits all. It aims to create greater access and usability for all people.

Additionally, universal design would benefit non-traditional hardware users operating mouseless, keyboardless, or mobile technology. The widespread use of mobiles and tablets is especially important in the academic environment where increasing numbers of students are accessing Shakespeare’s texts via mobile instead of relying on printed books. For example, the Folger Shakespeare Library’s Digital Texts collection relies on a complicated XHTML structure that does not render well on mobile devices. This is the purpose of SHKSPR.mobi: txtspk displays maximum information on mobile screens; it was not a challenge to academic literacy. Regardless, optimizing editions to hardware-friendly and mobile standards will have the added benefit of increasing access and participation. The larger problem, access to hardware and online connections, remains a global concern.

This third and final global concern is much larger than access: representation. Editions should account for how “race, ethnicity, transnationalism, gender, and sexuality” – as well as other identities – appear in online editions, especially for populations that might not be represented presently (McPherson). Tara McPherson noticed a distinct lack of how identity manifests in digital humanities after attending the American Studies Association Conference and a private workshop funded by three of the most prestigious foundations, the National Science Foundation, the National Endowment for the Humanities, and the Institute of Museum and Library Services. She finds that the workshop had less concern for identity representation even though it was more endowed and selective. Similar to Eden’s project to translate Shakespeare’s canon into Mandarin, there is a great need to recognize privilege and value identity in spheres of power. Whether in print or online, Shakespearean editions have a lot to consider in moving forward. None of these concerns – access to content from legal, ability, hardware, and individual perspectives – are greater than another. All of them need to be addressed, one online edition at a time.

CONCLUSIONS
This paper offers responses to two major concerns for online editions and explores future barriers. However, with an ever-changing online landscape, this analysis cannot claim to be permanent or complete. Currently academia’s unease over who posts content and who accesses content is the greatest anxiety, but the misconception that txtspeak butchers English is of equal concern. Little attention has been given to how online access and literacy might benefit academics, but this paper revealed a few advantages: free content means free access and no author rights means projects can be easily translated; txtspk is nothing more than the natural evolution of language and has existed in Shakespeare’s canon since it was printed. Before attacking an online edition of Shakespeare’s canon, it is important to remember that there is not a singular existence of Shakespeare’s plays: even the original texts survive in different Quartos and Folios. While SHKSPR.mobi might not be cited as the primary text in the next issue of Shakespeare Survey, this edition is overlooked for its important contribution in promoting intellectual discussion in the academic community as an extension of Shakespearean editing practices.

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WORKS CITED


2014 McNair Scholar Articles
A FIRST-PRINCIPLES COMPUTATIONAL STUDY OF STRUCTURAL AND MECHANICAL PROPERTIES OF ZNO

BY JEEVAKE ATTAPATTU

ABSTRACT
We report on a first-principles computational study of structural and mechanical properties of zinc oxide (ZnO), which is a semiconductor with wide-ranging applications in many fields of science and technology. We have examined three structural phases of ZnO in wurtzite, rock salt, and zinc blende structures, respectively. We have compared the total energies of these relaxed structures at different pressures to determine the phase transition pressure, and the obtained results show that the wurtzite and zinc blende phases transform to the rock salt phase as pressure exceeds 11 gigapascal (GPa). We used the Birch–Murnaghan equation of states fitting to obtain the bulk modulii of 129, 166, and 129 GPa for the wurtzite, rock salt, and zinc blende phases, respectively, at ambient pressure. We also calculated high-pressure bulk modulus using the direct derivative method, and obtained 193, 229, and 192 GPa, respectively, for the three phases of ZnO. Furthermore, we calculated the elastic parameters that describe the stress response of these three phases near their equilibrium structures. The results provide a useful guide on the strength of ZnO under different structural deformation modes, which correspond to various loading conditions that may occur in applications.

INTRODUCTION
The purpose of this study is to determine structural and mechanical properties of zinc oxide (ZnO) using first-principles computational methods. ZnO is a semiconductor widely used in many electronic and optical applications. These applications range from micro processors to photovoltaic cells to piezo-electric materials. Besides its properties suitable for these applications, ZnO is also economically and environmentally desirable – first, both the constituent elements are abundant on Earth and therefore inexpensive for large-scale applications; second, it is non-toxic, which is another favorable aspect for wide applications.

Among the most important fundamental physical properties of materials are the stable crystal structure and the bulk modulus and the elastic constants. The bulk modulus indicates how a material responds to uniform pressure, while the elastic constants provide information on how the structure responds to strains along specific directions. Applying such specific strains can change the prop-
erties of the material including the electronic band gap and electrical conductivity that are key parameters in most device applications.

The electronic band gap is a measure of how much energy an electron requires to change from a valence electron in to a conduction electron in a semiconductor. The magnitude of the band gap directly affects the material’s electrical properties, such as the electrical conductivity. Since electrons also carry heat, the band gap also affects the thermal conductivity of the material.

The most significant contribution of this study is the simulations of the high-pressure phases. This is because a majority of previous research publications focused on the ambient-pressure properties. These high-pressure simulations are important because the rock salt phase of ZnO obtained at high pressure can be recovered at ambient pressure1, and this new structural phase possesses different properties that may be more useful for certain applications. The results also provide insights into the physical mechanisms that determine the structural phase transformation and mechanical properties, and these insights may be useful in further probing ZnO and other similar materials.

**LITERATURE REVIEW**

Several past studies have been referenced for the present work. The first such study2 calculated the elastic constants using the computer code CRYSTAL983. It also calculated the electronic structure using hybrid density functionals. The elastic constants were calculated for the wurtzite and zinc blende phases of ZnO and ZnS.

The second study4 for comparison obtained the elastic constants using the density functional theory (DFT) package called ABINIT5. It uses pseudopotentials and a plane wave basis set. For this study local-density-approximation (LDA) pseudopotentials were used. The bulk modulus was calculated using the Birch-Murnaghan equation of state fitting. Calculations were done for the wurtzite, rock salt, and zinc blende phases of ZnO, BeO, MgO, SrO, BaO, and CdO.

The third study6 for comparison obtained the elastic constants using the DFT package called WIEN2k7, which uses an augmented-plane-wave basis and generalized gradient approximation (GGA) pseudo potentials. The bulk modulus was calculated by using the Birch-Murnaghan equation of state fitting. Bulk moduli and elastic constants were calculated for the wurtzite, rock salt, and zinc blende phases of ZnO. While the elastic constants are the main focus of this study, there are a multitude of publications on ZnO that address its potential uses. For example, ZnO thin films were tested for photovoltaic properties8. The efficiency was found to be 3.7%. Recently9, TiO2-ZnO grains have shown an efficiency of 5.31% as a photo anode. Moreover, ZnO also has numerous uses in electronics. For example, ZnO has been studied as a candidate material for uses in LEDs10, n-p junctions11,12, and Al/Au ohmic contacts13. Since ZnO is known to have a band gap of 3.4 eV14, ZnO-based LEDs would produce UV light (the visible spectrum has energies between 1.8 eV and 3.1 eV). The n-p junction is the basic unit in diodes and transistors in integrated circuits. The ohmic contact gives a linear I-V curve as opposed to the n-p junction’s exponential curve.

There has been recent interest in Al-doped ZnO for its thermoelectric properties15,16,17. This is because this material possesses a high Seebeck coefficient, which measures the electrical potential generated by applying a thermal (temperature) gradient. The structural stability at temperatures above 1300°C15 allows ZnO to be used as a high-temperature thermoelectric generator.

ZnO nano-particles have been studied for photocatalytic applications18. A photo-catalyst is used as a catalyst for a chemical reaction under certain lighting conditions. ZnO thin films can be used to degrade chemicals such as methyl blue into less toxic chemicals19.

ZnO thin films have been studied for use as a fiber-optic temperature sensor20, and it can also be used as a NH3 gas sensor21. Au-ZnO thick films have been studied for use as an ethanol sensor22. Various forms of ZnO with dopants or composites have been studied for use as a variety of bio-sensors. ZnO inverse opal electrodes have been studied for use as a glucose sensor23. A ZnO based paste has been studied for use as a BPA sensor24. A flower shaped ZnO nanostructure has been studied for detection of meningitis25. ZnO has even been added to cellulose to study for increasing immune response26.

**SUMMARY OF LITERATURE REVIEW**

ZnO has a wide variety of uses in many different forms. Computational studies have been done to calculate the elastic constants of ZnO at ambient pressure. However, there is a shortage of computa-
tional studies of high-pressure (and recovered) phases of ZnO.

METHODS

The primary tool used in this paper is the Vienna ab initio Simulation Package (VASP). VASP uses DFT to calculate the ground-state energy of a substance, which can be used to determine various properties of that substance.

DFT is primarily based on the Hohenberg-Kohn-Sham theorem. The first statement of the theorem is that the ground state energy of a many body system is a unique functional of the particle density. The second statement is that the functional has its minimum relative to variations of the particle density at the equilibrium density. This means that the ground state is simulated by reaching the minimum energy through variations of the particle density. Equation (1) is the total energy functional used in DFT.

\[ E[n] = T[n] + E^H[n] + E^{xc}[n] + \int V(\rho) n(\rho) d^3r \]  

Where \( T[n] \) is the kinetic energy, \( E^H[n] \) is the energy from electron-electron repulsions, and \( E^{xc}[n] \) is the exchange correlation energy. The integral is the potential applied over the density \((n \text{ is the density and } V \text{ is the potential})\).

To treat the exchange-correlation energy term, various approximation schemes have been introduced. Among them, LDA [eq. (2)] uses the exchange correlation energy \( E_{xc} \) of a homogeneous electron gas. The electron gas models treat electrons as gas molecules with similar movements and energy distributions. Meanwhile, GGA [eq (3)] further introduces the gradient of the local density into the term.

\[ E^{xc}[n] = \int n(\rho) \tau_{xc}[n(\rho)] d^3r \]  

\[ E^{xc}[n(\rho, \tau), n(\rho, \lambda)] = \int f[n(\rho, \tau), n(\rho, \lambda), \nabla n(\rho, \tau), \nabla n(\rho, \lambda)] d^3r \]  

These approximations usually carry systematic errors when compared with experimental results. LDA tends to underestimate the volume, which, in turn, overestimates the elastic constants and the bulk modulus. It also overestimates the band gap. GGA tends to overcorrect and overestimate the volume and underestimate the band gap. For this study, most of the simulations were done using the GGA pseudo potentials, which produced results in better agreement with available experimental results.

There are three known phases of ZnO. At ambient pressure the energetically favored structure is wurtzite (W), which is a hexagonal closely packed (HCP) lattice, and it is similar to multiple layers of graphene stacked together. At high pressure there are two energetically favored structures. The first is rock salt (RS), which resembles the structure of NaCl crystal, and the second is zinc blende (ZB), which is adopted by diamond.

The initial step is to determine the transition pressure for the structural transformation between the ZnO phases. This helps set a clear distinction between the high pressure and ambient pressure calculations. The ambient pressure simulations were done at 0 GPa, and the high pressure simulations require a pressure above the transition pressure, but at values where the structure is still stable.

The second step is to obtain the bulk modulus. To calculate the bulk modulus, each structure is placed under a series of uniform pressure values. The resulting energy data are then fitted against the Birch-Murnaghan equation of states described in equation (4) below; where \( V_0 \) is the ambient-pressure volume, \( B_0 \) is the corresponding bulk modulus, and \( B'_0 \) is the derivative of \( B_0 \) at ambient pressure. A direct definition of bulk modulus is given by equation (5). Though less accurate, it is a simple method of calculating bulk modulus at non-zero pressures.

\[ \Delta E = \frac{35}{48} \left( \left( \frac{V}{V_0} \right)^{7/3} - 1 \right) B'_0 + \left[ \left( \frac{V}{V_0} \right)^{2/3} - 1 \right] \left( \frac{B_0}{V_0} \right) \]  

\[ B = -\frac{\Delta V}{\Delta P} \]  

The third step is to calculate the elastic constants. The RS and ZB phases have cubic lattices, and they can be described by the following matrix notation, where \( a \) is twice the lattice constant.

\[ \begin{pmatrix} a & a & a \\ 0 & a & a \\ a & 0 & a \end{pmatrix} \]   

To calculate the elastic constants, distortions are applied to the lattice. By using the difference in energy between the distorted and undistorted structure, the elasticity of the structure can be calculated. The distortion described by equation (7)\(^{30}\), where \( \delta \) is a small change of lattice constant, gives the energy difference in equation (8)\(^{30}\).

\[ \Delta E_i = V_0 \left( C_{11} - C_{12} \right) \delta^2 \]  

\[ \begin{pmatrix} a & a & 0 \\ 0 & a & a \\ a & 0 & a \end{pmatrix} \begin{pmatrix} 1 + \delta & 0 & 0 \\ 0 & 1 - \delta & 0 \\ 0 & 0 & 1/1 - \delta^2 \end{pmatrix} = \begin{pmatrix} a(1 + \delta) & a(1 - \delta) & 0 \\ 0 & a(1 - \delta) & a/1 - \delta^2 \\ a(1 + \delta) & 0 & a/1 - \delta^2 \end{pmatrix} \]  

\[ \begin{pmatrix} a(1 + \delta) & a(1 - \delta) & 0 \\ 0 & a(1 - \delta) & a/1 - \delta^2 \\ a(1 + \delta) & 0 & a/1 - \delta^2 \end{pmatrix} \]
To calculate $C_{11}$ and $C_{12}$ equation (9)\(^{30}\) is used to get equation (10). A third distortion\(^{30}\) described by eq (11) is required to calculate $C_{44}$ [eq (12)]. Solving equation (8) and (10) for $C_{11}$ and $C_{12}$ results in equation (13) and (14).

$$\begin{bmatrix}
  a & 0 & 0 \\
  0 & a & 0 \\
  0 & 0 & a
\end{bmatrix} + \begin{bmatrix}
  1 + \delta & 0 & 0 \\
  0 & 1 + \delta & 0 \\
  0 & 0 & 1 + \delta
\end{bmatrix} = \begin{bmatrix}
  a(1 + \delta) & a(1 + \delta) & 0 \\
  0 & a(1 + \delta) & a(1 + \delta) \\
  a(1 + \delta) & 0 & a(1 + \delta)
\end{bmatrix}$$

(9)

$$\Delta E_2 = \frac{1}{2}V_0(C_{11} + C_{12})\delta^2$$

(10)

$$\begin{bmatrix}
  a & 0 & 0 \\
  0 & a & 0 \\
  0 & 0 & a
\end{bmatrix} + \begin{bmatrix}
  1 + \delta & 0 & 0 \\
  0 & 1 + \delta & 0 \\
  0 & 0 & 1 + \delta
\end{bmatrix} = \begin{bmatrix}
  a(1 + \delta) & a(1 + \delta) & 0 \\
  a_0 & a & a \frac{a_1}{1 - \delta^2} \\
  a & a_0 & a \frac{a_1}{1 - \delta^2}
\end{bmatrix}$$

(11)

$$\Delta E_3 = 2V_0C_{44}\delta^2$$

(12)

$$C_{11} = \frac{2(a_0^2 + a_1^2)}{3V_0\delta^2}$$

(13)

$$C_{12} = \frac{2(a_0^2 + a_1^2)}{3V_0\delta^2}$$

(14)

The wurtzite structure can be described by the matrix notation in Eq. (15). It is the primitive cell of a hexagonal closely packed lattice. Here $a$ is the lattice constant.

$$\begin{bmatrix}
  a & 0 & 0 \\
  0 & a & 0 \\
  0 & 0 & c
\end{bmatrix}$$

(15)

Given the lower symmetry of the W lattice, more distortions\(^{31}\) need to be applied. Equations (16), (18), (20), (22), and (24) describe the distortions\(^{31}\), while equations (17), (19), (21), (23), and (25) give the respective energy differences.

$$\begin{bmatrix}
  a & 0 & 0 \\
  -\frac{a}{2} & \frac{a\sqrt{3}}{2} & 0 \\
  0 & 0 & c
\end{bmatrix} + \begin{bmatrix}
  1 + \delta & 0 & 0 \\
  0 & 1 + \delta & 0 \\
  0 & 0 & 1 + \delta
\end{bmatrix} = \begin{bmatrix}
  a(1 + \delta) & 0 & 0 \\
  0 & a(1 + \delta) & 0 \\
  0 & 0 & a(1 + \delta)
\end{bmatrix}$$

(16)

$$\Delta E_4 = V_0(C_{11} + C_{12})\delta^2$$

(17)

$$\begin{bmatrix}
  a & 0 & 0 \\
  -\frac{a}{2} & \frac{a\sqrt{3}}{2} & 0 \\
  0 & 0 & c
\end{bmatrix} + \begin{bmatrix}
  1 + \delta & 0 & 0 \\
  0 & 1 + \delta & 0 \\
  0 & 0 & 1 + \delta
\end{bmatrix} = \begin{bmatrix}
  a(1 + \delta) & 0 & 0 \\
  0 & a(1 + \delta) & 0 \\
  0 & 0 & a(1 + \delta)
\end{bmatrix}$$

(18)

$$\Delta E_5 = V_0(C_{11} - C_{12})\delta^2$$

(19)

$$\begin{bmatrix}
  a & 0 & 0 \\
  -\frac{a}{2} & \frac{a\sqrt{3}}{2} & 0 \\
  0 & 0 & c
\end{bmatrix} + \begin{bmatrix}
  1 & 0 & 0 \\
  0 & 1 & 0 \\
  0 & 0 & 1 + \delta
\end{bmatrix} = \begin{bmatrix}
  a & 0 & 0 \\
  0 & a & 0 \\
  0 & 0 & c(1 + \delta)
\end{bmatrix}$$

(20)

$$\Delta E_6 = \frac{1}{2}V_0C_{33}\delta^2$$

(21)

$$\begin{bmatrix}
  a & 0 & 0 \\
  -\frac{a}{2} & \frac{a\sqrt{3}}{2} & 0 \\
  0 & 0 & c
\end{bmatrix} + \begin{bmatrix}
  1 & 0 & 0 \\
  0 & 1 & 0 \\
  0 & 0 & 1 + \delta
\end{bmatrix} = \begin{bmatrix}
  a & 0 & 0 \\
  0 & a & 0 \\
  0 & 0 & c\frac{a(1 + \delta)}{\sqrt{3}}
\end{bmatrix}$$

(22)

$$\Delta E_7 = 2V_0C_{44}\delta^2$$

(23)

$$\begin{bmatrix}
  a & 0 & 0 \\
  -\frac{a}{2} & \frac{a\sqrt{3}}{2} & 0 \\
  0 & 0 & c
\end{bmatrix} + \begin{bmatrix}
  1 + \delta & 0 & 0 \\
  0 & 1 + \delta & 0 \\
  0 & 0 & 1 + \delta
\end{bmatrix} = \begin{bmatrix}
  a(1 + \delta) & 0 & 0 \\
  0 & a(1 + \delta) & 0 \\
  0 & 0 & c(1 + \delta)
\end{bmatrix}$$

(24)

$$\Delta E_8 = \frac{1}{2}V_0(2C_{11} + 2C_{12} + 4C_{13} + C_{33})\delta^2$$

(25)

$$C_{66} = \frac{1}{2}(C_{11} - C_{12})$$

(26)

By using algebraic manipulations similar to equations (13) and (14), equations (17), (19), (21), (23), and (25) along with the initial conditions, the elastic constants are calculated.

**RESULTS**

Figure 1 illustrates the result of the transition pressure simulations. The RS and ZB phases have higher energy at ambient pressures and they become energetically favorable (that is, lower in energy) at high pressures compared to the W phase. Since lower energy indicates higher stability, results in Figure 1 show that the RS and ZB phases of ZnO are less stable than the W phase at ambient pressure, and that the reverse is true at high pressure. The x-intercept in Figure 1 indicates a transition pressure of approximately 11 GPa for the RS phase. This is close to the experimental result of 12 GPa. A transition pressure for the ZB phase could not be calculated because at pressures above 35 GPa the wurtzite phase becomes unstable in VASP simulations and, therefore, a comparison between with the ZB phase above 35 GPa could not be made.

![Figure 1. The energy versus pressure plot for the ZnO phases. The red line is the RS phase energy relative to the W phase energy. The blue line is the ZB phase energy relative to the W phase energy. The simulations were conducted at 5 GPa intervals. The horizontal black line is the x-axis.](image)
Figure 2 shows the results of the bulk modulus simulations. The resulting bulk modulus for the fitting is shown in Table 1. The high-pressure bulk modulus was calculated from using the direct derivative definition of bulk modulus given in equation (5).

![Figure 2](image)

The ambient pressure results for the W and RS phases are below the published results. This is to be expected from using the GGA pseudo potentials. Meanwhile, the result for the ZB phase is higher at ambient pressure than the published result. Since the RS and ZB phases are high-pressure structures, experimental results are taken at high pressure. This means that the experimental results should be higher than the simulated results in this study. This is obvious in the comparison between the simulated results at 0 GPa and 15 GPa.

Table 1. The results of the bulk modulus simulations. All simulations were conducted with the GGA pseudo potentials.

<table>
<thead>
<tr>
<th>Phase</th>
<th>B at ambient (GPa)</th>
<th>B at 15 GPa (GPa)</th>
<th>Published Results (5) (GPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>129</td>
<td>193</td>
<td>135</td>
</tr>
<tr>
<td>RS</td>
<td>166</td>
<td>229</td>
<td>171</td>
</tr>
<tr>
<td>ZB</td>
<td>129</td>
<td>192</td>
<td>125</td>
</tr>
</tbody>
</table>

The dashed lines are the results of the linear fits.

By using a linear fit for each of the elastic constants above, the value at 0% distortion is extrapolated. Since some of the energy differences are small, larger distortions are preferred for higher accuracy. However, using large distortions can lead to complications such as an unexpected large drop in the value of \(C_{44}\) value for ZB at 0 GPa with a 2.0% distortion. This is possibly due to a breakage of bonding state. The 2nd distortion used is not a volume conserving distortion. The distortions need to be kept small enough that the volume change does not factor in the calculations. Table 2 lists extrapolated values along with the distortions used.
The elastic constants for the wurtzite phase of ZnO are shown in Figure 2. For the 15 GPa calculations, the smaller distortions do not provide enough of an energy difference. This causes large and unreliable results at low distortions. Extrapolation to 0% distortion at high pressure is then limited by using the values at 1.5% and 2.0%. The low pressure distortions are less affected by the energy difference accuracy. The wurtzite phase is the ambient pressure structure of ZnO. Therefore, the experimental values should be closer to the 0 GPa calculations. Table 3 summarizes the calculated results of the elastic constants for wurtzite ZnO. The published results are in between the calculated values at 0 GPa and 15 GPa. Given that GGA underestimates the elastic constants, it is expected that the values from this study should be lower than the experimental results.

Table 3. The calculated elastic constants of wurtzite ZnO. The \( \delta \) values indicate the range used to extrapolate down to 0% distortion. Since the high-pressure calculations are more erratic at low distortions, 1.5% and 2.0% distortions are used for the extrapolation. \( C_{66} \) is calculated using equation (26). Since \( C_{66} \) can be obtained from \( C_{11} \) and \( C_{12} \) for the wurtzite structure, most publications do not include the value for \( C_{66} \).

The value of \( C_{33} \) does not agree closely with the 0 GPa result. This is because the distortion was not large enough. Referring to results in Figure 3, the 1.5% distortion reduces the extrapolated value significantly.

Table 2. The elastic constants of the RS and ZB phases of ZnO. All elastic constants are in GPa. The published values for the RS phase were calculated with the optimized structure. The first published value for ZB is from the optimized structure. The second value is from another theoretical calculation from a different paper.

The published results come from calculations suing the LDA pseudo potential. This underestimates the volume, which leads to a larger than experimental value. The values calculated for this study used the GGA pseudo potential, which overestimates the volume. This results in elastic constants smaller than experimental results.
Since Si is the most commonly used semiconductor, it can be used as a comparison for the elastic constants calculated in the present work. Si has $C_{11}=166$ GPa, $C_{12}=64$ GPa, and $C_{44}=80$ GPa. Comparing to the results in Tables 2 and 3, one can see that only $C_{55}$ and $C_{66}$ of wurtzite ZnO are smaller than the data for Si, while all other elastic constants are larger.

CONCLUSION & FURTHER STUDY

The present work predicts a structural transition from the wurtzite to RS phase of ZnO at 11 GPa. We therefore performed high-pressure calculations at 15 GPa. The bulk moduli for the ambient pressure structures are within 5% of previously reported results. Our calculations indicate that the high-pressure bulk moduli of ZnO phases increase between 58% and 50%.

The RS and ZB phases of ZnO show increasing values of $C_{11}$ and $C_{12}$ at higher pressure, while the value of $C_{44}$ decreases at higher pressure. On the other hand, the wurtzite ZnO shows all increased elastic constants with increasing pressure.

A comparison was made between the elastic constants of the ZnO phases and silicon. With the exception of $C_{55}$ and $C_{66}$ in the wurtzite phase, the three phases of ZnO exhibit higher values of elastic constants, indicating their higher strength under structural deformation.

An important topic for future study of ZnO is to explore the electronic band structure and phonon dispersion, which will determine the properties crucial in many device applications. The structural results obtained in this work have laid a key foundation for continued research.

REFERENCES


A COMPUTATIONAL PERSPECTIVE OF SCHIZOPHRENIA

BY ERNESTO BEOY

ABSTRACT
The etiology of schizophrenia remains largely elusive, thus dampening the effectiveness of current treatment strategies. Examinations of brains of post-mortem schizophrenic patients reveal alterations in N-methyl D-aspartate (NMDA) glutamate receptors and changes in gamma amino-butyric acid (GABA)-ergic interneurons and reduced abundance of parvalbumin-expressing (PV) neurons. Abnormal neural migration and neurogenesis in the hippocampus have also been suggested to be an involved in schizophrenia.

A few approaches, including computational modeling, have investigated schizophrenia as a network disorder. Computational modeling uses mathematics to predict the behavior of biological systems based on the input of a set of parameters collected from laboratory experiments. This study uses a computational model to examine a possible biological mechanism that aberrant migration or neurogenesis of PV-positive interneurons disrupts normal functioning circuit in the hippocampus.

Using the Neuron software, a healthy hippocampal model was designed by having 1 PV neuron synapse with 10 pyramidal neurons, one of which synapses with the same PV neuron in a closed-loop fashion. Based on data from a schizophrenia model in the laboratory, a second PV neuron was added to that circuit to disrupt the healthy activity. The results confirm biological data that the activity of all pyramidal neurons is altered with the addition of a second PV neuron in the network. A more conspicuous observation can be seen in the pyramidal neuron that is directly synapsed with the second PV neuron since it no longer fires in synchrony with the other pyramidal neurons in the circuit. The preexisting PV neuron appears to be unaffected by a second PV joining the circuit. Further adjustments must be made to this model to produce a more realistic representation of a healthy and schizophrenic hippocampal circuits.

INTRODUCTION
The complexity of the human brain is both, a blessing and a curse. On one hand, intelligence has increased the survival rate of our species. But on the other hand, the intricacy of neural architecture allows more room for error and for these errors to remain largely elusive. One prominent mental
disorder proposed to result from neural wiring gone awry is schizophrenia. Schizophrenia affects 1% of the U.S. population, which translates to approximately 260,000 individuals (Regier et al., 1993). Schizophrenia is characterized by positive symptoms such as hallucinations and delusions and negative symptoms such as apathy and anhedonia (NIMH, 2009). Given the wide range of possible etiologies, the disease is not fully understood and as a result, treatment strategies only target symptoms instead of the actual disease (NIMH, 2009). A better understanding of the disease would aid in the development of more precise treatments that could reduce or eliminate symptoms.

Symptoms of schizophrenia appear to be exacerbated by amphetamines, which suggest that the binding site for amphetamines may be involved in the pathology of schizophrenia (Snyder, 1974). This data on psychoactive drugs has established that chemicals in the brain called neurotransmitters and various receptors that respond to these neurotransmitters play a role in the mechanisms of schizophrenia. Diminished function of NMDA glutamate receptor on GABA-ergic interneurons has been proposed as a model of schizophrenia (Woo et al., 2008). Post-mortem examinations show evidence of a reduction in the expression of the calcium-binding protein parvalbumin in GABA-ergic interneurons located in the cortex and hippocampus (Beasley & Reynolds, 1997). Recent findings implicate that abnormal migration of newborn PV neurons in the hippocampus may be involved in schizophrenia (Jakob & Beckmann, 1994). When the NMDA antagonist ketamine is administered in rats, there is an increase in the number of PV-positive neurons specifically in the hippocampus (Sabbagh et al., 2013). These changes may alter the connectivity between neurons, thus crippling the routine activities of a healthy brain.

The precise regions in the brain impacted by schizophrenia have not been identified. Suspected areas include the prefrontal, temporal and inferior parietal lobes as well as the hippocampus, amygdala and septum (Zec & Weinberger, 1986). The pervasive characteristic of the disease suggests that symptoms may arise from a network disorder that disrupts the communication between these brain regions (Torrey, 2007). Neuroimaging via magnetic resonance imaging (MRI) found that the spatial topological pattern of the brain functional network in the frontal, parietal and temporal lobe is altered in schizophrenic patients (Liu et al., 2008). Other MRI findings have revealed a link between schizophrenia and a disproportionate reduction of gray matter volume in the heteromodal association cortex (Schlaepfer et al., 1994). A relationship was also identified between the right prefrontal white matter volume and the right amygdala-hippocampus volume, suggesting abnormal limbic-cortical connections in schizophrenia (Brier et al., 1992). Computational approaches represent an opportunity to investigate differences such as the ones above to understand schizophrenia as a network disorder.

A computational model is a mathematical representation of a complex system that contains variables that can be modified to alter its behavior. Data from laboratory experiments are collected and input into these systems in order to procure reasonably realistic outcomes. The interaction between the computational model and the variables creates a simulation that accurately predicts the behavior of a complex system based on the variables input. Computational models have been used in weather forecasting, earthquake analysis and more recently in biomedical research including simulating side-effects of drugs and predicting treatment strategies for infections (NIBIB, 2014). With the refinement of computational algorithms, even more complex systems such as the brain have been explored with computational models.

Computational modeling is cheaper and faster than many laboratory experiments. Simulations can predict pathogenic behavior without precarious exposure to disease. Research costs can be reduced since simulations allow researchers to encounter mistakes that can be effortlessly corrected before conducting highly expensive laboratory experiments. Many laboratory experiments take years to yield data whereas once a computational model is designed, it only takes seconds to analyze experimental data and produce results. This advantage allows researchers to probe for a direction to pursue in laboratory experiments that are more likely to produce promising results instead of embarking on a dead-end experimental investigation for a significant period of time. An additional benefit of computational modeling is that simulations, unlike real-life phenomena, can be slowed down and paused so that the data can be examined in detail. Any novel data discovered during such analysis could invite new opportunity for exploration.
Computational modeling has its share of shortcomings. Although closely linked with experimental data, there are confounding variables that may not be accounted for. The most obvious flaw is that the simplification of neural phenomena to be tractable computationally may take away from it being accurately depicted in the simulation (Anderson, 2014). Computer models may also yield erroneous predictions due to a small error in the scripting or input incorrect variables. Nevertheless, computer simulations can render reliable data if errors and confounding variables are minimized.

Computational models have been used to test various possible etiologies of schizophrenia. One simulation demonstrated that impairments observed in schizophrenic patients during the performance of a simple cognitive task could be accounted for by disturbances in gating mechanisms due to abnormal dopamine activity (Braver et al., 1999.) Another computational model tested the interaction among a few brain systems including the basal ganglia, hippocampus, and prefrontal cortex to explain cognitive performance in schizophrenic patients (Rolls et al., 2008).

In this study, we constructed a computational model to explore the ramifications of additional PV neurons migrating to an aberrant location in the hippocampus and interfering with a closed-loop circuit between a preexisting PV neuron and 10 pyramidal neurons. Evidence suggests that PV neurons provide GABAergic input and oscillating gamma rhythmicity (50-80 Hz) to pyramidal neurons in the CA1 region of the hippocampus (Tukker et al., 2007). We predict that asynchronous release of action potentials from a migratory PV neuron will decrease the level of excitation and reduce the gamma-band activity in our closed-loop computational circuit. If this computational model can make an accurate prediction, it may serve to be a reliable tool to probe the direction of future research in not only schizophrenia, but in a wide range of mental afflictions. Additional research with this computational model can test the consistency of its ability to reproduce data found in other laboratory experiments.

**METHODS**

Using the Neuron software developed by professors at Yale and Duke Universities, a computational model of 11 neurons was created to represent a closed-loop neural circuit located in the CA1 region of the hippocampus. The axon of 1 PV neuron (PV 1) was programmed to synapse with the dendrites of 10 pyramidal neurons. The 10 pyramidal neurons were set to receive random and continuous stimuli, collectively producing gamma-band activity (60Hz), to represent the input they would normally receive from other brain regions. A self-sustaining closed-loop system was created by having the axon of 1 pyramidal neuron (Pyramidal 1) synapse with the dendrite of PV 1. To represent a schizophrenic model, a second PV neuron (PV 2) was added with its axon synapsing with the dendrite of a pyramidal neuron in that same circuit (Pyramidal 2). PV 2 receives stimulation from an external neuron not part of the original circuit. This external neuron receives the same random and continuous stimuli as the 10 pyramidal neurons.

**DATA ANALYSIS**

Neuron displays a simulation of electrical activity recorded from the soma of each neuron programmed into the model. To aid in differentiating each neuron in this intricate ensemble, each neuron is color-coded. Pyramidal 1 is red; Pyramidal 2 is green; PV 1 is black. A series of steps were tested to confirm the validity of each feature encompassed in this model.

First, baseline pyramidal neuron activity was analyzed. In this model, each neuron consists of 1 dendrite and 1 antipodal axon attached to a soma. A single pulse current clamp called IClamp was used to stimulate each soma continuously by setting the duration to 1e99. The 10 pyramidal neurons were programmed to fire in synchrony with one another, using the “uniform” command, but in a stochastic formation produced by a random number generator governing the amplitude of the stimulations. The amplitude is set to randomly fire between –1 to –20 nA ([-1,-20]) to achieve a negative recording.

Second, the connection between PV 1 and the 10 pyramidal neurons was analyzed. A synapse was put on each pyramidal neuron’s dendrite and those synapses were connected to the same point on PV 1’s axon. Every simulation starts with a spike that is not intentionally coded for in this model. It is hypothesized to be the cell membrane normalizing when the simulation initializes. As a result, the first spike is ignored in our analyses. In this trial, Py 1’s maximum specific sodium channel conductance (SCC) was increased from 0.12 mho/cm^2 to 0.58 mho/cm^2. This increase of SCC in PV 1 engendered
the perpetual repetition of the initial normalization in equidistant intervals. That pulse was used to test if the pyramidal neurons received current from PV 1.

Third, the connection between Pyramidal 1 and PV 1 was analyzed. The connection between PV 1’s axon and the dendrites to the 10 pyramidal neurons was temporarily removed. A synapse was put on PV 1’s dendrite and that synapse was connected to Pyramidal 1’s axon. Pyramidal 1 was stimulated by a positive amplitude to test PV 1’s reception of the signal.

Fourth, the network was made recurrent by connecting the synapse on PV 1’s dendrite with Pyramidal 1’s axon and connecting the synapses of the dendrites of all 10 pyramidal neurons with PV 1’s axon.

Fifth, PV 2 was introduced to the recurrent network by placing a synapse on Pyramidal 2’s dendrite and connecting that synapse to PV 2’s axon. PV 2’s SCC was set to 1.00 mho/cm^2 to test the connection between PV 2 and Pyramidal 2.

RESULTS
In the series of figures below, we highlight the development of the computational model and specific characteristics. While the figures are not specifically data, they do demonstrate the progression of the model development.

Figure 1 demonstrates the interconnection between the several components of a neuron. A stimulated soma clearly generates a voltage response in its axon and dendrite. After establishing a connection between each neural component, we can begin attaching other neurons to its dendrite and axon.

Figure 2 compares the synchrony between Pyramidal 1 activity and the activity of all 10 pyramidal neurons. They are synchronous and the only difference to be noted is the increased density in the activity of the 10 pyramidal neurons in Figure 2B.

Figure 3 exemplifies asynchrony by manipulating the amplitude of 1 pyramidal neuron. Only the neuron with the tampered amplitude fires asynchronously. The unhampered neurons continue to fire synchronously amongst each other. Maintaining a synchronous collection of pyramidal neurons allows us to detect variances in any specific neuron when certain variables are modified.

A sine oscillation is a key component to the rhythm observed in PV-pyramidal hippocampal circuits.

Figure 4 demonstrates how sine oscillations are created by increasing PV 1’s SCC value.

The PV to Pyramidal network is tested in Figure 5. PV 1’s axon synapses with the dendrites of the 10 pyramidal neurons. When there is no PV activity, the pyramidal neurons remain unaffected, as seen in Figure 5A. When there is PV activity, the pyramidal neurons mirror PV activity in rhythmic oscillations, as can be seen in Figure 5B.

The Pyramidal to PV network is tested in Figure 6. When there is no connection between the PV neuron and pyramidal neurons, the PV neuron remains inactive. When a connection is created between Pyramidal 1’s axon and PV 1’s dendrite, the PV reacts to pyramidal stimuli. In order to observe a continuous response in the PV neuron, the pyramidal neurons must be stimulated with a positive amplitude. In Figure 7, the pyramidal neurons are set to a positive amplitude set of [0,6], which results in a continuous response in the PV neuron, however, there are random moments of low voltage. Figure 8 illustrates that these low voltage moments could be eliminated by increasing the pyramidal neuron amplitude to [0,10]. A model with uninterrupted oscillations represents the framework of a healthy hippocampal circuit.

Figure 9 illustrates a closed-loop network between the PV neuron and 10 pyramidal neurons. The PV neuron only appears to influence the pyramidal neurons if its SCC is increased from 0.12 to 0.58 mho/cm^2. Figure 10 compares a closed-loop circuit with 1 PV neuron and 10 pyramidal neurons, representing a normal functioning system, with the same closed-loop circuit invaded by the presence of a second PV neuron synapsing with 1 pyramidal neuron (Pyramidal 3). The addition of the second PV creates low voltage moments, which represent a decrease in the level of excitation and reduced gamma-band activity.

Figure 11 focuses on asynchronous activity of Pyramidal 3. Since PV 2 synapses directly with Pyramidal 3, it no longer fires in synchrony with the rest of the pyramidal neurons. Figure 12 show that PV 1 remains unaffected by this modification. The output in Figure 11 represents the goal of the above project to simulate the effects of altered PV neuron
number within this network and the effects induced to synchronous activity.

DISCUSSION

A reliable computational model accurately portrays the system that it is simulating. Figures 1-9 represent the necessary milestones to ensure the computational model that we developed was in fact simulating the system that we envisioned: a closed-loop circuit with 1 PV neuron and 10 pyramidal neurons. Figures 10-12 illustrate the results of us testing our hypothesis by adding a second PV-neuron to the circuit.

Figure 1 illustrates the sequence of the activity in Pyramidal 1. At first the soma fires because it is initially stimulated. The axon fires after the soma, which substantiates that the sequence of the firing begins with the soma and ends with the axon. The voltage change in the dendrite is evidence of backpropagation, which occurs when voltage activity travels backwards from the soma to its dendrite. In this computational model, when the dendrite length is decreased, the dendrite’s voltage becomes more positive than the soma. If the dendrite length is increased, the dendrite’s voltage becomes more negative than the soma. Increasing the length also causes signals to attenuate between the dendrite and its presynaptic neuron. To maximize the signal received from the presynaptic neuron, the dendrite length was decreased, thus resulting in a voltage magnitude similar to that of the initially stimulated soma.

It is important to keep track of the activity of all of the neurons so that we can detect any variances in individual neuronal activity when variables are manipulated. Figure 2 reveals that all of the pyramidal neurons are firing in synchrony because the frequency and intensity are the same. The denser quality of the activity in Figure 2B signifies that more neurons are firing with the same frequency and intensity.

Figure 3 demonstrates that when a more positive amplitude is input into the random number generator, a more positive voltage is generated in the simulation. The frequency and intensity remain unaffected. This figure also substantiates the synchrony between the 10 pyramidal neurons because a slight alteration of the amplitude of one neuron creates asynchrony between that neuron and the remaining pyramidal neurons. Since it has been demonstrated that all 10 pyramidal neurons are firing in synchrony, Pyramidal 1 is used to represent all pyramidal neurons. Figure 4 shows that increasing PV 1’s SCC creates a continuous echo from what is hypothesized to be the initial cell membrane normalization. This echo creates an oscillated pulse that transmits its voltage to any interconnected outlet. We use this echo to test if the pyramidal neurons receive signals from PV 1. Figure 5A shows that with no PV 1 activity, the pyramidal neurons remain unaffected in the PV to Pyramidal network. However, when there is PV 1 activity as portrayed in Figure 5B, the pyramidal neurons are no longer firing randomly and instead mirror PV 1 activity in rhythmic oscillations. It therefore can be concluded that PV 1’s axon is successfully transferring signals to the dendrites of all 10 pyramidal neurons. This observation also demonstrates that as long as PV 1 fires in equidistant pulses, it can transform random firing into apparent sine oscillations. This replicates the biological interaction of PV and pyramidal neurons creating gamma-band oscillations (Tukker et al, 2007). In addition, biological evidence shows that PV neuron action potentials are followed by brief but large afterhyperpolarization (Kawaguchi et al., 1987). In Figure 5B, the pyramidal neurons undergo brief and large hyperpolarization every time PV 1 emits an action potential. In nature this occurs because PV neurons are inhibitory (Tukker et al., 2007). Although this model depicts PV 1 having the converse polarity from the pyramidal neurons, all neurons in this model are excitatory.

In Figure 6A, no interaction can be observed between PV 1 and Pyramidal 1 since no connection is established. In Figure 6B, Pyramidal 1’s axon is connected to PV 1’s dendrite. When the IClamp is programmed to stimulate Pyramidal 1’s soma with an amplitude of 15 nA at 500 ms, a massive spike is generated from Pyramidal 1 and a reaction from PV 1 follows. This response demonstrates that Pyramidal 1 is connected to PV 1 because when Pyramidal 1 is stimulated, PV 1 fires shortly afterward. An important detail to note is that while Pyramidal 1’s amplitude is between [-1,-20], there is no influence on PV 1. It is not unless Pyramidal 1’s amplitude is a positive value that a response in PV 1 is evoked. We continue by testing positive amplitudes to maintain continuous interaction between the neurons. In Figure 7, Pyramidal 1 is firing randomly and with a positive amplitude of [0,6]. Although it evokes a response in PV 1, this
value allows low peak voltage moments to occur. Each time the simulation is played, the low peak moments occur in different locations. It is hypothesized that these low peak moments are the result of the random number generator generating pyramidal neuron amplitudes predominantly closer to 0 and consequently the summation may not reach a threshold required to activate PV 1. This needs to be corrected in order to display uninterrupted oscillations to represent the framework of this model. When the amplitude for the IClamp in Pyramidal 1 is set to [0,10], the low voltage moments are minimal in frequency and duration as seen in Figure 8A. This evokes a continuous response from PV 1 which can be seen more robustly in Figure 8B when PV 1’s SCC is increased from 0.12 to 0.58 mho/cm^2.

The oscillations of PV 1 in Figure 4B are identical to the oscillations of Pyramidal 1 in Figure 8B. In addition, Pyramidal 1 in 8B no longer fires randomly as it did in Figure 5A. It appears that a positive amplitude alone creates these high-peaking oscillations. Negative amplitudes create the random activity portrayed in Figure 5A. When Pyramidal 1 has a positive amplitude, PV 1 and Pyramidal 1 fire positively and negatively at the same time. Although this model does not demonstrate a converse polar activity between Pyramidal 1 and PV 1, it demonstrates that Pyramidal 1 can influence PV 1.

Figure 8 demonstrates that PV 1’s response to Pyramidal 1 can be amplified if PV 1’s SCC is increased to 0.58 mho/cm^2. Similarly, a recurrent network appears unchanged in Figure 9A when PV 1’s SCC is set to 0.12 mho/cm^2. However, when PV 1’s SCC is increased to 0.58 mho/cm^2, as demonstrated in Figure 9B, the firing patterns of all neurons are altered.

More erratic behavior can be observed in all neurons in Figure 9B when compared with Figure 8B. An explanation is that when PV 1’s SCC is low, it is not able to deliver a robust signal to Pyramidal 1. It is only when PV 1’s SCC is high that it is able to influence Pyramidal 1 with its activity. Furthermore, the pattern change in Pyramidal 1 causes it to fire differently, resulting in a pattern change in PV 1 activity.

When comparing Figure 10 it can be noted that PV 2 influences the pyramidal neurons by creating more low voltage moments as can be seen in Figure 10B. Although PV 2 only has direct contact with pyramidal 2, its indirect affect over all the pyramidal neurons is evident. Pyramidal 2 is especially disoriented due to its direct contact. Figure 11 illustrates the aftermath of PV 2 migration. Pyramidal 2 becomes asynchronous from the group of pyramidal neurons in the circuit.

Figure 12 compare the affect PV 2 migration has on PV 1. No obvious differences are observed. This is not consistent with laboratory data. This may be because all neurons are programmed to be excitatory, when in biology, PV neurons are GABAergic, and therefore emit inhibitory signals.

**CONCLUSION**

Our goal was to build a reliable computational model that can be used to test future research questions. A reliable model can save time and money by allowing researchers to explore ideas before engaging in protracted laboratory experiments. To test our model, we designed a normal functioning hippocampal circuit. We then added a second PV neuron to mimic observations seen in patients with schizophrenia and compared our simulation with EEG data collected in the laboratory. Although we received mixed results, we confirmed that we successfully created a computational model that can simulate neuronal activity.

Previous studies suggest that altered numbers of PV neurons in the hippocampus interfere with existing closed-loop circuits between PV and pyramidal neurons (Jakob & Beckmann, 1994). The computational model designed in this study confirms the finding that asynchronous release of action potentials from a migratory PV neuron decreases the level of excitation and reduces the gamma-band activity. When PV 2 is introduced, there are more low voltage moments in pyramidal neuron activity.

The accuracy of the simulation can be improved by inputting biological parameters obtained in the laboratory including sodium channel conductance and axon/dendrite lengths. These details may have great impact on how each component interacts in the model. In addition, although the neurons in this model are identified as PV and pyramidal, they do not possess any characteristics of their biological counterparts. For example, both neurons in the model are excitatory although the PV in nature is
inhibitory. Having exclusively excitatory neurons to represent this network could easily skew results as exemplified by the inconsistent outcome of PV 1 not being influenced by the addition of PV 2 to its network. PV neurons in the hippocampus are also fast-spiking (Hu et al., 2014). Programming inhibitory neurons that are fast-spiking may create the sine oscillations presented in Figure 5B, while maintaining the positive amplitude for the pyramidal neurons to ensure interaction with the PV neuron in the circuit.

This model is also simplified to have all 10 pyramidal neurons receive uniform stimulation that result in synchrony between them. Their biological counterparts receive different patterns of stimulation from thousands of other neurons. The synchrony between the pyramidal neurons should result from PV inhibition, not from uniform excitatory stimulation delivered to the pyramidal neurons.

Future research could investigate these shortcomings and a more developed computational model can be designed to reevaluate our hypothesis.
Figure 4A depicts PV 1 with the SCC set to 0.12 mho/cm². The initial spike is hypothesized to be cell membrane normalization. Table 4B depicts PV 1 with the SCC set to 0.58 mho/cm². This engenders the cell membrane normalization to continue at equidistant intervals.

Figure 5A shows Pyramidal 1 activity when PV 1’s SCC is set to 0.12 mho/cm² in a PV to Pyramidal network. There is no PV 1 activity to influence Pyramidal 1. Figure 5B shows Pyramidal 1 activity when PV 1’s SCC is set to 0.58 mho/cm² in a PV to Pyramidal network. Pyramidal 1’s random activity transforms into sine waves.

Figure 6A illustrates the influence Pyramidal 1 has on PV 1 if they are not connected. PV 1 does not respond to Pyramidal 1 activity. Figure 6B illustrates the influence Pyramidal 1 has on PV 1 if they are connected in a Pyramidal to PV network. Pyramidal 1 activity is followed by PV 1 activity. In both instances, PV 1’s SCC is set to 0.12 mho/cm².

Figure 7 demonstrates how the Pyramidal to PV network is affected if Pyramidal 1’s amplitude is raised to a positive value of [0.6] and PV 1’s SCC is set to 0.12 mho/cm². PV 1 is consistently reacting to Pyramidal 1’s activity but PV 1 has 2 moments of hyperpolarization during which the voltage peaks of Pyramidal 1 dramatically decrease.
Figure 8

A

B

Figure 8A demonstrates how the Pyramidal to PV network is affected if Pyramidal 1’s amplitude is raised to \([0,10]\) and PV 1’s SCC is set to 0.12 mho/cm². PV 1 is consistently reacting to Pyramidal 1’s activity and there are no moments of PV 1 hyperpolarization or Pyramidal 1 voltage peak reductions. Figure 8B demonstrates how the Pyramidal to PV network is affected if Pyramidal 1’s amplitude is set to \([0,10]\) and PV 1’s SCC is raised to 0.58 mho/cm². The voltage peaks of PV 1 increase.

Figure 9

A

B

Figure 9A depicts a recurrent network with Pyramidal 1 sending signals to PV 1 and PV 1 sending signals to Pyramidal 1. PV 1’s SCC is set to 0.12 mho/cm². The network shows no significant changes from the Pyramidal to PV network displayed in Figure 8A. Figure 9B depicts an identical recurrent network except PV 1’s SCC is raised to 0.58 mho/cm². Pyramidal neuron activity loses its uniform pattern depicted in Figure 9A and becomes haphazard. PV 1 activity superficially resembles the pattern depicted in Figure 8B, however, closer examination reveals PV 1 in Figure 9B contains several spikes with a more positive voltage.

Figure 10

A

B

Figure 10A is a duplicate of Figure 9B except PV 1 is visually eliminated to improve focus on Pyramidal 1 activity. Figure 10B demonstrates the changes that occur in Pyramidal 1 when the recurrent network is disrupted by PV 2 sending signals to Pyramidal 2. When PV 2 is added to the network, Pyramidal 1 experiences more frequent and longer duration low peak voltage moments.

Figure 11

The asynchrony between Pyramidal 1 (red) and Pyramidal 2 (green) when PV 2 synapses with Pyramidal 2 in the recurrent network is apparent in Figure 11.
Figure 12A is a duplicate of Figure 9B except Pyramidal 1 is visually eliminated to improve focus on PV 1 activity. Figure 12B shows PV 1 activity in a recurrent network when PV 2 synapses with Pyramidal 2. No apparent difference can be observed with PV 1 activity when comparing Figure 12A and 12B.

References


ABSTRACT
Gambling disorder (formerly known as problem gambling and pathological gambling) occurs when valuables are wagered irrespective of financial losses and potential beliefs of financial gain, as a manifestation of addictive behavior. To predict problem gambling behavior, a survey of Machiavellian personalities, money attitudes, and impulsive/compulsive buying behavior was administered to 410 college students in southern Nevada. The results suggested that disordered gambling behavior may be predicted for the general population by the money status factor of the Klontz Money Script Inventory. In contrast, amorality from the Machiavellian Personality Scale, money worship, and money vigilance were significant in predicting African-American pathological gambling, suggesting that races with historical financial shortcomings may be inclined to gamble if money is not valued or budgeted. For Asians, both money status and money vigilance factors loaded significantly, suggesting that cultures with high historical prevalence of gambling may be inclined to endorse gambling norms if saving is not practiced.

Keywords: pathological gambling, problem gambling, gambling disorder, Machiavellianism, money attitudes, money beliefs, money scripts, status

INTRODUCTION
The term, “gambling disorder” is the new label devised by the DSM-V for the formerly known pathological or problem gambler. Because excessive gambling behavior has shifted from an impulse control paradigm to an addiction paradigm, the modern definition of gambling disorder is more reflective of a substance abuse disorder. In this case, the “user” risks valuables in order to achieve stimulation or escape from reality (Blaszczynski & Nower, 2002). In the existing literature, problem gambling and pathological gambling are used interchangeably to refer to “persistent and recurring maladaptive gambling behavior” resulting in devastating personal, familial, financial, professional, and legal consequences (American Psychiatric Association, 2013). When characterized separately, problem gamblers are...
“individuals who gamble to excess and as a result experience moderate-to-severe financial and personal/familial harm” (Blaszczynski & Nower, 2010). The prevalence of problem gamblers is estimated at 2-5% (Klontz, Britt, Archuleta, & Klontz, 2012). Pathological gamblers, however, are characterized by the inability to control or stop gambling behavior despite repeated losses or attempts to cease (Blaszczynski & Nower, 2010). The prevalence of pathological gamblers is estimated at 1-2% (Klontz et al., 2012).

The consequences of gambling disorder are loss of money and time intended for social relationships and/or work, in some cases, leading to divorce. Gambling disorder may also lead to increased criminal activity, stress, depression, and suicide. Further negative effects include loss of appetite and poor health. Finally, because gambling disorders occur more frequently in young individuals and in low socioeconomic status groups (particularly in ethnic minorities), the consequence of monetary loss is exacerbated by lacking life experience and preexisting financial hardship (Rantala & Sulkunen, 2012). Given the detrimental consequences for families and individuals, readers may seek to understand how people can gamble themselves into destitution. In other literature, the Pathways Model (Blaszczynski & Nower, 2002) provides elaboration.

According to the “Pathways Model of Problem and Pathological Gambling” (Blaszczynski & Nower, 2002), gambling behavior becomes disordered through three paths. In the least severe case, gambling behavior may occur more frequently because of an increased availability or accessibility in which the player fluctuates between regular and heavy wagers due to classical and operant conditioning effects; however, there is no impulse control issue, so the gambler is likely to cease wagers with minimal intervention. Essentially gambling pathway one is a social experience gone bad, but the gambler did not have a preexisting neurological or affective vulnerability; so the player is more likely to recover from the disordered gambling. In pathway two, an emotional and/or neurological vulnerability precedes gambling behavior, and cessation of betting occurs when their abnormal state of mind is corrected. Preexisting disturbances are satisfied through gambling because the individual seeks to gain more stimulation with complex games or seeks distraction from reality with low-skill games (Frost, Meagher, & Riskind, 2001). For example, an individual suffering from anxiety or difficult life circumstances may seek emotional escape by playing slot machines (a low skill game). In contrast, an individual suffering from chronic boredom or dopaminergic deficiencies may seek high levels of arousal by playing craps or engaging in sports betting (high skill games). In the most severe instance of pathological gambling, pathway three gamblers suffer from preexisting emotional and/or biological vulnerabilities in addition to impulsive traits. Individuals with anti-social behaviors, a history of substance abuse, or childhood ADHD demonstrate extreme difficulty in ceasing gambling behaviors because emotional and/or neurological disturbances are satisfied by impulsive activities (Blaszczynski & Nower, 2002).

The Impulsive/Compulsive Debate
Because gambling disorders may manifest in the presence or absence of an impulse control disorder (Blaszczynski & Nower, 2002), research has delineated gambling disorders from the Disorder of Impulse Control Not Otherwise Specified category in the DSM-V, but many studies have linked gambling disorders to impulsive manifestations. For example, Slutske, Caspi, Moffitt, and Poulton (2005) have documented problem gambling behavior in high conjunction with substance abuse disorders including alcohol, nicotine, and cannabis dependence. According to Petry (2001), individuals with both substance abuse and gambling problems demonstrated increased impulsivity in which the players inclined to accept short term gains, despite long term losses in a card game exercise. Excessive gambling has also been linked to criminal activity (Rantala & Sulkunen, 2012). Gambling disorders may also occur comorbid with attention-deficit hyperactivity disorder (ADHD), depression, Parkinson’s disease, cyclothymia, and bipolar disorder (Ashley & Boehlke, 2012; Schreiber, Odlaug, & Grant, 2012). Furthermore, Specker, Carlson, Christenson, and Marcotte (1995) have documented compulsive buying behavior and compulsive sexual behavior in significantly more pathological gamblers as compared to controls. Although some researchers (Frost, Meagher, & Riskind, 2001) have reported that little evidence exists of a relationship between pathological gambling and impulsivity, many articles do document associations between pathological gambling and impulsive activities and disorders including substance abuse, crime, ADHD, bipolar disorder, and compulsive buying.
Some researchers dispute that gambling disorders are an impulsive control issue, instead arguing that it is a disorder similar to compulsion in nature (Blaszczynski, 1999; Durdle, Gorey, & Stewart, 2008; Frost, Meagher, & Riskind, 2001). Specifically, Durdle, Gorey, and Stewart (2008) conducted a meta-analysis to assess the effect size between obsessive compulsive disorder (OCD) and pathological gambling. Although a weak effect size was reported between the two disorders ($d = .07$), a strong effect size was reported for pathological gambling and obsessive-compulsive behaviors ($d = 1.01$). In addition, Frost, Meagher, and Riskind (2001) compared light versus heavy gamblers in obsessive-compulsive behaviors. The researchers found that heavy gamblers, compared to light gamblers, had significantly higher scores on compulsive buying, hoarding, and impulsiveness to violate social norms. Although compulsive buying and hoarding are not recognized as disorders in the DSM-V, evidence exists to frame gambling disorder from an impulse-control paradigm, to an obsessive-compulsive paradigm, and to the present addiction paradigm.

From a consumer research perspective, a significant contribution to the literature may be a pathological gambling delineation between obsessive-compulsive buying and impulsive buying.

The present study intended to predict disordered gambling behavior from an amalgam of factors including shopping behavior. Due to the research community debate with regard to impulsive or compulsive paradigms to pathological gambling, the first hypothesis is as follows:

**H1:** An individual with high scores on either the impulsive or compulsive buying factors of the Richmond Compulsive Buying Scale will score high on the pathological gambling factor of the Klontz Money Behavior Inventory.

The Richmond Compulsive Buying Scale (Ridgway, Kukar-Kinney, & Monroe, 2008) measures shopping behavior in both impulsive and compulsive domains. An individual with a high score on impulsive shopping behavior may be inclined to purchase items they did not need or did not plan to buy. An individual with a high score on compulsive shopping behavior may harbor guilt about their shopping behavior (because it results from an affective compulsion) by hiding purchases in closets.

The Klontz Money Behavior Inventory (Klontz et al., 2012) is an assortment of disordered money behaviors factored into constructs such as compulsive hoarding, workaholism, and financial dependence. For the purpose of this study, only the factor concerning pathological gambling was used in the analysis. A high score on the pathological gambling factor indicates escalating betting behavior with players having to increase wagers to maintain excitement, thereby increasing difficulty in controlling gambling behavior.

**Gambling and Personality**

Other predictors of a gambling disorder are also present in personality research. High scores on negative emotionality, stress reaction, alienation, and aggression occur in conjunction with high problem gambling behavior scores (Slutske et al., 2005). Thus, the problem gambler is highly susceptible to emotional breakdowns in the presence of stressful stimuli, often suffers from anxiety, is quick to anger, and typically expresses feelings of being victimized; especially in young adults. Furthermore, problem gamblers also demonstrate particularly low scores on the constraint factor of the Multidimensional Personality Questionnaire, indicating that they are more impulsive in nature and more prone to risk-taking behaviors (Slutske et al., 2005).

In another personality study (Martinotti, Andreoli, Giametta, Poli, Bria, & Janiri, 2006), used Cloninger’s Temperament and Character Inventory to link pathological gamblers to higher levels of novelty-seeking and self-transcendence; and lower levels of self-directedness and cooperativeness compared to non-pathological gamblers and controls. Thus individuals with a gambling disorder may be characterized as being impulsive and extravagant with a strong belief in fate, and less inclined to function productively as an individual or blend in with social norms (Kim & Grant, 2001; Martinotti et al., 2006). Yet, harm avoidance and persistence factors did not significantly distinguish gamblers from controls, indicating that pathological gamblers are no more shy, anxious, ambitious, or hard-working than non-gamblers (Martinotti et al., 2006).

The present study aims to predict pathological gambling from Machiavellianism personality factors including amorality, distrust of others, desire for status, and desire for control. Because a gambling disorder is linked to impulsiveness, the second hypothesis is as follows:
H2: An individual scoring high on the amorality factor of the Machiavellian Personality Scale will score high on the pathological gambling factor of the Klontz Money Behavior Inventory.

The Machiavellianism Personality Scale (Dahling, Whitaker, & Levy, 2009) measures one’s propensity to manipulate others for personal gain. A high score on amorality indicates that the individual would be willing to cheat or lie in order to gain a personal advantage. Other factors include distrust for others such that a high Machiavellian personality (Mach) believes others have competitive, ulterior motives. A high Mach also desires status in the accumulation of wealth and prestige. In addition, a high Mach desires control and seeks to lead groups and foster power separation with subordinates.

Gambler Money Attitudes
Although ample literature analyzing pathological gambling correlates with impulsive, compulsive, and personality constructs, only one study has been published to explain gambler’s cognitive money attitudes (Blaszczynski & Nower, 2010). In broad terms, money has been conceptualized both as a drug and as a tool (Lea & Webley, 2006). When considered as a drug, monetary gains stimulate neurotransmitter release in cortical reward pathways that the player would naturally receive from an exciting event (Ross, 2008). Because hedonic chemical releases are stimulated from gambling behavior, the player may develop an addiction noted as a gambling disorder. When considered as a tool, money is a functional means to an end as opposed to a chemical experience. Instead of obtaining a “high,” money is put to use through purchasing behavior in order to buy material goods. Although the money as a drug theory is more widely adopted in pathological gambling literature, problem gamblers may execute the tool theory by conceptualizing wagers and games as a sort of product instead of a tangible, material good (Blaszczynski & Nower, 2010). Blaszczynski and Nower (2010) found that problem gamblers scored significantly higher than low risk, moderate risk, and controls on the obsession and power/spending factors of the Money Beliefs and Behaviors Scale (Furnham, 1984) and on the power and anxiety factors of the Money Attitudes Scale (Yamauchi & Templer, 1982). Therefore, gamblers are preoccupied with their thoughts of money and obsess over means to acquire more wealth. Furthermore, gamblers use money as a means to impress others and gain social status. Specifically, pathological gamblers experience anxiety in financial scarcity and use money as a pasime to alleviate anxiety in activities like shopping (Blaszczynski & Nower, 2010). To date, no literature is available to explain gender or ethnic differences in pathological gambler money attitudes, however, gender differences in preexisting conditions in pathological gamblers have been documented.

Although Blaszczynski and Nower (2010) examined pathological gambling in conjunction with the Money Beliefs and Behaviors Scale (Furnham, 1984) and the Money Attitude Scale (Yamauchi & Templer, 1982), the established Short Money Ethic Scale (Tang, 1995) and the newly developed Klontz Money Script Inventory (Klontz, Britt, Mentzer, & Klontz, 2011) have yet to be tested in conjunction with a gambling construct. Thus, the third and fourth hypotheses are as follows:

H3: An individual scoring high on the desire for status factor of the Machiavellian Personality Scale and the money status factor of the Klontz Money Script Inventory will score high on the pathological gambling factor of the Klontz Money Behavior Inventory.

The Klontz Money Script Inventory (Klontz et al., 2011) is a scale of four factors indicative of cognitive money attitudes. A high score on the money status factor represents a strong personal association between net-worth and self-worth in which goods are used to enhance life and social position. Because compulsive buying behavior is overrepresented in pathological gambling samples (Specker et al., 1995), and because compulsive buyers are highly inclined to purchase luxury goods that enhance status (Roberts & Jones, 2001; Workman, 2010), then perhaps the money status factor will predict pathological gambling behavior.

H4: An individual scoring high on the budget factor of the Short Money Ethic Scale will score low on the pathological gambling factor of the Klontz Money Behavior Inventory.

The Short Money Ethic Scale (Tang, 1995) is another cognitive money attitudes measure composed of three factors: success, budget, and evil. A high score on the budget factor is indicative of an individual who spends their money carefully and executes thoughtful purchases. The success factor represents
the social respect earned and opportunities available with wealth. Finally, an individual who scores high on the evil factor believes money is the root of all evil.

**Gender and Ethnic Differences**

Blanco, Hasin, Petry, Stinson, and Grant (2006) conducted a U.S. study of 45,093 participants to demonstrate gender and ethnic differences in pathological gambling. Foremost, the prevalence of subclinical pathological gambling behavior was higher in men (6.79%) compared to women (3.26%), with men engaging in higher gambling frequency, moreover, women have a significantly later age of onset of gambling disorder (34.9 years) than men (29.6 years). Furthermore, women were more likely than men to have preexisting mood and anxiety disorders such as depression, and were inclined to gamble in an effort to alleviate negative emotions by playing slot machines, bingo, and keno. In contrast, men were more likely than women to have preexisting addictive behavior including nicotine, alcohol, and drug dependence, and were inclined to gamble in an effort to chase losses by playing roulette, betting on sports games, or trading in the stock market. In addition, men experienced more preoccupation with gambling than did women (Blanco et al., 2006). In terms of ethnic differences, Blanco et al. (2006) reported a higher prevalence of subclinical pathological gambling in black and Hispanic women.

Because the aim of this study is also to delineate pathological gambling predictors among sexes and ethnicities, the fifth and sixth hypotheses are as follows:

**H5:** Women scoring high on the compulsive buying factor of the Richmond Compulsive Buying Scale will score high on the pathological gambling factor of the Klontz Money Behavior Inventory.

Compulsive buying is “chronic, repetitive purchasing that becomes a primary response to negative events or feelings” that can result in an “irresistible urge to repeatedly purchase unnecessary and unaffordable items” (Faber & O’Guinn, 1992; Sang-Hee & Yun-Jung, 2012). The prevalence of compulsive buying behavior in the U.S. is estimated at about 5.8% with about 80% of compulsive buyers being women (Koran, Faber, Aboujaddoude, Large, & Serpe, 2006; Workman, 2010). Compulsive buying, by definition, is an attempt to alleviate stress or depressive feelings, and because the majority of compulsive buyers are women, perhaps female participants with high scores on pathological gambling will also score high on compulsive buying to escape personal distress through shopping or gambling (Blanco et al., 2006; Workman, 2010).

**H6:** Men scoring high on the money worship factor of the Klontz Money Script Inventory will score high on the pathological gambling factor of the Klontz Money Behavior Inventory.

Because males demonstrated significantly higher instances of preoccupation with gambling than women (Blanco et al., 2006), men may be more obsessed with money in general. A high score on the money worship factor would indicate that an individual (presumably males) believes they would be happier if only they had more money, and that money equates to power.

**METHOD**

**Participants**

As part of a larger sample, a sample of 410 undergraduate psychology students: 111 males, 299 females; 174 Caucasian, 34 African-American, 108 Hispanic, and 94 Asian (mean age = 20.34 years, SD = 4.89 years; range 16-55 years) from the University of Nevada, Las Vegas volunteered to complete a series of money oriented questionnaires as partial fulfillment toward their research participation requirement for their psychology course.

**Materials**

Although 13 scales were completed by the participants, for the purpose of the present study, only 5 scales were used in data analysis. The Compulsive-Buying Scale (Ridgway et al., 2008) is a 6-item measure of both a compulsive buying and an impulsive buying factor with a reported Cronbach’s α of .84, and a Cronbach’s α of .85 in the present study. Compulsive buying is represented by 3 items with a reported Cronbach’s α of .99 and a Cronbach’s α of .82 in the present study. Impulsive buying consists of 5 items with a Cronbach’s α of .78 and a Cronbach’s α of .82 in the present study.

The Machiavellian Personality Scale (Dahling, Whitaker, & Levy, 2009) is a 16-item measure of manipulative self-empowerment with an overall reported Cronbach’s α of .82 and a Cronbach’s α of .85 in the present study. Amorality, distrust of others, desire for status, and desire for control are
represented by 5, 5, 3, and 3 items respectively with reported Cronbach’s α of .83, .75, .72, and .70 respectively and a Cronbach’s α of .81, .79, .81, and .79 in the present study respectively.

The Klontz Money Script Inventory (Klontz et al., 2011) is a 51-item measure of four money script factors “defined as beliefs individuals hold about money.” The money status factor represents a strong personal association between net-worth and self-worth in which goods are used to enhance life and social position. The money status factor is represented by 15 items with a reported Cronbach’s α of .77 and a Cronbach’s α of .80 in the present study. Another factor, money avoidance, indicates an individual’s phobia of money in which excess results in negative outcomes. The money avoidance factor is represented by 15 items with a reported Cronbach’s α of .77 and a Cronbach’s α of .86 in the present study. The money worriers associate money with happiness and perceive money as a solution to difficult life circumstances. The money worship factor is represented by 11 items with a reported Cronbach’s α of .77 and a Cronbach’s α of .84 in the present study. Finally, the money vigilance factor encompasses those who save money and keep finances secret. The money vigilance factor is represented by four items with a reported Cronbach’s α of .77 and a Cronbach’s α of .57 in the present study. The overall scale has a reported Cronbach’s α of .84, whereas we computed the entire scale’s Cronbach’s α at .87.

The Short Money Ethic Scale (Tang, 1995) is a 12-item measure on a seven-point scale anchored at 1 = strongly disagree and 7 = strongly agree. The scale is divided among three factors with scores having an overall reported Cronbach’s α of .70, and a Cronbach’s α of .79 in the present study. The success factor has eight items with a reported Cronbach’s α of .76 and a Cronbach’s α of .89 in the present study. The budget factor has two items with a reported Cronbach’s α of .83 and a Cronbach’s α of .91 in the present study. Lastly, the evil factor has two items with a reported Cronbach’s α of .66 and a Cronbach’s α of .86 in the present study. Finally, the Klontz Money Behavior Inventory (Klontz et al., 2012) is a 53-item measure of disordered financial habits. The overall Cronbach’s α was not provided by Klontz et al. (2012), so in our analysis, we computed the entire scale’s Cronbach’s α at .72. For the purpose of the present study, only the pathological gambling factor was used in analysis, with a reported Cronbach’s α of .95, and a Cronbach’s α of .93 in our analysis.

Procedure
All questionnaires were randomized via Qualtrics block settings to prevent user fatigue and general carry-over effects. The survey was administered online via Qualtrics and could be completed from any location via a computer so as to maximize student privacy and free response. The majority of participants completed the survey taking between 30 and 90 minutes.

Results
To predict pathological gambling behavior, multiple regression analyses and correlation analyses were performed to examine spending behavior, personality, and money attitude predictors across sexes and ethnicities. The independent variables for the multiple regression model consisted of the two factors: compulsive buying and impulsive buying from the Compulsive-Buying Scale (Ridgway et al., 2008); the four factors: amorality, distrust of others, desire for status, and desire for control from the Machiavellianism Personality Scale (Dahling, Whitaker, & Levy, 2009); the four factors: money avoidance, money worship, money status, and money vigilance from the Klontz Money Script Inventory (Klontz et al., 2011); and the three factors: success, budget, and evil from the Short Money Ethic Scale (Tang, 1995). The dependent variable was the pathological gambling factor from the Klontz Money Behavior Inventory (Klontz et al., 2012). The overall model was statistically significant, R = .414, R2 = .171, F (13, 409) = 6.302, p<.001. Only money status contributed a statistically significant amount of the variance to the overall equation. Interestingly, neither the obsessive-compulsive buying t (409) = -.137, p>.05, nor impulse buying dimensions t (409) = 1.362, p>.05, did not adequately predict pathological gambling in the overall model.

For males, the overall model was statistically significant, R = .536, R2 = .287, F (13, 109) = 2.976, p<.01. Only money status t (109) = 3.042, p<.05 contributed a statistically significant amount of the variance to the overall equation. For females, the overall model was statistically significant, R = .403, R2 = .163, F (15, 297) = 4.240, p<.001. Again, only money status t (297) = 5.354, p<.001 contributed a statistically significant amount of the variance to the overall equation.
For Caucasians, the overall model was statistically significant, $R = .447$, $R^2 = .200$, $F(13, 175) = 3.070$, $p<.001$. Again, only money status $t(173) = 4.473$, $p<.001$ contributed a statistically significant amount of the variance to the overall equation. For African-Americans, the overall model was statistically significant, $R = .806$, $R^2 = .649$, $F(13, 33) = 2.847$, $p<.05$. Amorality $t(33) = 2.644$, $p<.05$, money worship $t(33) = -2.624$, $p<.05$, and money vigilance $t(33) = -2.531$, $p<.05$ each contributed a statistically significant amount of the variance to the overall equation. For Hispanics, the overall model was not statistically significant, $R = .416$, $R^2 = .173$, $F(13, 107) = 1.512$, $p>.05$. For Asians, the overall model was statistically significant, $R = .556$, $R^2 = .309$, $F(13, 93) = 2.754$, $p<.05$. Both money status $t(93) = 3.941$, $p<.001$, and money vigilance $t(93) = -2.593$, $p<.05$ contributed statistically significant amounts of the variance to the overall equation.

To address the hypotheses presented in the introduction, correlations were computed to confirm or disprove the experimental predictions. Hypothesis 1 was weakly supported by statistically significant correlations $r = .087$, $p<.05$ between the obsessive-compulsive buying and impulse buying dimensions $r = .102$, $p<.05$ and pathological gambling. Hypothesis 2 was supported, $r = .256$, $p<.001$, demonstrating that high scores on amorality resulted in high scores on pathological gambling, although these correlations are in the “low range” (Cohen, 1988). Hypothesis 3 was partially supported with a statistically significant correlation $r = .361$, $p<.001$ between money status and pathological gambling. Interestingly, the desire for status factor of the Machiavellian Personality Scale did not significantly correlate with pathological gambling scores $r = .037$, $p>.05$. Although the money status and desire for status factors are very similar, only high scores on the money status factor from the Klontz Money Script Inventory indicate high scores on pathological gambling. Hypothesis 4 was not supported $r = -.073$, $p>.05$, thus low scores on budget did not determine high scores on pathological gambling. With regard to hypothesis 5, women scoring high on the obsessive-compulsive buying factor was weakly supported with slightly higher scores on the pathological gambling factor $r = .105$, $p<.05$. However, impulsive buying scores did not result in a statistically significant correlation with pathological gambling $r = .051$, $p>.05$. Hypothesis 6 was not supported $r = -.040$, $p>.05$, thus a high score on the money worship factor did not result in a high score on the pathological gambling factor.

**DISCUSSION**

In predicting pathological gambling behavior, the money status factor of the Klontz Money Script Inventory (Klontz et al., 2011) was significant in the overall, male, female, Caucasian, and Asian models. Some sample items of the money status factor are “People are only as successful as the amount of money they earn” and “Poor people are lazy.” Thus, pathological gamblers associate money with overall life enhancement and may hold negative views toward individuals lacking financial security. Further analysis of the Klontz Money Script Inventory indicates that the money worship factor loaded significantly only for the African-American model and was a negative predictor (those who worship money are less likely to exhibit pathological gambling behaviors). Some sample items of the money worship factor include “Money is power,” “You can’t trust people around money,” and “Things would get better if I had more money.” Some pathological gamblers may not value the utility of money, meaning they do not conceptualize money as a source to make changes in their lives, but rather as a source of stigma, in which those who have money are pedestal and those who lack money are shamed. As such, the gambler does not feel protective of their earnings and wagers funds on impulse because the player has a very loose attachment to money. Thus, the gambler does not believe their problems will be solved with money, but rather enforces the social norm that the presence of money equates to status.

Further analysis of African-American culture yields specific reasons as to why the money worship factor loaded negatively in the ethnic-specific model predicting pathological gambling. Over the past decade, African-American households with $75,000 of annual income have increased by 64% (Tinuoye, 2012). Due to increasing income and higher church involvement, African-Americans made 25% higher charitable donations than did Caucasians (Kellogg Foundation, 2012). In sum, African-Americans are experiencing financial plenty more so today than in the past, and because this culture is inclined to give away earnings, African-Americans may have a generalized loose attachment to money, making this race susceptible to gambling behavior.

For both African-Americans and Asians, money vigilance loaded significantly to negatively predict pathological gambling behavior. According to Raylu and Oei (2004) both African-Americans and Asians...
are characterized with higher gambling prevalence than Caucasians. The Chinese and Vietnamese have long cultural histories of gambling and view the activity as a social norm in the present day. In fact, 3,000 years ago, a popular form of keno was played among the Chinese to fund the Great Wall of China construction (Loo, Raylu, & Oei, 2008). Because pathological gambling behavior is more likely in individuals whose parents have gambled (Raylu & Oei, 2004), perhaps the positive cultural attitude towards gambling has snowballed for generations, leading to a three-fold higher prevalence in Asian (12.5%) samples as compared to Caucasians (4%). For Asian immigrants, casinos are seen as a place where they are respected and welcomed as opposed to differing cultural social activities (e.g. sports events; night clubs). When acculturating to places like Australia and the U.S., Asians are inclined to spend leisure time gambling because they “know the rules of the game,” unlike other social activities (Raylu & Oei, 2004). Thus, Asians who believe “Money should be saved not spent,” as itemized in the money worship factor, may be less inclined to gamble because they are going against their cultural norm. African-Americans who also embrace savings behavior are also acting outside their cultural norm to relinquish money for spending or charitable purposes.

With regard to the experimental hypotheses, impulsive and compulsive buying factors of the Richmond Compulsive Buying Scale (Ridgway, Kukar-Kinney, & Monroe, 2008) did not adequately predict pathological gambling behavior. Although hypothesis one was supported with statistical significance, the practical significance of the correlations are negligible.

With regard to the second hypothesis, the amorality factor of the Machiavellian Personality Scale (Dahling, Whitaker, & Levy 2009) significantly predicted pathological gambling scores. Although research has not been conducted to link pathological gambling behavior with Machiavellian personality traits, many studies have documented a strong link between antisocial personality disorder and pathological gambling (Blaszczynski, McConaghy, & Frankova, 1989; Pietrzak & Petry, 2005). Antisocial personality is a tendency to disregard the feelings of others, and instead act for personal gain with typical behaviors including failure to conform to social norms, deceitfulness, impulsivity, aggression, recklessness, irresponsibility, and lack of remorse (American Psychiatric Association, 2013). In a Vietnamese twin study of over 12,000 pairs of twins, Slutske et al. (2001) found significantly higher odds ratios for pathological gamblers with conduct disorder, adult antisocial behavior disorder, and antisocial personality disorder. Specifically, twins with a history of antisocial personality disorder were 6.4 times more likely to have a history of gambling disorder. Thus the correlation between amorality and pathological gambling behaviors is expected and consistent with existing literature.

The third hypothesis predicted that both the desire for status factor of the Machiavellian Personality Scale and the money status factor of the Klontz Money Script inventory will result in higher pathological gambling scores. Only the money status factor, and not the desire status factor correlated positively with pathological gambling because of an inherent difference between the two factors. The money status factor represents affective attitudes towards money alone. In contrast, the desire for status factor represents affective attitudes towards money and social class. The desire for status factor includes items: “Status is a good sign of success in life,” “Accumulating wealth is an important goal for me,” and “I want to be rich and powerful someday.” Thus the desire for status factor may not resonate with the pathological gambler because of the apparent dominance over others in the scale. The money status is less socially driven and represents both negative views of the poor and positive views of the rich, but does not reflect upon the individual’s social goals. In conclusion, we can interpret pathological gamblers as individuals deeply rooted in financial prejudice, in which the rich are seen as positive and the poor are seen as negative; however, they are not goal-driven to acquire status themselves.

Hypothesis 4 yields another scale discrepancy given that the budget factor of the Short Money Ethic Scale (Tang, 1995) did not significantly predict pathological gambling, but the money vigilance factor of the Klontz Money Script Inventory was significant in African-American and Asian regression models. Both the budget and money vigilance factors are intended to represent savings behaviors; however, the budget factor is more reflective of individual behavior, and the money vigilance factor is more reflective of general philosophy. The budget factor consists of items: “I budget my money very well” and “I use my money very carefully,” whereas
the money vigilance factor consists of items: “You should not tell others how much you have or make,” “Money should be saved not spent,” and “It is important to save for a rainy day.” In order for an individual to agree with the budget factor, they must have been good savers, but an individual agreeing with the money vigilance factor only needs to believe in the importance of savings, and not necessarily execute the behavior themselves. Thus, the budget factor may be too exclusive given that the sample was a collection of college students, many of whose savings behaviors are infantile and will likely develop with age (Dew & Xio, 2011).

Hypothesis 5 predicting high scores on compulsive buying and impulsive buying in conjunction with high scores on pathological gambling for women was only partially supported with a weak correlation in favor of compulsive buying. In conclusion, pathological gambling behaviors are not adequately predicted by shopping behaviors in either obsessive-compulsive or impulsive dimensions.

Finally, with regard to hypothesis 6 predicting high scores on the money worship factor for men in conjunction with high scores on pathological gambling did not yield statistical significance. As explained earlier, pathological gamblers do not recognize the utility of money as a powerful, life-changing force. They do, however, recognize the social prejudice of money (better represented by the money status factor in contrast to the money worship factor). Money worship is not a characteristic of pathological gamblers because money is easily relinquished in gaming activity especially for African-Americans (due to charitable cultural norms) and Asians (due to historical cultural norms).

Future research on pathological gambling should continue to study gender and ethnicity differences in predicting gambling behavior. Given that gambling behavior tends to spawn from positive parental attitudes (Raylu & Oei, 2004), perhaps future research could closely examine childhood upbringing in relation to gambling disorder. One possible project might consider if family influence from specific members such as mothers, fathers, or grandparents contribute to pathological gambling behavior in adulthood. Additional projects may also consider how various pay structures (weekly, bi-weekly, or monthly checks) influence gambling activity.

REFERENCES


STAYING TOGETHER: THE JOURNEY OF HEALING AFTER INFIDELITY

BY JENNIFER BOLICK

ABSTRACT

Relationships are an important aspect of a fulfilling life. They can bring joy and pleasure or pain and devastation. One of the most detrimental issues within the context of relationships is infidelity, and subsequently it is one of the most prevalent issues seen in therapy. Although it is a common presenting problem in couple therapy, research on the treatment and healing of infidelity is limited. Infidelity is a highly sensitive topic, and the humiliation and shame that accompany this indiscretion may be one reason the research is limited. The rehashing of traumatic events unearths fresh wounds for couples attempting to rebuild their foundation. A majority of the literature is focused on the clinician’s point of view rather than the couples’ perspective. This realm of study provides information and guides to implementing treatment, but lacks direct information from couples about how they successfully navigate the arduous process of healing after an indiscretion. The purpose of this paper is to present the results of a qualitative study of eight public weblogs in which individuals and couples described their experience with healing from infidelity. Utilizing grounded theory procedures, the researchers are seeking to identify factors outlined by the bloggers that contributed to their healing experience.

Staying Together: The Journey of Healing After Infidelity

One of the most devastating and debilitating issues a couple may face is infidelity. Infidelity rates have been reported as high as 25% (Blow & Hartnett, 2005b), but when the definition of infidelity is expanded to include emotional and online affairs, the rates may be even higher. The betrayal of one's commitment to the partner, as well as to the relationship, becomes the focus of contention as couples attempt to work through the pain caused by infidelity as well as the issues that led to the affair. Failing to acknowledge the relationship itself as a tangible part in need of respect and attention may be a contributing factor in the contention. It is unclear whether marital discord leads to the indiscretion or if the indiscretion leads to marital discord (Blow & Hartnett, 2005a).

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Current research and data relating to infidelity is complex and hard to interpret. Each couple’s relationship, perceptions, and issues are vastly different. Most of the literature is from the therapist’s point of view, which can provide a basis for treatment but does not include enough insight from couples that have successfully navigated the course of healing and recovery after infidelity. The client’s voice is critical in understanding the recovery process. We sought to analyze and interpret the process of healing from infidelity through the perspective of those who have experienced it. Our purpose is to enhance current research by providing a systematic and detailed account of the thoughts, emotions, and journey toward healing that couples experience after the affair.

LITERATURE REVIEW
The mere mention of infidelity piques interest, but why? In a society where marriage and fidelity are lauded, salacious indiscretions are commonly breaking news. “Over 90% of Americans consider extramarital affairs morally unacceptable” (Lamanna & Riedmann, 2009, p. 133) yet when surveyed, 25% of men and 15% of women admitted to having at least one affair outside of their marriage (Laumann, Gagnon, Michael, & Michaels, 1994). With high expectations for faithfulness, people are cheating at a higher rate than is expected. What is the allure and why are so many willing to risk everything for a forbidden tryst? A loving relationship can bring joy and satisfaction into one’s life, but it also can evoke pain and sadness. Partners may enter a committed relationship with expectations regarding fidelity, but sometimes couple’s boundaries are ambiguous, and the definition of sexual and emotional fidelity may be unspoken, leaving the possibility for challenges to arise. However, infidelity can cause serious damage to a loving relationship, with consequences that are calamitous and long-lasting.

Definition
Blow and Hartnett (2005a) assert that infidelity can be defined in several ways, with a range of behaviors including, but not limited to: having an affair, extramarital relationship, cheating, sexual intercourse, oral sex, kissing, fondling, emotional connections that are beyond friendships, internet relationships, pornography use, and others. Regardless of the specific behaviors, most definitions generally include a violation of trust within a committed relationship. The inconsistency and differing definitions of what is considered infidelity can lead to confusion for researchers and couples alike. Fife, Weeks, and Gambescia (2007) pose: “Infidelity is any form of betrayal to the implied or stated contract between partners regarding intimate exclusivity” (p.71). Some consider cheating only to include sexual intimacy with others outside of the primary partnership. Others may include emotional connections, a combination of both (Glass & Wright, 1992) or internet/cyber infidelity (Hertlein & Piercy, 2008). Moreover, Wilson, Mattingly, Clark, Weidler, & Bequette (2011) further clarify this by using the Perceptions of Dating Infidelity Scale (PDIS), a three factor model comprised of Ambiguous, Deceptive, and Explicit behaviors (p. 80-81):

Ambiguous behaviors are those in which the individual’s motivations seem unclear but may be benign (e.g., eating/drinking, dancing, and hugging: least indicative of cheating).

Deceptive behaviors are those in which the individual’s behaviors are mainly internal or hidden and are aimed at actively deceiving one’s partner (flirting, fantasizing, lying to or withholding information: moderately indicative of cheating).

Explicit behaviors are those in which the individual clearly breaks the agreement of monogamy by engaging in sexual behaviors with someone other than a romantic partner (sexual intercourse and oral sex: most indicative of cheating).

Infidelity may include sexual, emotional, and cyber betrayal. Sexual infidelity is “The occurrence of sexual involvement with a third party that violates the ground rules established by the couple” (Leeker & Carlozzi, 2014, p. 69). Emotional infidelity consists of fostering an emotional connection with someone outside of the primary relationship that may or may not include sexual behavior (Wilson et al., 2011). According to Hertlein and Piercy (2008) “Internet infidelity is defined as a romantic or sexual contact facilitated by internet use that is seen by at least one partner as an unacceptable breach of their marital contract of faithfulness” (p. 484).

Prevalence
According to the American Association of Marriage and Family Therapy (AAMFT), clinicians state that 46% of clients have had an affair (Humphrey, 1987; Bird, Butler, & Fife, 2007). Yet, prevalence can be difficult to determine. Several studies report that men are more
unfaithful than women; however, this difference may be due to the strict sexual constraints used in previous literature. Wiederman (1997) stated 22.7% of men and 11.6% of women report engaging in extramarital sex (EMS), but when examining the data for participants under 40-years-old, gender differences diminish. This may be attributed to more liberal views and shifting cultural values regarding sexuality in the United States (Leeker & Carlozzi, 2014). Brand, Markey, Mills, & Hodges (2007) found that men were not more inclined to cheat, and women had a higher incidence of self-reported cheating, when non-sexual behaviors were included (men 24%, women 31.4%). On the other hand, a separate study revealed that while both were unfaithful, women cheated with less frequency (Brand et al., 2007).

Men and women seem to differ in types and meanings of affairs. Men are more inclined to participate in sexual involvement void of the emotional component, whereas women are more inclined to have emotional connections or combined-type affairs (Glass & Wright, 1992). Individuals seek to justify motivations for extramarital affairs. Motivations for the sexual category include sexual excitement, curiosity, enjoyment, and variety; while the emotional category includes intellectual sharing, companionship, understanding, and heightened self-esteem. Other reasons involve extrinsic motivations (i.e., career advancement or revenge) and affection and love (Glass & Wright, 1992).

Impact
The impact of infidelity can be traumatic to all involved. The immediate impact is a loss of trust. Trust permeates every aspect of relationships, thus is crucial and highly valued. Trust promotes and encourages open communication, and facilitates a feeling of safety between couples (Bird et al., 2007). The foundation of the relationship is trust, and a betrayal such as infidelity leads to questioning the partner, the relationship, and even turning the inquiry inward. Additionally, couples are faced with personal and relationship chaos and may experience several emotions consisting of hurt, betrayal, shame, anger, depression, and guilt. Betrayed partners may experience symptoms of PTSD, with excessive thinking about the affair and anxiety (Bird et al., 2007).

Treatment
As distressing and painful as infidelity can be to couples and relationships, some view this strife as an opportunity for personal growth and choose to mend their relationship. An affair can be seen as a catalyst to seek balance in the marriage and obtain the absent piece (Fife, Weeks, & Filbert, 2015). Many seek out the guidance of a marital therapist in order to repair the relationship and begin the journey of healing.

Infidelity has been deemed one of the most challenging issues by therapists (Whisman, Dixon, & Johnson, 1997). Considering the extreme emotional disarray couples are facing, therapists need to be cautious, careful, and well-prepared in their approach. Thorough comprehension of infidelity and the process of healing is critical in assisting these couples through this difficult period. One important component is the therapist’s position of acceptance and nonjudgment. One client reported that this stance allowed her the ability to discover “some potentially difficult and painful self-realizations” that contributed to the demise of the relationship (Gordon, Baucom, & Snyder, 2005, p.1405). Others have discussed how feeling judged can hinder progress. At the same time, therapists must attentively navigate not absolving the partner who engages in the infidelity (Gordon et al., 2005). Infidelity is deemed a relationship challenge, even when one partner is clearly the culprit (Fife, Weeks, & Gambescia, 2008).

Couples seeking reconciliation and healing must be prepared for a lengthy and arduous undertaking, wrought with challenges and emotions that demand patience and commitment. Many seek the guidance and direction of a therapist to assist with healing. One must consider the role of the therapist, the couple, each of the partners, and the relationship as separate pieces of a system in order to prevail over the strain caused by infidelity. The partners endure distress together and therefore should heal together. Fife, Weeks, and Gambescia (2008) indicate that treatment consists of the following five overlapping phases: (1) crisis management and assessment, (2) systemic considerations, (3) facilitating forgiveness, (4) treating factors that contribute to infidelity, and (5) promoting intimacy through communication. Crisis management consists of seeking to achieve a sense of calm within the chaos and establish some semblance of “stability and order” (p. 317). This is achieved by creating a safe environment to manage
emotional reactions, commitment, accountability and trust. Assessment consists of evaluating the following (a) the type of infidelity and the level of deception, (b) the duration of infidelity (including frequency and location), (c) history of past occurrences, (d) relationship of the affair partner to both partners, (e) degree of collusion by the betrayed partner, (f) perceived attractiveness of the affair partner, and (g) social and cultural context of the infidelity. Systemic considerations involve identifying risk factors, relationship issues that may have contributed to the indiscretion, and implementing reframing (a new perspective of the problems). Facilitating forgiveness is comprised of empathy, humility, remorse, apology, softening, accepting responsibility, and extending forgiveness. Treating factors that contribute to infidelity involves exploring love through the lens of intimacy, passion, and commitment. Promoting intimacy involves improving communication (Fife et al., 2008).

SUMMARY OF LITERATURE REVIEW
A societal expectation for fidelity in committed relationships seems to be the consensus, yet infidelity occurs at a rate of up to 25% and is one of the leading reasons that motivates couples to seek out counseling (Atkins, Baucom, & Jacobson, 2001). Infidelity causes an “emotional roller coaster” (Olson, Russell, Higgins-Kessler, & Miller, 2002, p. 426) for the individual partners and the relationship. While some choose to separate, others come to view infidelity as a chance to reevaluate their relationship and strengthen themselves through healing. Although infidelity can be one of the most difficult cases to treat considering the depth of emotions involved and lack of empirical data (Whisman et al., 1997), therapists can provide hope and direction at a time when couples are struggling. Due to the negative impact of infidelity and the need for therapists to be knowledgeable about the process of healing in order to assist couples, more information about this topic is needed. The purpose of this study is to examine the process of healing by conducting a qualitative analysis of eight online blogs of individuals who have experienced infidelity.

METHOD
Participants & Data Collection
Data from eight separate weblogs were included in this study. In order to be included, participants had to experience infidelity within their relationship, remain together, and provide detailed accounts of the process of healing and recovery. Seven of the participants are female and one is male. The eight public weblogs were converted into Word documents for purposes of analysis. Each data set was analyzed by at least two separate researchers to identify themes related to the healing process. Institutional Review Board (IRB) approval was sought and granted.

Analysis
A team of five researchers conducted qualitative analysis. The analysis process was guided by grounded theory methodology initially focusing on a process of “constant comparison,” which is characterized by continually moving in and out of the data in order to form conceptual categories (Harry, Sturges, & Klingner, 2005). As the researchers are the primary instrument of analysis, the coding necessarily incorporates the perspective of the researchers involved, as filtering through the data shapes meaning (Glaser & Strauss, 1967). Part of the purpose of including multiple researchers in the analysis is to prevent too narrow of interpretation of the data. The group analysis process enhances the rigor of the research and increases the trustworthiness of the results.

The first stage “open coding” was used to find key terms and themes in the data, constantly comparing them to refine the specific codes and to begin to determine how they fit together. The next stage “axial coding” was used to identify and group intersecting themes of discrete codes. The last stage “selective coding” was used to designate how the themes pertain to each other and what the narratives reveal (Strauss & Corbin, 1998; Harry et al., 2005). In order to prevent influence, each researcher analyzed the first blog separately. The next step involved comparing relevant themes with the other researchers and independently analyzing the blogs again. Subsequent analysis was completed on the remaining seven blogs by at least two researchers. Researcher team members consulted as group to determine the salient themes and processes of healing from infidelity that emerged from the analysis of the data.

RESULTS/DISCUSSION
Preliminary results indicate recovery and healing is a long, continuous process. Some compare healing to a roller coaster of emotions of which forgiveness is an integral part. The five key emerging themes are as follows: faith, awareness/personal accountability, counseling, commitment to the relationship, and
honesty. Faith includes finding strength and courage through prayer. Awareness/personal accountability entails both partners taking responsibility for their part in the demise of the relationship, as well as changing behavior. Counseling involves seeking out professional help in order to alleviate challenges, and to foster better communication. Commitment to the relationship includes setting healthy boundaries and agreeing to work on the relationship. Lastly, honesty is comprised of being truthful in all regards, including full disclosure of the affair. It appears that experiencing these stages on a continuum lead to forgiveness.

Conclusion/Further Study
Many committed relationships will be affected by infidelity. Some couples will choose to remain together and work on the relationship. The results of this study suggest that it is possible to overcome the anguish of infidelity and find love and happiness again. However, healing is not a simple or easy process. Forgiveness seems to be a necessary and critical component of the healing process, and many seek therapy to help. The complexity of emotions that follow from infidelity leaves therapists and couples in a delicate and challenging predicament. The results of this study highlight important aspects of healing that are grounded in the experience of individuals and couples who have experienced and overcome many the effects of infidelity. This information can be valuable for therapists who work with couples through this traumatic experience. Further study should include accounts and insight from couples that have experienced and moved past infidelity with self-described success.

REFERENCES


SYNTHESIS AND CHARACTERIZATION OF PT(II) COMPLEXES FOR ANTICANCER THERAPY

BY MIHAELA CIULEI

ABSTRACT
Four novel platinum Pt(II) complexes were synthesized from 4,4'-substituted-2,2'-bipyridine ligands and their chemical structures, properties, and purity were characterized using the $^{1}\text{H}$, $^{13}\text{C}$ NMR (nuclear magnetic resonance spectroscopy), melting points by DSC (differential scanning calorimetry), and elemental analysis. Additionally, these ligands were prepared by multi-step procedures and determined their purity by spectroscopic techniques as well as elemental analysis prior to the preparation of Pt(II).

INTRODUCTION AND PURPOSE OF THE STUDY
The goal of this study is to synthesize and characterize new cisplatin complexes as better anticancer drugs. It is well known that cancer is the second leading cause of death in the United States. However, it is also one of the leading causes of death worldwide. In 2012, approximately 8.2 million cancer deaths (~15% of all deaths) and 14.1 million adults were diagnosed with cancer worldwide.\(^5\) Moreover, it is expected that the number of cancer cases and deaths to increase with an estimated 21.4 million new cases and 24 million deaths by 2035.\(^2\) As a result, immediate steps must be taken to reduce this tragic number of deaths.

Platinum compounds synthesis history dates since the 1960s, when the first Platinum (II) complex was synthesized by accident.\(^3\)\(^-\)\(^4\) Since then the platinum compounds research synthesis has been progressing in aiding in the anticancer treatment.\(^5\)

The current statistics estimate that approximately 50% of cancer chemotherapeutic drug administration consists of platinum-based drugs.\(^3\)\(^-\)\(^4\) A great deal of research has been conducted but only a few compounds have been approved for clinical use. Although the value of cancer treatment using platinum compounds has been shown, they have limitations such as narrow spectra of activity, resistance, and toxic side effects.\(^3\)\(^-\)\(^8\)

The current research is directed towards developing platinum drugs with greater effectiveness and less toxic side effects. While many researchers have continued to focus on improving Pt(II) complexes for many years, some

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are expanding into the development of Pt(IV) complexes. Unlike Pt(II) complexes which have four coordinating ligands attached to the platinum center (giving it a +2 oxidation state), Pt(IV) complexes have six coordinating ligands (giving it a +4 oxidation state). These complexes are generally prepared by oxidation of Pt(II) compounds with H2O2 and further modified by reactions with various reagents to produce the desired axial ligands.9

This project objective is to synthesize a series of platinum Pt(II) complexes, I-IV, which will be targeted for testing in different cell lines for their therapeutic effects in biochemistry lab facilities. The structure-activity relationship will provide a rational basis for the discovery of novel platinum compounds with increased effectiveness and low toxic side effects. The chemical structures, properties, and purity of platinum Pt(II) complexes will be identified by using the 1H, 13C NMR (nuclear magnetic resonance spectroscopy), and melting points via DSC (differential scanning calorimetry).

LITERATURE REVIEW

As it was mentioned earlier cancer is the second leading cause of death in the U.S. after diabetes, consisting 1 out of 4 deaths.1 Extensive research must be conducted to reduce this tragic number of deaths annually.

There are different types of cancer therapies based on how advanced the cancer is. The three main therapies are surgery, radiotherapy, and chemotherapy. If the cancer is identified at its earlier stage then surgery is preferred in order to eliminate the malign cells, but if the surgery cannot eliminate all the cells then the patient has to go through radiotherapy or chemotherapy or a combination of both. There are other, newer, more selective therapies such as targeted therapy and immunotherapy that have been discovered more recently.

Starting in 1978, the platinum compounds have been discovered and eventually used for cancer therapy.3-4 Their usage continues to show promise for further treatment even today. The first anticancer drug discovered is cisplatin. Cisplatin is known as the Penicillin of Cancer because of its popularity in treating cancer via chemotherapy and also for being the first one.5 Cisplatin or cis-diamminedichloroplatinum(II) (CDDP) is a square planar Pt(II) complex.5

Platinum is the metal that was the first one used in chemotherapeutic cancer treatment.10 It was accidentally discovered in the 1960s by professor Rosenberg at the Michigan State University and his lab group.5-7 During an experiment, they were studying the effects of the electric fields on the growth of cells and they found that platinum complexes are able of inhibiting the cell cycle of the cell.10 With this discovery, they proposed that these compounds may be able to treat cancer. When they tested these compounds in mice they discovered that cis-[PtCl2(NH3)2] is very effective.10 As a result these cisplatin compounds obtained approval for clinical treatment by the U.S. Food and Drug Administration (FDA) in 1978.7

Cisplatin is used alone or in combination with other cancer drugs aiding in treatment of various types of cancers such as lung, ovarian, bladder, testicular, head and neck, esophageal, colon, gastric, breast, melanoma, and prostate cancer.10 The two most common cancers in males are prostate and lung cancer and in women, breast and lung cancers.11
The drawback of cisplatin drugs is the side effects that are quite severe. The side effects differ from patient to patient, but the most common ones are changes in how the food tastes, diarrhea, nephrotoxicity, neurotoxicity, nausea, vomiting, ototoxicity, alopecia, electrolyte imbalance, electrolyte imbalance, thrombocytopenia, leucopenia, myelosuppression, numbness in the extremities.\textsuperscript{5}

Although more and more chemotherapeutic drugs are being developed, cisplatin is used even today and it is the most commonly used chemotherapeutic drug.\textsuperscript{4,7} In addition to the cisplatin drugs two more Pt(II) complexes have been approved worldwide. These two drugs are carboplatin and oxaliplatin (see Figure 2).

Carboplatin [diammine (1,1-cyclobutane–dicarboxylato)-platinum (II), CBDCA] or cyclobutane-1,1-dicarboxylate where O and O’ are the ligand donor atoms. This drug is considered to be “much less oto- and nephrotoxic” than cisplatin, which means less side effects versus the very well known drug, cisplatin. Carboplatin is considered the second generation platinum anticancer drug.\textsuperscript{12} Its effectiveness is against ovarian cancer, bladder cancer, non-small cell lung cancer, and cervix cancer.\textsuperscript{13}

Mechanistically, carboplatin binds in the grooves of DNA-DNA or DNA-protein and ceases replication, transcription, and repair. This process leads to apoptosis, or programmed cell death. Researchers are still investigating this process and how carboplatin leads to DNA-protein cross-linkage.\textsuperscript{13}

A more recent anticancer drug is oxaliplatin, [Pt(ox-O,O’), (1R, 2R)-dach-N,N’]. the “ox” stands for oxalate and the “dash” represents 1,2-diaminocyclohexane. In 1999 this drug was approved by the European Union in 1999 and in 2002 was approved in the U.S.\textsuperscript{12} Like carboplatin, this drug has been proved to be less nephro- and oto-toxic than cisplatin. Moreover, in comparison with carboplatin this one is less myelosuppressive and it is used to treat cisplatin-resistant tumors.\textsuperscript{12} Its efficacy increases when used in combination with 5-fluorouracil (5-FU) in metastatic colorectal cancer.\textsuperscript{12} Its side effect is that it leads to peripheral neuropathy or nerve damage. Nerve damage affects touch and sensation to cold because these drugs are complexed with Calcium ions which are important in the neuronal signaling system. These ions are released from the drug in the cells at the dorsal root ganglion located in the spinal system.\textsuperscript{12}

In addition to the cisplatin, carboplatin, and oxaliplatin there are a few others platinum(II) compounds that have been approved in other countries. These compounds are nedaplatin, lobaplatin, heptaplatin, satraplatin, and picoplatin.\textsuperscript{12}

Although 50\% of cancer chemotherapeutic regimens consist of platinum-based drugs only a few compounds have been approved for clinical use due to toxic side effects.\textsuperscript{3-4} According to Barefoot the treatment administration has to be individualized in order to ensure efficacy and diminish the side effects. The drug administration has to be monitored very well in order to ensure maximum efficacy.\textsuperscript{14}

The majority of the platinum compounds that have antitumor activity have been noted to belong to the same set of structure-activity relationship. The antitumor platinum compounds have one of the general formulae cis-[PtX2(Am2)2] or cis-[PtX2Y2(Am)2]. The X is a leaving group such as Cl− (this anion should have an intermediate binding strength) in cisplatin drug. The Am is an inert amine with at least one N-H group. In aqueous media that contain chloride in low concentrations two complexes are formed, monohydrated cis-[PtCl(NH3)2(H2O)]+, and dihydrated cis-[Pt(NH3)2(H2O)2]2+. The available research points out that the monohydrated form is more cytotoxic. Mechanistically these cisplatinum hydrated species bind to the guanosine bases of DNA via intra- and interstrand cross-linkages. The majority (>80\%) of the DNA linkages are intrastrand cross-links.\textsuperscript{14}

In order to synthesize the platinum compounds a starting material or ligand has to be made. A very well known ligand that has been used extensively is 2,2’-bipyridine. This compound was first synthesized in 1888 by Fritz Blau and then by Newkome et al.\textsuperscript{15} This ligand is used extensively because different functional groups can be attached and it owns high redox stability.\textsuperscript{15} Historically, many metal containing compounds containing 2,2’-bipyridine have been shown to have antitumor activity.\textsuperscript{15}
Although other compounds have been synthesized and show promising results in antitumor activity, they are hard to synthesize. Specifically, they require strong bases such as lithium diisopropylamide which is not easy to use because of its reactivity with water. Furthermore, some reactions require specialized glassware under argon or nitrogen, or expensive fluorinated alcohols. As a result, our lab is determined to develop platinum complexes containing the ligand 2,2'-bipyrididyl with greater efficacy, better reaction conditions, and more cost-effective. The proposed compounds have not been synthesized yet by other research labs. So, we propose to synthesize the Pt(II) complexes with the known procedures from the appropriate starting compounds and to characterize by the experimental techniques including 1H, 13C NMR spectroscopy, elemental analysis, and differential scanning calorimetry (DSC).

SUMMARY OF LITERATURE REVIEW
The number of deaths due to cancer worldwide is increasing alarmingly. Although the cancer research has been expanding since 1978 when cisplatin got FDA approval, there are very few anticancer drugs that are effective and have few side effects. Our hopes are that the proposed Pt(II) complexes will have a greater effectiveness and less toxic side effects.

METHODOLOGY AND RESULTS
General
The starting materials used in this project including 4,4'-dimethoxy-2,2'-bipyridine and the reagents required for the synthetic procedures were purchased from the following companies: Sigma-Aldrich, TCI, Alfa-Aesar, Acros, and Degussa. These materials did not require further purification because they were good quality products unless otherwise noted.

Chemical characterization instrumentation
The NMR spectra was obtained by running a Varian spectrometer at 298 K or the indicated temperature using deuterated dimethyl sulfoxide (DMSO-d6) or chloroform (CDCl3) as the solvents: 1H NMR, 400 MHz. Tetramethylsilane (TMS) or other residual solvents were utilized to determine the internal chemical shift reference. For the thermal transitions were identified by using a TA Instruments DSC 2010 differential scanning calorimeter in nitrogen at heating and cooling rates of 10 °C min⁻¹. The temperature axis of the DSC thermogram was calibrated with reference standards of high purity indium and tin before use. No more than 3mg of compound was required in this experiment. The Tonset and Tmax temperature of a melting endotherm of a compound was recorded from the DSC thermogram as Mp (Tonset -Tmax). Elemental analysis was performed in NuMega Resonance Labs Inc. (San Diego, Ca) by using a Perkin Elmer PE2400-Series II with a CHNS/O analyzer.

The synthetic routes for the preparation of Pt(II) complexes I and II are shown in Scheme 1.

Preparation of 2,2'-bipyridine-4,4'-diol
The 2,2'-bipyridine-4,4'-diol was made by following a previously published procedure, some modifications were required to the reaction condition. A 48 wt% aqueous HBr (15.5 equiv) solution was slowly added to a solution of 4,4'-dimethoxy-2,2'-bipyridine (1.0 equiv) in glacial acetic and the resulting mixture was heated to reflux for a period of 72 h. The solvents were removed under vacuum resulting in the product residue that was dissolved in H2O. Insoluble material was removed by filtration and the pH of the filtrate was adjusted to neutral using NH₄OH.
The colorless solid product precipitated out and was collected by vacuum filtration. It was then washed with plenty of H₂O and dried at 80 °C in vacuo. The compound was then used without further purification in the next step.15 Mp 555.5 °C.

Preparation of 4,4′-diheptyloxy-2,2′-bipyridine

The appropriate alkyl halide (2.2 equiv.) was slowly added to a mixture of 2,2′-bipyridine-4,4′-diol (1 equiv.) and K₂CO₃ (2.2 equiv.) in DMF at ca. 60 °C. A catalytic amount of potassium iodide was then added and the reaction flask was heated to reflux for 72 h and then allowed to cool down to room temperature. The crude product was collected by vacuum filtration and washed with minimum amount of DMF and lots of water. The white shiny crystals were obtained by recrystallization from methanol. The final product was dried in vacuo at 50 °C overnight.15

4,4′-Didodecyloxy-2,2′-bipyridine (L-7C) 3. Yield: 76%, white shiny crystals. Mp 72.4 °C. ¹H NMR (298 K, 400 MHz, CDCl₃): δ (ppm) = 8.45 (d, J = 5.6 Hz, 1H), 7.94 (d, J = 2.5 Hz, 1H), 6.82 (dd, J = 5.7, 2.6 Hz, 1H), 4.12 (t, 2H), 1.87 – 1.75 (m, 2H), 1.51 – 1.40 (m, 2H), 1.40 – 1.24 (m, 6H), 0.95 – 0.85 (m, 3H). ¹³C NMR (298 K, 100 MHz, CDCl₃): δ (ppm) = 166.14, 157.84, 148.41, 112.83, 110.15, 70.14, 51.69, 29.02, 28.74, 25.76, 22.58, 14.07. Anal. calcd for C₂₄H₃₆Cl₂N₂O₂Pt (650.54 g mol⁻¹): C, 44.31; H, 5.58; Cl, 10.90; N, 4.31; O, 4.92; Pt, 29.99%; found: C, 44.41; H, 6.51; N, 4.37%.

[PtCl₂(4,4′-diheptyloxy-2,2′-bipyridine)] complexes

[PtCl₂(4,4′-diheptyloxy-2,2′-bipyridine)] (Pt-7C) 1

The ligand 4,4′-diheptyloxy-2,2′-bipyridine was reacted with the K₂[PtCl₄] (0.564 g, 11.5 mmol) salt in water (20 mL total) with 0.5 mL HCl and heated to reflux for 24 h to give [PtCl₂(4,4′-diheptyloxy-2,2′-bipyridine)], which precipitated out as bright yellow in color. The mixture was vacuum filtered and the yellow precipitate was washed with water and diethyl ether. The platinum compound I was purified in chloroform at room temperature and the solvent was removed by rotary evaporator. Finally, it was dried in vacuo at 50 °C over night. Yield: 86% (0.647g). Mp 171 °C. ¹H NMR (298 K, 400 MHz, CDCl₃): δ (ppm) = 8.65 (d, J = 6.8 Hz, 1H), 7.45 (d, J = 2.8 Hz, 1H), 6.65 (dd, J = 6.7, 2.6 Hz, 1H), 4.30 (t, 2H), 1.86 (m, 2H), 1.57 – 1.45 (m, 2H), 1.45 – 1.30 (m, 6H), 0.96 – 0.87 (m, 3H). ¹³C NMR (298 K, 100 MHz, CDCl₃): δ (ppm) = 166.91, 157.83, 148.41, 112.83, 110.15, 70.14, 51.69, 29.02, 28.74, 25.76, 22.58, 14.07. Anal. calcd for C₂₄H₅₀Cl₂N₂O₂Pt (650.54 g mol⁻¹): C, 44.51; H, 5.58; Cl, 10.90; N, 4.31; O, 4.92; Pt, 29.99%; found: C, 44.41; H, 6.51; N, 4.37%.

Figure 3: (a) ¹H NMR spectra of ligand 3 and Pt(II)-complex I recorded in CDCl₃ (b) ¹³C NMR spectra of ligand 3 and Pt(II)-complex I recorded in CDCl₃.

Comparing the ¹H spectrum of 3 with that of I, proton peak corresponding to 6,6′ positions of I shifted downfield and those of 3,3′ and 5,5′ positions shifted upfield suggestive of the formation of Pt(II) complex.

Figure 4 shows a sharp melting endotherm for the ligand 3, but a complex thermal profile for Pt(II) complex I.

Preparation of cis-[PtCl₂(CH₃)₂SO]₂

An amount of K₂[PtCl₄] (1.00g, 2.41 mmol) was placed in a 50mL-beaker and dissolved in water (20 mL) at room temperature. Then the solution was filtered through silica in order to remove the impurities of K₂[PtCl₄] from commercial K₂[PtCl₄]. Dimethyl sulfoxide (0.69 mL, 9.64 mmol) was added and the reaction mixture is stirred with a Teflon-coated magnetic bar at 20-25 °C for 24 h. The pale yellow precipitate that formed was collected on a
Hirsch funnel, washed with three 1-mL portions of water, and dried in air at 20-25 °C. The pale yellow powder was dried in vacuo at 80 °C overnight. Yield: 88%. Mp  227.0 °C. Anal. calcd for C34H24Cl2O2PtS: C, 47.83; H, 2.39; S, 15.19%; found: C, 11.36; H, 2.84; S, 15.20%.

Preparation of [PtCl2(4,4′-didodecyloxy-2,2′-bipyridine)] (Pt-12C) II
The ligand 4,4′-didodecyloxy-2,2′-bipyridine (0.250 g, 0.476 mmol) was mixed with 15 mL solution of MeOH: CH2Cl2 (1:1) and stirred at room temperature for 1-2 minutes. In the resulting mixture, the cis-[PtCl2(CH3)2SO]2 (0.250 g, 0.476 mmol) was added and stirred at room temperature for 24 h. Yield: 94% (0.354 g, 0.476 mmol).18 1H NMR (298 K, 400 MHz, CDCl3): δ (ppm) = 8.77 (d, J = 2.8 Hz, 1H), 7.46 (d, J = 6.8 Hz, 1H), 4.29 (t, 2H), 3.72 (m, 2H), 3.50 – 3.61 (m, 2H), 3.26 (m, 2H), 1.45 – 1.25 (m, 15H), 0.95 – 0.85 (m, 3H). 13C NMR (298 K, 100 MHz, CDCl3): δ (ppm) = 166.98, 157.90, 148.75, 112.75, 110.13, 70.13, 31.90, 29.66, 29.62, 28.75, 25.82, 22.66, 14.09.

Preparation of [PtCl2(4,4′-diamino-2,2′-bipyridine)] complex IV
It was synthesized in multi-step reactions in accordance with the Scheme 2 shown below:

Preparation of 2,2′-Bipyridine N,N′-dioxide A
The 2,2′-bipyridine (5.5 g, 35.2 mmol) was added in glacial acetic acid (41 mL) in 125 mL Erlenmeyer flask and heated up between 70-80 °C. A 30% aqueous hydrogen peroxide (7.15 mL) was added slowly in order to maintain the temperature. An addition volume of hydrogen peroxide (4.95 mL) was added and the temperature maintained at 70-80 °C for a further 19 h. On addition of acetone (100 mL) 2,2′-bipyridine N,N′-dioxide precipitated. The white precipitate was collected on a Hirsch funnel, washed with acetone, and dried in air at 20-25 °C. The white needles were dried in vacuo at 60 °C for 48 h. Yield: 95%. Mp 297 °C.

Preparation of 4,4′-dinitro 2,2′-bipyridine N,N′-dioxide B
A solution of 2,2′-bipyridine N,N′-dioxide (1.9 g, 8 mmol) in 7.2 mL of concentrated sulfuric acid was cooled to 0 °C and 2.5 mL of fuming nitric acid was cautiously added. The solution was stirred at 100 °C for 22 h. The solution was cooled to room temperature and poured onto ice. The yellow precipitate was filtered off and washed successively with H2O. Yield: 39%. Mp 261 °C. 1H NMR (298 K, 400 MHz, DMSO-d6): δ (ppm) = 8.69 (dd, J = 3.3, 0.5 Hz, 1H), 8.60 (dd, J = 7.3, 0.5 Hz, 1H), 8.57 (dd, J = 7.3, 3.3 Hz, 1H).

Preparation of 4,4′-diamino 2,2′-bipyridine C
The 4,4′-dinitro 2,2′-bipyridine N,N′-dioxide (0.500 g, 1.08 mmol) was mixed with a minimum volume of EtOH and purged with N2 gas. More EtOH was added to ensure proper stirring of the mixture and heat was applied to reflux. Once the mixture was brought to reflux, 2 small spatulas of Pd/C (10%) were added. A mixture of 3 mL NaN3 in 5 mL EtOH was added dropwise over 1 h in the reaction flask while the reaction was still purged with N2 gas. The resulting solution was refluxed for 15 h. After the reaction time was over, the solution was filtered hot through a bed of Celite and washed with boiling EtOH. The solvent was removed via the rotary evaporator. The yellow precipitate...
was poured in ice-cooled water and left in the refrigerator overnight. The white solid that formed was vacuum filtered, washed with water, and dried in vacuo at 50 °C.21

CONCLUSIONS
The compounds I and II were synthesized according to the Scheme 1 following the described literature procedures with modifications. The chemical structures, properties, and purity of the prepared platinum Pt(II) complexes were confirmed by using the 1H, 13C NMR (nuclear magnetic resonance spectroscopy) as shown in Figure 5, melting points by DSC (differential scanning calorimetry), and elemental analysis as shown in Figure 4. Similarly, the ligands 3 and 5 were checked for their purity prior to the preparation of I and II by the identical techniques as those used for I and II. The synthesis of III is in progress in our laboratory, and it can be synthesized from the ligand 4,4’-dinitro-2,2’-bipyridine, which will be prepared from the compound C on heating with PCl₃ in chloroform to deoxygenate. The synthesis of IV is in progress and will be synthesized from ligand D by using cis-[PtCl₂{(CH₃)₂SO}₂] as shown in the Scheme 2.

FURTHER STUDY
As far as we know, there is no literature available on the tumor activity of compounds I and II, but several [PtCl₂(4,4’-dialkoxy-2,2’-bipyridine)] complexes in the series have shown positive results in cancer cell lines recently reported from our laboratory, and, therefore, I and II along with III and IV will be tested in various cancer cell lines.15 Our hopes are that these novel platinum compounds will have increased effectiveness and low toxic side effects.

REFERENCES


PRE-TRAUMATIC FACTORS OF CAREER-RELATED PTSD: A SYSTEMATIC REVIEW OF THE LITERATURE

BY MICHAEL CURTIS

ABSTRACT
This paper examined and synthesized the (limited) available literature on the pre-traumatic predictors of PTSD, specifically targeting populations in which traumatic events are experienced frequently because of the requirements of their positions, i.e., firefighters, police, and military personnel. A total of 21 articles were included in the final literature review and were used to assess the current available knowledge of the pre-traumatic traits of career-related PTSD, and address potential gaps in the literature. The culmination of this research was used to create specific risk profiles for each of the high risk careers included in this review, firefighters, police, and military personnel. The research presented here discovered very little literature surrounding these high risk populations. Future research focusing on longitudinal prospective studies should be conducted on high risk populations so that training could better equip officers, firefighters, and military personnel to deal with PTEs, thus lowering the overall development of PTSD.

INTRODUCTION
Posttraumatic stress disorder (PTSD) is a disorder that occurs after one has experienced a traumatic event, which can include, but is not limited to, perceived or literal physical or emotional violence. To receive a diagnosis of PTSD one must meet all of the following 8 criteria: (A) exposure to a traumatic event; (B) re-experiencing that event; (C) numbing towards or avoidance of said event; (D) negative cognitions and mood associated with the event; (E) alterations in arousal associated with the event; (F) the symptoms must last more than a month; (G) symptoms must cause significant psychological impairment; and (H) the disturbance cannot be attributed to another disorder, whether it be physical or mental (American Psychiatric Association, 2013).

PTSD can be linked to a specific potentially traumatic event (PTE). At one point or another in their lifetime, every individual experiences a PTE, but only 8.7% of people in the United States meet the DSM criteria for PTSD by the age of 75 (Medina, 2010). This percentage dramatically
increases in professions in which there is higher-risk of experiencing PTEs, making these populations at higher risk for PTSD.

Rates of PTSD hover between 44-47% percent among veterans and recently deployed soldiers (Medina, 2010), whereas among firefighters it is about 22% (Heinrichs et al., 2005), and among police it ranges between 7 and 19% (Maguen et al., 2009). In these professions, men and women are well aware of the risks associated with the requirements for their job; with this in mind, these professionals go through rigorous training to combat the development of psychological disorders, such as PTSD. Yet, the above statistics place these public defense populations far above the 8.7% national average, making them a significant topic of research. These professional populations present a unique opportunity for researchers to examine pre-traumatic factors that may be associated with PTSD because researchers may be able to get baseline statistics before a PTE and follow up data shortly after one or multiple PTEs. However, very little research has been performed on this subject.

Because it is expected that professionals working in these high risk careers experience multiple traumatic events, the number of PTSD cases should be higher than in the general population. If simply being exposed to a deeply traumatic event leads to the development of PTSD symptoms, then there should be a higher prevalence among individuals who experience multiple traumatic events as related to their chosen profession. This paper will examine and synthesize the (limited) available literature on the pre-traumatic predictors of PTSD, specifically targeting populations in which traumatic events are experienced frequently because of the requirements of certain positions, i.e., firefighters, police, and veterans.

METHODS
A literature review was preformed via a search of seven peer reviewed journal search engines: PsyINFO, Academic Search Premier, Psychiatry Online, ScienceDirect Journals, PsycARTICLES, Sage Collection, and Scopus. Key words used in the search included, but were not limited to, PTSD, prospective, police, firefighters veterans, combat-related, trauma, and longitudinal. For inclusion in this literature review, articles had to meet all following criteria: (1) the study centered on pre-traumatic factors of PTSD, (2) the study was conducted on a population that experiences frequent traumatic events related to their career, i.e. active duty military or veterans, firefighters, and police (3) participants were assessed before and after a period of time in which a traumatic event occurred, (4) the article was considered to be “recent” research published within the last 10 years, and (5) the study must have been written in English. The articles that were included in this review were limited to those published between 2004 and 2014 because they include the most recent literary research and represent the current demographics of high-risk careers. Articles were excluded if they did not meet all of the above requirements. A total of 21 articles were included in the final literature review and were used to assess the current available knowledge of the pre-traumatic traits of career-related PTSD, as well as address potential gaps in the literature.

RESULTS
The results of the literary search yielded a total of 21 studies that met the above criteria. The subject population of the articles were broken down as follows: 4 articles exclusively involved firefighters, 5 articles involved police officers, and 11 articles involved military personnel. One article had populations composed of firefighters and police officers but the majority of participants (65%) were firefighters. The overall average age of participants in the studies ranged from 18 – 51 years old. All research was conducted on men with the large majority being of Caucasian or white decent. Three articles used the same set of data provided by the Neurocognition Deployment Health Study as seen in Table 3 (Franz et al., 2013; MacDonald, Proctor, Heeren, & Vasterling, 2013; Vasterling et al., 2010).
### Table 1
**Firefighters Characteristics**

<table>
<thead>
<tr>
<th>Citation</th>
<th>Population</th>
<th>Mean Age (SD)</th>
<th>Trauma Exposed Sample Size</th>
<th>Baseline</th>
<th>Follow-Up Assessment schedule</th>
<th>Primary findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bryant and Guthrie (2007)</td>
<td>Firefighters</td>
<td>PTSD: 30(7.13) Non-PTSD: 30.02(4.40)</td>
<td>33(52)</td>
<td>Prior to active duty</td>
<td>W1: 4 years later</td>
<td>Higher levels of negative appraisal of themselves before predicted PTSD symptoms. PTSD symptoms precluded a difficulty in recalling specific memories surrounding certain traumatic events.</td>
</tr>
<tr>
<td>Bryant et al. (2007)</td>
<td>Firefighters</td>
<td>29.6(5)</td>
<td>60</td>
<td>Prior to active duty</td>
<td>W1: 4 years later</td>
<td></td>
</tr>
<tr>
<td>Guthrie and Bryant (2005)</td>
<td>Firefighters</td>
<td>30.1(5.1)</td>
<td>71</td>
<td>Prior to active duty</td>
<td>W1: 1 year later</td>
<td>Heightened biological arousal may be a vulnerability for PTSD.</td>
</tr>
<tr>
<td>Heinrichs et al. (2012)</td>
<td>Firefighters</td>
<td>25.6(3.5)</td>
<td>15</td>
<td>While training at the academy</td>
<td>W1: 6 months W2: 9 months W3: 12 months W4: 24 months</td>
<td>High hostility and low self-efficacy predicted PTSD symptom severity.</td>
</tr>
<tr>
<td>Orr et al. (2012)</td>
<td>Firefighters &amp; Police Officers</td>
<td>27(6.5)</td>
<td>308</td>
<td>While training at the academy</td>
<td>W1: 19.4 days (SD=12.2), W2: 12.3 days after W1 (SD=11.5)</td>
<td>Inability to relax after a PTE; Lower IQ and higher levels of depression predicted PTSD symptoms.</td>
</tr>
</tbody>
</table>

### Table 2
**Police Officers Characteristics**

<table>
<thead>
<tr>
<th>Citation</th>
<th>Population</th>
<th>Mean Age (SD)</th>
<th>Trauma Exposed Sample Size</th>
<th>Baseline</th>
<th>Follow-Up Assessment schedule</th>
<th>Primary findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inslicht et al. (2010)</td>
<td>Police Officers</td>
<td>27(4.60)</td>
<td>278</td>
<td>While training at the academy</td>
<td>W1: 1 year</td>
<td>A history of substance abuse, psychotic symptoms, and/or mood or anxiety disorders in first degree full biological relatives increased the development of PTSD symptoms.</td>
</tr>
<tr>
<td>Maguen et al. (2009)</td>
<td>Police Officers</td>
<td>27.2 (4.7)</td>
<td>180</td>
<td>While training at the academy</td>
<td>W1: 1 year</td>
<td>Work environment predicted PTSD symptom.</td>
</tr>
<tr>
<td>McCaslin et al. (2008)</td>
<td>Police Officers</td>
<td>27.24(4.7)</td>
<td>180</td>
<td>While training at the academy</td>
<td>W1: 1 year</td>
<td>Dissociating from the emotions that the event produces increases the presence of PTSD symptoms.</td>
</tr>
<tr>
<td>Meffert et al. (2008)</td>
<td>Police Officers</td>
<td>27.2 (4.7)</td>
<td>180</td>
<td>While training at the academy</td>
<td>W1: 1 year</td>
<td>Baseline trait anger predicts later PTSD symptoms and that PTSD symptoms are associated with increased state anger, independent of baseline anger.</td>
</tr>
<tr>
<td>Yuan et al. (2011)</td>
<td>Police Officers</td>
<td>27.2 (4.6)</td>
<td>233</td>
<td>While training at the academy</td>
<td>W1: 1 year</td>
<td>A benevolent world was associated with lower symptoms of PTSD.</td>
</tr>
</tbody>
</table>
Discussions

Firefighters

The majority of research that is being conducted on PTSD is being conducted upon police officers and veterans. There is relatively little research being conducted upon firefighters; out of the 21 studies that met the criteria to be included in this review only 5 of them were conducted on firefighters. This lack of research was surprising because throughout their firefighting career, these men and women are likely to experience several situations in which their lives or the lives of others around them are in danger.

Heinrichs et al. (2005) attempted to fill this gap in the literature by conducting a longitudinal study that examined firefighters’ psychological and physiological changes through the first 2 years of probationary employment. The study began with 43 professional firemen immediately after they completed basic training; female firefighters had been excluded because of a lack of representation. Subjects had also been excluded if they met the criteria for PTSD at the beginning of the study. For the purposes of this study participants were subjected to a battery of psychological tests, as well as saliva and urine samples, at a number of points over their first 2 years of employment; immediately

Table 3
Military Personnel Characteristics

<table>
<thead>
<tr>
<th>Citation</th>
<th>Population</th>
<th>Mean Age (SD)</th>
<th>Trauma Exposed Sample Size</th>
<th>Baseline</th>
<th>Follow-Up Assessment schedule</th>
<th>Primary findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Franz et al., (2013)</td>
<td>Military Personnel</td>
<td>25.7(5.9)</td>
<td>774</td>
<td>Prior to active duty</td>
<td>W1: National Guard = 197.5(SD=34) days, Military = 73.5(SD=19.5) days</td>
<td>Identified 4 factors that directly affected threat appraisal: pre-deployment PTSD symptoms, prior history of warzone deployment, pre-deployment unity cohesion, and preparedness</td>
</tr>
<tr>
<td>LeardMann et al. (2009)</td>
<td>Military Personnel</td>
<td>NG</td>
<td>55021</td>
<td>While training at the academy</td>
<td>W1: 2.7 years (SD=.5)</td>
<td>Soldiers with overall poorer physical and mental health predicted the presence of PTSD</td>
</tr>
<tr>
<td>Lommen et al. (2014)</td>
<td>Military Personnel</td>
<td>23.82(4.94)</td>
<td>221</td>
<td>Baseline: Prior to active duty</td>
<td>W1: 2 months W2: 9 months</td>
<td>Trait anger before deployments predicted presence of PTSD symptoms</td>
</tr>
<tr>
<td>MacDonald et al. (2013)</td>
<td>Military Personnel</td>
<td>25.7(5.9)</td>
<td>774</td>
<td>Prior to active duty</td>
<td>W1: National Guard = 197.5(SD=34) days, Military = 73.5(SD=19.5) days</td>
<td>Overall severity of re-experiencing, avoidance, and hyper-arousal symptoms increase significantly in post-deployment</td>
</tr>
<tr>
<td>Rademaker et al. (2011)</td>
<td>Military Personnel</td>
<td>31.1(8.98)</td>
<td>410</td>
<td>While training at the academy</td>
<td>W1: 4 months W2: 6 months</td>
<td>Type D personality was shown to make military personnel more susceptible to the development of PTSD symptoms</td>
</tr>
<tr>
<td>Sandweiss et al. (2011)</td>
<td>Military Personnel</td>
<td>NG</td>
<td>22630</td>
<td>Prior to active duty</td>
<td>W1: 1 to 3 years later W2: 4 to 6 years later</td>
<td>Severity of health functioning has also been shown to be marginally related to PTSD</td>
</tr>
<tr>
<td>van Liempt et al. (2013)</td>
<td>Military Personnel</td>
<td>28.85(9.06)</td>
<td>453</td>
<td>Prior to Deployment</td>
<td>W1: 6 months</td>
<td>Pre-deployment nightmares were demonstrated as being predictors of PTSD after deployment</td>
</tr>
<tr>
<td>Vasterling et al. (2008)</td>
<td>Military Personnel</td>
<td>NG</td>
<td>800</td>
<td>Prior to active duty</td>
<td>W1: average of 95.2 days</td>
<td>Health related functioning was found to be weakly related to PTSD; PTSD symptoms adversely affect physical and mental health causing increased negative day-to-day functioning</td>
</tr>
<tr>
<td>Vasterling et al. (2010)</td>
<td>Military Personnel</td>
<td>25.7(5.9)</td>
<td>774</td>
<td>Prior to active duty</td>
<td>W1: National Guard = 197.5(SD=34) days, Military = 73.5(SD=19.5) days</td>
<td>PTSD symptoms increased overall after deployment once scores were adjusted for pre-existing symptoms</td>
</tr>
<tr>
<td>Wright et al. (2012)</td>
<td>Military Personnel</td>
<td>49% between 18 and 25</td>
<td>522</td>
<td>2 months before deployment</td>
<td>W1: 3 months after 12-month deployment</td>
<td>Soldiers who scored lower in social functionality and had greater exposure to combat stress had higher levels of post-traumatic symptoms</td>
</tr>
</tbody>
</table>
after graduating from basic training, at 3 months on the force, at 6 months, at 12 months, and at 24 months. Over the course of the study, 7 subjects were lost to attrition, making the sample size at the end of the study 36, of which 7 (19.4%) met the full criteria for PTSD and 8 (22.2%) showed significant symptoms of PTSD.

The psychological and physiological tests that firemen were asked to complete measured alexithymia, body weight, cortisol, depression, epinephrine levels, global severity, hostility, psychiatric symptoms, self-efficacy, and trait anxiety. Amongst the tested variables, two significant physiological factors were identified: high hostility and low self-efficacy (Heinrichs et al., 2005). These two significantly separate variables made up for 42% of the variance at the end of the 2 years. Thus, Herinrichs et al., (2005) concluded that high hostility and low self-efficacy are strong predictors of developing PTSD symptoms after experiencing several traumas.

High hostility may be a risk factor because it may cause social isolation, a lack of social support, and/ or a lack of effective social coping skills. Individuals with significant PTSD symptoms frequently have lower levels of social support (Clapp & Gayle Beck, 2009). This lack of support could also be connected to low self-efficacy because it can refer to a lack of self-confidence, which can render life perceptively more “unpredictable and uncontrollable” (Heinrichs et al., 2005). This lack of self-efficacy could also correlate with how one appraises oneself because a perception of one’s ability is connection to perception of one’s self. Research conducted by Bryant and Guthrie (2007) on firefighting trainees showed that trainees with higher levels of negative appraisal of themselves before beginning active duty also had higher levels of PTSD symptoms compared to their counterparts. This negative appraisal was geared directly towards themselves and not to the world or the work place (Bryant & Guthrie, 2007).

Firefighters’ negative appraisal about themselves may also be linked to the way in which they recall certain aspects of the PTE. Bryant, Sutherland, and Guthrie (2007) studied the ability of firefighters to recall memories; they discovered that firefighters with PTSD symptoms had a difficulty in recalling specific memories surrounding certain traumatic events. This inability to recall traumatic events correlates with the inability to process traumatic events alongside positive situations, that leads firefighters to clinging more to the negative emotions surrounding the specific traumatic event instead of the positive things that are occurring in their lives (Bryant, Sutherland, & Guthrie, 2007). They also suppose that a lack of recall could be connected to poorer problem solving and higher rates of depression (Bryant et al., 2007).

The high risk group in the Heinrichs et al., (2005) study saw a general increase in all psychopathological symptoms over the course of the study, particularly between the 6 and 12 month follow-ups. The researchers attributed this spike to an increase in stress, because it is during this time that new firefighters are sent out on more calls to test their ability to do the job. Subsequently, their findings support additional research where high levels of PTSD symptoms occurred more readily in firefighters with pre-traumatic psychopathological symptoms, such as depression (Bomyea, Risbrough, & Lang, 2012).

Guthrie and Bryant (2005) also looked at the biological factors that may be associated with PTSD in firefighters. In this study it was concluded that heightened biological arousal may be vulnerability for PTSD. Firefighters with PTSD were shown to have higher states of reactivity than their counterparts (Guthrie & Bryant, 2005). In this heightened state, certain aspects, or triggers, can stir a strong negative emotion connected to a traumatic event, thus inhibiting the firefighter from processing new emotional information surrounding the event. This study also looked at alcohol dependency discovering a positive correlation between the two, which could represent a genetic disposition; however, further research is needed to test this theory (Guthrie & Bryant, 2005).

By using the data that is presented here, a vulnerability profile can be created for men. This profile would say that firefighters who have high hostility, low self-efficacy, low levels of social support, negative life appraisal, issues with memory recall, pre-duty psychopathological symptoms, and heightened biological arousal would be at the greatest risk for acquiring PTSD symptoms post-duty. These findings tell us little about firefighter’s personality, the effects of their work place environment, and coping ability.

The findings presented here, though enlightening,
cannot be reliably generalized for the general populous or additional high-risk career populations. Firefighting is a unique profession wherein firefighters routinely face life threatening or injuring situations involving fire, which frequently leaves them scarred. Firefighting is potentially more psychologically damaging because many times firefighters know the situation before arriving and force themselves to enter potentially collapsing buildings to save victims. The research that is available for this niche is meagre; additional studies need to be conducted.

Police

The nature of police officers' duties includes confrontation and dangerous situations that may lead to threats of violence or literal harm. Since potentially traumatic events are frequent parts of police officers' daily routine, PTSD occurs quite often in officers. Incidents of PTSD can range from 7%-19% (Maguen et al., 2009, McCaslin et al., 2008, Yuan et al., 2011) which, although lower than the military average, is still higher than the national average, thus warranting research on this section of the work force. Police officers are a unique population because they are carefully screened and trained to manage and deescalate PTEs; thus, experiments conducted on civilians cannot be generalized for general population and vice-versa (Inslicht et al., 2010).

Aggressive behavior is one of the primary changes that can take place when a person develops PTSD, and having aggressive tendencies before service has been shown to exacerbate PTSD symptoms in police populations (Meffert et al., 2008). Meffert et al., (2008) concluded that PTSD had a dual relationship with anger in that trait anger predicted the development of PTSD symptoms and that PTSD was associated with increased state anger levels. Trait-anger and state-anger levels were not linked and were measure independently (Meffert et al., 2008). Police officers with high levels of trait anger levels did not significantly raise or lower over time, whereas police who scored lower on the trait anger scale had significantly higher state anger after working on the force. Meffert et al., (2008) suggest that these variations are linked to the interpersonal interactions that are had by the police. The researchers indicate that higher levels of anger damage support systems, impair social and/or occupational functioning, and increase the risk of interpersonal violence; yet social support was not found to be significantly associated with PTSD or anger in this study (Meffert et al., 2008). However, in another study conducted on police officers, social functioning was shown to be negatively associated with PTSD symptoms (Yuan et al., 2011). A lack of a cohesive support system can lead to individuals having less access to treatment and can exacerbate self-destructive or reckless behavior in PTSD victims because they have no one to rely upon psychologically to stabilize them and to serve as a buffer for the more debilitating aspects of the disorder. A strong support system can also help the victim physically by impeding the potentially self-destructive behaviors and monitoring the victim’s physical health.

The primary source of support comes from the familial bond. Coping skills and resilience to traumatic events are rooted in family history and heritability. Humans learn to cope with extreme stress and emotion by observational learning from their familial bonds. A history of substance abuse, psychotic symptoms, and/or mood or anxiety disorders in first degree full biological relatives have been shown to be associated with a significant increase of development of PTSD symptoms (Inslicht et al., 2010). These familial traits were shown to have a strong link and frequently co-occurred (Inslicht et al., 2010). This correlates with a model of addiction that stems from the inability to positively cope with stressful life events. In parental addiction situations, children are taught unhealthy coping skills from their primary caretakers, although the addictive tendencies may not be passed down, but the parent’s inability to cope with PTEs very well maybe. The effect is slightly different when the relatives are siblings because they are not the primary observational teachers. In the sibling relationship the effect stems from the positive or negative family dynamics between the officer, their sibling(s) and their parents (Inslicht et al., 2010). The same conclusions can be drawn when examining psychotic symptoms.

A critical component of a strong support system is the one formed in the workplace, especially for careers, such as police officers, where one relies heavily on co-workers for support. Whereas working as a police officer, proper support and equipment can mean the difference between living and dying; thus work environment is a contributing factor to a situation’s perceived threat level. A positive compassionate work environment has
been shown to mediate the development of PTSD (Maguen et al., 2009) because the culture of the police force creates a context in which potentially traumatic incidents are interpreted and processed. The work environment factor was found to be even more important than negative life events and the number of potentially traumatic events (Maguen et al., 2009). For example, whereas an actual or perceived violent attack could lead to PTSD symptoms in a civilian, these sorts of attacks are commonplace in a police officer’s line of work and are perceived as simple day-to-day occurrences. Maguen et al., also attribute this effect to a positive workplace being representative of effective leadership, which has been shown to diffuse the effects of stress and increase morale, role clarity and job engagement.

Apart from the work environment factor, an officer’s interpretation of the fundamental functioning of the world can have an effect on the development of PTSD symptoms. Specifically, seeing the world as a more benevolent place has been shown to be associated with lower symptoms of PTSD: viewing the world through benevolent lenses can influence the way in which individuals appraise stress and may be helpful in the coping process (Yuan et al., 2011). A more positive attitude in reference to the world can also affect the degree to which officers assign emotions to a PTE in that officers with a higher level of benevolence would be less apt to connect profoundly negative emotions to an event. The event-emotion connection is made at the very moment when stimuli are sent to the brain. In a study conducted on police and firefighter trainees, it was discovered that in individuals with higher levels of PTSD symptoms, muscles stayed tense after a jarring noise was introduced to the environment (Orr et al., 2012). This inability to relax could be related to their inability to cope with the sudden rush of stimuli. These individuals were also found to have lower IQ levels and higher levels of depression, which supports the idea that a more malevolent outlook on life could be a predictor of PTSD (Orr et al., 2012).

Whereas positively interpreting the events has been shown to help mitigate the development of PTSD symptoms, dissociating from the emotions that the event produces has the opposite effect and can actually increase PTSD symptoms (McCaslin et al., 2008). In a study that assessed dissociation while in the police academy and one year after service, police officers with high levels of baseline dissociation were more disposed to experience greater levels of dissociation after a potentially traumatic event, leading to a higher risk of PTSD symptoms than those of their counterparts who scored low on trait dissociation (McCaslin et al., 2008). Dissociation from a traumatic event is common because victims avoid the emotions connected to the event; the avoidance becomes a negative psychological pattern of coping, which causes symptoms that are potentially connected to PTSD. McCaslin et al. (2008) show that although post traumatic event dissociation is linked to high levels of PTSD, trait dissociation place victims at higher risk which could be linked to employing less adaptive coping strategies.

**Military**

Most research that has been conducted on the pre-traumatic PTSD examines military populations. Although the related publications centered on the military account for the majority of the available literature for career-related PTSD, only a few articles met the criteria for this review because many articles that were cited as prospective studies did not conduct baseline pre-service assessments. Military personnel are carefully screened and trained to deal with PTEs, but active duty war-zone military personnel are at a greater risk of being killed, disfigured, or psychologically damaged due to the nature of their service.

The overall severity of re-experiencing, avoidance, and hyper-arousal symptoms increase significantly in post-deployment military personnel as compared to their pre-deployment scores on the PTSD Checklist, a widely used self-reported PTSD measurement scale (MacDonald, Proctor, Heeren, & Vasterling, 2013). Higher levels of pre-deployment hyper-arousal was shown to be an indicator of increased PTSD symptoms after deployment (MacDonald et al., 2013). The 4th symptom in this cluster, numbing, did not significantly change (MacDonald et al., 2013). Though numbing did not undergo any significant change, it was shown to be the strongest predictor of all of the other symptoms in the cluster. This could indicate that a pre-deployment tendency to numb against negative emotions can result in exacerbating the other symptoms in the cluster.

There is a common belief that emotional numbing could manifest itself in nightmares and/or insomnia, though unfounded. However, pre-deployment nightmares have been demonstrated as being
predictors of PTSD after deployment (van Liempt, van Zuiden, Westenberg, Super, & Vermetten, 2013). Nightmares may also represent prior trauma or an inability to deal with stress.

In researching this population, Rademaker, van Zuiden, Vermetten, and Geuze (2011) believed that there was a certain personality type that was more susceptible to military service related PTSD than others. Type D personality was examined and characterized by high levels of negative affectivity in combination with a tendency to inhibit the expression of emotions in social interaction, i.e. introversion. Significant associations were found to be associated between Type D personality traits and concurrent PTSD symptoms. Although the presence of Type D personality was shown to make military personnel more susceptible to the development of PTSD symptoms, the relationship was not a significant one after controlling for prior symptoms (Rademaker et al., 2011). This may be due to these individuals being naturally predisposed to suppressing emotions and internalizing psychological issues.

In this article it was also discovered that a significant predictor of developing PTSD symptoms was comprised of higher levels of pre-deployment negative affectivity and higher levels of self-reported exposure to childhood emotional abuse (Rademaker et al., 2011). Childhood emotional abuse and pre-deployment PTSD symptoms were found to predict post-deployment PTSD scores independently of each other (Rademaker et al., 2011).

Higher levels of hostility and lower levels of self-directedness before deployment helped predict the presence of PTSD symptoms after deployment (van Zuiden et al., 2011). Similar findings were seen in firefighting population as discussed above (Heinrichs et al., 2005). The presence of pre-deployment PTSD symptoms were also significant predictors for future post-deployment PTSD (van Zuiden et al., 2011). Scoring low on the self-directedness could represent military personnel as being immature and irresponsible. These individuals may also generally have difficulties accepting responsibilities and setting long term goals. The number of previous deployments was not significantly related to the development of PTSD before or after recent deployment (van Zuiden et al., 2011). Because the number of deployments was not found to be significant factor, it stands to reason that it is not the number or length of duties that effect PTSD development but the intensity of the duty and the soldiers' intrinsic vulnerabilities.

Another facet of personality that was accessed was anger. Lommen, Engelhard, van de Schoot, and van den Hout (2014) concluded that: 1) trait anger before deployments predicted presence of PTSD symptoms; 2) trait anger two months after deployment did not predict PTSD symptom severity after nine months of duty; and 3) the predictive effect of pre-deployment trait anger on subsequent PTSD symptom severity remained when stressor severity, content overlap, and baseline symptoms were included in the model, but not when neuroticism was included. It was discovered that neuroticism and trait anger were both vulnerability factors for PTSD symptoms severity, with neuroticism being the stronger predictor. Anger and neuroticism may also lead to negative appraisals of a traumatic event. Trait anger did not seem to be a consequence of PTSD symptomatology (Lommen et al., 2014).

Anger as a vulnerability for PTSD was identified in a subsequent study that examined the effects of functional deployment on PTSD development. In that study, military personnel were assessed on how well they function in their daily lives outside of the military. They were assessed before deployment on factors such as how well they got along with other people and how well they took care of things at home and in the workplace (Wright, Cabrera, Eckford, Adler, & Bliese, 2012). These factors were combined and personnel were scored using a functionality impairment scale. Soldiers, who scored lower on the functionality scale and had greater exposure to combat stress, had higher levels of post traumatic symptoms (Wright et al., 2012). This implies that soldiers, who are experiencing diminished functionality in their lives, may be at higher risk for developing PTSD symptoms during or following deployment (Wright et al., 2012). This also implies a significant interaction between PTSD and deployment.

This interaction was examined in a study conducted by Vasterling et al., (2010). These researchers studied the development of PTSD symptoms pre- and post-deployment. As expected, PTSD symptoms
increased after deployment once scores were adjusted for pre-existing symptoms (Vasterling et al., 2010). Greater increases were seen in soldiers with pre-existing PTSD symptoms, signifying that soldiers with pre-existing scores on the lower end of the PTSD spectrum scored towards the top end of the spectrum after deployment (Vasterling et al., 2010). There was also a positive correlation between pre-existing PTSD scores and combat intensity, as the soldiers with high levels of combat exposure reported not only an increase in PTSD symptoms but also their symptoms were more severe (Vasterling et al., 2010). Their research suggest that the protection from developing PTSD that can sometimes occur when soldiers have stressful home lives or have experienced previous traumatic events is overridden by subsequent severe combat exposure (Vasterling et al., 2010).

Vasterling et al. (2010) also examined the effects that the home-front can have on soldiers’ PTSD development. Through their research, they found that soldiers who experienced significant home-front concerns while deployed had higher levels of PTSD severity (Vasterling et al., 2010). Their findings show a need to look at the development of PTSD from a holistic point of view where social interaction and relationships are weighted as heavily as combat intensity. Although PTSD symptoms can sometimes be traced to a single or multiple events, the disorder is influenced by a number of factors. Soldiers with overall poorer physical and mental health scores were 58% more likely to develop new and/additional PTSD symptoms after deployment (LeardMann, Smith, Smith, Wells, & Ryan, 2009). In related research, day-to-day health functioning has been shown to have a dual relationship with PTSD symptoms. On the one hand, health related functioning was found to be weakly related to PTSD development when corrected for the influence of health symptoms; on the other hand, PTSD symptoms adversely affect physical and mental health causing increased negative day-to-day functioning (Vasterling et al., 2008). Vasterling et al., found no evidence that smoking or drinking had significant effects on the development of PTSD or health functioning post-deployment (Vasterling et al., 2008). Severity of health functioning has also been shown to be marginally related to PTSD symptoms (Sandweiss et al., 2011). The more severe the baseline psychiatric disorder and/or deployment-related physical injury, the higher the rate and severity of the subject’s PTSD symptoms (Sandweiss et al., 2011).

Vasterling et al. (2010) also identified the perception of threat during deployment as a predictive indicator of PTSD development. This is supported by further research conducted by Franz et al. (2013), who examined the factors that affected perceived threat. In their study, they identified 4 factors that directly affected threat appraisal: pre-deployment PTSD symptoms, prior history of warzone deployment, pre-deployment unity cohesion, and preparedness (Franz et al., 2013). Excluding unit cohesion, these factors influenced threat appraisal, which, they concluded, mediated the effects between the previously listed predictive factors and post-deployment PTSD severity (Franz et al., 2013). Although unit cohesion was not shown to be a significant factor, their findings suggest an indirect connection: cohesion was a predictor of how well units prepare for deployment (Franz et al., 2013). Pre-deployment elevates arousal and hypervigilance can potentially make PTEs seem even more threatening and thereby affect threat appraisal. Prior history of warzone deployment affects PTSD in much of the same way. On the contrary, preparedness was shown to be a protective factor by making it more likely that soldiers appraise deployments as less severe (Franz et al., 2013).

**GENERAL CONCLUSIONS**

The focus of this research was to survey the current literature that is available for the pre-traumatic factor of post-traumatic stress disorder in the potentially highly traumatic careers of the men and women working in firefighting, police, and military service. These populations are unique in that individuals voluntarily choose to enter a potentially dangerous career.

The culmination of this research can be used to create specific risk profiles for each of the high risk careers included in this review. The high-risk profile for firefighters includes individuals with individuals with higher levels of negative self-appraisal, difficulty recalling memories surrounding a PTE, heightened biological arousal, high hostility, low self-efficacy, inability to relax after a PTE, lower IQ levels and higher levels of depression (Bryant et al., 2007; Bryant & Guthrie, 2007b; Guthrie & Bryant, 2005; Heinrichs et al., 2005; Orr et al., 2012). For police officers, this high-risk group includes officers who have a history of substance abuse, psychotic...
symptoms, and/or mood disorders, poorer work environment, are more apt to dissociation from PTEs, have higher baseline trait anger, and have a malevolent outlook on the world (Inslicht et al., 2010; Maguen et al., 2009; McCaslin et al., 2008; Meffert et al., 2008; Yuan et al., 2011). Lastly, the high-risk group for military personnel includes individuals who have poorer physical and mental health, higher levels of trait anger before deployment, Type D personality, nightmares before deployment, and low social functionality (LeardMann et al., 2009; Lommen et al., 2014; Rademaker et al., 2011; Sandweiss et al., 2011; van Liempt et al., 2011; van Zuiden et al., 2011; Vasterling et al., 2008; Wright et al., 2012).

The studies examined in this review varied on their assessment subject, yet 3 commonalities were identified. First, across all three high-risk careers the presence of mental health disorders was shown to exacerbate the development of PTSD symptoms (Orr et al., 2012; Inslicht et al., 2010; LeardMann et al., 2009). Second, high levels of trait anger predicted the presence and severity of PTSD symptoms in police and military populations (Meffert et al., 2008; Lommen et al., 2014). Lastly, positive perception of oneself and the world buffered the development of PTSD symptoms for firefighters and police (Bryant & Guthrie, 2007; Yuan et al., 2011).

These populations also give researchers an opportunity to monitor the development of PTSD from its beginning stages and to explore which factors may make individuals susceptible to developing PTSD symptoms. I conclude that this opportunity is not being utilized. Only prospective articles, where baseline data was taken before service, were included in this review. The majority of the research that is currently available on PTSD is retrospective, but such studies may be biased by a variety of factors and skewed by the length of service. The research presented here discovered very little literature surrounding these high risk populations. Future research focusing on longitudinal prospective studies should be conducted on high risk populations so that training could better equip officers, firefighters, and military personnel to deal with PTEs, thus lowering the overall development of PTSD.

REFERENCES


MALE-FEMALE WAGE-GAP: A COMPARISON OF DIFFERENT EMPLOYMENT CLASSES

BY RICHARD V. FOSTER

ABSTRACT
This study is being conducted and reported in two parts. The first part, this report, is a statistical examination of the male-female wage gap. By evaluating the average (mean) differences between men and women within the workplace, pay differential trends can be ascertained and examined to support the need for additional study. The second stage, to be conducted Fall 2014 at the University of Las Vegas, Nevada, will use regression analysis to differentiate between explained and unexplained portions of said pay-gap to better understand how the remaining gap is related to discrimination.

Both stages of this study will use data obtained from the Current Population Survey, covering a period from 1999 to 2013. The study takes each year’s averages to establish individual data points as well as year-over-year trends for the study period. The data analyzed will explore and establish baselines for both real and nominal wages, then examine classes of worker, e.g., governmental, private for-profit companies, or private non-profit companies, and finally, look at the effect of union coverage of the gender pay-gap.

INTRODUCTION
Historically, women have always been paid less than men for equal work. Over the last half century, the pay-gap between the sexes has narrowed significantly. However, in the last few decades, the closing of this gap, or “convergence,” has slowed. During the 1980s, the overall gap decreased 9%, compared to the 1990s during which
the overall gap decreased by an additional 3.5%. The primary question to be considered is: In the last fourteen years, are there segments of the workforce that have made significantly more progress at closing the pay-gap than others? Secondary concerns include whether there have been substantive changes to the pay-gap, what trends have emerged over this period, and whether there is a need for further research.

The study uses data obtained from the Current Population Survey, beginning in 1999, and evaluates each successive year through 2013. For each year, in each category to be studied, averages are used to create an individual data point to represent that year. These points are then used to evaluate tends. This report will explore the data by first examining the overall population, as represented in the sampling, to establish a baseline in terms of both nominal and real wages. Then the study will examine employment classes of workers, e.g., governmental, private for-profit companies, or private non-profit companies to determine whether there are differences in trends between general employer types. Finally, consideration is given to union influences on the gender pay-gap.

The goal of this research is to identify statistical trend patterns to the gender pay-gap in an effort to better understand the true direction of the pay discrimination phenomena. This study helps to establish current quantifiable findings to expose this form of discrimination and hopefully serve as a tool to help facilitate continued change.

LITERATURE REVIEW

The difference in male-female pay rates is often studied by economists; this pay difference is commonly referred to as the “gender pay-gap.” Over the last sixty years the gap in pay between men and women has narrowed. Generally speaking, from the 1950s to the early 1980s, the ratio of a female’s income was approximately 60% of a man’s. By the early 1980s, the ratio had improved - women were paid 70% of a man’s wage. This means in the period from the 1950s, through the 1970s, women were paid 40% less than their male counterparts in similar jobs. By the early 1980s, this gap of discrimination had diminished - women averaged earning only 50% less. From this point, progress in closing this gap has slowed and is showing signs it may have plateaued.

To understand the gap and its ramifications, the causes must be understood. Generally speaking, the pay-gap has two “broad sets of causes.” They are differences in individual characteristics and unequal treatment of workers. Characteristic differences are differences in the qualities of each individual worker, which separate one person from the next in the workplace. These qualities include characteristics such as age, marital status, number of children, and education levels. For the unequal treatment portion, this is the way the “labor market discriminates against women” in the pay between the sexes. To determine the level of discrimination caused by unequal treatment, one must first account for differences between worker qualities; whatever is left between male/female pay levels is generally considered by economists to be attributed to discrimination.

In considering the characteristic differences between workers, one of the most critical components is the amount of capital investment made by each worker. One problem that helps to maintain the pay-gap is that many women avoid making a large capital investment in the same areas compared to men. As a general rule, the largest capital investment to be made is that of education, but then this investment must be leveraged to create an economic return. This creates a conundrum, because it is a well-documented fact that women obtain more college degrees than do men; however, overall men gain more financially from their educational investment.

A partial solution to the education investment return conundrum is how women and men choose to deal with their family needs. Instead of focusing on work, many women choose to longer term family goals above careers, while men choose to make their careers a priority. To keep family a priority, many women may choose to focus their education on careers that allow maximum

3 Ibid.
5 Ibid.
6 Ibid, 190.
7 Ibid, 191.
workplace flexibility. To gain this flexibility, women tend to select careers in which their “skills and knowledge . . . [do not] become quickly outdated” when they take extended time away work.8 Additionally, many women, especially those with young children, work only part time.9 By making such choices, women suffer what is commonly referred to as a “motherhood penalty” while men tend to be rewarded with promotions, thus helping maintain a gender pay-gap.10

In order to best close the gender pay-gap, the number of women working in higher paying jobs needs to increase. However, in order for women to increase their pay, they must first obtain more marketable job skills. The problem is many women choose to put family needs above obtaining or maintaining these job skills. Many women tend to self-select jobs that offer long term flexibility. However, these tend to be lower skilled positions – and consequently positions with lower pay. This is best shown by women earning more college degrees, but men earn a higher number of degrees within technically skilled fields, thus leading to superior pay for men.11

Since the 1980s, women have begun to close this skilled educational gap by choosing college majors at the professional level, as an example, “women have achieved near parity with men in graduation from [both] law and medical schools.”12 However, still notably lacking is the presence of women within the fields of both sciences and mathematics - jobs that also lead to higher paying careers.13

The ongoing trend for women is to self-select and “to work in a fairly small number of relatively low-paying, predominantly female jobs,” e.g., teachers, nurses, librarians – occupations which tend to be lower paying “compared to predominantly male professional occupations.”14 The problem of this self-selection is improving. Women have more success entering the “white-collar and service occupations than blue-collar categories” previously dominated by men; the issue of women working low-skilled jobs remains.15

For those women who choose to focus on reaching senior level positions, the benefits are far reaching and “pronounced for second-level” management.16 When women are placed in leadership positions at the head of a firm, the wages for all women in that firm tend to rise.17 This is due in part because those women who have reached the top tend to give back to other women. They “pay forward” this success via quality mentoring; simply speaking, women make better mentors for other women than do men.18 This attention of women from the top of the management structure and focus on equal pay helps to lead to “greater parity,” thus helping to reduce the gender pay-gap.19

The larger the company, the larger is the benefit to other women working in the company. The problem is that while women have made progress entering larger companies, many women still tend to migrate to small firm that offer more flexibility; these firms also tend to pay lower wages.20 In smaller firms, the benefits to both the women who work there, as well as improvement to the national gender pay-gap are minimal.

When discussing the issue of a “pay-gap,” what is not clearly understood by most people is that there is a portion of the gap that can be explained by the differences in workers. A remaining portion cannot be explained, and is therefore attributed to discrimination. Back in the 1970s, Oaxaca devised a way to calculate this segmentation in terms of a “discrimination coefficient.”21

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8 Kim, “Policies to End the Gender Wage Gap in the United States,” page 279.
9 Ibid.
10 Ibid, 176.
12 Ibid, 626.
13 Ibid.
14 Blau and Kahn, “Gender Differences in Pay,” pages 76-79.
15 Ibid, 80.
18 Ibid.
19 Ibid, 398.
fewer bonuses than males. A study in China showed discrimination also includes base pay, bonuses, and even other pay (benefits). In almost every study, women are not compensated in the form of fringe benefits at the same level as men.

The literature shows a clear problem, one that has been well documented for decades. While the gender pay-gap has been closing, there is still much progress to be made. This progress can better occur if the full causes of the discrimination are understood. Only then can policies can be enacted to resolve the lingering discrimination, thus closing the gap completely.

**DATA ANALYSIS/METHODOLOGY**

The data source used to examine this research topic is the Monthly Earner Study of the Current Population Survey (CPS). The CPS is conducted by the Bureau of Census, on behalf of the Bureau of Labor Statistics. The data set was selected for the quantity of characteristic variables as well as the large number of collected observations.

The period of the data set covers 1999 to 2013. This time period was selected because it covers a contemporary period that is not well documented, and it includes the variables of union coverage and union membership, characteristics that typically tend to be significant when examining other compensation-related labor economic topics.

A major advantage to the CPS data set is that it is a large representative sample of the U.S. population. While there is bias in any survey, the CPS dataset includes a weighting variable to help counteract a large portion of that bias. To further ensure the least amount of statistically-caused bias is eliminated, this study uses only actual reported income data and excludes all statistically generated data reporting income.

In order to make use of the CPS data for this study, most of the fields first had to be programmatically converted from text notations into a form that...
could be manipulated for statistical analysis. This was accomplished by creating a series of new variables, mostly indicators, allowing the data to be examined.

The problem with any data conversion is that often, in order to transform the variables, difficult choices need to be made. When these choices are made, data can be lost or transformed, thus changing the meaning or introducing biases. To reduce the chances of introducing external bias, reductions or changes of data were kept to a minimum. For instance, the original CPS data set has a variable named “race,” used for tracking racial identifiers of each observation. Unfortunately, over the period of the study, this variable changed definitions three times. During the first period, from 1999 to 2002, there were only 4 possible answers for race. In the period from 2005 to 2011, the number of race choices increased to 21. Finally, the 2012 to 2013 period increased again to 26 possible selections for this one variable. To make the race variable consistent throughout the study, only the most common choices between the periods were used. In this case, the study examines White, Black, American Indian, and Asian as the four original selections. However, to protect the remaining 21 to 26 possible selections within the race variable and retain the information, all the remaining instances of race that did not fall directly into these four common categories were merged into a fifth variable “race other.”

The scope of the observations used in this study were limited to include only workers who were age 18 and above, with no top end age limitation. Additionally, only workers who had earned wages the prior week were included in this study; all unemployed workers, regardless of cause, were excluded. The final data set used to conduct this study contained 112 variables within 1,214,910 individual observations. Of these, the most significant to the study are variables involving income, individual human capital characteristics, and general employment characteristics.

There was some overlap when preparing the earnings section. The hourly variable is a stated wage rate for how an hourly worker’s base pay is calculated, and that hourly calculation is not included for salaried workers. Each observation in the data set shows a weekly wage (if any income was earned), but not all observations include an hourly wage. This creates a potential overlap that should be noted when comparing hourly pay rates and weekly gross income used in this report. However, this impact is considered minimal and no further adjustment was made for the purposes of this study.

The base year used for all real wage calculations, wages adjusted for inflation, is 2013. This allowed for all years in the study to be backwards adjusted to 2013 dollar values. In preparing the data set to calculate the real wages, information was obtained from FRED to determine proper inflation adjustments.²⁹

RESULTS
When examining the results of the data over the entire study period from 1999 to 2013, not taking any differences into account, women across this period earned on average only 71.6% of what their male counterparts earned within the same time period. If the examination were to stop here, on average women are at a 28.4% disadvantage to men when it comes to the idea of equal pay. However, this is not the entire story; despite what politicians and special interest groups might choose to focus on, the fact is the pay-gap between men and women has been decreasing over time. In Table 1, the lowest observed pay-gap in the federal class in 2012 was 14.0%, and the worst case of gender pay discrimination was observed in 1999 at 35.5%.

In looking at changes of pay for instance, once backward adjusted for inflation, in terms of 2013 dollars, in 1999 women on average earned 67% of what men did. Moving forward to 2013, the pay-gap had decreased. As of 2013, women on average, statistically (without accounting for any other mitigating factors) earn a weekly salary of 75% of that of their male counterparts. Over the 14 year study period this is an overall improvement of 8% on average.

²⁹ http://stlouisfed.org
When comparing the gains of women in closing this pay inequality gap, in terms of both nominal dollars and real dollars (adjusted for inflation), the slopes are as expected, nearly identical. However, what is interesting is that on average, the wages of women are less sensitive to inflationary pressures than are those of men. In Figure 5, in the Appendix-Tables and Figures section, female worker’s pay rates have increased at a near steady rate, increasing overall pay with a 10% gain over the period, while in the same period, men’s wages have fluctuated, and in terms of real dollars, have even fallen slightly.

The effect of hourly pay versus overall weekly income of all workers, in both hourly and salaried, women have fared better on average over this same period than men have. Over the last fourteen years, women have averaged an hourly pay that is 86.4% that of men, and in 2013, the average is over 89.4%. When looking at hourly workers, female wages have remained relatively stable, however, the gains in real wage income show a 5% increase over this period. Men’s wages are more susceptible to inflationary pressures than that of women’s. Over this same period, in terms of real dollars, men working hourly jobs have actually seen just over a 5% pay cut, accounting for the remainder of the 8% narrowing of the pay-gap.

In examining the statistical averages of worker classes, there are three major classes of employer: governmental, for-profit companies, and non-profit entities. While analyzing these three classes, all show improvement over the study period, and each shows a different response to the changing payroll environment.

For governmental workers, regardless of whether within federal, state, of local entities, the most telling factor is that for the hourly worker, there is little if any stability when it comes to differences in the pay-gap. In the series of figures below, each shows the pay-gap percentages, while each is trending in a direction to reduce the gender pay-gap, each of the year data points in each governmental segment varies widely from the rest. The governmental sector with the most aggressive slope for the average to lower the pay-gap is within state governments.

All classes show a preference to discriminate against salaried workers; the worst of the offenders are found in for-profit companies. Within for-profit companies over the period of this study, men have enjoyed a wage between 28.7% and 35.5% higher than that of women. While this statistic is discouraging, between both hourly and weekly pay, the decrease in this discriminatory gap has been falling at a uniform rate, showing improvement.

The last of the three classes to be examined in this study is the non-profit arena. These workers, as do their peers in the for-profit companies, see a sharp difference in the level of discrimination between hourly rate workers and total weekly earnings. As with the for-profit companies, the discrimination for the total weekly pay is substantial, ranging over the same period from a low of 22.3% to a high of 30.5%.
well lower for those in for-profit companies. What is most interesting is that for hourly wage workers in non-profit companies, there is little if any discrimination in the results. In fact, in Figure 6 in the Appendix, during four of the years from the period, women actually averaged a higher hourly pay than their male counterparts. This might seem to be an extraordinary finding; yet when examining the structure of non-profits, hourly workers tend to be low-level workers, most earning near minimum wage, so there is little if any room for discriminatory practices.

In comparing averages between workers within union groups and those not covered by union contracts, there is still discrimination. However, the rate of discrimination in the pay rates is slightly lower for union-represented workers than for non-union workers. Again, a separation can be seen between hourly rates and total weekly earnings. As previously observed, there is less discrimination existing for hourly workers, who in 2013 only experienced a 10.2% pay-gap on average as compared to weekly averages that are approximately 12.7%.

CONCLUSION/FURTHER STUDY
The outcome of the first stage of this study is both compelling and clear; there is significant support for the conclusion that women are currently paid less than their male counterparts in most every segment of the workplace. The only segment of the workplace that did not see this discrimination is within the class of non-profit employer’s hourly workers. In this single segment, it would appear that both men and women are equally paid, with women showing a slight advantage in some periods of the study. However, it is worth repeating that this advantage is not significant, as most of the workers are within the minimum wage segment of the hourly scale.

It is also clear that when compared to for-profit companies and to each branch of the government, there is not a single case in which women are treated equally to men. At each point, across all years of the study, women’s pay is substantially below that of their male counterparts. However, the good news is, at least here in the United States, there is continued narrowing of the pay-gap. The pay-gap continues to fall, but is progressing at a slower pace than seen between the 1950s and 1999. It is important to understand that the conclusions
from this first part of the study is limited in scope to a statistical means study. No regression analysis was conducted, so the results are still suspect. Without the aid of regression analysis to hold other variables constant, it is impossible to see what happens to one segment when another changes. This is the reason this study will require a second phase. In the second stage of this study, regression analysis will be applied and the same statistics will be re-examined. The study will use a variety of decomposition tools such as Oaxaca, to tease out the difference between the part of the pay differential that can be explained by other factors, e.g., education, number of children, type of work, region in the country, etc. After decomposing the pay-gap, whatever part of the gap that is not explained, and in the absence of other controls to support the difference, must be attributed to discrimination.

BIBLIOGRAPHY


BIG DATA VS BIG BROTHER: DRAWING THE LINE FOR PERSONALIZATION AND CUSTOMIZATION TO AVOID AN INVASION OF PRIVACY?

BY WANDA INTHAVONG

ABSTRACT
Purpose – The purpose of this paper is to review the privacy issues surrounding Big Data and developing recommendations to aid in resolving these issues.

Design/methodology/approach – This article reviews current literature regarding the subject of Big Data and its implication on privacy.

Findings – Further regulation changes or additions may not be as beneficial as some researchers believe. It is our belief that creating and streamlining one universal regulation that better protects consumer privacy information will gain back consumer confidence.

INTRO/PURPOSE OF THIS STUDY
"Finding the right balance between privacy risks and Big Data rewards may very well be the biggest public policy challenge of our time." (Polenetsky & Tene, 2013)

The Issue of Privacy in the Era of Big Data
Privacy has been a long-standing and growing concern to various stakeholders in society (Smith 2011). In the past, most privacy concerns have been geared toward government control (Lesk 2013) but, at present, it has evolved into information privacy, specifically consumer privacy (Pavolotsky 2014). This is due to the rapid accumulation, constant growth, and storage of Big Data (“Hiding from,” 2014). Issues of consumer privacy have been brought into the public eye due to negative publicity pertaining to corporations utilizing Big Data (Cannon 2002) in questionable ways and data brokers who have collected, housed and distributed significant amounts of data to each other, the government, and advertisers – often without consumer knowledge (Kroft 2014), with the intent to personalize communications, track consumers, and improve the offering and effectiveness of marketing activities. In order to gain a better understanding of the consumer
privacy issue in an era of Big Data, we will briefly discuss the evolution of Big Data and how it has created new privacy concerns.

Big Data is still a fairly new concept that has been defined in multiple ways, creating some confusion pertaining to the term. In this paper, we will look at Big Data as an evolutionary phenomenon. What first began as small individual pieces of data grew into specified databases, which later evolved into databases of personal information to more voluminous amounts of data gained from multiple sources (Birnhack 2013). Many scholars think of Big Data as an evolution of size – from bit to byte to megabyte to terabyte and so on. In 2001 Doug Laney, an industry analyst at Gartner, Inc., argued that Big Data evolved from three basic elements: 1) Volume – amount of data; 2) Velocity – speed of generated and flowing information; and 3) Variety – multiple sources and kinds of data available (McAfee & Brynjolfsson 2012, Nunan 2013, Alam et. al. 2014, George et. al. 2014). Big Data was further defined by the group as being, “high-volume, -velocity and -variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making,” (Sicular 2013). The use of Big Data has been beneficial to organizations, consumers, and the general public. It has been found that the more a company embraces the Big Data movement, the better they are at business performance (McAfee & Brynjolfsson 2012). For instance, in business, Big Data is utilized with the following goals in mind: “cost reduction; time reduction, support in internal business decisions; and developing new offerings,” (Alam et. al. 2014). Marketers apply Big Data to effectively personalize and customize communications and other content for consumers. In many cases this has resulted in fewer communications, with those being sent more relevant messages and offers which create more value for the recipients.

Privacy issues surrounding collection and use of data have existed for many years. As of 2011, many public opinion polls reported privacy as a major concern among consumers. The concerns of consumers are affirmed by a survey conducted in 2007 by The Ponemon Institute, they found 62% of respondents had been notified of personal data breaches with 84% of them expressing increased concerns due to the breach (Smith et. al 2011). With the emergence of the Internet, consumer data collection increased due to data no longer being limited to traditional data collection methods. Issues further resulted from 1) a huge lack of secure data storage in many organizations resulting in multiple data breaches; 2) the use and sharing of data for marketing purposes; 3) the introduction of the USA PATRIOT ACT and the amendment of the Foreign Intelligence Surveillance Act (FISA) after 9/11 (Jaegar et.al. 2003, Smith et. al. 2011, Kemp & Moore 2007, Herther 2014); 4) the Internal Revenue Service (IRS) tax profiling uproar (Chittum 2013, Grensing-Pophal 2014) and 5) the expanded use and distribution of consumer data by database marketers (Pike 2005). Two examples highlight the issue of privacy in an era of Big Data: In 2012, Target received unfavorable attention for their development of an algorithm, which allowed them to identify a pregnant teen before her parents were aware of her condition (Duhigg 2012, Calo 2013, Watson 2014, Herther 2014). This algorithm was developed to analyze buying history, credit card, and other data as a means to better target their newest “holy grail” of customers – new parents. More recent – Google’s U.S. privacy lawsuit alleging the organization co-mingled user data across varied products with the intent to disclose data to marketers and advertisers without consumer knowledge (Reuters 2014). Other cases of information privacy issues include compromised records on thousands of individuals when several data brokers had their computers infiltrated in 2013 (“Data Broker,” 2013). It is no wonder only 5% of consumers are able to trust businesses with their personal data (“State of,” 2013).

In the following section we review Big Data and privacy in more detail. This purpose of this review is to provide a framework into creating a way of distinguishing when Big Data usage infringes on consumer privacy.

LITERATURE REVIEW

I. BIG DATA – Review of the literature

Big Data is all around us - intertwined into our lives in more ways than many care to acknowledge. It is a combination of existing and emerging online data sources (Pavolotsky 2013, “Fact sheet,” 2014). Although the term has only emerged into public eye just recently, it is also a new point along the changing “continuum of Small-Medium-Large-Extra
Large data situations\(^1\), (Birnhack 2014). Big Data can be traced back further to 2000 and earlier but not at such a scale as today (McGeveren 2014). Big Data was first viewed as a potential issue in the early1970’s, when data collection to improve direct marketing effectiveness and efficiency first emerged (Solove 2004). Prior to this, collection was rather difficult due to the difficulty of distinguishing consumers from one another. The government began selling census data at this time— all individual information was still being collected, instead it was typically stored on paper and scattered around the world. There was no way to link or search the data easily (Sloan & Warner 2014).

The Emergence of Big Data

Even though there is no exact definition of “Big Data,” as it varies depending on the discipline in which you apply the term, one thing that can be said is that it has been described as a collection of data retrieved from a variety of sources that serve as a basis for continuous discovery and analysis (Arthur, 2013).

Many disciplines, especially those in the business realm, state “Big Data” as having three basic characteristics better known as the 3 V’s: Volume, Velocity, and Variety – reflecting the growing technological abilities of capturing, accumulating, and managing these large amounts of data (Podesta et. al. 2014, Alam et. al. 2014). Because of these three components, traditional methods of capturing, combining, and analyzing data are now significantly lacking.

Volume: Refers to the “bigness” or size of the datasets (George et. al. 2014) – the immense size of data created (Eggimann & Tamo 2014). It is comprised of both unstructured and multi-structured data (Arthur 2013). To put this into perspective, just think: 2.5 quintillion bytes of data are created daily throughout the world. Of the data accumulated to 2012, approximately 90% has been created in the last two years alone (Dijks). Further, as of 2013 it has been estimated that the amount of information being generated worldwide has grown 9x in the last five years to about 4 zetabytes\(^2\) yielding 2.4 billion Internet users worldwide – that is an 8% growth year over year (Meeker 2013).

Velocity: Rapidness at which data is created, collected, processed, and analyzed. Data is being retrieved in real-time or as close to real-time as possible (McAfee & Brynjolfsson 2012).

Variety: Referring to the depth of data today, data sources are captured from a myriad of sources and formats ranging from text messages, geospatial technologies, social networks posts, sensor reading and more. It is also good to note that many of the more important sources utilized today are still fairly new (Freiwald 2014).

Big Data Sources

Big Data encompasses different types of granular data, with five key sources of high volume data being (George et. al. 2014):

Public Data – typically retrieved and held by governments, their organizations, and local communities. Examples of this data would include census, transportation, energy use, and health care data.

Private Data – held by private organizations, non-profits, and individuals. It consists of individual private information, which cannot be easily accessible on public sources easily. Examples include consumer transaction data, website browsing, mobile phone usage, among numerous others.

Data Exhaust – collected by the original collector, deemed as not useful and unimportant. These bits of information can be recombined and reanalyzed for another purpose. Examples include Internet searches, ambient data generated from mobile phones, or other types of private call center data.

Community Data – extracted from unstructured data, usually textual, that is broken into “dynamic networks that capture social trends”. Once pulled for significance, community data is then used to “infer any patterns in social structure.” Examples include Twitter feeds and product reviews (Kennedy 2008).

Self-Quantification Data – any personal behaviors or actions revealed by an individual. An example would be wristbands or phone applications that monitor movement, running distance, or calories eaten/exhausted.

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\(^1\) This continuum was imagined by Birnhack and refers to how data has evolved from small pieces of data (bytes) to extra large amounts of data (big data).

\(^2\) One zetabyte amounts to 1,000,000,000,000,000,000,000 bytes or units of information. One byte equates to one character of text.
The Promise of Big Data
A more important question on Big Data is what can Big Data do? There are a wide variety of potential uses of Big Data to generate incomparable new knowledge for society by gathering, grouping, and mining data (Wu 2014). All this newly extracted and collected knowledge has come to be known as the “key to power in the information age,” (Solove 2004) and described as being “just like oil” - data will be a “core asset” as stated by IBM CEO Virginia Rometty (Duetscher 2014). Additionally, Hirsch (2014) believes data will become the fundamental resource to power the information economy. With it, comes a promise of a variety of uses touching upon business, academia, government, healthcare and everyday life (Richards & King 2013).

All of these uses allow organizations the ability to save lives, make the economy work better, allow personalization of products and services, fuel new services and business models, help mitigate business risks in real-time, or even saving taxpayer dollars (“Fact sheet,” 2014, Buytendijk & Heiser 2013). It is no wonder that data-driven companies ranked in the top third of their industry “were, on average, 5% more productive and 6% more profitable than their competitors;” (McAfee & Brynjolfsson 2012).

The Issue of Big Data
Although Big Data holds potential for more opportunities in the future, there lies a multitude of privacy related worries. In order to address and resolve these issues, a balance between reaping the rewards of Big Data and stakeholder risk protection is needed (Sloan & Warner 2014). Are there sufficient legal, ethical, and social norms protecting our privacy?

Richards and King (2014) suggest that three paradoxes can be used to help us understand the true nature of the Big Data issue; each touching upon the biggest issue facing Big Data today - privacy:

The Transparency Paradox: Although Big Data collects all sorts of private information ubiquitously, it does it in a way that threatens loss of privacy. This is due to its collection efforts – It occurs invisibly, almost completely cloaked in legal or commercial secrecy. Meaning - there is just no clear understanding of who is collecting the data and what, when and how they really intend on using it.

Identity Paradox: Citizens are afforded the right to create their own identity and have a choice of making that identity public or private (Wagner 2013). But the collection of consumer data from a multitude of sources, such as social media activity, browser history and phone records, have made it extremely difficult to create, separate and keep their identities private.

Power Paradox: Although Big Data has the power to create great change in the world, it also gives this privilege of power to government and intermediary corporate entities. Institutions who utilize these the tools will benefit and become “winners” by having a better picture of the world (Mayer-Schonberger & Cukier 2013) while individuals being mined, analyzed, and sorted become “losers” as Richard and King coined them in 2013 (Podesta et. al 2014).

II. PRIVACY – Review of the literature
Privacy has been widely researched for over 100 years, and although every person understands the concept, no one is able to “articulate what it means” (Solove 2006). The term has been used to represent a number of concentrations, which include: “personal information control; reproductive autonomy, access to places and bodies, secrecy, and personal development,” (Kemp & Moore 2007). Numerous unsuccessful attempts have been made to marry each distinctive perspective of the term, but all that came about were “fragmented concepts, definitions, and relationships” – all of which have inconsistencies and are not empirically validated (Smith et. al 2011). With no clear definition, privacy has come to be a “weaker right” (Charters 2002), resulting in a lack quality individual protection that most other rights are afforded.

In regard to consumer information privacy issues, it is necessary for consumers to have knowledge of the data collection process and their own perceived control on how their private data was being used (Culnan & Bies 2005). As such, this approach affirms that privacy be defined as an individual right – allowing consumers “to be liberal or conservative” in regard to the attainment and handling of personal information, while emphasizing their civil liberties over the preferences of organizations (Rapp et. al. 2015).

Big Data is further evolving the definition of individual privacy (Jerome 2013). In order to gain the benefits promised by Big Data, individuals must
be willing to provide their personal information. As a result, it has made it rather difficult for consumers to properly make an informed decision on what information they would like to keep private. Privacy has now become a “commodity that can be bought or sold” (Jerome 2013); data centers and other organizations are now putting a price tag on our privacy (Lesk 2013). And in today’s economy the monetization or privacy has become “something of a holy grail” (Jerome 2013).

Why is Information Privacy an Issue?
There are numerous reasons why information privacy is a “top of mind” topic for consumers and organizations. Consumers now question the reasoning behind Internet companies and social networks – Google, Twitter, Facebook and others – using data-based profiling (Nunan & Di Domenico 2013, “State of,” 2014). Consumers seem to become aware of privacy when they “lose or lack it,” and they are now realizing that in order to gain access to something, such as Facebook or Twitter access, they must “voluntarily” provide information that is likely to reduce their privacy (van Aaken 2014). Moreover, even with laws in place which allow the expunging of data from their permanent records, there is little chance of any person having their past completely forgotten (Herther 2014). Additionally, consumers are worried about specific privacy issues: 1) transparency and awareness levels when their data is gathered and dispersed; 2) security and protocols currently in place to ensure the protection of information from outside sources; and 3) liability of available remedies when data is improperly utilized or when errors occur in records (Milne & Gordon 1993, Lesk 2013).

Currently, consumers lack an understanding of the collection and control over their private data usage. Huge amounts of consumer data are being sold off continuously. Take for instance Acxiom, the largest mailing list vendor; with revenues in 2013 at $1.13 billion. At the time, they had records for about 500 million people; each record contained an average of 1,500 data points for each person (Lesk 2013). Furthermore, one of their datacenters, measuring 250,000 sq. ft., contained 23,500 servers – allowing Acxiom to handle 12 Petabytes (PB)\(^3\) of data.

Brookman & Hans (2014), consumer and/or organization concerns revolve around these five threat models:

- Data Breach: Considered as one of the most common threats arising from the collection of personal data. This is usually due to poor security measures or aggressive external hacking. The consequences of a breach become more pronounced each day due to ongoing collection and retention of data for future use. Furthermore, the more robust an organization’s data is the more appealing it is to hackers. This can result in consumer information falling into the wrong hands – making consumers quite susceptible to identity theft and financial fraud. To add, this data may even contain embarrassing information a consumer does not wish to share.

- Internal Misuse: Dubbed as “data voyeurism” (Brookman & Hans 2014) – internal misuse occurs as rogue employees within an organization accesses consumer data with the intent to do something malicious.

- Unwanted Secondary Use: The use of consumer data by organizations that appear unfavorable to consumers. Examples include the constant retargeted advertising (or the like), price discrimination and even more unappealing, selling consumer data to a data broker who could, in turn, resell the data or use it to deny credit or employment.

- Government Access: Seen by many to be the most significant threat. This information is not all gained by the government alone, they are now gaining access to data obtained by commercial stores even without probable cause. To add, it is fairly difficult for consumers to find ways in guarding their information from government access.

- Chilling effects: With all the above combined, many consumers have grown tired of being “watched.” It is because of this threat of surveillance that consumers are now discouraged from adopting new technologies and speaking and/or acting freely. The constant observation of consumers is now a coercive threat due to the influx of Big Data.

In addition to the above, there is a communitarian claims which numerous scholars believe that “privacy is no longer relevant in the age of transparency” – due to the growth of information, technology, and ubiquitous computing (Rosen 2000, Kemp & Moore 2007).

\(^3\) PB= Petabyte which is equal to 10^15 or 1,000,000,000,000,000 Bytes
Laws Relating to Information Privacy and Big Data

Based on Collection -
- The Children’s Online Privacy Protection Act (COPPA) – Regulates information acquisition of individuals under 13 years of age for marketing purposes.
  *Issue(s):* These mechanisms are limited for entities serving outside the specified parameters; data brokers are not covered. Also, those entities limited develop creative ways to transfer the needed information to third parties and Big Data processors – leaving the data free of legal constraints (Freiwald 2014).

- Code of Fair Information Practice Principles (FIPPs or FIPs) – helps to ensure all federal government and agencies adhere to certain guidelines regarding security and communication. It addresses individual rights, how information is to be controlled, and the proper way to collect, use and store, and disclose information (Pavolotsky 2014).

- Electronic Communications Privacy Act (ECPA) – Enforces procedural protections before entities utilize electronic devices to gather information or compel the disclosure of communication information from various service providers.
  *Issue:* There is no limit on purchasing data in bulk from commercial vendors or gathering it in fusion centers. Both enable the analysis of Big Data for “preventative law enforcement” (Freiwald 2014).


- USA PATRIOT ACT – used to help keep America safe by enhancing tools law enforcement officials use to thwart terrorist attacks (Herther 2014). Requires information to only be collected when there is proof of its relevance and as a protective measure against international terrorism or “clandestine intelligence activities” (Freiwald 2014).

Based on Identification:
- COPPA – Under identification regulations it is also required that website operators comply with demands from parents to remove data regarding their children from databases (Freiwald 2014).

- Foreign Intelligence Surveillance Act (FISA) – intention is to discard wrongly intercepted communications of U.S. individuals once no relevance to foreign intelligence has been found.
  *Issue:* If the data has been sold or copied to other entities prior to the discard at the original entity then it may become merged into a master database from another or even forwarded to the FBI for any law enforcement purpose – making the deletion no good as all the information has already been sent elsewhere (Freiwald 2014).

Based on Other Regulations:
- Consumer Privacy Bill of Rights – Gives consumers these clear protections: 1) Individual control – right to control what data a company can collect and how they will use it; 2) Transparency – consumers should easily understand a company’s privacy and security practices in regard to their information; 3) Respect for content - consumers expect organizations to disclose data in the way they intend; 4) Security – encourages companies to properly secure and handle consumer data responsibly; 5) Access and Accuracy – ability to access and correct collected information; 6) Focused Collection – limits what companies can collect; and 7) Accountability of companies holding their information.

- Fair Credit Reporting Act – promotes “accuracy, fairness, and privacy protection” of information collected by consumer reporting agencies (Podesta et. al. 2014).

- Gramm-Leach-Bliley Act; – limits distribution of certain information to only those with specified consent, such as SSNs and related personal info (Pike 2005, Britt 2005)
• Health Insurance Portability and Accountability Act (HIPAA) – addresses how individual health information held by “covered entities” can be used and disclosed; allows for the individual to understand and control their health information (Podesta et. al. 2014).

Unlike the United States, Europe has embraced the need for data protection for its consumers (Eggimann & Tamo 2014). The rights that protect an individuals’ private and family life came about by the European Convention for Human Rights (ECHR) and the Charter for Fundamental Rights (EUCFR).

Previous Recommendations for the Big Data Privacy Issue
There have been many recommendations on how the Big Data privacy issue should be addressed. Below are a few of the more recent ones, which we believe draw some significance and require further research:

• Brookman & Hans (2014) suggests that consumers should have a privacy interest in the commercial collection of their data instead of trusting entirely in use limitations.

• Colonna (2014) suggests that more data does not necessarily create more problems if all individuals, not just governments and organizations, are able to benefit for the analyses of Big Data. States that the current theory of “data protection” should shift more towards “data empowerment” in order to reveal a greater connection with the existing “technological reality”.

• In the article, “Hiding From Big Data,” the author suggests the creation of a big market for privacy products. This is because he believes that companies and consumers alike will be reluctant to pay for greater privacy they will take extra care into what they do online.

• Tene & Polonetsky (2012) calls for a model to be developed where benefits of data for organizations are balanced alongside consumer privacy rights, thus aiding in data collection justification based on organizational interest or only needing consumer consent. This will also help determine if the consent of information collection and use should be designed as “opt-in or opt-out.”

• The working group assigned by the President to address the privacy issues surrounding Big Data suggested the following (“Fact Sheet,” 2014): 1) The Consumer Privacy Bill of Rights must advance – consumers deserve clear, comprehensible, reasonable standards on how their personal information is used; 2) National Data Breach Legislation should be passed – Providing one single national standard, that coincides with the White House Administration’s 2011 Cybersecurity legislative proposal; 3) Privacy protections should also extend to non-U.S. persons; 4) Data collected on students must be used only for educational purposes; 5) Technical expertise must be expanded – to stop discrimination on protected classes; and 6) The Electronic Communications Privacy Act must be amended - to ensure online, digital content protection is consistent with the physical world.

• Thierer (2014) argues that privacy must be looked at from the “bottom up,” educating consumers, as well as children, on ways to behave and respond in a variety of data driven situations. He further states that regulatory control will become harder to justify when the costs begin to exceed its benefits.

CONCLUSION
As we have found, Big Data has grown and will continue to grow exponentially year over year, with consumer privacy shadowing its every move. While although, we can find significant potential in generating value for organizations, consumers and the public, it is still at the cost of privacy. Many scholars and government entities have suggested ways or designed regulations that would create balance between the two as a way to appease both parties involved. But many of these regulations today have numerous challenges or are too broad allowing for entities to find ways around them. As for the many of the recommendations, we see notable discrepancies in them or find they require further primary research to substantiate them. Also, with privacy not clearly defined, it is hard to confirm what is or is not a violation.

RECOMMENDATION AND FURTHER STUDY
It is our recommendation that in order to have a better handle on consumer information we need to look into streamlining all privacy efforts. These regulations should be extremely well defined and must distinctly state that any collection of personal data that has the potential of causing harm to its owner is to be omitted from data collection. This would include financial, health, sexual orientation,
race, etc. Above that, any individuals under the 18 years of age should not be included in data collection.

Also, for further study, scholars should continue to research ways on how to better handle personal data already in possession of the government and other entities. Although we currently have laws in place, they are much lacking in protecting their intended consumers.

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MODULATORY EFFECTS OF GABA(B) RECEPTOR FACILITATION IN A MODEL OF CHRONIC INFLAMMATIONS

BY MICHAEL A. LANGHARDT

ABSTRACT

Inflammation within the brain (neuroinflammation) has been associated with a number of neurodegenerative diseases, including Alzheimer’s disease (AD). Within the brain, inflammation is defined broadly as prolonged activation of the brain’s immune cells, known as glial cells. Excessive activation of glial cells within the brains of AD patients is a hallmark of the disease, however the mechanism by which this contributes to disease pathology is relatively unclear. Recently, studies have shown that glial cells, known as astrocytes, are able to synthesize and release the inhibitory neurotransmitter GABA. Further, microglia cells, the primary immunocompetent cells of the brain, have been shown to be GABAceptive cells, which express GABA(B) type receptors. Early characterizations of AD first described alterations in astrocyte location and activation in the disease and interestingly, differences in the total abundance of GABA within the brains of AD patients have recently been reported. Combined, these data provide support for the hypothesis that astrocytes regulate microglia activity through the release of GABA acting at GABA(B) type receptors. The activation of GABA(B) on microglia may serve to reduce the activation status of these microglia, thereby reducing the number of pro-inflammatory cytokines present within the brain. In the present study, we examined the effects of the GABA(B) agonist baclofen on chronic inflammation in rodents administered lipopolysaccharide (LPS). LPS is a bacterial endotoxin derived from the cell wall of gram-negative bacteria and is capable of mounting an immune response through the activation of toll-like receptor 4 (TLR4). Our data indicate that the administration of baclofen initially attenuated the pyrogenic effects of LPS administration, though this effect was lost after two weeks of injections. Furthermore, the administration of baclofen rescued deficits in spatial learning and memory seen in animals chronically administered LPS. Together, these data provide evidence that the modulation of GABA(B) receptor function altered the immune response evoked by activation of TLR4. These data also provide support for a potential role of GABA(B) in

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modulating aberrant immune activity seen in AD populations.

**INTRODUCTION**

For many decades, researchers considered the brain to be an immunologically privileged organ, owing to the presence of the blood brain barrier (BBB) (Muldoon, 2013). The BBB is a thin layer of tight junction endothelial cells, which limits the entry of immune and immune effector cells into the brain. The inability of a large number of immune cells to enter the brain led many to conclude that the brain was not capable of mounting a classical immune response. More recently however, studies have shown the ability of a class of glial cells, known as microglia, to serve the role of the immune system within the brain. These studies demonstrate that microglia express classical immune markers such as B- and T-lymphocyte markers, and are capable of presenting antigens in the context of major histocompatibility complex (MHC) class molecules, in a manner similar to other antigen presenting cells (APCs) (Streit, 2004). The ability of microglia to serve as APCs has given them the title of the “macrophages of the brain.” Further, microglia are able to secrete small signaling molecules known as cytokines, which may act in both a pro- and anti-inflammatory manner, a characteristic vital to immune accessory cells. The combination of these data has provided substantial support for the notion of microglia as the primary immunocompetent cells of the central nervous system.

Recent decades have seen a large increase in the number of studies documenting the role of neuroinflammation in neurodegenerative diseases such as Alzheimer’s disease (AD). AD is a severely debilitating neurodegenerative disease, characterized by progressive memory decline and an overall loss in cognitive function (Sabbagh et al., 2015). The pathological hallmarks of the disease include deposits of amyloid plaques and neurofibrillary tangles consisting of hyperphosphorylated tau protein (Jo, 2014). While the pathological hallmarks of the disease have been extensively studied, the mechanism by which they contribute to disease pathology is still largely unknown. As AD is classified as a neurodegenerative disease with declining prognosis over time, mechanistic studies of the disease have largely focused on progressive neuronal cell loss. However, as mounting evidence shows alterations in glial signaling within the brains of AD patients, there exists a great need to examine a possible role for glia in the pathology of the disease (Solito et al., 2004).

Within the brains of AD patients, glial cells undergo prominent changes in morphology and gene expression (Jo et al., 2014). Indeed, some of the earliest characterizations of AD found a significant increase in the number of reactive astrocytes surrounding amyloid plaques within the brains of AD patients compared to healthy controls. This increase in the number of reactive astrocytes would be expected to accompany changes in overall gliotransmitter release, which may in turn alter the function of surrounding microglia cells (Streit, 2004). Recent data have suggested a primary mechanism by which astrocytes may regulate microglia activation is through the release of the inhibitory neurotransmitter GABA (Charles et al., 2003). These data have shown the ability of astrocytes to synthesize and release the inhibitory neurotransmitter GABA (Lee et al., 2011) and have shown that microglia express GABA(B) type receptors (Kuhn et al., 2004). The activation of GABA(B) receptors on microglia would be expected to diminish the overall activation status of these microglia, thereby reducing the number of pro-inflammatory cytokines released within the brain. Combined with data showing alterations in the total abundance of GABA within the brains of AD patients (Lanctot et al., 2004), these data suggest a potential role for GABA in modulating aberrant immune activity seen in the disease.

In this study, we examine the extent to which the GABA(B) receptor agonist baclofen modulates a chronic inflammatory response in rodents, evoked through the administration of lipopolysaccharide (LPS). LPS is capable of mounting an immune response through the activation of toll-like receptor 4, and in rodents has been shown to induce deficits in learning and memory in a step-through passive avoidance task (Jo et al., 2014). Here, we examine the extent to which LPS induces deficits in learning and memory in the Morris water task and examine the effects of baclofen on performance. Further, as neuroinflammation is a significant risk factor in AD and recent AD literature has identified oligomeric Aβ protein species to play a role in the pathology of the disease, we examined the overall abundance of Aβ oligomers in the brains of these animals using western blotting. Combined, these data constitute a novel investigation into the effects of GABA(B)
receptor facilitation in chronic neuroinflammation and identify a role for the GABA(B) receptor in modulating aberrant immune activity seen in AD.

METHODS

Subjects

30 male Sprague Dawley rodents (n=30) were used in this experiment. Subjects were divided into three groups (n=10/group) and randomly assigned to one of three treatment schedules: Saline-Saline (control), LPS-Saline (LPS), or LPS-Baclofen (LPS-Bac). All animals were individually housed in a standard animal facility with a 12-12 hour light dark cycle with food and water available ad libitum throughout the course of the experiment. All procedures were performed in accordance with the institutional Animal Care and Use Committee and NIH guidelines.

Drug Administration

As part of a larger experiment, stereotaxic surgeries were performed on all animals under aseptic conditions and ketamine/dexmedetomidine anesthesia (Kinney et al., 2003). 8mL of artificial cerebrospinal fluid (ACSF) was slowly administered into each lateral ventricle using the stereotaxic coordinates 0.7mm posterior, 1.4mm lateral to Bregma, and 3.5 mm ventral to the surface of the skull. Following a recovery period of one week after surgeries, animals received intraperitoneal (i.p) injections of LPS (0.5mg/mL/kg) or saline (1mL/kg) twice a week for seven weeks for a total of 14 injections. Four hours following LPS or Saline injections, animals received i.p. injections of baclofen (1mg/mL/kg) or saline (1mL/kg) resulting in the three treatment groups: Saline-Saline (control), LPS-Saline (LPS), and LPS-Baclofen (LPS-Bac).

Temperatures

To ensure an immune response was evoked by the administration of LPS, rectal temperatures were tracked prior to drug administration and at 1, 2, and 3-day intervals post injection throughout the course of the experiment. Following the last injection, animals were given three weeks for temperatures to return to baseline prior to behavioral testing.

Morris Water Task

The Morris water task was conducted in a white circular tank, 1.8 m in diameter, 75 cm in height, and 4.7 mm in thickness. Each day the tank was filled with tap water approximately 48 cm deep and maintained at a temperature of 25° C. To mask the hidden platform, each morning the water was made opaque with the addition of white non-toxic paint. For each subject, a 10cm x 10cm square platform was placed in the center of one of the four quadrants of the tank, 1.5 cm below the water. At the start of each trial, rats were placed into the maze and given sixty seconds to find the hidden platform located below the surface of the water. If after sixty seconds the animal was unsuccessful in locating the hidden platform, a trained experimenter guided the animal to the hidden platform. Once reaching the platform, animals were given twenty seconds to orient themselves to the distal spatial cues. Each animal performed four trials for each day of experimental testing. Twenty-four hours after the control group reached an average latency of ten seconds, a single probe trial was conducted in which the platform was removed from the maze and selective search behavior was recorded for each animal. Following the probe trial, a single day of visible training in which the hidden platform was replaced with a visible platform was conducted in order to detect any visual or motor deficits. All trials were recorded using a video tracking system (Smart, San Diego Instruments, San Diego, CA) recorded from a Sony Handycam camera connected to a Cobalt Instruments computer. For each trial, latency, path length, swim speed, and quadrant location was recorded. During the probe trial, the amount of time the animal spent in each quadrant, as well as the number of times an animal’s path crossed over the previous platform location (annulus crossings) was also recorded (Sabbagh et al., 2013).

Western Blotting

Half of the animals from each group run in the Morris water task were randomly selected for dissection and hippocampal tissue was prepared for western blotting (Sabbagh et al., 2013). Hippocampal tissue dissected from animals was homogenized using RIPA lysis buffer and supernatants were collected following centrifugation at 15,000 g for 15 minutes. The protein concentration of the supernatant was determined using a bicinchoninic acid assay. For each sample, 20 micrograms of protein was then loaded in 10% SDS-PAGE gels and proteins were separated by molecular weight through electrophoresis. Proteins were then transferred to nitrocellulose membranes and blocked in a solution of 5% milk to prevent non-specific antibody binding.
Following blocking, membranes were incubated overnight in primary antibody (rabbit β-actin, 1:20000, ProteinTech) at 4°C. Following overnight incubation, membranes were washed and placed into secondary antibody solution (IR dye anti-rabbit 800, 1:5000, Li-Cor; IR dye anti-mouse 680, 1:10000, LiCor) for 2 hours. Membranes were imaged using the Odyssey CLx Infrared Imaging System and band intensity was obtained for each target of interest. Each sample was run in duplicate with β-actin to normalize protein levels.

**RESULTS**

**Temperatures**

Prior to the first injection of LPS, no differences were seen in temperatures between control, LPS, and LPS-Bac animals (F1,27=0.157, p>0.05; ANOVA). Following the first administration of LPS, rectal temperatures were significantly elevated in LPS animals on days 1 and 2 post-injection compared to controls (Tukey post-hoc control vs. LPS, p < 0.05) but returned to baseline on post-injection day 3 (Tukey post-hoc, p>0.05). Temperatures were not significantly elevated in LPS-Bac animals on post injections day 1, 2, or 3, however, suggesting an anti-pyrogenic effect of the baclofen treatment (Figure 1) (Tukey post-hoc, p>0.05). Prior to the last injection of LPS (injection #14), baseline temperatures were elevated in LPS and LPS-Bac treatment groups, indicating chronic inflammation in these animals (F1,27=4.69, p < 0.05; ANOVA). Following the last injection of LPS, temperatures were significantly elevated in both LPS and LPS-Bac treatment groups at post injection days 1 and 2 (Tukey post-hoc control vs. LPS; control vs. LPS-bac, p < 0.05), but returned to baseline in LPS-Bac animals on post injection day 3 (Tukey post-hoc, p<0.05) (Figure 2). Temperatures were significantly elevated in LPS animals compared to controls on post injection day 3 (Tukey post-hoc control vs. LPS, p<0.05).

**Morris Water Maze**

During hidden training, the latencies of LPS animals did not decrease across days comparable to controls, suggesting a spatial learning deficit in these animals (F1,27=62.12, p<0.05). No differences were seen between the latencies of LPS-Bac and control animals however (Tukey post-hoc control vs. LPS-bac, p > 0.05); suggesting that treatment with baclofen rescued spatial learning and memory deficits evoked by chronic administration of LPS (Figure 3). No differences were seen in animal’s latencies between all treatment groups in the visible trial (F1,27=1.96, p > 0.05), suggesting no motoric or visual deficits in these animals (Figure 3). In addition, no differences were seen in the mean swim speed of animals between all treatment groups, further suggesting that no deficits in motor activity were responsible for the observed effects of treatment on performance (F1,27=.934, p > 0.05). During the probe trial, all three treatment groups spent significantly more time in the target quadrant, suggesting selective search behavior in these animals (F1,27=28.6, p<0.05). However, when examining annulus crossings in the probe trial (the number of times the animal crosses over the location where the platform was previously), only control animals show a significant increase (F1,27=4.425, p<0.05) (Figure 4).
Both LPS and LPS-Bac animals showed a significant increase (F1,27=4.331, p<.05) in the abundance of hippocampal total Aβ oligomer protein levels compared to controls (Figure 5). 

**Figure 3.** Average latency(cm/s) (± SEM) in the Morris water task across days. *

*Significant difference (p<.05) compared to controls.

**Figure 4.** Average number of annulus crossing (±SEM) in the probe trial of the Morris water task. *

*Significant difference (p<0.05) compared to controls.

**Figure 5.** Western blot results. Proportion of Aβ oligomers to actin density compared to controls. *=Significant difference (p<.05) compared to controls (A). Representative blot of total Aβ oligomers (B).

**DISCUSSION**

In this study, we demonstrate the ability of the GABA(B) agonist baclofen to modulate the pyrogenic response evoked by the administration of LPS in rodents. Following a single administration of LPS, temperatures were significantly elevated in animals compared to controls before returning to baseline at three days post-injection. Animals administered baclofen at four hours following LPS injections however, demonstrated a reduced fever response on post-injection day 2, suggesting an anti-pyrogenic effect of baclofen treatment. Over the course of the experiment, the ability of baclofen to reduce the fever response evoked by LPS was reduced however; following the last LPS injection (injection #14) a significant difference between LPS and LPS-Bac animals was still seen on post-injection day 3. Combined, these provide novel evidence for the role of GABA(B) in modulating the pyrogenic effects of LPS in rodents. As a proposed mechanism for modulating inflammation within the brain is through the action of GABA at GABA(B) type receptors, these data support the hypothesis that GABA(B) plays a role in modulating chronic inflammation. Further, these data are consistent with previous reports, which demonstrate the ability of baclofen to modulate cytokine release in LPS treated murine pituicytes (Kjeldsen et al., 2002).

Our data further show that chronic inflammation evoked through the administration of LPS induces deficits in learning and memory in the Morris water task. During hidden training, the latencies of LPS animals did not decrease across days comparable to controls, suggesting a spatial learning deficit in these animals. The latencies of LPS-Bac animals decreased across days comparable to controls in the task however, suggesting that treatment with baclofen rescued the learning and memory deficits evoked by chronic treatment with LPS. These data provide novel evidence for the role of GABA(B) in rescuing behavioral deficits induced by chronic inflammation. In addition, the ability of baclofen to alter the behavioral effects of LPS administration
further suggests a role for GABA(B) in modulating chronic neuroinflammation.

Recent lines of evidence have pointed to the progressive accumulation of Aβ oligomers within the brains of AD patients to play a key role in the pathology of the disease (Kuhn et al., 2004). These Aβ oligomers are separate from the larger amyloid plaques associated with the disease and have served as a way to resolve the lack of correlation between Aβ plaques and the severity of cognitive impairment. Accumulating evidence has suggested that soluble Aβ oligomers are indeed the proximate effectors of synapse loss seen in the disease (Sabbagh et al., 2015). As neuroinflammation has been identified as a key risk factor in AD, we examined the effects of chronic inflammation on total protein levels of Aβ oligomers within the hippocampus of animals in this study and further examined the effects of baclofen on Aβ oligomeric protein levels using western blotting. Our data show that chronic administration of LPS induces a significant increase in the protein levels of total Aβ oligomers within the brains of animals administered LPS. This effect was observed in both LPS and LPS-Bac treatment groups, suggesting that baclofen administration did not alter Aβ oligomeric protein levels. While our results do not show a significant treatment effect for baclofen, the ability of chronic administration of LPS to induce changes in total Aβ oligomeric protein levels is interesting, and may have relevance to immunopathology in AD.

Combined, the data in this report provide substantial evidence for a role of the GABA(B) receptor in modulating chronic inflammation. Further support will come from future studies, which will examine the overall abundance of cytokines within the plasma of animals in this study. The ability of baclofen to alter the concentration of cytokines present within plasma would provide direct evidence that the facilitation of GABA(B) alters the immune response in these animals. In addition, future studies will utilize RT-PCR to examine overall levels of cytokine mRNA, which will demonstrate the ability of baclofen to modulate the regulation of inflammation and further define a role for the metabotropic GABA(B) receptor in modulating aberrant immune activity seen in neurodegenerative diseases such as AD.

REFERENCES


The current study examined the quality of peer relationships among children with selective mutism. Previous research suggests that children who are selectively mute have difficulty making friends and have poor outcomes in treatment. Participants were derived from the UNLV Child School Refusal and Anxiety Disorders Clinic. An initial assessment was conducted by the Clinic therapist. The study utilized a demographic form, the Child Behavior Checklist, and the Anxiety Disorders Interview Schedule—Parent Version. The current study found that children who are selectively mute ranged in the quality of friendships, and this knowledge may be used to help treatment outcome.
Uhde, 1995; Dummit et al., 1997; Steinhausen \& Juzi, 1996). The child may speak to parents at home and display fewer symptoms than at school (Edison et al., 2011; Schill, Kratochwill, \& Gardner, 1996).

Mute behaviors can adversely affect social functioning and peer interactions (Sharkey \& McNicholas, 2008). Positive peer relationships may play a vital role in the treatment of selective mutism. A child with selective mutism, who speaks to one or two peers, may be encouraged by those peers to speak to other people. Current literature is not sufficient on peer relationships in clinical samples. Therefore, the purpose of the current study is to examine the quality of peer relationships among children with selective mutism and explore the implications of positive peer relationships for effective treatment. The following section will briefly review anxious and oppositional symptoms in children with selective mutism and discuss their impact on peer relationships.

Anxiety and Opposition in Selective Mutism

Children with selective mutism often have a comorbid diagnosis of social anxiety disorder (Blum et al., 1998; Vecchio \& Kearney, 2005). These children, therefore, may have difficulty making friends. Children with selective mutism often experience difficulties with social engagement and are behaviorally inhibited (Asendorf, 1993; Crozier, 1999; Kristensen \& Torgersen, 2002). Children with behavioral inhibition may become quiet and withdraw in anxiety-inducing situations (Kagan, Reznick, \& Snidman, 1987). Mutism may be a specific form of withdrawal and allows the child to avoid verbal interaction (Ford, Sladeczek, Carlson, \& Kratochwill, 1998). A child with selective mutism may prefer being alone because speaking around other children may be too anxiety-provoking. Additionally, peers may not approach an anxious child with selective mutism because they may seem disinterested in play.

Furthermore, children with selective mutism exhibit lower social competence than typically developing children (Cunningham et al., 2004; Cunningham, McHolm, \& Boyle, 2006). Mutism often restricts involvement with other peers, and teasing by peers may occur (American Psychiatric Association, 2000; Giddan, Ross, Sechler, \& Becker, 1997). Children with selective mutism have been reported to score significantly higher than population norms on the Child Behavior Checklist social problems scale (Achenbach, 1991; Achenbach \& Rescorla, 2001; Steinhausen \& Juzi, 1996). Risk for long-term problems with peer relationships and social adjustment may occur (Kolvin \& Fundudis, 1981).

Defiant and oppositional characteristics also co-occur with selective mutism. Children with selective mutism have been reported as aggressive, disobedient, sulky, stubborn, negative, manipulative, suspicious, controlling, oppositional, and demanding (APA, 2013; Andersson \& Thomsen, 1998; Brown \& Lloyd, 1975; Hesselman, 1983; Kolvin \& Fundudis, 1981; Kratochwill, 1981; Krohn, Weckstein, \& Wright, 1992; Pustrom \& Speers, 1964; Wergeland, 1979). Defiant and oppositional behaviors occur both at school and home for children with selective mutism.

Defiant and oppositional behavior have been reported at home and school for some children with selective mutism (Kolvin \& Fundudis, 1981). Sulky behavior has been reported with strangers and aggressive behavior at home. These children reportedly manipulated their environment to get their way and were described as having a "will of iron" (Rosenberg \& Lindblad, 1978; Wright, 1968). Defiant behaviors may also occur at school. Defiant symptoms may be reported more often by teachers than by parents (Cunningham, et al., 2006). Oppositional behavior may be reported more often in classrooms because this is where speaking is less likely to occur. Oppositional features likely affect the quality of peer relationships among children with selective mutism. The following section reviews prognosis for children with selective mutism.

Prognosis

Selective mutism is generally viewed as a persistent disorder with a poor outcome (Kolvin \& Fundudis, 1981; Remschmidt, Poller, Herpertz-Dahlmann, Hennighausen, \& Gutenbrunner, 2001; Steinhausen, Wächter, Laimböck, \& Metzke, 2006). Residual effects may be reported for adults diagnosed with selective mutism as children. Residual social phobia, poorer speaking behaviors and other anxiety disorders may be seen in adults (APA, 2013; Steinhausen \& Juzi, 1996). Deficits in social communication can result in social withdrawal and economic impairments, including higher rates of unemployment (Remschmidt et al., 2001).

Complete remission has been reported at 59-100% in the Scandinavian, Anglo-Saxon, and German literature (Kurth \& Schweigert, 1972; Remschmidt et
Researchers conducting a 12-year longitudinal study found that 61% continued to struggle with emotional difficulties and communication (Remschmidt et al., 2001). Individuals with a former diagnosis of selective mutism described themselves as less academically motivated, less independent, and less confident than a reference group (Remschmidt et al., 2001). Steinhausen and colleagues (2006) reported that 18% had slight improvement in mutism symptoms, whereas the rest had noticeable increase in speech. A complete remission rate of 58% was reported. However, psychopathology was reported in 57.6% of cases at follow-up. Effective treatment for selective mutism is vital given the often poor prognosis. The following section briefly overviews behavioral therapy as a treatment for selective mutism.

**Behavioral therapy**

Behavioral techniques are an essential component of intervention for selective mutism. Behavioral strategies aim to boost verbalizations, reduce anxiety, and reduce inappropriate attention seeking or oppositional behaviors (Cohan, Chavira, & Stein, 2006). Behavioral techniques utilize systematic desensitization, contingency management, verbal praise, video feed-forward, positive reinforcement, stimulus fading, shaping, unveiling a desired reward, self-modeling, and response initiation (Blum et al., 1998; Cohan, Price, & Stein, 2006; Kehle, Madaus, Baratta, & Bray, 1998; Krysanski, 2003). The goal of behavioral therapies is to remove reinforcement for mute behavior and reward verbal behavior (Krysanski, 2003).

Systematic desensitization involves learning to manage and overcome progressively more anxiety-provoking situations (Hung, Spencer, & Dronamraju, 2012). This type of therapy may be particularly effective for a child with selective mutism and may utilize peer interactions. Systematic desensitization may begin with a task meant to produce little anxiety for a child with selective mutism. A child may be asked to speak a word in front of a peer in which they are comfortable talking. The child may then be gradually exposed to situations that are increasingly anxiety-provoking and require larger speech demands. More specifically, a child may be asked to gradually speak in front of a greater number of peers. Comfortable peers may offer support and encouragement to the child if they are feeling anxious or overwhelmed. An eventual treatment goal for a child with selective mutism may involve speaking comfortably with the child’s teacher and peers in the classroom.

**PURPOSE OF THE STUDY AND HYPOTHESES**

The purpose of the current study is to examine the quality of peer relationships among children with selective mutism. The finding of positive peer interactions has implications for effective treatment. Specifically, peers that the child feels comfortable interacting with could aid in generalization of speech to other people and environments.

**Hypotheses**

Hypothesis 1 is that most children with selective mutism will be reported by their parents as having either zero or one friend. Children with selective mutism often do not speak in the classroom, and therefore, developing friendships may be difficult.

Hypothesis 2 is that children with selective mutism will be reported by their parents as displaying a range of anxious and oppositional behaviors. Specifically, children are hypothesized to not be liked by other children, be cruel or mean to others, get in many fights, physically attack people, be teased a lot, and be seen as too shy or timid, and withdrawn. These behaviors are expected to vary across children, and are hypothesized to hinder peer relationships.

Hypothesis 3 is that children with selective mutism will have trouble making friends, keeping friends and fear joining conversations, as reported by their parents.

**METHODOLOGY**

**Participants**

Participants (n=57) included youth with selective mutism assessed at the UNLV Child School Refusal and Anxiety Disorders Clinic aged 3-11 years. Participants were 59.6% female (n=34) and 40.4% male (n=23). Youth were European American (45.6%), Hispanic (21.1%), multiracial/biracial (12.3%), Asian (10.5%), unreported or other (8.8) and African American (1.8%). Yearly family income was 0- $20,000 (1.7%), $21,000- $40,000 (22.4%), $41,000- $60,000 (22.4%), $61,000- $80,000 (8.6%), $81,000- $100,000 (6.9%), $100,000 or more (17.2), or not reported (20.7%). Parents were reported as married (62.1%), divorced (17.2%), separated (5.4%), or did not report their marital status (17.2%). Families had 1 additional child (58.6%), 2 additional children (26.5%), 3 additional children (8.7%) or 4 or more additional children (5.5%).
Measures
Demographic Form. Parents completed a demographic form to assess for child’s gender, child’s ethnicity, child’s grade and age, educational information for father and mother, current marital status of the child’s parents, family income, and gender and age of child’s siblings.

Child Behavior Checklist (CBCL; Achenbach, & Rescorla, 2001). The CBCL is a 118-item rating scale used to measure externalizing and internalizing problems in children and adolescents aged 6-18 years. A form for children as young as age 4 years is also available. Both of these measures were used. A 3-point Likert-type scale from “0” (not true) to “2” (very true or often true) is used by parents/guardians to rate their child’s behavior. The CBCL contains several narrow-band scales: anxious/depressed, withdrawn/depressed, aggressive behavior, social problems, thought problems, somatic complaints, attention problems, and rule-breaking behavior. Overall scores for Total Problems, Internalizing problems, Externalizing problems, and DSM-oriented scales are also provided. Items on the CBCL that capture peer relationships and peer interactions were used in the current study.

Anxiety Disorders Interview Schedule for DSM-IV--Parent and Child Versions (ADIS-C/P; Silverman and Albano, 1996). The ADIS-C/P is a diagnostic semi-structured interview that assesses symptom frequency, severity and duration of anxiety disorders in children. This study utilized only the parent version (ADIS-P). A parent-rated impairment level on a 9-point Likert-type scale (0-8) is included in the parent version. A score of 4 or greater indicates a clinically significant problem. The ADIS-C/P has good test-retest reliability (0.42-1.0, Silverman & Albano, 1996) and excellent interrater reliability (0.65-1.0). The measure follows DSM-IV guidelines for the major childhood disorders and has shown good construct validity (Langley, Bergman, & Piacentini, 2002; Tracey, Chorpita, Douban, & Barlow, 1997). The interpersonal relationships section of the ADIS-P was included in the current study.

PROCEDURE
Participant data was obtained from the UNLV Child School Refusal and Anxiety Disorders Clinic. Data from families entering treatment in 2013-2014 and from past clients was included. Youth presenting to the Clinic are referred by counselors or school staff from Las Vegas and surrounding communities or are self-referred. The Clinic is a specialized setting to address anxiety disorders and school refusal behavior. Clinic therapists are clinical psychology doctoral students.

Initial assessments for youth and their families were conducted by the therapist. An initial assessment includes behavioral observations, parent behavioral measures, parent and youth structured interviews, and youth self-report measures. The study utilized the demographic form, Child Behavior Checklist, and Anxiety Disorders Interview Schedule—Parent Version (ADIS-P). Youth assent and parent consent was also secured.

DATA ANALYSES
A descriptive analysis was utilized via SPSS 21 to examine items pertaining to peer relationships on the Child Behavior Checklist (CBCL) and interpersonal relationships on the Anxiety Disorders Interview Schedule—Parent Version (ADIS-P). Results represent the number of parents endorsing that item for their child.

RESULTS
Hypothesis 1
The first hypothesis was that children with selective mutism will be reported by their parents as having either zero or one friend. Children with selective mutism were found to have a range of close friends. Results are in Table 1.

Table 1.

<table>
<thead>
<tr>
<th>Number of Close Friends</th>
<th>None</th>
<th>One</th>
<th>Two or Three</th>
<th>Four or More</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
<td>13</td>
<td>19</td>
<td>3</td>
</tr>
</tbody>
</table>

Hypothesis 2
The second hypothesis was that children with selective mutism will be reported by their parents as not being liked by other children, to be cruel or mean to others, to get in many fights, physically attack people, be teased a lot, and be seen as too shy or timid, and withdrawn.

Children with selective mutism were more likely to be reported as too shy or timid, and withdrawn. As previously mentioned, children with selective mutism often have trouble engaging socially.
(Asendorf, 1993; Crozier, 1999, Kristensen & Torgersen, 2002). Additionally, social anxiety disorder is often comorbid with selective mutism and may cause a child to be shy and withdrawn in social situations (Ford et al., 1998). Items, such as cruelty, bullying or meanness to others, gets in many fights, and physically attacks people, were not reported as occurring often. Therefore, these behaviors may be of less concern for children with selective mutism and may not greatly impact peer relationships. Additionally, children with selective mutism were not reported as not liked by other kids often. Children with selective mutism are reportedly liked by their peers even though they may not talk in their classroom. Results are in Table 2.

**Hypothesis 3**

Hypothesis 3 is that children with selective mutism will have trouble making friends, keeping friends and fear joining conversations as reported by their parents. Hypothesis 3 was partly supported. Children with selective mutism were found to have difficulty making friends but were able to keep friendships once made. Additionally, fear of joining conversations was reported for almost all children. Children with selective mutism may struggle making friendships without the ability to initiate speech with another child. Results are in Table 3.

**DISCUSSION**

Previous research has reported that children with selective mutism may be rejected by their peers and experience few friends (Sharkey & McNicholas, 2008). However, findings from the current study support that children with selective mutism have a range of close friends, and also tend to get along with and are liked by other peers. However, support of interpersonal difficulties was reported. For example, children with selective mutism were found to have difficulty making friends, but were able to keep friends. One factor that likely plays a role in developing friendships is the child’s difficulty joining conversations and speaking with those they are not comfortable. Speech is often necessary to get to know, share interests with and feel comfortable around another person. Children with selective mutism may be limited in their ability to develop friendships and may need to rely on those they feel comfortable with to help make friendships.

Peer relationships may play a vital role in the treatment of selective mutism. The current study proposes that when treating children with selective mutism, it may be effective to already have a social network in which the child feels comfortable speaking. Children with selective mutism with positive peer relationships may receive encouragement from these peers to integrate into groups, start talking and make friendships. Ultimately, treatment can utilize the child’s trusted peers to help generalize speech.

**REFERENCES**


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**Table 2.**

*Descriptive Analysis on the CBCL*

<table>
<thead>
<tr>
<th>Items</th>
<th>Not true</th>
<th>Sometimes true</th>
<th>Very true</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. Cruelty, bullying or meanness to others</td>
<td>49</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>37. Gets in many fights</td>
<td>51</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>38. Gets teased a lot</td>
<td>40</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>48. Not liked by other kids</td>
<td>46</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>57. Physically attacks people</td>
<td>49</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>75. Too shy or timid</td>
<td>1</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>111. Withdrawn, doesn’t get involved with others</td>
<td>19</td>
<td>17</td>
<td>21</td>
</tr>
</tbody>
</table>

**Table 3.**

*Interpersonal Difficulties*

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trouble making friends</td>
<td>39</td>
<td>12</td>
</tr>
<tr>
<td>Trouble keeping friends</td>
<td>9</td>
<td>39</td>
</tr>
<tr>
<td>Fear of Joining Conversations</td>
<td>48</td>
<td>3</td>
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</table>


ABSTRACT
This self-study experimental research focuses on finding a positive correlation between hyperglycemia in type 1 diabetics and the ingestion of foods that cause inflammation. The goal of this research is to question if the removal of inflammatory foods from diet, as well as prohibiting the use of inorganic or non-prescribed substances, will decrease hyperglycemic rates in type 1 diabetics. Spanning for a period of 60 days, the participant followed two contrasting eating habits for 30 days each. The first 30 days contained foods linked to cellular inflammation, and the following 30 days consisted of anti-inflammatory foods suggested in The Gerson Therapy.

Daily blood glucose (BG) readings were recorded, noting significant health changes or moods that the participant experienced during eating regimens. Overall BG levels dropped from an average of 156.6 mg/dL in the first month to 106.8 mg/dL during the second month. These results suggest that type 1 diabetes hyperglycemia can be influenced by food, a concept under-researched by traditional western medicine. During the Gerson diet, an increase in mental and physical energy, improved sleep and intestinal health, and 15.8 pounds of weight loss were experienced. Increased time participating in a more structured anti-inflammatory meal plans and using more effective tools for extracting nutrients from food should also increase potency of the organic food diet as well.

INTRODUCTION
Investigating whether or not there is an improvement of BG average levels when a type 1 diabetic adheres to a diet of nutrient dense foods free of chemicals and/or compounds that can cause internal allergic reactions or food intolerances is worth the time and effort. It contributes information to a limited resource database of alternative methods of managing type 1 diabetes. This research is inspired by a case study in Healing The Gerson Way: Defeating Cancer and other Chronic Disease, a work published by Charlotte Gerson and Beata Bishop in 2007. Dr. Charlotte Gerson specializes in the reversal of cancers, malignant tumors, and autoimmune diseases, and conducted the experiment at the Gerson Institute.
of alternative medicine in Mexico (The Gersen Institute. 2013b). Ronald H. Henrarichs, a 41 year old man referred to in the study as R.H., reportedly suffered from BG levels over 340, high blood pressure, gout, and obesity. During a period of 10 weeks, R.H. was put on an eating regimen of organic and alkalized foods high in fiber and low in sodium or acids, mainly consisting of vegetables and low glycemic index fruits. Most of his meals were consumed in the form of freshly pressed juice to optimize nutrient absorption, and R.H. took mineral supplements of chromium piccolinate and other Gerson approved medications while also performing coffee enemas four times daily. By the end of the 10 weeks, R.H. had lost nearly 100 pounds and was taken off all insulin, as well as high blood pressure medications (Gerson & Bishop, 2007, p. 56).

Alternative medicine health retreats, such as the Gerson Institute, are the only sources that provide tangible research on this topic. By working with patients who voluntarily pay for treatment without medical insurance, clinics like these stay afloat independent of government funding. The United States Diabetes Association’s medical standards do not approve of the use of diet alone to treat type 1 diabetes. Traditional hormone replacement therapy of synthetic insulin is the only approved treatment for this disease, having 245 billion dollars spent on diabetic medical expenses alone in March of 2013 (National Diabetes Statistics Report, 2014). However, this severe and rare form of diabetes lacks research that investigates the influence of anti-inflammatory food on hyperglycemia.

Though the R.H. study was available to the public, a patient’s right to privacy limits the detail which research can provide (De Board, et al., 2013). Because of this legal restriction of medical confidentiality contracts, finding studies like this research in the U.S. is nearly impossible, which is why this self-study is so important. Having lived with type 1 diabetes for over 10 years, the participant studied provides candid documentation of the effect that food has on type 1 diabetes through firsthand experience and observation. The goal of this research is to find out how much of the improvement of BG readings in type 1 diabetic patients, such as the patient R.H., depends on diet alone. Austerely eating food only of the Gerson Therapy diet in this study produced results that echoed those of R.H., and lowered measured BG readings by 31.8%. Temporary removal of the use of insulin medication was also experienced.

**LITERARY REVIEW**

Type 1 diabetes, prefixed IDDM for insulin dependent diabetes mellitus, occurs when the body produces antibodies that attack cells in the pancreas responsible for synthesizing insulin called beta cells. Insulin is a hormone that converts sugar our body metabolizes from the food we eat into a source of energy for cells. Improper insulin production leads to hyperglycemia, which is an overabundance of unused glucose sugar within the bloodstream. Any BG reading out of the range of 70-120mg/dL is considered to be pre-diabetic, or distinctly diabetic if antibodies are present in blood readings. Hyperglycemia in type 1 diabetes is commonly treated using synthetic insulin, however, a cure is not yet commercially available (Atkinson et. el, 2013, p. 69-77).

As of June 10 of 2014, the National Diabetes Statistics Report of The American Diabetes Association (ADA) stated that 29.1 million people have been diagnosed with diabetes and over 86 million people are pre-diabetic. Of those diagnosed with diabetes, only 5% suffer from type 1 diabetes (American Diabetes Association, 2014). According to the ADA, type 1 diabetics do not produce the insulin hormone created in the pancreas that is “needed to convert sugar, starches and other food into energy needed for daily life” and that only “with the help of insulin therapy” can IDDM patients, “manage their condition and live long, healthy lives” (National Diabetes Statistics Report, 2014).

Though synthetic insulin can manage IDDM, diabetes “was the seventh leading cause of death in the United States in 2010”, and accounted for over 69,071 deaths. Complications of diabetes, regardless of today's popular synthetic hormone replacement treatment, are hypertension, dyslipidemia, cardiovascular disease, blindness and eye problems, heart attack, stroke, kidney disease, and amputations caused by neuropathy (National Diabetes Statistics Report, 2014). All of these ailments are linked by one thing: high levels of low-density lipoproteins (LDL’s) in the bloodstream caused by diet (Mayo Clinic, 2014).

Diets high in insoluble fat and refined sugars, yet low in fiber, directly cause an increase of LDL in the blood system. Animal products contain the highest...
sources of trans fats and saturated fats that are known to increase cholesterol and raise blood pressure. Dairy, eggs and meat also do not contain any source of fiber. Fiber lowers blood cholesterol by combatting LDL’s and slows the metabolic absorption of sugar in the foods that we eat, helping to balance BG levels (Mayo Clinic, 2014).

Dr. Gabriel Cousens, author of the There is a Cure for Diabetes: The Tree of Life 21 Day+ Program, emphasizes the importance of fiber because of its benefits on BG and identifies the two food categories responsible for cellular inflammation. The first are high-glycemic index foods that metabolize into glucose easily, including: white sugar, any white flour or rice, honey, alcohol, wheat, junk food and most fruits outside of berries. The second category of inflammatory foods are high-insulin index foods that provoke spikes in insulin and diabetogenic responses, even though they are low in glycemic index, such as meat and dairy (Cousens, 2008, p. 37).

Hamburgers, french fries and milkshakes are but a few examples of stereotypical staple foods found in the cultural cuisine of America that are high in fat, meat, dairy, sodium, refined sugar and starch. These kinds of foods cause diabetogenic responses, even in non-diabetic persons. The American Journal of Clinical Nutrition stated that cultured dairy and heavy meats actually elevated insulin levels higher than some carbohydrates; merely 3 slices of cheese or 1 hamburgers’ worth of beef spiked insulin more than 2 cups of the high glycemic index food of cooked pasta (Snowdon & Phillips, 1997, p. 1264). In the National Health and Nutrition Examination Survey studying foods that cause hyperglycemia in IDDM, results showed that a “quarter pound of beef raises insulin levels in diabetics as much as a quarter pound of straight sugar” (Diabetes Care, 2003, p. 465).

Diet plays a big role. Eating the combination of meat and sugar causes an excess amount of uric acid to build in the blood. This can cause gout, like that experienced by R.H., which is a painful disease that is caused by the crystallization of uric acid in joints. High uric acid levels may also elevate the risk for high blood pressure, stroke, heart disease, diabetes, and death. By avoiding meat and sugar, uric acid levels are decreased (Greger, Michael, 2013).

According to a study done by Harvard University this year, milk not only increases risk of coronary heart disease, but also increases the risk of ovarian and prostate cancers (Harvard School of Public Health, 2014). However, dairy has a lower source of calcium than kale (Heaney & Weaver, 1990).

According to a study done by Dr. Shari Lieberman, gluten intolerance causes hyperglycemia in type 1 diabetics. Dr. Lieberman spoke of an IDDM patient suffering from high sugars when her high fiber diet included foods containing gluten; 2 weeks after removing gluten from her diet, her patient no longer needed to take insulin medication (The Gluten Connection, 2007, p. xvii-xviii). All these diet complications can be avoided by eating organic produce. Even the largest land animal on earth, the African Elephant, is an herbivore (National Geographic, 2014).

Foods that lower inflammation and improve your body’s ability to heal are fruits and vegetables. However, not all produce is created equal. The quality of food is important. In fact, a study done in 2013 showed that organic tomatoes held more micronutrients than inorganic tomatoes, and that organic tomatoes of a previous year’s harvest were more nutrient dense than the following years batch grown from the same farm (Hallmann et al., 2013). This study not only found that organic food is more nutrient dense than inorganic food, but also brings attention to the decline of nutritional value in produce as a whole. By concentrating the nutritional abundance in pounds of food into mere liters of liquid, juicing organic fruits and vegetables during this research was the most effective way to get as many nutrients as possible.

SUMMARY
Meat, dairy, gluten, and refined sugars do more harm to the body than good. They link to cellular inflammation that leads to autoimmune diseases like IDDM. Treatment approaches in traditional western medicine for managing IDDM do not reverse the disease, leading to long-term complications and an average decrease of 10 years in life expectancy for those who suffer with diabetes (National Diabetes Statistics Report, 2014). A diet of organic foods dense in nutrients and fiber, that animal products and refined sugars lack, can be used to balance BG levels in IDDM.

METHODS AND DATA ANALYSIS
This study hypothesizes that once foods that cause inflammation in the body are removed from the diet and replaced with foods that promote healing and decrease inflammation, rates of hyperglycemia...
will decrease in IDDM. The objective is to understand whether eating certain types of food over others can help, or hinder, the overall health of type 1 diabetics. Respectively, the term “the participant” refers to me, the controlled variable. The independent variables are the types of food allowed in the participant’s diet. The dependent variables are the subsequently recorded changes in BG levels.

This study is limited in external validity due to lack of sample size, lack of time allotted for observation of the effectiveness of an anti-inflammatory diet, and possible experimenter bias errors due to the impossibility of conducting a double-blind test. However, testing BG at designated times during the diets, using a reliable tool for measuring BG levels, injecting the same brand of insulin throughout both diets, and using the same insulin ratio amount for grams of carbohydrates eaten helped to increase internal validity.

Tools of the experiment were a OneTouch Ultra 2 glucose monitor used to test BG levels, a Jack La Lanne’s Power Juicer for juicing fruits and vegetables during the Gerson Therapy diet, a Medtronic MiniMed insulin pump, Apidra fast-acting injectable insulin/glulisine of RDNA origin, and organic foods purchased only at Whole Foods markets. Blood sugars were taken an average of 14 times daily, with 5 tests taken at 8:00am, 11:00am, 3:00pm, 7:00pm, and 11:00pm. Results were averaged every 3 days, giving a distribution of 20 sample means calculated over a span of 60 days. A decrease of averages between the 1st and 2nd month supports the hypothesis that diet has an effect on the rates of hyperglycemic levels in type 1 diabetics.

Toiletries made of inorganic compounds/chemicals that may increase cellular inflammation were replaced with holistic alternatives to improve construct validity. These replacements were: Lypsyl Beeswax lip balm, Toms of Maine Fluoride Free toothpaste, Burt’s Bees Gud: Red Ruby Groovy softening hair conditioner, Shea Moisture Curl Smoothie leave-in hair conditioner, Shea Moisture Coconut & Hibiscus sulfate free shampoo and conditioner, Shea Moisture Hold & Shine Moisture Mist, Shea Moisture Baby Healing Lotion, and the use of deodorant was completely prohibited. No consumption of alcohol or use of non-prescription drugs took place throughout the experiments entirety.

In the first 30 days, the participant ate meals that contained dairy, gluten, meat, and refined sugars. None of the foods prepared contained organic ingredients. Most meals were cooked and came prepackaged. Of the foods cooked, most were prepared in the microwave. Uncooked foods came in the form of fruit smoothies or protein shakes. Foods consumed during this time were: Lottie 7 Beck Maple and Brown Sugar Oatmeal, Weightwatchers Smart Ones Spicy Black Bean Soup, Quaker Oat & Yogurt sandwich Biscuits, Breakfast Choice Multi-grain Flakes, Rice A Roni Quick Serve (Chicken flavor), Michelina’s Zap Ems Stir Fry Rice & Vegetables, skinless chicken breasts, Kellogg’s Chocolate Delight protein shake, Wal-Mart 2% milk, West Soy plain lowfat soymilk, Advocare Meal Replacement Shake, Canyon Farms Frozen Strawberries and Bananas, Canyon Farms frozen Mixed Berries, Embie Farms Italian Vegetable Mix, and McDonalds’ french fries.

Common physical reactions to the inflammatory food diet were: lethargy after eating, accompanied by a rise in BG, gas, constipation, dry skin and acne, inability to sleep, sour smelling breath and noticeable body odor. On this diet, the participant would feel hungry within 2-3 hours of eating. Weight fluctuated between 147 and 149 pounds.

The Gerson Therapy diet excludes all but organic fruits and vegetables. It prohibits ingestion of any food or drink that may cause significant inflammation, including: dairy products, meat, gluten, refined/unrefined cane sugar, and alcohol or non-prescription drugs. Foods consumed during the Gerson diet: refined unsweetened soy milk, green bell peppers, beets, red cabbage, cauliflower, celery, Dino kale, loose carrots, red radish, purple eggplant, romaine lettuce, spinach, tomatoes, gluten free/dairy free/meat free pizza, almond milk, red kale, unsweetened vanilla almond milk, and cold pressed apple juice (only when BG was low and participant needed to consume higher levels of sugar). All produce was juiced 4 times a day, at a liter of juice each meal. This totaled gallon of juice consumed daily converts to 8.8 pounds of liquid.

Noted events experienced by the participant while eating 100% organic included physical expressions of internal change. Overall appearance of skin improved. Within two weeks, acne and dandruff disappeared and participant experienced more satisfying sleep. Participant experienced an
improvement in exam scores, suggesting that cognitive processes improved with diet as well. Participant no longer experienced excessive gas or bloating and fecal excretion occurred regularly 2-3 times daily, suggesting that overall intestinal health also improved. On this diet, the participant would often feel satiated after eating a meal while eating every 3-4 hours. A total weight loss of 15.8 lbs. occurred while eating organically, from 148.6 pounds to 132.8 pounds, plateauing at day 17 of the last 30 days.

On the night of the 24th, participant was taken off of all medication due to severe hypoglycemia (low BG) episodes, and medication was not retaken for day 25, 26, or 27. On day 25, hypoglycemia occurred within the first 14 hours of being off medication, but stabilized on days 26 and 27. On day 28 the participant was put back on medication and experienced severe hypoglycemic episodes again. For the sake of health risks, the participant withdrew from the experiment on the night of the 28th day and strayed from the organic eating regimen to match carbohydrate demand of insulin pump’s basal rate (a set hourly dose of insulin medication).

RESULTS AND DISCUSSION
The participants average BG level while eating inflammatory foods was 156.6 mg/dL, 49.8 mg/dL higher than the reading of 106.8 mg/dL once those foods were removed from the diet during the second half of the experiment. Being taken off medication suggests that an organic and anti-inflammatory diet low in carbohydrates can allow complete independence from insulin in type 1 diabetics. This not only supports the hypothesis that diet can affect hyperglycemia rates, but it can also induce hypoglycemia when paired with an excess amount of synthetic insulin.

This study lacked specificity and structure. Improved methods for conducting this experiment would be to develop meal plans prior to conducting the experiment, using recipes that describe what types of food will be eaten and in what amounts. Charting this will clarify how the participant achieved the results from eating the organic foods used in the Gerson Therapy diet, increasing external validity.

CONCLUSION
This self-study experiment questioned how much of an effect diet has on BG levels in type 1 diabetics. Due to being characterized by insulin resistance and inability to create insulin, traditional western medicine declares that IDDM cannot be managed or affected by diet. Though synthetic insulin medications give diabetics the option to eat freely, it is not the only option. This study hypothesized that foods linked to cause inflammation in the body
also cause higher rates of hyperglycemia, even when managed with insulin.

By eliminating inflammatory foods from diet, overall BG readings should lower. The results of this study supported that claim, showing a significant decline of BG levels while on an organic juice diet, allowing the participant to temporarily stop taking all medication. Further research should be done to identify the most effective kinds of anti-inflammatory foods that caused this decline in hyperglycemia. Structured meal plans incorporating those foods can be given to future participants of studies like this.

**BIBLIOGRAPHY**


COMMERCIAL SEXUAL EXPLOITATION OF TEENS

BY TEMIEKA MEADOWS

ABSTRACT
This research explores whether commercially sexually exploited children (CSEC) abuse drugs or face greater histories of abuse than their delinquent peers. This research will evaluate whether girls who are CSEC victims experience more abuse of drugs or experience more physical, emotional, or sexual abuse. The study also explores whether CSEC victims witnessed more abuse than non-CSEC victims. A survey of needs and issues facing delinquent girls was given to 130 girls between the ages of 13 to 18. Questions asked about their drug use, abuse history, and whether they witnessed abuse. This research found that many girls who are CSEC victims experience and witnessed more abuse than non-CSEC victims. The results also showed that CSEC victims and non-CSEC delinquent peers showed no difference in drug use.

INTRODUCTION AND PURPOSE
The purpose of this study was to understand whether girls who were involved in prostitution use drugs such as alcohol, meth, cocaine, and other drugs more than delinquent girls who were not involved in prostitution. The purpose of this study was also to determine whether girls who were involved in prostitution had a greater history of abuse than those who were not involved in prostitution. Many teen girls are introduced into prostitution everyday across the United States and it is hoped that this study will give a better insight into why teen girls enter prostitution and what effects prostitution has on them. This study may also give people a better insight into the girls that enter into prostitution in hopes that it will help identify the resources they need to either never enter prostitution or to leave prostitution.

This study used data collected for the “Girls’ Needs Assessment” conducted by Doctor Alexis Kennedy. The survey was given to 130 girls that were aged twelve to eighteen and held in the Clark County Juvenile Detention Center. Girls were interviewed in person by Dr. Kennedy and her graduate students from University of Nevada, Las Vegas Criminal Justice Department. The interviews took place from August 2013 through December 2013 and questions were pulled from the Center for Disease Control’s Youth Risk Behavior Survey, a
Demographics categorized the girls by education, abuse history, sexual health, and drug use. By getting a better understanding of the girls’ background, researchers and service providers can get a better understanding of the girls who enter into prostitution and why they do it.

The importance of this study is to help girls who enter prostitution to leave prostitution or to give the criminal justice system a better understanding of the girls who enter into prostitution. Knowledge about the effects of prostitution on girls and why they enter into prostitution can help service providers offer better community resources to the girls. These resources can be a help to girls before they enter prostitution, during prostitution, or once they have left prostitution. This research will help law officials and community resources understand young women involved in commercial sexual exploitation.

LITERATURE REVIEW
Teen girls are being brought into prostitution every day and are constantly being sexually exploited. Men are exploited into prostitution too, but women and teen girls are the main victims of sex trafficking (Rivers & Saewyc, 2012). Academics defined prostitution as “an adapted and dynamic process involving a transaction between a seller and a buyer of sexual services. Prostitution has to do with all exchanges of sex for money or goods and services, such as drugs, food, housing, clothing, etc.” (Lavoie, Thibodeau, Gane, & Hebert, 2010 p. 1149).

Girls can be brought into prostitution through friends, pimps, family, and are sometimes trafficked. It has been estimated that 400,000 children are involved in prostitution in the United States every year (Hellemann & Santhiveeran, 2011). Many youth who do participate in prostitution will still partially attend school and prostitute on the side (Grace, Starck, Potenza, Kenney, & Sheetz, 2012).

Many girls are victims of physical abuse, verbal abuse, sexual abuse, or even murdered during their time as a prostitute (Hellemann & Santhiveeran, 2011). Women in prostitution are more vulnerable to being victims of homicides. In 2011 2.5% to 2.7% of female homicides were women involved in prostitution and 2 to 10 million children under 18 years of age were prostituted (Hellemann & Santhiveeran, 2011).

Teens can be introduced to prostitution through friends, pimps, family, or even themselves. Some girls will advise other girls to prostitute for money so they can have the financial resources they need (Barnett & Tyndale 2010). Fathers and mothers may force their child to be prostitute so they can have extra income and do not care about the effects on the child (Barnett & Tyndale 2010). When an incapable guardian raises a teenager then that teenager has a greater risk of being involved in prostitution (Lutya, 2010).

Many girls turn to prostitution for reasons such as, needing shelter, clothing, food, money, and etc. Many girls involved in prostitution are runaways who are trying to leave their abusive family environments (Menaker & Franklin, 2013). According to Anderson many girls get involved in prostitution because of their financial needs and will exchange sex sometimes in exchange for goods. As a result, women do not look at themselves as victims, but rather as survivors or helping their men out financially because they feel as though they are in love (Anderson, 2014). In an earlier study they used the phrase “Survival Sex” to explain woman-selling sex for financial gain or for products such as clothing or food (Lavoie et al, 2010 p. 1149). Those who are economically disadvantaged and are women of color are at more of a risk to be blamed for being prostituted and are considered offenders rather than victims (Menaker & Franklin, 2013). What we see is that girls who struggle financially are at more risk of being involved in prostitution. Teen girls tend to have less money and income than older women making them more prone to prostitution (Barnett & Tyndale 2010). Girls will try to raise their social status also by obtaining gifts such as clothes, shoes, phones, and money for sexual favors (Barnett & Tyndale 2010). If a girl does not follow the orders of the guy or pimp then he may rape her or find someone else to have sex with and she will lose the income she may need (Barnett & Tyndale 2010). Girls struggle to get away from traffickers and a trafficker will use all kinds of threats to keep them involved in prostitution including threatening their family or having children with the victims and threatening to keep the children away from them (Anderson, 2014).
Hellemann and Santhiveeran did a study of 31 other studies on female adolescents and women who entered prostitution when they were adolescents. What they found was that women in prostitution were victims of physical and sexual assaults, robbery, and had many health problems (Hellemann & Santhiveeran, 2011). 71% to 86% of the women involved in prostitution were abused more if they did not want to do the sexual activities that were requested of them and those who worked on the streets were abused more than those who used social media (Hellemann & Santhiveeran, 2011). They found that on average three out of five female adolescents were raped five or more times (Hellemann & Santhiveeran, 2011). Eighty-three percent of adolescents aged 14 to 18 were robbed while living on the streets and 45% were physically assaulted during the robbery (Hellemann & Santhiveeran, 2011). What we see is a higher abuse rate and higher risk factors for those involved in prostitution.

Many prostituted individuals have dental problems, hepatitis, and serious liver and kidney problems due to drug use and risky sexual behavior (Hellemann & Santhiveeran, 2011). We also tend to see a higher rate of sexually transmitted diseases amongst adolescents involved in prostitution. Some girls do not use condoms because they may get paid more if they do not use condoms (Anderson, 2014). Women can be seen as being prostitutes because they have control of the encounter (Barnett & Tyndale 2010). Men can choose whether or not to use condoms and if the girl does not comply she may be beat. Therefore, the women are not really in control and if a pimp controls her, she has no real say in what she does. What research has found is that the girl has no say in whether to use a condom even if it is discussed the boy makes the ultimate decision (Barnett & Tyndale 2010). Some prostituted individuals will use traditional medicine and self-care or other survival strategies to survive in prostitution (Hellemann & Santhiveeran, 2011). The problem with using self-care is that the people are diagnosing themselves and that diagnosis could be wrong. Some people even try to make their own medication and in doing so will make medications that suppress their symptoms, but not cure the sickness they may have.

Prostitution includes a great amount of stress and adolescents involved in prostitution can experience many psychological problems due to the stress. Many girls enter prostitution due to stressful life events such as breakups, death of someone close, and changes (Lavoie et al., 2010). In Hellemann and Santhiveerans study 17 of the girls they studied experienced depression, post-traumatic stress disorder (PTSD), suicidal thoughts, and strong feelings of shame and guilt (Hellemann & Santhiveeran, 2011). PTSD was a common psychological problem amongst adolescent girls in prostitution (Hellemann & Santhiveeran, 2011). PTSD comes from experiencing a horrible ordeal that involves the threat of or actual physical harm (www.nimh.nih.gov). When a girl experiences PTSD they can be stressed or terrified even when they are not in danger (www.nimh.nih.gov). Some girls can end up with dissociative disorders that can affect them their entire life (Grace et al., 2012).

Prostituted individuals use many different ways to cope with being in prostitution, such as using drugs to suppress the feelings they have or the shame and guilt they feel. Teens will use multiple different drugs to cope and some are introduced to drugs from their pimps who use drugs to make sure they comply with their demands and this can make them addicted to the drugs (Grace et al., 2012). Once a trafficker has introduced the girl to drugs they make the girls dependent on them for the drugs and force them to work for them (Lutya, 2010).

Drug use will make a teenager more at risk for being victims of prostitution (Lutya, 2010). Many girls involved in prostitution come from homes where they have a parent that is involved in drugs, too. A study of 222 prostituted individuals in Chicago found that 83% were raised by parents that are addicts (Grace et al., 2012). Girls in prostitution may feel that they are not accepted by society and feel ashamed or guilty (Hellemann & Santhiveeran, 2011). Studies have even shown that the young people who do approve of prostitution are at risk of being involved in prostitution (Lavoie et al., 2010). Studies found that many adolescents used drugs and alcohol and even self-mutilation as coping strategies and 21% to 96% of the girls involved in prostitution used drugs and alcohol (Hellemann & Santhiveeran, 2011). Girls who perceive themselves, as victims may feel trapped, oppressed, and use drugs to deal with their pain and some girls feel as though they cannot change their circumstances and lose hope (Rubenson, Hanh, Hojer, & Johansson 2005). Some girls feel abused by society and law enforcement looking down upon them (Rubenson et al., 2005).
other studies, girls involved in prostitution used positive coping mechanisms by focusing on positive thoughts, including their personal strengths, an optimistic future, and the increased economic opportunities gained for their families" (Hellemann & Santhiveeran, 2011).

Instructive to understanding the experience of surviving through prostitution are summaries of accounts from a study done on 22 Vietnamese women who were prostituted and experienced abuse and drugs. The first victim described how when she first started prostituting she would not require her clients to wear a condom because they would pay more (Rubenson et al., 2005). She was beaten for sex and as a result of suffering from depression started using heroin. She was trafficked to Macao and was put to work in a brothel. She became an addict due to her depression and now struggles to stop using drugs. A guy then bought her from the brothel in Macao and put her in a house and made him his personal woman that he owns. The second example narrative was the story is of a girl who was raped and abused as a child and then was the girlfriend of an older man. The boyfriend raped her and then forced her to have sex with other customers. She was then sold by her mother and after leaving one abusive boyfriend she got another boyfriend who beat her and then forced her to take on customers. She ran away and then went to work in a brothel. The brothel owner has bailed her out of jail twice and bought her clothing and now she is in debt to the brothel owner. She also abused drugs regularly.

What these stories show is how a woman with a bad living environment may turn to prostitution for financial gain. Once a woman has entered into the world of prostitution, they may be beaten, raped, and introduced into drugs. A trafficker will stop at nothing to keep their “property” even if that means making them in debt to them. It becomes extremely hard for a woman to leave the world of prostitution once they have entered. They may become fascinated with money or be enslaved by their trafficker.

Many research studies address the effects of prostitution, but do not give solutions to the problem. A way to stop prostitution is to identify whether or not a teen is prostituting. Since many teen girls still attend school using school officials can be one way to combat teens entering into prostitution. One research study that was very interesting was conducted in 2012 by a group of researchers (Grace et al., 2012). In this research, two tables were present that gave red flags to help identify if a girl may be involved in prostitution (Grace et al., 2012). Nurses that recognized the red flags were able to help the girls by calling law enforcement (Grace et al., 2012). According to Rivers and Saewyc nurses are at the “front line” to help teens involved in prostitution (Rivers & Saewyc, 2012).

This study took place in Boston and by training school nurses on CSEC and helping them to identify which adolescents may be involved in prostitution. The school nurses are taught what red flags to look for, such as visible signs of abuse, a history of running away/ absences from school, and changes in appearance (ex. Having new expensive clothing) (Grace et al., 2012). If there is any reason to suspect prostitution the nurse can then ask them questions to determine if they are involved in prostitution or not. Once the victim is identified the teen should be handled the same way a child reporting child abuse should be handled (Grace et al., 2012).

In understanding CSEC, school nurses learned how there are some girls that are more prone to being involved in prostitution than others (Grace et al., 2012). The Letot Center in Dallas works with sexually exploited children and found that 93-95% had been physically and sexually abused. Many girls who have been introduced into the sex industry have had a childhood full of physical and emotional abuse and even sexual abuse. Those who have been sexually abused as a child have a higher risk of becoming prostituted due to their lack of self-esteem or confusion about their sexuality (Lavoie et al., 2010). Girls who exhibit certain risk factors are more susceptible to enter prostitution (Lutya, 2010).

Girls may choose to not report the abuse that they endure during prostitution because they may fear retaliation, being arrested for prostitution, or being put back in there undesirable home situations (Grace et al., 2012). Some girls may exhibit Stockholm syndrome and feel as though their pimps are a giving and loving person and they will become in denial about their abuse. This makes it difficult for service providers to provide help for those who are sexually exploited because they feel as though they
are not victims. Also, girls may feel there is no hope for them and that no one can help them and they may have trust issues (Grace et al., 2012). There are stereotypes that affect these girls such as women of color have a stereotype of being “Jezebels” due to media (Menaker & Franklin 2013). Jezebels are women that are sexually promiscuous and manipulative and they provoke their own victimization making them seem as though they are not victims, but desire their victimization (Menaker & Franklin 2013). Some girls may be told by their trafficker “that adults will be repulsed by what they’ve done” (Grace et al., 2012 p. 415). In addition, police officers view victims of prostitution as willing “prostitutes” and are not as concerned with prostitution (Menaker & Franklin 2013, p. 2026).

Many girls work in exploitative conditions where they are forced to work and are not allowed to keep any money and are confined. When they are confined they cannot access medical care, cannot be social, and are forced to be in those conditions (Lutya, 2010). Lutya stated that there are five elements that make a teen more at risk for being involved in prostitution and these five elements are “role expectations, structural constraints, adaptations, associations and exposure” (Lutya, 2010 p. 96). Role expectation can be a teen needing to provide for her family and structural constraints can be if a teen lives in an area where they are limited to areas of victimization (Lutya, 2010). Adaptions are roles teens adapt to and their lifestyle where they use drugs and frequent areas that are frequented by traffickers (Lutya, 2010). Exposure is where a victim is constantly exposed to environments where they could become victims and an association is where the teen sustains relationships with people who are involved in the same lifestyle (Lutya, 2010).

Youth involved in prostitution are looked at as needing help or as teens willing to be involved in prostitution (Halter, 2010). According to Halter police in the United States do not treat youth involved in prostitution all the same (Halter, 2010). Several laws have been created to help teens involved in prostitution, such as The Trafficking Victims Protection Act of 2000 and The Protection of Children from Sexual Predators Act of 1998 (Halter, 2010). The Trafficking Victims Protection Act of 2000 has been rewritten to include victims under 18 who have been forced or not as victims of trafficking (Menaker & Franklin 2013). Some states have “Safe Harbor” laws the decriminalize prostitution amongst minors and offer other programs for teens (Menaker & Franklin 2013). The programs help prostituted teens and understand their background history and help them with the trauma they have endured (Menaker & Franklin 2013). The programs are tailored to not blame the victim and only eight states have these laws (Menaker & Franklin 2013). These eight states are New York, Illinois, Minnesota, Tennessee, Vermont, Massachusetts, Connecticut, and Washington (Menaker & Franklin 2013). It would be a great accomplishment if Las Vegas were to also create Safe Harbor laws.

**METHODOLOGY**

This research focused on CSEC victims and their history of drug use, witnessing abuse, physical abuse, and emotional abuse compared non-CSEC girls. The research issue considered was whether there are factors that can distinguish girls involved from prostitution from those who are not.

**Procedure**

From August 2013 to December of 2013 face-to-face interviews were conducted of teenage girls. All the girls were detained at the Clark County Department of Juvenile Justice Services (DJJS). The girls were asked questions from the Center for Disease Control's Youth Risk Behavior Survey, the survey developed by Owen and Bloom (2000), and the GIRLS Initiative Workgroup convened by DJJS. The interviews were closed for confidentiality and respondents were not named. 130 girls were interviewed by graduate students from the Department of criminal justice and were supervised by Dr. Alexis Kennedy.

To understand the rates of risky behavior, a quantitative study was conducted polling a variety of behaviors. The girls were asked questions about their drug use and abuse history. The girls were asked if they used crack, cocaine, heroin, marijuana, alcohol, meth, and other drugs. The girls were also asked if they had witnessed abuse of a family member or been physically and mentally abused themselves.

They were then asked about their abuse history and whether or not they had been abused or witnessed abuse. They were asked about abuse in their relationships and how old their partners were. They rated their relationships and answered if they though their relationship was very good, good, fair, bad, or very bad. By assessing their relationship history, we can figure out if they are exhibiting factors that could lead them into prostitution.
The girl’s sexual activities were assessed and they were asked if they were sexually active and if they used condoms or not. The girls were then asked how old their partners were and what kinds of sex they had experienced (i.e. anal, oral, or vaginal) and how old they were when they had their first encounter. The girls were asked if they had any STD’s and when they had their first sexual encounter was it consensual or not. Girls were asked about their history if they had ever traded sex for items and if so what kinds of items. They were asked what age did they trade sex and if they ever had sex for money.

In this study all girls were in juvenile detention and this limited the kinds of girls that were evaluated. To overcome these limits a total of 150 girls were asked questions. Also, these girls may not want to disclose information for identification purposes or answer certain questions for their own reasoning’s. To overcome this obstacle girls were interviewed individually face-to-face and assured that all information was confidential. Girls were allowed to decline to answer a question and if they did when calculating percentages they were not excluded from the calculation of that question.

RESULTS
All of the 150 girls interviewed were between the ages of 12 and 18. Out of the 150 girls 94 were non-CSEC victims and 56 of the girls were CSEC victims. For the remained of the results, the victims were compared to the non-CSEC involved girls.

Drug Abuse History
We asked the girls if they used different groups of drugs. The group of drugs girls was asked about included alcohol, methamphetamine, crack, cocaine, heroin, marijuana, and others. The first drug that was compared was alcohol. The results showed that out of 94 non-CSEC victims 78.7% of the girls used alcohol. The other results showed that out of 36 CSEC victims 91.7% of the girls did abuse alcohol. Then we went on to compare the use of methamphetamine. 35% of the non-CSEC girls abused methamphetamines and 47.2% of the girls who were CSEC victims abused methamphetamines. We then went on to compare the use of crack it showed that 8.5% of non-CSEC girls used crack and 22.2% of the CSEC girls abused crack. What we found out about heroin use is that 25.5% of the non-CSEC girls used cocaine and 41.7% of the CSEC girls used cocaine. We then asked about the use of heroin and found out that 18.9% of the non-CSEC girls used heroin and 22.2% of the CSEC girls used heroin. Marijuana seemed to be the highest used drug amongst all the drugs used. 97.2% of the girls who were CSEC victims used marijuana and 86.7% of the girls who were non-CSEC victims used marijuana.

While CSEC victims were more likely to use drugs, they were not using at a statistically significantly higher rate than their delinquent peers for most drugs other than crack. The test results showed that there was no significance difference between the use of meth and whether a girl is a CSEC victim or not (t=1.925, p< .084). When we analyzed the use of crack we found that there was a significant difference between those who used crack and whether they were a CSEC victim or not (t=4.534, p< .033). When we compared cocaine use we found out that the results were on their way to significance (t=3.227, p< .072). When we compared heroin we realized that there was no significant difference at all between those who are CSEC victims and those who are not (t=.180, p< .672). When girls who used meth were compared we found that the significance was approaching (t=3. 096, p<.078).

Abuse
How different aspects of violence and abuse affected girls who were CSEC victims and those who are not CSEC victims were considered. The first question analyzed was “when you were growing up, did you ever see your mom or dad get so angry that they
hurt each other or someone else? 92 out of 94 girls who were not CSEC victims answered this question and the results showed that 40.2% of the girls had witnessed domestic violence. 55 out of 56 girls who are CSEC victims answered this question and results showed that 71.4% of the girls had witnessed domestic violence. The girls were also asked the question "have you ever been physically abused?" 93 out of 94 girls answered this question and results showed that 57.6% of the girls who were not CSEC victims had been physically abused and 61.1% of the girls who were CSEC victims had been physically abused. When assessing emotional abuse the girls were asked "have you ever been emotionally abused?" Results showed that 54.3% of the girls who were not CSEC victims had been emotionally abused while 61.8% of the girls who were CSEC victims had been emotionally abused. The girls were also questioned and asked if they had a history of abuse or sexual abuse. 94 non-CSEC girls answered this question and the results showed that 40.4% of the girls had a history of abuse. 35 out of 36 CSEC victims answered the question and the results showed that 74.5% of the girl had a history of abuse or sexual abuse.

The results showed that there was a significant difference between those who were CSEC victims and witnessed domestic violence compared to those who were not CSEC victims and had not witnessed domestic violence (t=9.885, p< .002). When whether a girl had been physically abused was analyzed the results showed that the difference was significant (t=6.511, p< .012). Analysis shows that the question of whether the girls had been emotionally abused did not have a significant difference (t=1.234, p< .267). The two groups varied significantly on whether girls had a history of sexual abuse (t=11.697, p< .001).

**DISCUSSION**

The results show that there is not much difference between drug use amongst teen girls who are CSEC victims and those who are not CSEC victims. A high percentage of girls used marijuana and abused alcohol; however, there was no difference between the two groups of girls. These results could have occurred because both groups abuse drugs at about the same rate. However, no significant difference may have been found because the sample of girls was not big enough to analyze and show a difference in results. Similar to prior research on exploited populations, we found high rates of drug use among CSEC victims. According to several studies conducted by Hellemann and Santhiveeran many CSEC victims use drugs and alcohol as coping strategies (Hellemann & Santhiveeran, 2011). This could be because prostituted girls are introduced to drugs through their pimp, meaning they use drugs more often than the average adolescent girl (Grace et al, 2012). Many CSEC victims abuse drugs because they were raised by parents that abused drugs (Grace et al., 2012) What this project revealed is that CSEC victims use drugs more often than non-CSEC victims and according to the data table above we see that CSEC victims use drugs and alcohol more.

When we analyzed the results that pertained to CSEC victims and non-CSEC victims in regards to their abuse rates we found significant differences. We found out that CSEC victims significantly witnessed the abuse of family members more than the non-CSEC victims. As discussed in the literature review many girls leave their homes and become prostituted due to living in abusive family environments (Menaker & Franklin, 2013). According to Hellemann and Santhiveeran discussed how children involved in prostitution experience verbal assaults, beatings, and 2.5%-2.7% of female homicide victims are involved in prostitution (Hellemann & Santhiveeran, 2011). Women in prostitution tend to be exposed to a lot of violence through being assaulted by law enforcement, pedestrians, and even customers (Hellemann & Santhiveeran, 2011). Also, according to Hellemann and Santhiveeran three out
of five female adolescents involved in prostitution are raped (Hellemann & Santhiveeran, 2011). After reading Hellemann and Santhiveerans article I expected to find out that CSEC victims experienced more abuse more than non-CSEC victims and the results showed my expectation to be right. Results showed that CSEC victims were significantly more abused than non-CSEC victims. When it came to emotional abuse the results showed that there was no difference between the amount of emotional abuse CSEC victims suffered from than non-CSEC victims. CSEC victims were sexually abused significantly more than non-CSEC victims.

This brings us to the conclusion that CSEC victims are a hard group to understand and help. They are hard to help because they experience so many hardships in life. Many times they are raised in abusive environments with parents who are drug addicts. They are also raised in environments where they may experience others being abused or they may hang out in areas where they are targeted to be prostituted. When treating CSEC victims you have to treat each individual differently. These victims deal with problems ranging from physical abuse, rape, drug use, and psychological problems. CSEC victims have already experienced high sexual behavior where they are exposing themselves to different diseases. Then you add drug abuse and an abuse history on top of high-risk sexual behavior. This makes treating victims hard to do, because they all have different experiences and have different needs.

Learning how to identify whether a youth is a CSEC victim is possible and something that many people such as school official can be taught to identify. However, if states do not change their laws and treat CSEC victims, as victims instead of offenders these youth will continue to be victims. Las Vegas should educate communities and providers on how to help CSEC victims and make special laws for them. They should start by passing Safe Harbor laws and then making laws, according to assessments made on different CSEC victims. Officers and other individuals who help or come in contact with other CSEC victims should be trained and informed on how to better help CSEC victims.

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ABSTRACT
The underrepresentation of minority students in STEM fields is a concern in today’s society. Research suggests that identity plays a major role in students’ ultimate success within these fields. Using identity theory as a theoretical framework, this article explores the ways in which identity affects the academic careers of underrepresented students in STEM. The participants of this study consisted of undergraduates from various colleges and universities around the United States that attended the SACNAS 2010 research conference. Thematic analysis was used to identify four overarching themes from a set of narrative responses collected after the event. The identified themes include (1) motivation and future endeavors, (2) networking, (3) experienced others, and (4) disadvantaged backgrounds. These themes were analyzed to further understand the importance that identifying as a scientist has on students in STEM.

THINKING LIKE A SCIENTIST: A THEMATIC ANALYSIS OF STUDENTS’ EXPERIENCES AT THE SACNAS RESEARCH CONFERENCE

Over the last few decades, the United States has grown far more racially and ethnically diverse. This diversity, however, is not being reflected in fields related to science, technology, engineering, and mathematics (STEM). It is problematic not only for minority students, but also for institutions and society as a whole. Moreover, it is a cyclical problem where one alteration can affect the whole cycle of individual, institution, and society. As individuals, students of minority backgrounds are underrepresented within these fields because of their automatic, disadvantaged placement within society. Thus, many are not given an equal opportunity relative to students in the majority. In addressing this issue, whether that is through STEM enrichment programs, mentoring, or tutoring, colleges and institutions will have a growing number of students that persist within these fields. This will ultimately work in evening out the ratio of minorities in STEM. In a broader picture of society as a whole, reflecting the diversity of the United States onto STEM fields will
help in bridging the gap between minority and majority in society. The current societal placement of individuals will be less of a problem because the present minorities will no longer be placed in that same category, which will allow them greater advantageous equality. In time, this will lead to a higher rate of students graduating in STEM and becoming professionals within these fields.

In the remainder of this introduction, I will begin by explaining identity theory and the way it links to students in STEM fields. I will then explain the importance of identifying as a scientist and some models that support this theory, including the EnCID Model, social structures, and the Epistemological Reflection Model. Moreover, I will discuss factors, such as enrichment programs, that promote students to identify as scientists, as well as factors that detract from this, such as marginalization and stereotyping. Finally, a summary of the current study and research question will be presented.

**Theoretical Framework**

This study uses identity theory to understand how success in the STEM fields links to the ways in which students come to identify themselves (Brickhouse & Potter, 2001; Merolla & Serpe, 2013; Syed, 2010). Every individual has multiple identities. The salience of these identities depends on the placement of a particular identity in relation to all the others. The stronger the identity salience is, the more likely the individual will identify as such, and in turn be sustained over different situations. There are three types of identity: role, social, and person identity. An example of each would be an identity as a science student, as a person of a specific race or ethnicity, and as a ‘good’ person, respectively (Merolla & Serpe, 2013). Each one is inextricably linked to the others.

Identity theory suggests that the links between social identity and role identity have a major part in deciding how individuals choose which identity to enact. Based on social ties or relationships to a particular societal role, that role identity may become more salient. Therefore, it could affect individual behavior including decisions and success in academia, specifically within the STEM fields (Merolla & Serpe, 2013; Syed, 2010). There is already an abundance of evidence to show that individuals of minority social and economic status have a lower chance of entering the STEM fields. In addition to this, identity theory finds that the social structures and identity roles within them do not particularly encourage positive outcomes for underrepresented students. Furthermore, it suggests that white males, who are in the majority in STEM, are more likely to be surrounded by the social structures which encourage role identity based around the STEM fields (Merolla & Serpe, 2013). Therefore, there is a higher chance for these individuals to choose a major or career in STEM.

IDENTITY AS A SCIENTIST. Studies on role identity have continually found that science and professional identities are an integral part of becoming successful in STEM. There are many models which support this theory. One of these models is the Entropic Career Identity Development Model (EnCID) (Mack, Rankins, & Woodson, 2013). This model describes the steps that minority students must move through to successfully integrate into STEM fields. There are four phases of development: pre-encounter, encounter, immersion, and fully integrated. Each of these phases is pertinent to the complete integration or development of the individual’s particular career identity.

Throughout the first three phases of development described in the EnCID model, individuals will be challenged based on their race, ethnicity, and gender (specifically being a woman). These challenges could consist of stereotyping, disadvantages based on background, discrimination, marginalization, and being “token status.” However, it is in the immersion phase where these individuals learn to embrace their identity, not only racial, ethnic, and gender, but also professional. They come to find themselves identifying as scientists and, therefore, gain more of an advantage to prosper in STEM. It is only then that they can be “fully integrated” and complete the final phase of development. Again, this particular view of self is critical in an individual’s success in STEM.

Another influential aspect of role identity is social structures. These structures can significantly alter the chances that one has to enter STEM. Stryker et al. (2005) recognize three social structures that each play a part in identity development. These include large, intermediate, and proximate social structures. Each of these structures is linked to influencing social standings, as well as role identity. While large and intermediate structures are not as influential as
proximate, they can impact the proximate level in
direct ways, and, therefore, affect the individual. For
instance, the large social structures include very
broad groups such as race, ethnicity, class, and
gender. Placement into one of these groups can
affect the intermediate social structures. These
include neighborhoods and particular schools or
universities where individuals have been placed. The
third and final structure is the proximate social
structure. It is most closely related to the individual
and, therefore, enacts specific role identities related
to STEM fields. These types of social structures
could include science clubs, study groups, and
cohorts.

It is clear how large, intermediate, and proximal
structures work together, from the large social
structure trickling down to the proximate. The
particular groups where individuals are placed in
from their large social structures can greatly affect
the intermediate by influencing the neighborhood
they live in, the schools they go to, and possibly
their choice in college. From here, the intermediate
structures have an impact on the proximate
structures by influencing college majors, cohorts,
cubs the individuals may join, or programs they get
into. This level plays the largest role in how the
individual comes to identify themselves. However, it
is these three levels working in tandem, starting
from society’s forceful placement of individuals in a
group to the identity development that this can
create, which affects the development and salience
of a science identity.

The way that one organizes and interprets
knowledge is also important in understanding
identity development in STEM. One model that
uses this is the Epistemological Reflection Model
(Magolda, 2004). This model describes four levels
that individuals work through as they develop their
way of knowing, moving from absolute to
transitional, to independent, and finally to
contextual knowing. Each of these levels moves
closer to a more independent way of thinking, as
well as shaping their knowledge based upon
context. Once in the final level, knowledge no
longer needs to be absolute in every situation. As
related to identity, people move away from an
outside belief of knowledge and identity. This
includes what minorities are “supposed” to be and
how historically, society has and continues to group
them. They finally end in a far more internal way of
identifying one’s self, such as identifying as a
indicated that students in the undergraduate
research program were reported as having
“transformations.” These transformations were
attitude and behavior changes, where the mentors
saw students moving out of the absolute
knowledge towards the independent and
contextual knowledge. In other words, they began
to identify and act like scientists.

FACTORS THAT PROMOTE IDENTITY AS A
SCIENTIST. Some research has identified factors that
help underrepresented students. These studies find
that the lower success rates for underrepresented
groups cannot be attributed to lack of motivation
or bad study habits. Instead, research suggests that
supportive programs, which provide mentoring,
group learning, undergraduate research (where
students learn directly from faculty), and social
relationships have all been shown to improve the
success rates of underrepresented students (Hunter,
2006; Mack, Rankins, & Woodson, 2013; Merolla &
Serpe, 2013; Treisman, 1992). These interventions
not only provide academic assistance, but also aid
in the social aspects that minority students face in
STEM (Merolla & Serpe, 2013). It is also important
to have mentors and role models who have
identities similar to the students, racially or
ethnically, in their chosen fields (Syed, 2010).

As Hunter et al. (2006) discuss, the constructivist
theoretical model and Vygotsky’s learning model
are ways of learning that are far beyond sitting in a
classroom and hearing a lecture. Knowledge is not
something concrete, but it must be “constructed
and reconstructed” constantly (Hunter et al., 2006).
In doing this, professionals within the STEM fields
must guide the students, almost as if in an
apprenticeship. The students must practice and be
actively engaged in the roles that are assumed by
professionals in the STEM fields. Undergraduate
research is one of the key ways of accomplishing
this practice. Hunter et al.’s (2006) research focused
on students, who went through a summer research
program, where they were placed with mentors in
their fields to set up and produce their own
research. They worked closely with their mentor to
accomplish this goal, and the results of the study
found that 91% of students’ experiences in this
program were positive. Moreover, many students
stated that they were “thinking like a scientist.” They
were building a positive role identity for study in
STEM fields. It is in this way that individuals use
their identity to start moving from being on the outside of the community to the inside.

FACTORS THAT DETRACT FROM IDENTITY AS A SCIENTIST. Unfortunately, minorities are automatically placed at a disadvantage in society, especially at the university level. Colleges have historically been a white, male dominated place. While much of this changed over the decades through the Civil Rights Movement, Women’s Rights movement, Affirmative Action, and other significant social movements, there is still a very present minority in academia. History has placed a meaning on skin tone and visual appearance, and this meaning is reflected on society in many different ways. Studies have been done in an attempt to understand the effects that this reflection has on minority status individuals. In addition to stereotyping and discrimination, individuals have reported feeling marginalized and being of “token status” (Chinn, 1999; Malone & Barabino, 2008). This can affect the ways in which students participate in classroom settings, within the laboratory, among peers, and toward professors, as well as in other social situations. These social situations are important components that affect their success in STEM. However, because of the status of minorities, they are given an automatic disadvantage in both literal and psychosocial terms (Malone & Barabino, 2008). These pressures placed on minorities force an identity of a social race as opposed to a science identity.

Racial and ethnic stereotyping has been identified as one of the key contributors to the underrepresentation of minorities in STEM. It is a problem not only within colleges, but in primary and secondary schools as well (Chinn, 1999). Whether or not it is done consciously, schools, as well as teachers, have been found to be culprits of reproducing social stereotypes (Chinn, 1999). They label students, and therefore place them in unequal groups that not only limit educational resources for certain groups (Malone & Barabino, 2008), but also place students in a historically inaccurate world where race and ethnicity reflect academic ability. This, therefore, reinforces the flawed notions of what race and ethnicity mean. More specifically, it has created an imbalance in special education classes and preparatory classes. Special education classes are being an overrepresentation of minorities, as well as a cause in the higher rate of failure in STEM fields for minorities (Chinn, 1999; Treisman, 1992). Further implications can be seen in the identity development of minority students. Ultimately, this affects not only the success rates within these fields, but also the decision to enter one of these fields in the first place (Syed, 2010).

The Current Study
Identity theory provides an important theoretical framework in understanding the roles of identity and its salience for students in STEM. It is important for students to identify as scientists to be successful within these fields. However, research shows how this identity may be affected for underrepresented students due to factors like stereotyping, marginalization, and being of “token status”. It is, therefore, important to identify factors that promote identity as a scientist in underrepresented students. Thus, the current study aimed to provide some insight into the following research question: Does participation in an academic outreach program have positive implications for underrepresented students’ identity as a scientist? This research question was considered in a sample of undergraduates who attended a research conference. Data analysis focused on responses to a prompt about the conference. Using thematic analysis, significant categories were formed to better organize and analyze the data.

METHOD
Participants
The participants in this research consisted of undergraduate students from colleges and universities across the United States. These students attended the 2010 Society for the Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS) conference. There was a total of 124 participants in this sample, where 55% reported being first-generation college students. In terms of ethnic identity, 71% of the students identified themselves as a member of at least one underrepresented group, i.e. did not identify as White or Asian American. Finally, of the 124 participants, most of them were in pursuit of biology (38%), math (11%), biochemistry (10%), chemistry (9%), and computer science (5%). The data for this research was collected after the SACNAS 2010 conference. This society is geared toward encouraging students of Hispanic, Chicano, or Native American backgrounds with an interest in science to continue their education and become leaders in the science fields. As well, through their programs and national conferences, they hope to
aid in creating more equality within the science fields. It is, specifically, the national conference, which will be the focus of this study. The SACNAS conferences offer students opportunities for professional and leadership development, mentoring, networking, and scholarship opportunities, as well as attending an academic exhibit for research, graduate schools, and job opportunities. Moreover, students can participate or sit in on research presentations by professionals and other students, listen to experiences and lectures by keynote speakers, as well as enjoy the cultural atmosphere through activities and performances (http://sacnas.org/).

**Procedure and Qualitative Coding**
Participants were given a prompt to respond to at the end of the SACNAS 2010 conference. The prompt asked the following: “Please think back to the SACNAS 2010 research conference and write a few sentences about the experiences at the conference that you perceived to be especially beneficial.”

Participants’ responses were later transcribed into an Excel spreadsheet and coded using Braun and Clarke’s (2006) guide to thematic analysis. After analyzing a large selection of responses, several themes became evident. These themes were then described in detail in a coding manual. This coding manual was then used by two other individuals to test for reliability. These individuals were largely unfamiliar with the goals of this research. They coded a random selection of 19 responses. In comparing the three sets of coding, I found differences with the coding of the reliability testers and myself. To adjust for this, I modified the manual accordingly by defining each category more specifically. Using this modified manual, the remaining responses were coded based on these six significant categories.

**RESULTS**

The data consists of a total sample of 124 narrative responses that were analyzed using thematic analysis (Braun & Clarke 2006). It was coded into six meaningful categories which were later combined into four due to the similarity of the themes: (1) motivation/inspiration and future endeavors, (2) networking and connecting with other students, (3) others’ experiences, stories, and lectures, and (4) race/ethnicity and disadvantaged backgrounds. The original six themes separated motivation/inspiration and future endeavors, as well as networking and connecting with other students.

**Motivation and future endeavors:** The coding for this theme included 86 responses that mentioned motivation or inspiration. It was later combined with another theme to include individuals that mentioned reaching their future goals, including professional careers, continuing their education, or their pursuit in academia. Ultimately, this theme revealed the interest these students showed in continuing their education and foreshadowed their potential success in STEM. Sample responses include:

“The exhibit hall was the best experience during the conference weekend. I met so many representatives and expanded my networking… This conference provided an overwhelming amount of information that is very helpful towards my future endeavors in academia. Now I know that I have unlimited options in graduate school and I plan to take this information and apply it to my future goals.”

“I think one of the most beneficial parts of any scientific conference is the exhibition, where various universities and research institutions basically try to convince you to attend their institution/program. One particularly good experience I had was at the University of Dayton booth, with Dr. David Alcalá, who directs a post-baccalaureate program… That he is really interested in me makes me feel I can go out and compete. And, realistically, I think going into a science career can be really intimidating starting out, so conferences, such as SACNAS help in that they provide a support system and sincere encouragement.”

**Networking:** This theme included 62 responses that mentioned academic networking opportunities with professionals, including scientists, professors, doctors, mentors, exhibitors, and representatives. As well, this theme was combined with responses that included individuals who mentioned meeting and connecting with other students at this conference. This theme is useful in understanding science identity and its salience as the individual is surrounded and talking to others with similar identities. Also, as evident in the literature, support from professionals of similar identities is helpful in the success of students in STEM fields. Sample
responses to this theme include:

“I felt that I could connect [with] my peers. I felt that I was supported and that around me were other successful Hispanics that would be my future colleagues. I left the SACNAS conference feeling inspired.”

“This was my first experience at research and graduate studies in whole. It gave me an opportunity to see what other students have done, to ask questions, and, above all, learn what I could accomplish. There is probably not one name I could mention, since many of the staff and students helped me answer the questions that I wanted to know [the answer to]. I expect to use what I learned and experienced at SACNAS to better my studies, assert my future, and, above all, accomplish the goal of entering a graduate program.”

Experienced others: This theme included 37 responses that mentioned experiences, stories, and research by other individuals. This theme can be analyzed to look specifically at how this affected the student and whether or not this encouraged or motivated the students in pursuit of their goals. Also, as with the former themes, the ways in which it brings about the salience of their identities. A sample response to this theme includes:

“This wasn’t a particular event. It was the stories some of the professors had to share. Many of them came from such poor backgrounds; their parents were immigrants with little education and very little money. These stories were very empowering and humbling. I see their stories as motivation to succeed.”

Disadvantaged Backgrounds: This theme included 32 responses, which mentioned anything about race, ethnicity, background, and hardships of not only themselves, but also of all other individuals, including students, professors, and speakers or presenters. These responses will help in understanding whether or not the individual felt that this conference for Hispanics/Chicanos and Native Americans is supportive, encouraging, and empowering for their own pursuit in STEM. Some sample responses include:

“The most powerful experience I had at the conference was just being surrounded by so many students, faculty and staff of color. It was inspirational to be around these people and hear them talk about their journey[s] and how [they are] succeeding in science despite how hard it is to be a successful person of color in the science fields.”

“... Being a Mexican woman in science can be difficult, but this conference always seems to keep me motivated. I meet people who have overcome adversity and are doing amazing things. It inspires me to do more and never settle for less...”

CONCLUSION/FURTHER STUDY

The themes of this study highlight the role of identity in STEM. More specifically, it allows one to examine the positive effects of this conference on students’ identity as a scientist. Networking and meeting other students of similar ethnic and racial backgrounds show students that they are not alone, that there are others like them in pursuit of similar goals. Students also see professionals in their fields of study who identify with similar backgrounds, have dealt with hardships, or have been disadvantaged in society. This experience allows students to connect with other individuals and their science identity to become more salient. Moreover, the most prominent theme of motivation and future endeavors show the ways this conference has helped students’ enthusiasm and interest to continue the pursuit of their goals as professionals in STEM related fields.

Future research is necessary to get a more detailed understanding of the importance of identity as a scientist. As for this study, it is in its preliminary stages reliability testing. The thematic coding process was tested by two other individuals and the coding manual was altered after such testing. This manual was used to code, analyze, and interpret the data for this paper. This research would benefit from more formal inter-rater reliability testing. Additional directions for this research could include a longitudinal study on the students who participated. One could design a study to compare the individuals who attended the SACNAS conference or similar event to a group of students who did not attend such an event. Another possible direction would be a more ethnographic study of the students while they are at the conference. This paper examines a self-reflection of the students after the conference, so a closer observation of how the individuals behave, interact, and relate with one
another during the conference would be an interesting study to pursue. Ultimately, there is a countless number of ways to continue this research and further our understanding of the role that identity has on students and their success in academia.

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RACIAL DISCRIMINATION AND THE DEATH PENALTY: AN ANALYSIS OF THE UNITED STATES’ JUDICIAL SYSTEM

BY JESSICA RECAREY

ABSTRACT:
Racial discrimination is apparent in almost every aspect of society, including death penalty sentencing. This research seeks to understand and analyze the historical roots and scholarly research addressing race and the death penalty in order to understand any demonstrable link between the two. In order to analyze any correlation between race and the death penalty, this study will include a literature review covering many aspects of the subject, ranging from the historical context, to discussions of studies done analyzing the correlation. Following this review, an analysis of both published literature and current death penalty statistics augment the discussion of the death penalty.

INTRODUCTION AND PURPOSE OF THE STUDY
Racial discrimination within the United States has always been present, moving from the overt discrimination of the Jim Crow laws to more ambiguous discrimination occurring in modern times. When studying the American judicial system, one must remain cognizant of the racial discrimination that impacts judicial processes. In order to understand this impact, one must analyze certain key factors regarding racial discrimination in the judicial system. Racial discrimination and the death penalty have both a historical and statistical correlation, especially when analyzing African Americans and the implementation of this punishment. Historically, statutes and laws imposed the death penalty far more often on African Americans than whites. In modern times there have been movements to address this historical discrimination, leading to the enactment of certain legislation that attempt to lessen the historical arbitrariness of this punishment. However, while these acts have been beneficial, there still remains observable discrimination in the application of the death penalty.

This possible discrimination has been studied and analyzed in the past, with the most renowned study being that done by David Baldus and his
team in 1983. Following this study, scholars have analyzed and written on the impact of the study, racial discrimination, and the constitutionality of the death penalty in general. This research will focus on analyzing the historical context of the death penalty with regard to race, the Baldus study and its aftermath, and the major court cases that have impacted the death penalty as a punishment. The purpose of this study is to provide an overview of race and the death penalty within socio-political and historical lenses and further augment this discussion by providing an analysis of possible future outcomes of the death penalty within the United States.

LITERATURE REVIEW

Literature regarding discrimination in the United States is expansive, analyzing discrimination in its many forms. When analyzing the judicial system, more specifically the death penalty, racial discrimination seems to be present. From the United States’ inception it has had a peculiar adaptation of this punishment, which has historically targeted African Americans. Scholars have analyzed the historical underpinnings of the death penalty with regard to racial discrimination and have conducted several studies examining the correlation between the American judicial system and racial discrimination. Marvin Wolfgang conducted the first major study about the death penalty and race, which was used in the court case Maxwell v. Bishop (8th Cir. 1968). However, one of the most renowned death penalty and race scholars is the late David Baldus, who conducted several research projects on the subject. His study, “Comparative Review of Death Sentences: An Empirical Study of the Georgia Experience,” was most notably used in the Supreme Court case McCleskey v. Kemp 481 US 279 (1987). Following this study, many scholars have analyzed the impact of Baldus’ work, as well as the impact of the Supreme Court’s ruling in the Kemp case. In his study, Baldus found a correlation between the death penalty and the race of the victim, and he argued that Georgia’s comparative review system for death penalty sentencing was flawed. Further, other studies have been conducted by scholars analyzing the influence of race on death penalty sentence in other counties, such as Scott Phillips’ research of Harris County, Texas death sentencing.

Historical Underpinnings

The historical underpinning of the United States’ legal system has impacted the application of the death penalty on African Americans. The death penalty has historically been implemented against African Americans more often and for lesser crimes than whites. Charles Ogletree uses the case study of United States v. Shipp to describe the country’s history of lynching. During the early 1900s, Ed Johnson, an uneducated African American was wrongfully accused of raping a white woman. His trial did not follow procedure, and an all-white jury convicted him of rape and sentenced him to be lynched. Following this verdict, there were two African American lawyers and a white Supreme Court justice who attempted to step in and save Johnson from being wrongfully executed. The team was able to have Supreme Court Justice Harlan issue a stay of execution in wake of an appellate review. Unfortunately, their efforts were in vain, since Johnson was lynched by the sheriff of the town and the townspeople following the court mandated stay. The Sheriff was convicted of contempt of the Supreme Court, but he only served a few months of incarceration. Using this case study, Ogletree demonstrates how the race-based lynching that occurred during the 1800s and 1900s was done regardless of legality and illustrates the correlation between race and the death penalty that occurred during this time.

Between 1882 and 1968, about 5,000 lynchings occurred (Ogletree 2002 pp 21). Ogletree argued that “lynching was an expression of racism and racial discrimination,” citing sociologist Gunnar Myrdal who “suggested that lynching was a tool used to maintain racial caste distinctions and to keep blacks in a position of subjugation” (Ogletree 2002, pp. 21). To further expand his argument that lynching was a racist act, he attempts to connect this history with current death penalty patterns. Ogletree discusses the “recreational aspects” of lynching, comparing the lynch mobs with 1,500 journalists applying to “witness Timothy McVeigh’s execution” (Ogletree 2002, pp. 22). Essentially, Ogletree argues that modern society still views these executions as recreational to a certain degree.

Currently, some scholars argue that “racial discrimination has been the single most troubling issue for the death penalty in the United States in the past fifty years” (Gross 2012 pp. 1907). With this context in mind, it is understandable why the NAACP Legal Defense and Education Fund began their mission in 1965 to abolish the death penalty.
for all crimes, but this mission predominantly began due to "their deep experience with racial discrimination in the use of the death penalty in the South" (Gross 2012 pp. 1908). The death penalty is argued to be in violation of the Eighth and Fourteenth Amendments. The Eighth Amendment states that no "cruel and unusual punishments" will be "inflicted" (U.S. Const. amend. XVIII), as death is considered by many to be cruel and unusual.

Further, the Fourteenth Amendment states:

No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws (U.S. Const. amend. XIV).

This equal protection clause within the Fourteenth Amendment is applicable to the death penalty and racial discrimination, as will be seen in coming sections, but the contentions regarding race and the death penalty began far before the aforementioned Baldus study.

Marvin Wolfgang conducted the "first major empirical challenge to racial discrimination in the use of the death penalty in the United States" in the 1966 8th circuit case of William L. Maxwell (Gross 2012, pp. 1906). Maxwell was convicted of "raping a 35 year old, unmarried white woman" in Arkansas in 1962 and sentenced to death (Maxwell v. Bishop). He challenged his death sentence by arguing that "certain Arkansas statutes…dealing with the crime of rape and the punishment imposed therefor have been applied unconstitutionally to Negro men convicted of raping white women…" (Maxwell v. Bishop). Wolfgang collected data on about "3000 rape convictions from 1945 through 1965 in selected counties across the southern states," finding that "black men who were convicted of rape were seven times more likely to be sentenced to death than white men, and that black men who were convicted of raping white women were eighteen times more likely to be sentenced to death than men convicted of rape in any other racial combination" (Gross 2012, pp. 1906). Regardless of the statistical results presented, Wolfgang's study was rejected by the Eighth Circuit for three specific reasons. First, "the data were not specific enough; too few cases came from the county in which Maxwell was prosecuted or even from Arkansas at all" (Gross 2012 pp. 1906).

Second, "the data were not sufficiently detailed," meaning that not every variable was taken into account (Gross 2012 pp. 1906). Finally, "the study [did] not show intentional discrimination in Maxwell's case; they [did] not show that the petit jury which tried and convicted Maxwell acted in his case with racial discrimination" (Gross 2012 pp.1906). However, the Supreme Court did grant certiorari to the "Eighth Circuit's decision in Maxwell and reversed on an unrelated issue without mentioning race" (Gross 2012 pp. 1907). This pattern of rejecting race related questions continued in the Supreme Court case of McCleskey v. Kemp 481 US 279 (1987), which is the focus of most contemporary literature regarding race and the death penalty.

In 1972, the Supreme Court ruled that the death penalty statutes were in violation of the Eighth Amendment Cruel and Unusual Punishment Clause in Furman v. Georgia (Gross 2012 pp. 1908). The five-four decision was contentious, as all five concurring justices wrote their own opinions. However, Furman v. Georgia set the "guidelines for redrafting state statutes on capital punishments" in order to prevent the arbitrariness of past state statutes (Tatalovich 2011 pp. 53). These guidelines were: "1) have the support of the substantial majority of the people in the state; 2) provide statutory guidance and direction so that the decision to use the death penalty would not be made by jury or judge arbitrarily or capriciously; and 3) apply only to the most severe crimes and not to those crimes where the sentence of death would be grossly disproportionate and excessive punishment" (Tatalovich 2011 pp. 53). The ruling in Furman did not hold that the death penalty itself was unconstitutional, but that some of the state statutes governing the death penalty could be viewed as cruel or unusual; therefore, by providing the above-mentioned guidelines, they allowed states to restructure statutes to make sure they were in compliance with the Court's decision (Tatalovich 2011 pp. 48).

The Furman decision is "understood to prohibit the arbitrary imposition of the death penalty;" however, racial discrimination was mentioned in three of the justices' opinions (Gross 2012 pp 1908). Justice Douglas stated:

"It would seem to be incontestable that the death penalty inflicted on one defendant is
‘unusual’ if it discriminates against him by reason of his race, religion, wealth, social position, or class, or if it is imposed under a procedure that gives room for the play of such prejudices” (Furman v. Georgia 408 US 238 (1972)). Justice Douglas clearly states that discrimination of any kind in death penalty procedures is unusual and contentious. But while racial discrimination within the death penalty was addressed within the Furman decision on several occasions, the future dispute would be the definition of racial discrimination and if discrimination did in fact occur within the specific case at hand (Gross 2012 pp. 1909). As indicated in Maxwell, the Court often avoids addressing the issue of racism in future racial discrimination and death penalty cases.

In 1976, four years after the Furman decision, another monumental decision regarding the death penalty was made in Gregg v. Georgia and its accompanying cases. The Court held that "the newly revised death penalty statutes were now constitutional," allowing for the death penalty to begin functioning again by January 1977 (Tatalovich 2011 pp. 48). In Gregg, the Court found that the new standards for the implementation of the death penalty were objective "to guide, regularize, and make rationally reviewable the process by which the death penalty was imposed and these state policies became the model" for the rest of the states rewriting their death penalty statutes at that time (Tatalovich 2011 pp. 53). This decision overturned Furman, allowing the death penalty to begin again as long as it met the set guidelines.

The Baldus Study
David Baldus, Charles Pulaski, and George Woodworth conducted a large scale study titled "Comparative Review of Death Sentences: An Empirical Study of the Georgia Experience." This study discusses the significance of "comparative sentence review," also known as "proportionality review... [which is] a procedure by which a court determines whether a death sentence is consistent with the usual pattern of sentencing decisions in similar cases or is comparatively excessive" (Baldus et. al. 1983 pp. 663). A sentence would be determined to be "comparatively excessive" if, when compared to other cases with similar fact patterns, sentences other than death were prescribed within the same jurisdiction (Baldus et. al. 1983 pp. 663). It is pointed out that the Supreme Court "has suggested that proportionality review can be an important protection against arbitrary and capricious death sentences" (Baldus et. al. 1983 pp. 664). Ultimately, Baldus’ study’s "objective was to evaluate the effectiveness of the Georgia Supreme Court’s system of comparative sentence review" (Baldus et. al. 1983 pp. 679). The study states three reasons as to why the state of Georgia was specifically chosen for the study:

First, the Georgia statute has served as a model for many other states. Second, in Gregg v. Georgia, in the course of deciding that the Georgia Statute was constitutional on its face, the United States Supreme Court repeatedly stressed the requirement of a comparative sentence review in every death penalty case as a mean of preventing arbitrary, capricious, or discriminatory death sentences. Third, because the Georgia statute has operated for a substantial period of time and because both homicides and capital convictions occur in that state with relative frequencies, it offered sufficiently numerous data to permit the use of statistical tools.... (Baldus et. al. 1983 pp. 672).

Baldus and his team described the methodology of the study in detail, as it was argued that "the validity of the methodology used to identify potentially excessive sentences is central to the credibility of [their] conclusions" (Baldus et. al. 1983 pp. 679). Although Baldus and his team state that their methodology is "more comprehensive and systematic" than any of the methods used judicially at the time, they still contend that their results are to be considered "prima facie" (Baldus et. al. 1983 pp. 680). The team used two distinct data sets, one consisting of "150 pre-Furman murder defendants tried and sentenced by a jury between January 1, 1970 and September 29, 1972" and the second consisting of "594 defendants tried and sentenced for murder under Georgia’s post-Furman death-sentencing statutes" (Baldus et. al. 1983 pp. 680). Within the first data set, twenty of the defendants were sentenced to death, and in the second set there were "203 penalty trials with 115 death sentences imposed upon 100 different defendants" (Baldus et. al. 1983 pp. 680).

Once the researchers compiled the data set, they imposed seven measures in order to measure comparative excessiveness. Three "were modeled after the methods used by state supreme courts...
and the final three measured "system-wide excessiveness from different perspectives" (Baldus et. al. 1983 pp. 681). The first was the "salient factors method," with salient factors being the characteristics of the case that "seem most likely to have affected the jury’s decision" (Baldus et. al. 1983 pp. 681). The second was the "main determinants method," defining "similarity in terms of those factual characteristics which, in general, appear to influence the sentencing decisions most significantly" (Baldus et. al. 1983 pp. 684). The third was the "index method," which "classified cases as similar in terms of a single criterion—the probably in each case that the defendant will receive a death sentence" (Baldus et. al. 1983 pp. 689). In order to calculate the probability of a defendant receiving the death penalty within the third method they used a multiple regression analysis.

The three following measures are the system wide measures of comparative excessiveness. The first is the "legislative criteria measures," which classify cases as similar if: "(1) all cases in which the same statutory aggravating circumstance is present and (2) cases in which an equal number of statutory aggravating circumstances is present" (Baldus et. al. 1983 pp. 693). The second was "regression-based scales" developed "using the cases of all defendants convicted of murder at trial during the pre- and post-Furman periods" (Baldus et. al. 1983 pp. 694). They grouped the post-Furman cases into eight sub-sets and clustered them "according to the predicted likelihood" of a death sentence verdict (Baldus et. al. 1983 pp. 694). The third measure was to evaluate the excessiveness levels defining excessiveness "if other defendants with factually similar backgrounds received the death penalty only infrequently for committing factually similar offenses" (Baldus et. al. 1983 pp. 695).

Using these measures, Baldus and his team found many results within Georgia’s Supreme Court death sentencing comparative sentence review. A significant result of the study was finding which types of cases prosecutors choose to "forego a penalty trial" (Baldus et. al. 1983 pp. 706). They found that "when penalty trials do occur, Georgia juries impose death sentences in fifty-five percent of cases..." (Baldus et. al. 1983 pp. 706). However, there was a finding that Georgia did have a lower death-sentencing rate, but the study found that this reflected the lower "death sentencing rate in black victim cases" and the higher death sentencing rate in white victim cases (Baldus et. al. 1983 pp. 709).

Baldus and his team’s study resulted in several distinct findings. One finding is that when analyzing the death-sentencing system of Georgia using their measures, it could be identified as "presumptively excessive (Baldus et. al. 1983 pp. 728) (what could be presumptively excessive?). Ultimately, they argue that their data "suggested that Georgia’s death-sentencing system has continued to impose the type of inconsistent, arbitrary death sentences that the United States Supreme Court condemned in Furman v. Georgia and that the sentence review process failed (Baldus et. al. 1983 pp. 750). With these findings, they question whether or not this system was operating "in the consistent, evenhanded manner required by the Eighth Amendment” (Baldus et. al. 1983 pp. 750).

When analyzing discrimination within death penalty sentencing in the United States, one can see that most contemporary literature focuses on the previously discussed Baldus study cited in the Supreme Court case McCleskey v. Kemp 481 US 279 (1987), in which the Court held that “the statistical evidence [from the Baldus study] was insufficient to support an inference that any of the decision makers in the accused’s case acted with discriminatory purpose in violation of the equal protection clause...” (McCleskey v. Kemp, 1987). The court also stated that "at most, the Baldus study indicates a discrepancy that appears to correlate with race, but [that] the discrepancy does not constitute a major systematic defect," further illustrating that “the Baldus study does not demonstrate that Georgia capital sentencing system violates the Eighth Amendment” (McCleskey v. Kemp 481 US 279 (1987)). Following this 5-4 decision, many scholars have analyzed the impact the Kemp decision has had on the legal system with regard to racial discrimination and the death penalty. This decision parallels the court’s attitude in Maxwell essentially stating that the 1983 Baldus study’s statistics, even if valid, could not be applied specifically to the case at hand. Justice Powell delivered the opinion, arguing that the question at hand is "whether a complex statistical study that indicates a risk that racial considerations enter into capital sentencing determinations proves that petitioner McCleskey’s capital sentence is unconstitutional under the Eighth or Fourteenth Amendment” (McCleskey v. Kemp 481 US 279 (1987)).
Recent Scholarship
Scott Phillips conducted a study from 1992 to 1999, analyzing death penalty and race in Harris County, Texas. This county is "arguable the capital of capital punishment," and Phillips examined "whether race influenced the District Attorney's decision to pursue a death trial or the jury's decision to impose a death sentence against adult defendants indicted for capital murder" (Phillips 2008 pp 809). This study has a far more narrow scope than the Baldus Study, as Phillips only analyzed one specific county and only those defendants who were indicted for capital murder. Phillips argued that while his study was narrow in scope and could not be generalized throughout the country, no death penalty study can be generalized throughout the country due to the vast differences among states and counties. His findings are interesting, as they do not fully focus on the race of the victim, but they also found that the race of the defendant is relevant.

Phillips results suggested that the death penalty sentence in Harris County was impacted by race. He found that Hispanics and whites were treated equally, while blacks and whites were not. Phillips found that the conditional probability of "juries imposing a death sentence is: .23x=.17/23; x=.74" (Phillips 2008 pp 836). In order to simplify this, Phillips used a hypothetical that 100 black defendants and 100 white defendants were indicted for capital murder. Out of those 100 black defendants, the "DA would pursue death against 23" and the "jurors would impose death in 74% of cases, so 17 black defendants would be condemned" (Phillips 2008 pp 837). Out of the 100 white defendants, the DA would seek to impose the death penalty against 15 of them and "the jurors would impose death in 80% of the cases, so 12 white defendants would be condemned" (Phillips 2008 pp 837). Using this scenario, Phillips argued that this would mean that 5 black defendants would be sentenced to death due to race. To further his race argument, Phillips also took into account the race of the victim. Using the same hypothetical, he found that ultimately 5 defendants would be sentenced to death due to their victim being white (Phillips 2008 pp 837).

SUMMARY OF LITERATURE REVIEW
Essentially, literature regarding the death penalty and its correlation with racial discrimination illustrates the problematic nature of this punishment. The history behind the death penalty’s targeted focus begins with the country’s lynching obsession, in which sheriffs ignored the Supreme Court’s authority. Following this inherently biased punishment, studies were conducted in order to illustrate a correlation between the death penalty and race. Studies were also conducted in order to analyze the judicial system’s arbitrariness in administering the punishment. David Baldus and his team ultimately questioned Georgia’s death sentencing comparative review system and its constitutionality under the Eighth Amendment. While Baldus and his team’s research was intricate in its methodology and findings, the Supreme Court choose to not apply it to the McClesky case illustrating the Court’s pattern of disregarding statistical evidence as justification, as was done in Marshall previously. More recent studies have been done, such as Scott Phillips’ study regarding the death penalty and race in Texas. Phillips found that there was a correlation with race and death penalty verdicts within this Texas County, further augmenting the argument that the death penalty is applied arbitrarily.

METHODOLOGY
The methodology used within this research relies heavily on case studies and discourse analysis in order to gauge the relationship between the death penalty and race. Analyzing the discourse within the studies as well as the historical analysis regarding the death penalty and race is bolstered by the statistical data found regarding death penalty cases. The units of analysis used are the death penalty cases themselves with the intention of observing the affects that these cases have on the overall decision-making process of judges, juries, and the Supreme Court. The case studies and discourse analysis provides enough information in order make an argument regarding the death penalty’s arbitrary application.

ANALYSIS
The historical context and the work of previous scholars have shown that there is a correlation between race and the death penalty. When analyzing historical context, recent studies, and court cases one can see the dialectical process in which the death penalty has become far less applicable in today’s society. Ultimately, the arbitrary nature of this punishment is not in accordance with the Eighth Amendment, and former Supreme Court Justices have historically agreed.
Historically speaking, the death penalty was implemented on African Americans far more often and for lesser crimes than whites. From lynch mobs to trials, society not only allowed, but seemed to encourage, the state-issued death of African Americans during the 1800's and 1900's. The southern states were major contributors to executions, accounting for over 90% of the executions performed throughout the country (Ogletree 2002 pp 19). In order to fully understand the how the death penalty is often arbitrary with regard to race, one must analyze the problematic historical roots of the United States. Understanding that the country began with racist ideologies and following the country’s progression into the present allows one to argue that racism has not been fully eradicated. As humans have biases that impact their actions, one must remain aware that district attorneys, judges, jurors, and even researchers have their own biases. The courts are not infallible, especially with regard to the death penalty.

Currently, society seems to be moving away from the death penalty. While “35 states and the Federal Bureau of Prisons held 3,033 inmates’ with death sentences in 2012, this number is down 32 from 2011—the twelfth consecutive year that a decrease has occurred (Snell 2014 pp 1). While 35 states house inmates with death sentences, in 2013 only nine states participated in executions of inmates (Snell 2014 pp 3). The states performing these executions are accountable for almost three-quarters of the executions done. These states are as follows: Virginia, Georgia, Alabama, Arizona, Missouri, Ohio, Oklahoma, Florida, and Texas (Snell 2014 pp 3). These states are considered the Death Belt states, and the majority of them are located in the South. It is important to note that these are the same states that fought against civil rights and desegregation. When analyzing the statistics while simultaneously keeping the historical dialectic in mind one is able to see the legitimacy of the argument that the death penalty is applied arbitrarily.

CONCLUSION OR FURTHER STUDY
Racial discrimination within the death penalty is an incredibly contentious subject that continues to stir debate. With this in mind, it is imperative to remain vigilant about the issue in the upcoming years. The Supreme Court is moving towards an acceptance of statistical data within cases, a trend that was previously unheard of, as demonstrated within this research project. It would be interesting to analyze the Supreme Court’s current composition and leanings regarding statistical data. Using this analysis one could hypothesize that if a similar case to Kemp were to be introduced today whether the Court would accept the legitimacy of the data consequently dismissing the charges and declare the punishment unconstitutional. Further, scholars such as Phillips studying race and the death penalty are calling other scholars to do the same. There is far more statistical data that must be acquired in order to fully develop and understand the issue. It does seem that the death penalty is currently implemented in an arbitrary manner, even after the Supreme Court attempted to mediate this issue decades ago.

CITATIONS:


Furman v. Georgia 408 US 238 (1972)


AUTISM AND COMPUTER ASSISTED LEARNING

BY SHAE SILVER

ABSTRACT

Autism is a learning/social disorder that is gaining in frequency within our society. As educators grapple with overwhelmed, understaffed classrooms, finding ways to address the educational needs of this particular population can be very challenging. However, technology continues to create alternative “virtual” world opportunities are beginning to open up as learning tools for these students. This literature review is to examine how computer assisted instruction is helping teachers in the classroom to improve the literacy rates of autistic children.

Today’s technological advances are taken for granted as part of most people’s lives. As humans take quantum leaps in this realm, it presents the opportunity to assist those for whom social interaction is an impassable moat. If technology can be constructed in such a way as to allow these individuals a path to overcome this isolation and indeed improve their educational skill levels in academia, social, life, and career, would that then be a viable option? As the incidences of Autism Spectrum Disorder become more frequent, these types of questions take on a more pressing nature. Educators, parents, and underfunded schools are looking into the multitude of ways that this population of students will be able to gain a better education. Computer assisted technologies include desktop, laptop, and mobile device applications that build virtual reality platforms upon which the children are able to expand their knowledge. By interacting with these platforms the children are not faced with the typical stigma of isolation that previous generations endured. The following is an examination of five journal articles that highlight how the trends in education are changing.

Autism Spectrum Disorder most commonly used under the umbrella term of simply Autism covers a population that exhibits particular characteristics that make a traditional learning environment inadequate in the sense that the children do not get the attention they need to succeed. The Diagnostic and Statistical Manual of Mental Disorders, 5th Edition, also more commonly referred to as the DSM, states that “... people with Autism Spectrum...
Disorder (ASD) tend to have communication deficits, such as responding inappropriately in conversations, misreading nonverbal interactions, or having difficulty building friendships appropriate to their age…” (Association, 2013). In a classroom this can make educating the students a difficult task. In examining the current trends the focus is on whether or not computer assisted instruction (CAI) is effective in educating this population. This paper will review five current studies that address teacher led interventions and computer assisted instruction for students with literacy competency issues remarkable to the Autism Spectrum.

The first research study is, Emergent Literacy Skills of Preschool Students with Autism; A Comparison of Teacher led and Computer Assisted Instruction, that addresses the literacy skills among preschool students with autism (Travers J., 2011). Literacy is the foundation for future academic success, job security, and the ability to live an independent life as an adult. The question the research asked is whether or not students at the preschool level would be able to learn the alphabet better with teacher led intervention or by learning on a computer. This particular study was restricted to a small number of participants (N=17) that were between the ages of 3 and 6. All the students were tested prior and post using the Brigance Diagnostic Inventory of Early Development 2 to determine each student's level of comprehension and letter recognition skills. There were a total of five tests that the students were subjected to: pretest, posttest, and three maintenance tests. All were required to be able to sit in a chair for assessment, be able to use a mouse to click various instructional cues on a computer, and have been assessed for special education services for autism.

The students were exposed to teacher –led interventions using books that utilized chapters with large letters and distractor letters. The teachers would read each book ten minutes a day, four times a week for a period of one month. Following each reading the teachers would ask the children one by one to identify the target letter. Positive reinforcements were given in the form of nonverbal cues (high fives) and verbal cues. If a student did not identify correctly or took too long, they were reintroduced to the material and questioned again. Negative reinforcements were not a part of this study.

The CAI (computer assisted instruction) software program was specifically designed for this study. It encompassed learning the alphabet in a way that was similar to the teacher-led intervention. The children were given ten minute sessions that showed the target letter and provided games to reinforce the letter. During the ensuing weeks the children were required to discriminate between numerals/letters and current/previous letters respectively. The CAI provided reinforcement in the form of visual stimuli, sound effects and games. As with the teacher-led interventions, CAI was presented to the students four days a week, in ten minute sessions for one month.

The results of this study showed that students were able to increase their letter recognition significantly if exposed at an early age. The improvement did not lean in one direction or the other. By introducing the children to these interventions in preschool the ability for them to overcome some of the communication delays were important in their ability to form coherence when it refers to literacy. The study recommended longitudinal studies of students with autism who were exposed to a more comprehensive learning base that not only addressed the behavioral issue but also the cognitive aspects in conjunction with each other. Being aware of how literacy impacts a student’s success inclusive of behavior may indicate a key to future academic success.

The second study, Effects of a Computer Based Early Reading Program on Word List and Text Reading Skills in a Student with Autism, a much smaller study with important significance in terms of the software used. The student was introduced to CAI by the name of Headsprout Early Reading computer program that is designed to improve a student’s ability to acquire early reading skills. This particular program targets the five core elements of reading which include phonemic awareness, alphabetic principle, oral reading fluency, vocabulary, and comprehension (Whitcomb S., 2011). This student prior to this demonstrated an inability to independently decode or read without partial verbal prompts. With the prompts he was able to obtain a range from 40 – 100%. He was also exposed to Word Attack Skills Test where he read with a 27% accuracy. (Whitcomb S., 2011)

The instructors presented him with seven sessions of progressively difficult word sets using the CAI.
The lessons average twenty minutes and the student was given an opportunity to repeat the first five lessons twice. The data presented shows a slow arc of improvement from 80 -100 in the lower lesson number sets of 1 -3. The dramatic improvement is shown in word set 4. This word set is of higher difficulty than the previous sets. This student went from 0% to 78%. This is a marked improvement that demonstrates greater understanding is growing.

The second part of this study focused on reading improvement. Again, this student was presented with lessons that ranged from 1-4. There were five trials given for each lesson. The readers are based on mastery of the first 25 word set lessons. Over the course of the study the student improved from a baseline of 40% at the lowest to 100% for the highest with the average being in the 95% range.

The results of this study allow a window onto what is possible for students with autism. Integrating computer based systems with teacher led activities can improve the literacy of some students. Further studies with Headsprout Early Reading program on a larger scale may discount this finding or it could reinforce as a tool that bears fruit. Either way it is of note to speculate that these types of programs give the appearance of improvement for this population.

The study, Exploring Computer and Storybook Interventions for Children with High Functioning Autism, the idea of being able to use the CAI as a way to reinforce the reading comprehension of their students while the teacher was otherwise engaged was explored. (Armstrong T. K., 2012) This has the potential for being an essential tool in the tool box of teachers in overcrowded classrooms. The question presented had to do with comprehension of stories read and then the retelling of the story by the student to ensure an understanding (Armstrong T. K., 2012). The importance of being able to comprehend the material is paramount to a child’s success in later grades. Retelling the stories serves as a positive reinforcement for understanding the material presented.

There were 5 children who participated in this study. All were male and in the second grade with IQ scores greater than 80. The interventions were randomized with storybook and CAI sessions. There were a total of 20 sessions per child with both written and oral directions presented to the children. This is a short study with the children experiencing intervention sessions two to three times a week.

The results of this study showed that both intervention types increased the children’s overall performance. However, it did not show that either one was better than the other. Theoretically, this type of setup would allow teachers to present material orally once and the children could use the CAI to reinforce the material. The limitations of this study were the small group and time constraints. Further exploration of this format could yield an overall increase in comprehension through the CAI.

The pattern that is emerging through these studies seems to indicate that CAI interventions do help, although it is limited in scope and study. In order for this to become a more effective tool there needs to be a broadening of applications as well as a unification of products available. By utilizing the very traits that make autism so challenging into a format that helps the children feel comfortable CAI has more than potential, it has a place in the classroom. From low to high functioning children with autism, learning to read through these interventions is proving very beneficial.

The next study, Using Computer Assisted Instruction and the Nonverbal Reading Approach to Teach Word Identification, is interesting for a number of reasons. The first is that it involves only females. All of them have difficulties in being able to speak; they must rely on technology boards in order to communicate. (Coleman-Martin M., 2005) The dual diagnosis of autism with other physical disabilities creates an opportunity wherein CAI could become an integral part in educating this population. Students who lack the ability to speak are causally impacted in their ability to read as they are unable to “sound” out words. The theory presented is without the ability to rehearse the words in a subvocal manner the brain may not be able to transfer the phonological code from short term to long term memory. This inability makes learning to read, comprehending what is read, and retaining the information for future use increasingly difficult, if not impractical in certain individuals. (Coleman-Martin M., 2005)

The design used both a teacher guided practice component of learning, Nonverbal Reading Approach, and Power Point guided slides to introduce new words to the students. Nonverbal
Reading Approach or NRA, is a technique in which the student is taught using internal speech for decoding a word. An example of this would be the word "snap." The teacher would say "ssssss," "nnnaaaapppp," "snap." Then, instruct the student to say these sounds along with their head. The teacher would present distractor words along with the target word asking the student to identify the target. This is a very time consuming technique that requires "systemic sequencing, drill-repetition-practice-feedback and systematic probing." (Coleman-Martin M., 2005)

Integrating a Power Point system with headphones, a student is able to practice the target words until they have reached a level of mastery. In this study, the teachers started with teacher only patterns, then teacher-CAI, and then CAI. The teachers were careful to study how many sessions it took for proficiency to be achieved under each condition. Frustration levels can become an issue for students that have limited vocal ability. The students and teachers reported a preference for learning from the CAI platform. The results indicate that the CAI only condition worked at a faster rate for the students. Two of the three reached mastery within two sessions compared double the time it took for teacher only. The teachers also commented on the ease with which the students took to the platform. This suggests that these students prefer to guide themselves, at their pace, to gain a deeper way of communicating.

The final article, State of the Art of Virtual Reality Technologies for Children on the Autism Spectrum, proved to be the most enlightening in this field. They write of the summation of changes that have occurred in the field of technology in regards to autistic children covering the years from 1994-2011. (Parsons S., 2011) The idea of "potential" versus "realization" was prevalent in this paper. It was noted that while technology itself has progressed quickly over the intervening time period, the empirical research has not. Very few studies have been completed and those that have were of insufficient numbers to be as critically relevant as other types of studies.

Parsons et al. noted of a technology created by Wallace et al. (Wallace, 2010) called the "blue room" in which participants are exposed to an immersive 3D experience without the use of headsets. This technology was designed to assist adolescents in navigating "....street, playground, and corridor scenes." The participants spoke of the experience being "life like" without any negative sensory effects. This has the potential to really assist not only students with autism but all students that have difficulty learning in a traditional environment those social skills that are integral in a democratic society.

Many students in a variety of studies expressed greater enthusiasm and motivation when using technology that used a ".... self-video condition in which the participants saw a video clip of themselves engaged in an activity." (Mineo, 2009) For students to be able to recognize themselves in a situation, that is more lifelike than a video game, assists them in being able to make that intellectual leap between fantasy and reality. Engaging these children in these environments, allowing them to see the behavior modeled, then going through these same situations requiring them to think through it again safely can save many lives. In a busy city crossing the street, or knowing how to get out of the way of a tornado in the countryside, are lessons of a paramount importance that is taken for granted among children of regular development. For children with ASD this is not an easy task. There is a level of difficulty in explaining to them why they must follow through on these actions. By using technology, this allows them to see the situation while still being safe gives them the requisite knowledge that cannot be expressed with words.

Parsons et al. surmised that based upon the limited research, children with ASD as well as those with other physical barriers, are benefitting from the use of technology. There is room for expansion as we engage these students in a greater variety of circumstances. From teaching basic lifesaving skills such as fire safety, crossing the road safely, and not getting lost, to basic academic skills, the demand for better computer assisted instruction technology is going to grow. The need for larger scale research, expanded applications, and participants that are willing to be part of these studies is increasing. Parsons et al. stressed the need to understand not only the technology but how we can best utilize the features to support learning outcomes.

**DISCUSSION**
By creating storylines that engage the children into a more developed state of understanding, CAI could overcome traditional barriers. The work with 3D headsets that allow the students to experience a
virtual world in which to practice skills is going to become a greater tool as the size of the equipment gets smaller. The work that Google glasses has already begun could be adapted to allow children with autism to be able to interact with the CAI in a way that is as of now unforeseen. The world is becoming digitized. In a way, this is really becoming a world in which the autistic person can find a place comfortably. The ability to interact within virtual reality to communicate in a platform that is familiar and non-threatening would allow this population to live a happier life than has been experienced in the past.

Parents of children with ASD struggle daily to be able to engage them in activities that enrich, teach, and bring safety. Modern technology is providing a growing number of tools that can be adapted for use within not only this population but many others as well. These children are pioneers in a time when most feel that there are no frontiers left. Empowering, engaging, and helping them to learn ways to interact in a world that makes sense for them is one of the last legacies academia, science, computer technology, and the corporate world can give them.

Training in skills beyond social and literacy in this capacity could provide a source of employment in the future for these individuals. The possibility of training computer coding and teaching them through this platform how to expand an imagination has the potential to provide a rewarding scenario of independence. The ability to see the world through a different perspective, one that is almost predisposed to a digital reality can greatly aid all of us in understanding how truly versatile and amazing are the abilities of others.

RECOMMENDATIONS

The studies that have been reviewed were very small and few. Overall there is so much more room for exploration, understanding, and expansion of knowledge. Creating software that is consistent from one classroom to another, across different school districts and even different countries could greatly enhance the results to provide a better understanding of how best to support these students. The technology to engage students in the classroom by CAI has been available for long enough of a time period that it should be better focused. Create story lines where the child can choose different paths to foster decision making, imagination, and creativity. Create virtual worlds that a classroom of children on their individual tablets can log into to work collaboratively to build something through exercises such as math or social science.

Children that experience autism have much to offer. By investing in platforms that cater better to the way they experience the world we will be able to assist them in sharing that world with us. The richness of their lives can bring important breakthroughs for all of us to experience. Ask these individuals what they think will work, use their ideas to help you create, and together a better classroom or boardroom can be created.

Collaboration between multiple disciplines will create a better environment in which all students, teachers, and ultimately society to benefit from. Children with ASD are enthusiastically engaging in the digital world. The current levels of flexibility, adaptability, and user friendly interfaces that are available at a relative low cost should spur increased research. The opportunity for discovery and the pursuit of additional knowledge is something we can embrace.

REFERENCES


GENDER PERFORMANCE IN WOMEN’S MIXED MARTIAL ARTS

BY LINDA TOMPKINS

ABSTRACT
Academic research has typically focused on men who practice Mixed Martial Arts and their expression of hyper-masculinity. There is a lack of comparative work which examines women who practice MMA as a sport. This article aims to address this oversight by exploring the meaning and importance of the sports for women. The main focus is to explore how women navigate and “perform gender” in the patriarchal sub-culture of MMA. Drawing on a “grounded theory” approach, semi-structured interviews, content analysis, and participant observation, I developed a preliminary model of female Mixed Martial Artist. I examine three female fighter “types” ("Feminine inclined female fighters," "Neutral female fighters," and "Masculine inclined female fighters") and explore different aspects of gender performance which helped to signify these. In my research I discovered that in MMA there is a “gender order.” Many times when the gender order is disrupted women seek to recreate it. This results in the adaptation and navigation of the three fighter types that I mentioned previously. I also found that on many occasions women “purposely perform” a gender type making it an “explicit performance.” My findings demonstrate the need to consider the range and diversity of women’s fighter types. Further research should elaborate on the process of constructing a “gender order” amongst women as well as the sociocultural expectations of female fighters. Other research should also investigate how “gender order” applies to other social worlds such as non-combat sports and other leisure activities, work and occupations, and everyday life.

INTRODUCTION
The purpose of this study is to explore how gender is constructed and performed by women who engage in Mixed Martial Arts. MMA has historically been a predominately male sport. Men who engage in MMA typically express their masculinity by exaggerating the symbols and behaviors that make up typical and stereotypical male behavior. Hyper-masculine expectations to be tough and aggressive are encouraged in the social world of Mixed Martial Arts. MMA is not considered a “feminine” sport—even by many women who
practice it—resulting in a lack of understanding of why women engage in such an activity. The study that is more closely related and most often referenced is West and Zimmerman’s 1987 study on “Doing Gender.” West and Zimmerman believe that gender is performative, therefore it is a routine accomplishment in everyday life, done in and through interaction and in the presence of others. Since gender is performative it creates differences between men and women. These tend to reinforce the presumed essentials of gender. West and Zimmerman state that gender is the activity of managing situated conduct in light of normative conceptions of attitudes and activities appropriate for one’s sex category. In the social world of Mixed Martial Arts those actions are not always clear. Women’s actions are often questioned, challenged, and redefined. Women must learn to navigate, negotiate, and balance two sets of expectations, those that define being a woman and those that define being a fighter. This is significant because it provides insight into understanding women’s experiences and the reasons why they choose to integrate themselves into this male-dominated sphere. It allows room to develop ideas on how gender and gender performance can be fluid in nature. This also allows for a range in diversity in women fighter types and creates an understanding of gender roles and expectations that can be applied to other “gendered” situations.

**HISTORY OF MODERN DAY MIXED MARTIAL ARTS**

Scholars have found evidence to show that combat sports and martial arts date back hundreds of years. From the age of the gladiators to ancient Chinese combat practices, the world of “fighting” has evolved into a modern day organized sport. Today the most recognized and prominent organization in the world of “professional fighting” is the Ultimate Fighting Championship (UFC). The UFC was founded on November 12, 1993 and featured top ranked “elite” male athletes that have had success in other types of combat competitions. The UFC brings competitors of different fighting disciplines, including Boxing, Brazilian Jiu-Jitsu, Wrestling, Muay Thai, Karate, Judo, and other styles, and is considered the start of Modern day MMA. In 1985, Strikeforce focused on the discipline of kickboxing, but made its transition to MMA in 2006. On August 2009, Strikeforce headlined Carano vs. Cyborg with Gina Carano and Cristiane Santos. This was the first time two women headlined a major MMA event. It took the UFC nine years to sign its first female competitor. In November 2012, three years after Strikeforce welcomed women to the sport, the Ultimate Fighting Championship announced that Ronda Rousey had become the first female fighter to sign with the UFC. Currently, the UFC is the largest MMA pay-per-view event provider, broadcasting in 50 different languages to over 149 countries (UFC, 2013). Invicta FC was then created in 2012 and was the first fighting company created specifically for female fighters.

**GENDER PERFORMANCE**

Separating sex and gender is essential for understanding gender performance. Sex is the biology, anatomy, hormones, and physiology that makes a person (West and Zimmerman 1987). Gender is an achieved status that is constructed through psychological, cultural, and social means. In their 1987 article “Doing Gender,” West and Zimmerman argued that it is best to think of issues of male and female and issues of masculine and feminine, in terms of sex, sex category, and gender. Sex, is “a determination made through the application of social agreed upon biological criteria for classifying persons as females or males” (West and Zimmerman, 1987). Sex category, then, is achieved through application of the sex criteria, but in everyday life, categorization is established and sustained by social identity displays that proclaim one’s membership in one or the other category (West and Zimmerman, 1987). Gender, in contrast, is the activity of managing situated conduct in light of normative conceptions of attitudes and activities appropriate for one’s sex category. The theory that gender is a performance and therefore not determined by biology is reinforced by many other scholars.

A more recent study on gender performance provides a more complete explanation of the gender hierarchy, one which recognizes “the agency of subordinated groups as much as the power of dominant groups” (Connell and Messerschmidt, 2005). Connell (2002) has used patterns of power relations to explain the operation of the “gender order” and explains how men’s dominance over women is maintained. Connell’s (2002) explains how hegemonic masculinity is at the top of the gender hierarchy, above both subordinated masculinities and femininities, and is the “ideal of masculinity” centered on authority, physical toughness and strength, heterosexuality, and paid work. The concept of hegemonic masculinity was originally
developed in tandem with the concept of *hegemonic femininity*, but this was soon renamed *emphasized femininity* to recognize the asymmetrical position of masculinities and femininities in the patriarchal gender order (Connell & Messerschmidt, 2005). Emphasized femininity is normatively “oriented to accommodating the interests and desires of men” (Connell, 2002). This seems to be especially true in Western societies.

Western societies tend to support a binary system for gender, male and female, that correspond with masculine and feminine roles. There are social expectations and norms that people must follow to perform their roles. Gender roles are so common that they are engraved in everyday activities and every aspect of a person’s life. Men and woman are expected to act in a particular manner in their professional lives, at work, through household activities, and during leisure activities. The lines become blurred when those expectations are broken or challenged. Gender performance is constructed through sets of actions and interactions. Gender is a socially scripted dramatization of a culture’s *idealizations* of feminine and masculine natures played for an audience (Goffman, 1976). Members of a culture are very much aware of the norms of gender and the actions that correspond to each gender.

Ussher (1997) has provided a useful example of subordinated femininities that reject “emphasized femininity.” She states that women actively negotiate the various “scripts” of femininity and discusses four positions or “performances” women might adopt. None of these are said to be concrete or fixed and women may shift between them in different situations and at different points in time. “Being girl” refers to the archetypal position for most women, the position “taken up when a woman wants to be rather than merely do femininity.” “Doing girl” refers to how women might reflexively “perform the feminine masquerade” but knowing that this is about “playing a part” (1997). “Resisting girl” women ignore or deny the traditionally signified “femininity,” such as the necessity for body discipline and adoption of the mask of beauty, but do not reject all that is associated with what is considered to be feminine (1997). “Subverting femininity” refers to those women who “knowingly play with gender as a performance, twisting, imitating and parodying traditional scripts of femininity (or indeed masculinity) in a very public, polished display” (1997).

**GENDER PERFORMANCE IN SPORTS**
The social worlds of sports are very structured and extremely gendered. Sisjord and Kristiansen’s (2009) study of female wrestlers and “performances” of femininity in sport draws theoretically upon perspectives of gender relations and the “gender order” in society, and various conceptions of masculinities and femininities. In sports there is an idealized image of men known as *hegemonic masculinity*. It embodies the most honored way of being a man, it requires all other men to position themselves in relation to it, and it ideologically confirms the subordination of women to men. What happens when women express characteristics of hegemonic masculinity? Like the female wrestlers mentioned, not all women follow these gender expectations when it comes to the world of sports. Researchers argue that this creates room for the growth and the expansion of varied renderings of gender in sports. Because of women’s important symbolic link with dominant codes of masculinity, sports can be a powerful site through which to challenge binary, hierarchical conceptions of gender (Heywood and Dworkin 2003; Roth and Basow 2004). The divide of gender in MMA and team sports usually means men compete or train against other men and women against women. When it comes to the world of women’s MM, we can ask questions such as “why do women fight?” or “is it acceptable for men and women to train together?” The rationale for asking such questions extends from an understanding of the subversive significance of women’s participation in martial arts and related combat sports, which has been well documented by feminist scholars researching this phenomenon over the past two decades (De Welde 2003; Guthrie 1995; Hollander 2004; McCaughey 1997; 1998). Women who choose to embrace the more masculine characteristics of sports can also become “invisible” or ignored. Sisjord and Kristiansen (2009) suggest that those *subordinated femininities* that reject *emphasized femininity* have remained largely “invisible” because of the attention devoted to maintaining a version of emphasized femininity as the norm.

**SUMMARY**
Research suggests that there is a clear hierarchy of gender that applies to the social world of sports.
and mixed martial arts. We explore how gender is performed and constructed. The expectations placed by society on us suggests what is acceptable and what is not. This review explains the history of modern MMA and where it currently stands. To better explain gender performance this article explores the concepts of hegemonic masculinity and emphasized femininity, and explains how it is oriented to accommodating the interests and desires of men. In sports the characteristics of women that do not typically fit emphasized femininity are described as subordinated femininities. Ussher has provided examples of subordinated femininities that can be applied to the sports and MMA. She states that women actively negotiate the various “scripts” of femininity. The fours scripts they negotiate are Being girl, Doing girl, Resisting girl, Subverting femininity. Though research suggests that women who reject emphasized femininity are after pushed aside and made invisible to society research also indicated those challenges create a pathway for growth and change in sports and the ability to challenge the “gender order”. This allows for further exploration on the gender performances of female mixed martial artists.

**METHODOLOGY**
I approached this study using “grounded theory” Glaser and Strauss (2008) define grounded theory as “the discovery of theory from data.” A large portion of my research was based on field research and on integrating myself in the culture of “fighting” and becoming a participant observer at various gyms. This allowed me to gain useful insight and various perspectives of what it means to be a “female fighters.” I was able to use my body as an instrument as a tool for data collection. Collecting various forms of sensory data as well as emotional and physical information, made for a much more applicable and valuable understanding of women’s experiences. I conducted two formal, semi-structured interviews with professional female fighters. Some common questions included:

1. What made you want to become a fighter? Why do you fight?
2. What is the biggest challenge you have faced as a woman in an MMA?
3. Have you noticed of experienced any gender bias in the sport?
4. Where do you see MMA in five years?

As part of my participant observation I conducted over 10 informal interviews while training with other members at the gym. I found it useful to analyze two recent magazine articles and a promotional video of the first major female fighting events to further illustrate the concepts and ideas mentioned in this study.

**DATA ANALYSIS**
Typology of Female Fighter Types:
The first task I completed in conducting this research was creating a typology (see Table 1) to categorize and analyze different female fighter types. It is important to note that fighters may change their position on the chart from time to time, but they relatively remain the same on most occasions.

### Table 1. Typology of Female MMA Fighters

<table>
<thead>
<tr>
<th>Fighter Types</th>
<th>Description/Characteristics</th>
<th>Examples of Pro Fighters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feminine inclined-female fighters</td>
<td>Fighters who embody personality characteristics that are associated with femininity. They might express signs of aggression, but display clear gender associated traits like wearing make up and feminine clothing or vise-versa.</td>
<td>Miesha Tate, Gina Carano, Julianna Pena</td>
</tr>
<tr>
<td>Neutral female fighters</td>
<td>Fighters who embody both feminine and masculine characteristics. Might express aggression, but display clear gender associated traits like wearing make up and feminine clothing or vise-versa.</td>
<td>Ronda Rousey, Raquel Pennington, Cat Zingano</td>
</tr>
<tr>
<td>Masculine inclined female fighters</td>
<td>Fighters who embody personality characteristics that have an emphasis on physical strength and aggression. Physical characteristics may include focus on muscular built body, wearing clothing that covers most the body. Made out be to be aggressive and dominant during TV appearances and promotional videos. No clear sign of make-up.</td>
<td>Cristiane “Cyborg” Santos, Liz Carmouche, Germaine de Randamie</td>
</tr>
</tbody>
</table>
DIRECT OBSERVATIONS AND INFORMAL INTERVIEWS
The second aspect of my research are direct observations and observant participation. Having participated in Mixed Martial Arts Training while conducting this research allowed me to fully experience the way gender is perceived by other fighters. Drawing from direct observation, personal experience, and my field notes, I found various examples to support the three female “fighter types”. Self-categorizing myself as a neutral female fighter, I was able to see how other fighter types reacted to my type of gender performance. Being a neutral female fighter gave me an edge conducting this research. I labeled myself this fighter type because I display all the feminine characteristics: I wear make-up to training, I wear gender associated colors etc., but my ability to display physical toughness and aggression while training and set aside all my feminine characteristics allow me to consistently stay in the neutral category. On various occasions I would be paired up with a male opponent. We would begin to spar and he would clearly hold back. After he became more comfortable and began to fight back various comments followed along the lines of “Wow, you hit pretty hard for a girl.” I expected this reaction to some extent by male fighters. The more interesting part came from being paired up with other female opponents. When being paired with female fighter types that were more inclined to demonstrate masculine characteristics the reactions were pretty similar to those of male opponents. They would respond with “I didn’t expect you to hit that hard.” When I asked why they thought that, the general response would be along the lines of “You don’t look like you would.”

I also had experiences with being matched with other female fighters who expressed very feminine characteristics. In this scenario the direction typically went in two different directions. First, I would be paired with another woman who would put up a good fight (Neutral Female Fighter) by the end of the match we would typically say to each other “Good fight” or tap gloves to let each other know that it was a good match. The second direction, was with women who were afraid to throw a hard punch or be hit with a hard punch (Feminine inclined female fighters). On various occasions I would ask them why they trained in MMA if they were afraid to hit or be hit. Even though there were a few different responses the most common was that it was two for “psychical fitness” or “to stay fit.” The conclusion I draw from my observations and experiences is that in training, people are very well aware of the roles and performance they put on. MMA is still considered a sport for men. Despite its growing popularity amongst women, those stereotypes and discriminatory factors are still very much alive and are reinforced by both males and females toward female fighters.

SEMI-STRUCTURED INTERVIEWS.
The third aspect of my research was conducting semi-structured interviews. Lisa King is a full contact professional Muay Thai fighter. She has appeared in the films “Ring Girls” and “Fight Girls” and the Fight Girls television series with Gina Carano, as a mentor and trainer to ten aspiring female fighters. She has won many competitions worldwide and is a true pioneer in the world of competitive fighting and Mixed Martial Arts. My research has found that there is still a stigma associated with women fighters even today. Lisa King remembers when no woman was allowed to be in the UFC. My interview with Lisa King exemplifies many of the formal and informal interviews I conducted. According to her:

“I remember doing an article with TIME MAGAZINE probably 2005-2006, this is back in the day when Dana White said he would never allow women into the UFC, and I was quoted in TIME MAGAZINE saying, “If women can go to war then why wouldn’t we be allowed to fight?”

Somehow it is acceptable for women to put their lives on the line to defend our country, but unacceptable for them to be professional fighters. We have come a long way because more women are now mainstream fighters, but many people still struggle to accept women fighters. Most women fighters understand that women are looked at differently than men. Lisa says:

“There is a different appreciation for it, having to change peoples’ minds about women fighters! In my opinion women fight differently than men. Men are expected to know how to box, they are expected to know how to throw punches. Women are expected to do other girly things. I don’t think women are trying to compete with men, but we do have something to prove. So we go out there and give it our all.”
True pioneers like Lisa King have pushed this sport forward for women, but she knows first-hand the obstacles that women fighters face. She says that as far as how people perceived fighting and the obstacles there are for women, the unanimous thing is that “A person that doesn’t look like a fighter, can’t fight like a fighter.” She gives a great example from her life of these gender expectations:

“I would consistently go to fights where people would come up to me actually saying “You do realize you are going to get hit?” My outfits always matched, and my hair was done and the girl, because that’s who I am in general. The girls I was fighting had lots of muscles and looked the part. She wouldn’t even warm up because she thought it was such a walk in the park.”

This supports my finding on the expectations to keep the “gender order” and the type of response that is associated with the different fighter types. Lisa says, “Not only do you get this criticism from an outsider, but you get it from the “fighters” Lisa believes that her biggest obstacle is also her biggest opportunity, she says she can only go up from there and shine new light on the world of women’s fighting.

“It’s almost like Spice Girls, there is something [fighter type] out there for everyone. We leave nothing in the ring, we still have something to prove, so we go for it full.”

CONTENT ANALYSIS
MMA has proven to be a male dominated territory. All competitors at the outset were male and the UFC specifically targeted a male audience of 18–35 (Walton & Potvin, 2009). When the UFC first began the only women featured were the “Octagon Girls”. Octagon girls appear in provocative attire between rounds, providing entertainment predominantly to its male spectators. As the octagon girls began to gain fame for themselves, the UFC website devotes a section to introduce fans to the Octagon girls. Arianny Celeste, the UFCs top and most popular Octagon girl, was referred to in Maxim magazine as a “professional hot girl” in 2008. These examples show how the sport remains marginalized.

Recently there has been a lot of attention on a verbal altercation that happened between UFC fighter Ronda Rousey and UFC Octagon Girl Arianny Celeste, the top two most popular women in the world of UFC. Arianny Celeste told MMA Junkie Radio, “I don’t really like the way she carries herself,” referring to Ronda Rousey. She continued to say, “I don’t think she’s a good role model for women.” Ronda Rousey later fires back by saying “There’s a reason why the ring girls aren’t asked to star in movies, and it’s because they’re pretty but talentless.” This is important because even though Arianny Celeste is not a fighter, she is a big star in the UFC world. She is obviously hyper-feminine and believes that Ronda Rousey is a bad example of what a woman “should” act like. Rousey’s response as a female fighter is not a typical “lady like” response. This is a good example of Rousey’s gender performance. As a neutral female fighter type, she displays her femininity by the way she dresses, but it is clear to see that she has masculine characteristics by the way she expresses herself. She made it clear that “being pretty” is not important and that “talent” is more valuable. She displays her physical and mental toughness almost on every occasion ignoring and disregarding the symbol of femininity.

The final and most valuable example is the promotional video for Gina Carano and Chris Cyborg. On August 2009, Strikeforce made history by featuring two women as the main event. Chris Cyborg and Gina Carano. This was the first time in the history of MMA that women were in the spotlight. The promotional commercial for the fight is the perfect example of gender performance from two different fighter types. Gina Carano being a feminine inclined female fighter is depicted as glamorous and beautiful. She is shown coming out of a limo and in a dress. You can tell by the statement made in the video how her performance is perceived by others. “Gina Carano arrived to the world of MMA as an unwelcomed guest, a woman in a man’s world. With an impressive psychical intensity and a warrior’s will, she has proven to be more that a pretty face.” These small descriptions of “A woman in a man’s world” or “more than just a pretty face” make it very clear that she is able to maintain her femininity and negotiate the symbols to be able to navigate in a “man’s world”.

Chris “Cyborg” Santos is depicted in a completely different manner. Falling into the masculine inclined female fighter type. The video focuses on her body build, paying special emphasis on her
muscular body type and tough attitude. The video states, "Relentlessly perusing in her shadow [Gina Carano] is Chris Cyborg, a fighter with unheard of power, mercilessly punishing her opponents, her body a finely tuned machine, her mind trained on one purpose, demolish Gina Carano." There is no reference to her being feminine or any special attention on psychical attractiveness. There is only references of mental and psychical fortitude. There is a play on the words ‘demolish’ and ‘mercilessly punishing’ showing how her gender is performed and perceived by others.

RESULTS
I conducted this research using a "grounded approach" and discovered some unexpected but very interesting patterns. I found female fighters can be categorized into three different fighter types. The manner in which their performance, gender determines what category they are selected for. The three fighter types help explain how female fighters navigate the patriarchal sub-culture of MMA. Every fighter type has a specific "edge" on the competition and on societal views of gender. I found that feminine inclined fighters are usually underestimated in the world of MMA and therefor have a psychological edge on the competition. I also found that masculine inclined female fighters are expected to perform better in the world of MMA also creating a psychological edge for over the competition. As for the neutral female fighter, it is not uncommon for them to change their performance "type" based on the situation.. This allows them to adapt to both masculine and feminine expectations and change their fighter "type." My findings show that some women take a masculine role to maintain "gender order" and that gender is “scripted” and not concrete. This suggests that gender is fluid in nature and that the symbols and characteristics of gender can be negotiated and changed.

CONCLUSION AND FURTHER STUDY
The first step of this study was to create a typology describing the three female fighter types. I selected well known professional female fighters to represent each type. This allowed me to categorize and identify the mobility and static nature of gender. Gender is very often a “performance” and it is “scripted” in sports and MMA. This suggests that gender is not a concrete entity and can be challenged and changed. The "gender order" created through social norms often poses challenges for women in MMA. While some women adapt to masculine characteristics to recreate a sense of “gender order” others choose to continue to embrace their femininity. In this research I decided to conduct interviews and content analysis and become a participant observer to further understand the experiences of female fighters. I quickly found that attitudes amongst women often depended highly on the attitudes of their opponents “fighter type”. This further suggests that gender is an "explicit performance" for many people. There is a high level of criticism almost women in MMA. Possible studies for the future could include exploring women’s attitudes towards other women in mixed martial arts. Another suggestion for future study could be exploring the experiences of women who take the “dominate” or masculine role to try to maintain the "gender order" Women practicing MMA is new and there are many opportunities to conduct further research.

REFERENCES


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