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High School Juniors: Self-Efficacy Change After a Job Search Training Workshop, Given
Differing Identity Statuses

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McNair 2011 Research

Abstract

An identity status effect on occupational self-efficacy was planned to compare the outcome of a job search workshop group and a waiting control group. Further adapting Marcia's occupational identity grouping, two groupings were formed for comparison involving a healthy status identity and an unhealthy status identity. The participants were identified as high school juniors after a preliminary study with college students found a narrow distribution of identity statuses yielding primarily an achievement orientation. Developmentally, the high school age group has been shown to be more broadly distributed by identity status. Between group comparisons were planned to involve analysis of variance using a 2 (healthy x unhealthy identity) x 2 (workshop group x waiting control group) factorial design. The actual outcome was disappointing as the return rate of classification questionnaires and outcome questionnaires was insufficient to establish any groups for comparison. Actual attendance for the workshop was 1 student.

Identity status

The present study is interested in determining whether or not identity status predisposes high school juniors to be or not be receptive to self-efficacy changes as a consequence of job search training. Erikson identified two levels within his identity stage (achieved and diffused) as potential outcomes in the crisis adaptation process (Kumru & Thompson, 2003). Marcia extended Erikson's work further incorporating identity into the occupational domain and defined four identity statuses that demonstrate differences in occupational decision making. The four identity statuses include achievement, moratorium, foreclosure, and diffusion.

Achievement identity status emerges once a person has been faced with decisions and has committed to a course of action. Moratorium identity occurs while a person is confronting options and is involved in the decision-making process, but without commitment. Foreclosure identity status forms if a person establishes values and makes final decisions, potentially including occupational choice, resulting primarily from the influence of parental or authority figures. Identity diffusion arises when a person has not faced a need to consider options or has avoided commitment to a final choice. In the worst case, diffusion includes refusal to consider making decisions. Erikson addressed the concept of crisis resolution as means of adapting to developmental stages including the identity stage.

Crisis and variation in commitment help to define Marcia's four identity statuses. Identity status can be determined by measuring the levels of crisis and commitment that a person has experienced (Marcia, 1966). Such crises refer to a period of indecision that individuals experience when presented with opportunities or choices. Commitment involves the intention to adhere to decisions or continue particular courses of action which can apply to any aspiration, affiliation, or ideology.

Job-search self-efficacy

Self-efficacy is positively related to the amount of effort a person is willing to exert toward achieving a goal. Commitment is important as it applies to self-efficacy and similarly important to identity status. According to Bandura (1982), self-efficacy in its broadest definition is a self-assessment of aptitude. This means that a tendency toward commitment to certain goals is involved in increasing self-

efficacy. Additionally, self-efficacy tends to be more readily developed in individuals with high confidence over control of circumstances and less easily developed among those who demonstrate little inclination toward acquiring and maintaining control of their circumstances (Bandura, 1982). Inclination toward control suggests a level of need or readiness to use experience to control choices. In order to operationalize self-efficacy, Betz (2007) reviewed research in the field of career self-efficacy, ultimately identifying four major criteria important for the measurement of self-efficacy. These four criteria include: 1) the extent of exposure to learning experiences relevant to self-efficacy, 2) choices made by subjects specifically relevant to self-efficacy, 3) the nature of experiences or performances in subjects relevant to self-efficacy, and 4) perseverance in tasks relevant to the subject area of self-efficacy. Betz recommended that learning experiences be used as content indicators for the measurement of self-efficacy, primarily when measurement includes specific types of self-efficacy. Betz applied this thinking to career decision making in counseling. Learning experience can be either direct exposure or indirect experience gained through observation and promote self-efficacy by augmenting familiarity. Familiarity progressively increases confidence, and consequently increases self-efficacy (Betz, 2007). Self-efficacy development also depends upon whether participants have actively made any choices to pursue activity in related fields. For example, a measure of job search self-efficacy should take into account whether participants have willingly conducted job searches in the past. Successful past outcomes improve self-efficacy if they promote a sense of competence. Successful job search methods promote successful job search self-efficacy. Measurement might allow individuals to self-report whether or not they consider their prior job search methods to be successful. High self-efficacy is also characterized by the willingness to persevere despite a lack of immediate or optimal results. Levels of persistence can be self-rated. It is within this context of willingness to persevere that identity could contribute to a readiness.

Many high school and college-level participants may not have experienced a need for employment, and may be lacking experience and success with job searches. Regardless of experience, Betz's four factors must be taken into account to accurately measure self-efficacy.

Identity Status and Self-Efficacy related

Bandura developed self-efficacy theory to include the role of commitment to a choice, the tendency to allot proxy control over choice to another, and to the level of confidence related to a given choice. Achievement identity status contains both broad levels of commitment and high levels of confidence, without the influence of a proxy control. Proxy control entails dependence on external influences such as the influence that parents or authority figures exert over choice. Individuals avoid commitment in the moratorium and diffusion statuses and inability to commit may hinder development of self-efficacy. Foreclosure status differs from the other three statuses in the reliance on a proxy control for defining commitments; however, confidence is also inherent in foreclosure status. Although this confidence relies on the influence of external forces, it is a high level of confidence (Kumru & Thompson, 2003). Bandura regards a high level of confidence as strongly predictive of high self-efficacy, yet Bandura relates proxy control to low self-efficacy.

Confidence demonstrated in career decision self-efficacy has been found to be higher in those individuals who attained an achievement identity compared to moratorium, foreclosure and diffusion identity statuses (Nauta & Kahn, 2007). This finding supports study of the relationship between self-efficacy and identity status. Nauta and Kahn (2007) found developmentally that greater identity uniformity toward achievement and higher career decision self-efficacy occurred between the ages of 18-21. Heatherton (2002) also found that self-efficacy development is greatest in individuals with achievement identity status. Progression from moratorium status to achievement status may be a slower process than that reported by Nauta and Kahn (2007). In a review of studies on identity change, Cramer (1998) identified an increase in the frequency of moratorium status among college students over the past 30 years. Characteristically, identity status changes from moratorium identity to achievement identity as undergraduate students progress from freshman year to senior year.

Clappes and Haun, 2011 (unpublished) surveyed identity statuses in a sample of 127 undergraduate students at Bluefield State College resulting in 51 classified as achievement status, 32 classified as moratorium and diffusion status, 43 unclassified, and 1 classified as moratorium status.

Bennion and Adams (1986) also found an overlap of Marcia's identity statuses, but a positive correlation was found between the statuses of moratorium and diffusion while studying factorial validity within the Extended Measure of Ego-Identity Status (EOM-EIS). This finding suggests that a maximum of three factors are identifiable: achievement, moratorium/diffusion, and foreclosure.

Advances in the development of identity status typically occur during college age rather than during high school age. These advances are attributed to opportunities and learning experiences (Kumru & Thompson, 2003). The intent of the present study is to address the greater variability of the identity statuses in the adolescence age period and to determine if job search skills can contribute to increases of self-efficacy given the current identity statuses. Younger adolescents have been shown to have lesser developed identity statuses, usually in the foreclosure and diffusion statuses, in longitudinal studies (Kumru & Thompson, 2003). These suggest that there is a wider availability of identity statuses in the time frame of young adolescents. Given that identity status and career self-efficacy do relate to each other, with confidence being an important factor here, in this study we focus on increasing confidence in specific changes in self-efficacy.

Anxiety has been found to diminish between identity statuses, most notably between the transition from moratorium status to achievement status (Cramer, 1998).

Hypothesis

H1: Identity status will effect a change in job-search self-efficacy levels as a result of completing a job-search seminar, differing among achievement, moratorium/diffusion, and foreclosure identity statuses.

H0: Identity status will not effect a change in job-search self-efficacy levels as a result of completing a job-search seminar, differing among achievement, moratorium/diffusion, and foreclosure identity statuses.

Method

Participants

Six hundred and twenty high school junior students were invited to complete surveys prior to volunteering for a job search workshop. Participants were recruited for two phase process. In Phase 1, six hundred and twenty packets containing information letters to parents and participants, consent forms, demographic forms, and two surveys were distributed to high school juniors through their homeroom teachers one week before the Phase 2 workshop. All invited participants were of school age and required a parent or guardian's consent and personal consent before participating in this project. Six packets from Phase 1 were returned, and one participant volunteered for the workshop in Phase 2.

Materials and Procedure

Demographic Information Form (Appendix H)

A Demographic Information Form was distributed in Phase 1. Collected information included age, gender, race/ethnicity, indication of previous and/or current employment, and the number of times of previous employment. The Demographic Information Form is included in Appendix H.

Extended Objective Measure of Ego-Identity Status

The revised version of the Extended Objective Measure of Ego-Identity Status (EOMEIS) was used to classify identity statuses (Bennion & Adams, 1986). The EOMEIS (Appendix I) measures ideological and interpersonal dimensions of achievement, foreclosure, moratorium and diffusion identities. Ideological identity measurements focus on occupational designs and personal philosophies, and interpersonal identity measurements focus on social identity as pertains to friendship, dating, recreation, and sex roles. Change has also been considered, over time, and this changes with age (Kumru and Thompson, 2003).

Factor analysis by VARIMAX rotation supports the presence of three factors to include achievement, foreclosure and moratorium/diffusion. Due to this identified factor structure, the EOMEIS is being used to classify identify status according to these three factors.

Internal consistency reliability measured by Cronbach's alpha identifies a range for the subscale reliability coefficients from a low of .58 for interpersonal moratorium to a high of .80 for interpersonal foreclosure. Pearson correlations define discriminant validity, with identity achievement negatively correlated or uncorrelated to other statuses. However, diffusion was positively correlated with moratorium status, suggesting an overlap within the scale. Convergent validity between ideological and interpersonal subscales was also provided by significant Pearson correlations. Equivalent variances were found within each identity status type. Social desirability bias was assessed using a social desirability scale and responses did not significantly correlate with responses on the EOMEIS.

Concurrent validity is demonstrated with a positive correlation between the EOMEIS measure of identity achievement and the Rosenthal, Gurney, and Moore measure of identity (as cited by Bennion & Adams, 1986). All other identity statuses were negatively correlated with the Rosenthal et al. measure of identity.

The Revised Version of the EOMEIS originally contained sixty-four statements concerning occupation, religion, politics, philosophical life style, friendship, dating, sex roles, or recreation. The scale was believed to include identity areas considered to be highly sensitive or invasive for the age group being measured. A subjective review was made of the content by presenting the scale to a panel of parents with high school aged children. Ten statements were eliminated due to content that may be considered as unsuitable for the age group. The ten items were consistent across the subscales retaining equivalent measures across the identity statuses. Independent review indicated these items risked being too sensitive for the population being studied so the decision was made in order to maximize support for the project. The final measure consisted of 52 statements. Participants mark answers on a Likert-type scale numerically ranging from one to six, and descriptively ranging from *strongly disagree* to *strongly agree*. Statements are occasionally repeated with minor changes in order to assess response set. Examples include "Politics is something that I can never be too sure about because things change so fast. But I do think it's important to know what I can politically stand for and believe in," "I haven't really considered politics. It

just doesn't excite me much," and "I date only people my parents would approve of," "I haven't really thought about a "dating style." I'm not too concerned whether I date or not."

Career Search Efficacy Scale

The Career Search Efficacy Scale (CSES) developed by Solberg, Good, Fischer, Brown and Nord (1995), was used to determine levels of job search self-efficacy (Appendix). Principal components analysis yielded a three-factor solution with items retained if the item is loaded at greater than or equal to .50. A VARIMAX rotation loads meaningful on four factors. Internal consistency reliability yielded a Cronbach's alpha of $r = .97$ for the scale as a whole. Convergent and discriminant validity are established by components analysis of the subscales of the CSES with the subscales of the Career Decision-Making Self-Efficacy Scale (CDMSES), the Personal Attributes Questionnaire, the Rathus Assertiveness Schedule, and an interpersonal facility scale. Analysis provides three significant factors. Convergent validity is established between the CSES and the CDMSES on measurement of career efficacy. Discriminant validity is established between the CSES and the CDMSES measures on personality subscales related to masculinity and femininity.

The CSES has been revised for the present study by the addition of four items that incorporate the four factors Betz (2007) considered important for measurement of self-efficacy. Including these four additional items, the CSES contains thirty-nine items. Participants rate each item numerically between 0 and 9, and descriptively from *very little* to *very much*. Measure identifies personal confidence in career search ability. The additional questions sample confidence in searching for a career, succeeding in finding a career, putting effort into looking for a job, and coping with disappointment. A copy of the CSES is located in the Appendix J.

Procedure

The research was approved by the Human Subjects Review Board at Concord University. In Phase 1, six hundred and twenty packets containing information letters to parents and participants, consent forms, demographic forms, the EOMEIS and the CSES were distributed to high school juniors through their homeroom teachers one week before the Phase 2 workshop. All invited participants were of

school age and required a parent or guardian's consent and personal consent before participating in this project.

Packets were completed at home and the volunteers returned the packets to the school upon completion. Packets were then collected at the schools by the researcher. Scoring and workshop group assignments were planned after the return of the packets, but only six packets were returned. This response level was insufficient to establish comparison groups. The workshop was held at a central location after school hours. Only one participant attended the workshop. The workshop was presented for the benefit of the student, but response level was insufficient to conduct the study. The intent of the study was to measure job search self-efficacy before and after the workshop in the experimental condition and before the workshop in the waiting control group.

Results

The high school sample was not sufficient to test the hypothesis generated for this study. The Bluefield State College sample was also not sufficient to test the hypothesis generated for the previous study. A substantial confound existed which invalidated assignments to the training group or waiting control group. On an exploratory level, Bluefield State College data was evaluated in terms of an aggregate test and retest of job search self-efficacy.

The first step in data analysis was to test the distribution of each aggregate self-efficacy score. The stem and leaf plots are identified for test one and test two in Tables 1 and 2. The test of normality is identified in Tables 3 and 4. Both the first and second administrations of the test for normality met the criteria for a normal distribution.

Table 1 Stem and Leaf Plot for variable: JSchSET1

Frequency	Stem	& Leaf
1	1	3
1	1	7
5	2	11234
10	2	5666777789
3	3	123

Stem width = 100.00, max. Leaf depth = 1
Min. value = 137.000, Max. Value = 337.000
No. of good cases = 20

Table 2 Stem and Leaf Plot for variable: JSchSET2

Frequency	Stem	Leaf
2	1	56
4	2	1244
9	2	555666789
5	3	12233

Stem width = 100.00, max. Leaf depth = 1
Min. value = 152.000, Max. Value = 335.000
No. of good cases = 20.

Table 3 NORMALITY TESTS FOR JSchSET1

Shapiro-Wilkes W = 0.9505
Shapiro-Wilkes Prob. = 0.3749

Skew = -0.717
Kurtosis = 1.050
Lilliefors Test Statistic = 0.109
Conclusion: No evidence against normality.

Table 4 NORMALITY TESTS FOR JSchSET2

Shapiro-Wilkes W = 0.9292
Shapiro-Wilkes Prob. = 0.1491

Skew = -0.660
Kurtosis = 0.372
Lilliefors Test Statistic = 0.111
Conclusion: No evidence against normality.

In order to analyze self-efficacy results, analysis of means was completed involving correlated data. Because of the confounding variable of a job fair, it was assumed that all participants were exposed to conditions approaching the experimental group. Aggregate scores were analyzed as though participants were in the same grouping. Exploratory analysis was completed as if all participants attended the workshop. Main effects were evaluated in terms of pre/post-treatment self-efficacy measures on an exploratory level without a control group. The null hypothesis is rejected at $p \leq 0.05$; results yielded a $t(19, 1.729) = -0.751$. Given the fact that the hypotheses cannot be directly tested, no further interpretations are provided.

Discussion

The hypothesis could not be tested in the high school sample because of the poor response rate. Recommendations for future study need to be directed toward increasing the response rate. Offering

multiple Phase 2 screenings at different times, days, or locations may improve participation by increasing convenience and providing a more available location. The workshop is relevant to the age group in developing skills important to students and achieves career goals important to school districts. The workshop may maintain the interest of participants by justifying a time commitment during school hours. By focusing on different populations or a wider age range, future studies may also be able to obtain the identity status samples necessary for testing the hypotheses presented in this study. Taking the study to only one specific school may encourage participation. Without some larger encouragement from the district, adequate participation would not occur. Different school districts may allow this study, and have a more flexible schedule that allows participation to be completed during school hours. Another alteration that may present higher participation numbers would be to gather participants from another school district that would allow participation during school hours. Considering that the information given in the job search workshop is an educational value, the school could effectively use it to the student participants' advantage. The outcome is also interesting because it set the stage for future studies.

There may have been unique population characteristics of a non-traditional student majority at Bluefield State College. This uniqueness was demonstrated during initial screening when forty percent of students classified as achievement oriented out of $n=127$.

Based on Kumru and Thompson's (2003) results using the EOMEIS in a study, the sample population of undergraduate students at Bluefield State College is much different than the norm. The majority (40%) of students who participated at Bluefield State qualified for achievement status. In Kumru and Thompson's study, the clear majority of student participants tested as moratorium status. Additionally, their participants were all classified into one of the four identity statuses identified by Marcia using a less demanding classification measure than that of the present study. Participants at Bluefield State College classified into either achievement status, a mixed status category, or were undefined by identity status. Kumru and Thompson's identity status results did not contain a mixed group as our study did, nor did any of their participants remain unclassified. Of the 127 participants from Phase 1, 51 participants could be clearly identified as having an achievement status. Only one other participant

was able to be categorized clearly within any of the three remaining identity statuses. This participant was identified as moratorium status. Sampling did not provide the classifications necessary to test hypotheses. Even with exploratory regrouping of participants into achievement identity and a mixed identity status, a dropout rate of 75 percent between Phases 1 and 2 restricted meaningful exploratory analyses. Additionally, one-third of the 30 students present during Phase 2 did not satisfy requirements of the screening. Any further possibility for analysis of the results was eliminated due to the confounding activity of a campus-sponsored job fair the same day as implementation of Phase 2. The job fair commenced two hours prior to start of treatment conditions, consequently allowing ample time for students to have attended prior to participation in Phase 2.

Future study would benefit from completion of both phases by a larger number of participants. By focusing on different populations, future studies may also be able to obtain the identity status samples necessary for testing the hypotheses presented in this study. The skewed identity status distribution observed at Bluefield State College may be due to population demographics, so other colleges or universities might provide status ranges adequate to testing. Taking this study to a high school level might also result in a obtaining a more equal distribution of statuses, as young adults are likely to still be undergoing identity development.

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The Sweet Intervention: Self-Control Relies on Glucose as a Limited Resource

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The Sweet Intervention: Self-Control Relies on Glucose as a Limited Resource

Self-control is the ability to override thoughts, emotions, behaviors, and urges that are habitual or automatic responses (Banfield, Wyland, Macrae, Munte, & Heatherton, 2005). Self-control is especially important because it holds the responsibility of maintaining behaviors that are consistent with societal standards, norms, rules, and personal values, morals, and beliefs. With self-control, individuals are usually making an effortful attempt to restrain from within from acting upon something that goes against these societal or personal standards (Gailliot et al., 2007).

Past research has suggested that self-control relies on glucose as a limited resource in that a single act of self-control can deplete glucose levels. In turn, a subsequent attempt at self-control while glucose levels are still depleted may result in impaired performance. It has been suggested that the impaired performance on a second task is the result of depleted glucose levels stemming from the initial act of self-control (Gailliot et al., 2007; Benton & Owens, 1993; DeWall, Deckman, Gailliot, & Bushman, 2011; Gailliot, Plant, Butz, & Baumeister, 2007; Kokavec & Crowe, 2003; Muraven & Shmueli, 2006; Benton, 1990).

A Limited Energy Source, Glucose & the Brain

Glucose is a chemical in the bloodstream fostered by food intake that provides the brain with energy (McNay, McCarty, & Gold, 2001; Reivich & Alvari, 1983). After the consumption of food, carbohydrates within the food are broken down by the body into various sugar molecules, during a process called glycogenolysis. Those sugars include glucose. Glucose is directly absorbed into the bloodstream instantly after eating, but in order for glucose to be spread out into the body's cells and provide the body with energy, it needs the help of a chemical called insulin. Insulin is secreted from the pancreas in response to a rise in the amount of glucose in your blood, and allows the cells to open up and receive the glucose it needs while storing extra glucose in the liver and the muscles in the form of glycogen. Insulin stops being released once glucose levels return to normal through this process. After a period of time without eating, your glucose levels will start to drop. When this happens another chemical in the pancreas called glucagon signals the liver to breakdown the stored glycogen and allows glucose to

be released back into the bloodstream. Nearly all activities of the brain require glucose as fuel, thus, in order for the brain to function efficiently; there must be an adequate supply of glucose.

One biological problem is that the brain uses glucose faster than it can be replenished, thus cerebral activities can drain the brain of its glucose supply (e.g Benton, Owens, & Parker, 1994; Fairclough & Houston, 2004; McNay et. al., 2001). When glucose levels are depleted, cognitive and behavioral deficiencies, such as anxiety, confusion, and dizziness, may occur as a result of disrupted cerebral functioning. For everyone it is not as simple as making sure that you eat enough meals throughout the day. People with diabetes have difficulty or the inability to metabolize glucose efficiently due to an insulin deficiency. This effect is termed poor glucose tolerance (e.g Benton, Parker, & Donohoe, 1996). Diabetes is related to having dangerously high glucose levels. In diabetics, either too little or no insulin is secreted in response to the consumption of food, or the individual's body cannot use insulin properly. As a result, diabetic individuals' glucose levels remain high because without insulin doing its job, the extra glucose is not stored for future use. Diabetics may receive insulin injections as part of their treatment to help regulate, or lower, their glucose levels. Hypoglycemia, on the other hand is related to having dangerously low glucose levels. People can experience hypoglycemia as the result of the pancreas releasing too much insulin or if the person has diabetes and receives injections of too much insulin. If the secretion of insulin is excessive, it will continue to lower the glucose levels.

If the brain uses glucose for nearly every activity in which one engages, what makes self-control of special interest? One factor that seems different about self-control is how relatively expensive it is to the brain in terms of the amount of glucose it requires. Controlled responses relying on executive functioning are highly susceptible to minor fluctuations in glucose whereas more automatic responses requiring relatively little mental effort are less affected (Fairclough & Houston, 2004). We think of the "self" as the commander in chief of controlled processes, the decision maker, and the self-regulator (Baumeister, Bratslavsky, Muraven, & Tice, 1998). With that in mind, that set of processes would seemingly require a relatively high amount of glucose. Other mental processes besides self-control may also require large amounts of glucose energy, but such processes have yet to be reported.

Another contributor making self-control of special interest is its importance in everyday life and its highly adaptive effect on a wide array of behaviors. Self-control has been linked to many behaviors beneficial for people both individually and collectively. Self-control has been associated with better interpersonal relationships (Finkel & Campbell, 2001), a higher capacity to stifle prejudice and stereotypes (Gailliot, Plant, Butz, & Baumeister, 2007), lower rates of aggression and violence, which in turn, has been related to lower crime rates (Gottfredson & Hirschi, 1990; Rojas & Sanchi, 1941; Bolton, 1979; DeWall, Deckman, Gailliot, & Bushman, 2011; Mokdad et al., 2003; Henner, 1936; Hill & Sargent, 1943; Virkkunen, Dejong, Bartko, Goodwin, & Linnoila, 1989; Benton & Owens, 1993), less susceptibility to alcohol and drug use (Altura, Altura, Zhang, & Zakhari, 1996; Haier et al., 1998; Muraven & Shmueli, 2006), higher success rates in smoking, tobacco, and alcohol cessation (West & Willis, 1998), better coping with stress (Finkel & Poppen, 1948), and superior academic performance (Duckworth & Seligman, 2005). Exertion of self-control provides people with the ability to meet their goals in life and contribute to make society more peaceful.

Review of Empirical Findings

A wide variety of behaviors, that are related or involved with the exertion of self-control, have been reviewed to provide further insight on whether problems with glucose impair the general capacity to exert self-control. Specifically these include studies on crime, aggression, and violence, attention control, alcohol, smoking and tobacco cessation, and suppressing stereotypes and prejudice. In addition, different methods for assessing glucose, manipulating glucose, and examining the capacity to use glucose efficiently were briefly discussed.

To this point, the most common and convenient way to assess blood glucose levels is to use a compact glucose meter that measures the amount of glucose within a blood sample. The relationship between glucose and other factors can be examined by assessing glucose levels before and after performing or engaging in some task or other manipulation.

Experimentally, there are two ways to manipulate glucose levels, by either increasing the glucose level or decreasing the glucose level. A few different methods have been used to do each. The most

common way to increase the glucose level is either glucose injection or oral consumption of glucose. Following the administration of glucose, it takes about 8-10 minutes for glucose to metabolize in the brain (DeWall, Deckman, Gailliot, & Bushman, 2011). Comparisons usually include the examination of consequences of either receiving glucose or a placebo substitute. While most experiments involve increasing glucose levels, some involve decreasing glucose levels. One way to decrease glucose levels is to use a hyperinsulinemic clamp in which insulin is infused into the bloodstream (Gailliot et al., 2007). Insulin stores the excess glucose to be used in the future when glucose levels are within a normal range. In a properly controlled experiment, any occurrence of cognitive or behavioral changes could be interpreted as being due to the reduced availability of glucose.

Another way to examine the effects of low glucose levels is to look at and compare individuals who are likely to have low levels of glucose or poor glucose tolerance such as diabetics, with individuals who do not have deficiencies with glucose availability and use. Observing the performance of these two groups on self-control tasks could lend supporting evidence of the consequences of low glucose levels (Goetsch, 1989).

To determine whether an individual demonstrated good or poor glucose tolerance, baseline glucose levels would be assessed and then reassessed in intervals of time after receiving glucose. Individuals would be said to have good glucose tolerance if their levels increased but then declined back to baseline levels shortly after receiving the glucose. Poor glucose tolerance would be indicated by the individual's glucose levels remaining either abnormally high or low after receiving glucose. Using diabetics in experiments can be useful in examining behaviors consequential to poor glucose tolerance as they are less able to use glucose efficiently than those without diabetes (e.g.: Goetsch, 1989).

Crime, Aggression, and Violence

There have been many causes of aggression and violence suggested over the years such as frustration (Berkowitz, 1989), provocation (Berkowitz, 1989), influence of alcohol (Bushman, 1997), and violence in the media (Bushman, 1995). Thus, it seems that anyone, for various reasons, could easily turn ill-tempered and lash out. However, most people refrain from these impulses through the exertion of self-

control. Gottfredson and Hirschi (1990) have deemed poor self-control as the leading contributor to criminality. While the media may portray acts of violence and crime as well planned out schemes, most crimes are executed on impulse and in hopes of meeting instant gratification needs such as fast cash or possessions. These difficulties to resist giving in to such impulses may be the consequence of low self-control in that the individual could not forgo the instant gratification in exchange for long-term benefits such as not risking going to prison, losing a job, or losing one's family. If low glucose levels are linked to low self-control, and low self-control is linked to raising the likelihood of one acting out on impulses or committing crimes, then low glucose levels may contribute to criminal and aggressive behavior. Several correlational studies (Rojas & Sanchi, 1941; Bolton, 1979; DeWall, Deckman, Gailliot, & Bushman, 2011; Mokdad et al., 2003), case studies (Henner, 1936; Hill & Sargant, 1943; Virkkunen, Dejong, Bartko, Goodwin, & Linnoila, 1989), and experiments (Benton & Owens, 1993) have demonstrated this relationship.

One study that demonstrated a link between crime and low glucose was that of Rojas and Sanchi (1941), in which young offenders' glucose levels were assessed shortly after being brought into custody. Of the 129 offenders examined, 90% displayed low glucose levels. The researchers attributed the delinquency to low glucose levels. However, it should be pointed out that alternative explanations are possible. It could be that the low or depleted glucose levels could have resulted from the individual exerting self-control during the arrest process or just prior to the criminal act.

Poor glucose availability and poor glucose tolerance has historically been linked to aggression and criminal behavior with adolescents as well, with a particular group of individuals of interest, the Quolla Indians of Peru (Bolton, 1973). The Quolla is a society of Indians well known for engaging in criminal acts and rebelling against society's norms. It was revealed that hypoglycemia is common among the Quolla, thus their high difficulty metabolizing glucose or poor tolerance for glucose may be impairing their ability to exert self-control and increasing their aggressiveness and likelihood to follow through with violent and criminal-like behavior (Bolton, 1979).

Another correlational study by DeWall, Deckman, Gailliot, and Bushman (2011, study 2) looked at linking diabetic status to aggressiveness, and expected that self-control would account for this relationship. Participants completed three questionnaires; the 34-item Diabetic Symptoms Checklist Revised (Grootenhuis, 1994), the 16 item Brief Self-Control Scale (Tangney, 2004), and the 29 item Aggression Questionnaire (Buss & Perry, 1992). It was expected that if low glucose levels impair self-control, which is thought to stifle the desire to behave aggressively when frustrated or provoked, then individuals living with diabetes may demonstrate high levels of aggression. The results found that diabetic status was positively correlated with aggressiveness, thus suggesting that this could be related to self-control.

A correlational study found diabetic rates was positively correlated with violent crime rates (DeWall, Deckman, Gailliot, & Bushman, 2011, Study 3). The FBI has four categories for acts considered violent crimes: rape, assault, robbery, and murder. Reports of violent crimes were obtained (DeWall, Deckman, Gailliot, & Bushman, 2011, Study 3) from all 50 states along with state diabetic rates for the year of 2001 and found that the crime and diabetic rates for each state was positively correlated. While these studies do not offer causal explanations, only correlational support, they do suggest that aggression goes up when glucose levels go down. This could be interpreted in that when glucose levels go down, self-control goes down and so we are able to exert less self-control to refrain from acting aggressively and condoning violence and committing crimes.

Evidence from case studies have also linked low self-control and aggressiveness together as well. In many cases, studies came to find that individuals engaging in violent acts were in a hypoglycemic state at the time of engagement. In one case, a hypoglycemic man stabbed his mother to death (Hill & Sargent, 1943), and another shoved a woman off the edge of a trolley car (Henner, 1936, as cited by Gailliot, 2007); these studies again lend support to the idea that poor glucose tolerance impairs self-control. One longitudinal study by Virkkunen, Dejong, Bartko, Goodwin, and Linnoila (1989) used glucose tolerance to predict future violence of criminals after being released from a prison sentence. Those with low

glucose tolerance demonstrated more violence in the following years than those with high glucose tolerance.

More importantly, experimental approaches have also provided support linking low glucose to poor self-control and high levels of aggression and violence. One study showed that when attempting to play an impossible computer game, individuals were likely to get frustrated but when given a glucose drink instead of a placebo sugar substitute, it decreased the frustration levels of the individual (Benton & Owens, 1993), however, they did not measure aggression. DeWall, Deckman, Gailliot, and Bushman (2011, Study 1) sought to address this limitation. In their study, participants were given either a glucose drink or a placebo drink (a sugar substitute) before competing in a reaction time task against an ostensible opponent, meaning that the opponent was not a subject but actually one of the researchers. Participants were told they were participating in a “taste test” study so they would not question why they were consuming a drink. After the drink, they completed a filler task for about 8 minutes to allow glucose to be absorbed in the bloodstream. Afterwards, they were told that they would compete with their opponent to press a button as fast as possible on each of 25 trials, and whoever was slower would receive a blast of white noise through their headphones. At the beginning of each trial, the participant was able to set the level of noise their opponent would receive as a consequence of losing the trial, ranging from 60db (level 1) to the 105db (level 10) but also including level 0 where their partner would receive no noise. The participants also had control over how long their losing opponent had to endure this blast of noise. Noise level intensity and duration were as a measure of aggression. Participants who received the glucose drink before starting chose a lower level of intensity and shorter duration for their opponent to receive than those receiving the placebo drink; this pattern of results supports linking low levels of glucose with aggression. Those who drank the placebo drink behaved more aggressively than those with replenished glucose levels from drinking the sugar drink.

Suppressing Prejudice and Stereotyping

Prejudice and stereotyping are two big contributors to some of the conflict of interracial interactions in today’s society. For some people, suppressing prejudice and stereotyping requires the

exertion of self-control, for others it may not. Some people exert more self-control during interracial interactions than others depending on their level of non-prejudicial internal motivation. Non-prejudicial internal motivation is defined as a tendency to not respond in a prejudicial way due to the belief that such a response is wrong or immoral (Gailliot, Plant, Butz, & Baumeister, 2007). For people with high non-prejudicial internal motivation, they may not need to exert self-control because they are accustomed to the regular practice of suppressing prejudicial responses, and it is a rather habitual behavior for them. That is, those with low non-prejudicial internal motivation, those who do not normally suppress prejudicial responses in their every day life, may require a high level of self-control to refrain from responding in a prejudicial manner.

Gailliot, Plant, Butz, and Baumeister (2007) have shown that among participants with low internal motivation; interracial interaction decreases glucose levels, because they must exert much self-control in order to refrain from negative stereotyping when in a situation where they must suppress prejudicial responses. This was measured through the Internal Motivation Scale for Suppressing Prejudice and Stereotyping (Plant & Devine, 1998) that measured to what extent they felt like they exerted effort to avoid saying negative things, on a 9 point scale: 1 being very low effort and 9 being very high effort. Thirty-eight white, college undergraduates were asked to discuss two topics, both likely to activate racial stereotypes; criminal profiling and affirmative action. The participants were assigned to discuss these topics with either a black or white experimenter. Glucose levels were assessed before and after the interaction with the experimenter. Results found that those with low non-prejudicial internal motivation had lower levels of glucose after the interaction while those with high non-prejudicial internal motivation did not. Those with high non-prejudicial internal motivation had no change in glucose levels.

These results were interpreted in that glucose levels declined in those who were exerting self-control (those with low non-prejudicial internal motivation). Manipulating glucose levels in those with low internal motivation would seem beneficial in society as it would lessen conflict during interracial interactions.

Alcohol and Self-Control

Alcohol consumption reduces glucose levels in the brain, specifically in the frontal cortex; the area in which self-control activities are localized (Altura, Altura, Zhang, & Zakhari, 1996). Research has shown the impact that alcohol consumption has on exerting self-control. Alcohol increases the likelihood of engaging in risky behaviors, possibly because their capacity to refrain from indulging in instant gratification is impaired. People may get caught up in instant gratification and ignore long-term goals and plans, for example; having unprotected sex when intoxicated. This may explain why drinking often leads to inappropriate behaviors.

Alcohol consumption reduces glucose metabolism throughout the body and the brain. One study (Kokavec & Crowe, 2003) reported that participants' glucose levels dropped after the consumption of white wine after a meal. Another study by Haier (1998) found that performance on two divided attention tasks decreased after alcohol consumption, along with drops in glucose metabolic rates in the superior, inferior and medial parietal lobes.

The research of Muraven and Shmueli (2006) gives us reason to believe that increasing, or replenishing glucose levels during intoxication may help facilitate self-control. They examined the self-control costs of fighting the temptation to drink. In one of their first experiments, social drinkers, those who consumed at least two alcoholic beverages a day at least three times a week, were told they were going to sample two different beers and describe the characteristics and answer questions about each one and that later they would have a driving simulator task. Social drinkers were offered this free alcohol but were to refrain from going overboard to keep from getting too drunk intoxicated and performing poorly on the driving simulator task. Before drinking, half of the participants were given the task of suppressing their thoughts on some issue while the other half did simple math equations for five minutes. By the end of the night, those who were instructed to suppress their thoughts had consumed more alcohol than those who did math equations. Because alcohol consumption may result in lower glucose levels and thought suppression may also deplete glucose levels, the authors interpret this pattern of results by suggesting that

the combination of alcohol consumption and thought suppression impaired their ability to later exert self-control on a subsequent task of refraining from consuming the available alcohol.

If alcohol lowers the ability to exert self-control in part because it reduces glucose levels, it seems that the administration of glucose after the consumption of alcohol could reduce self-control failures while following alcohol consumption.

Smoking Cessation

West (1990- 2001) has conducted several studies examining the relationship between glucose and smoking cessation and has reported that glucose aids in the reduction of withdrawal symptoms and craving, giving people a greater success at abstinence. In his earlier experiment (1990) regarding glucose and smoking cessation, he examined the withdrawal ratings of 16 smokers from a smoking abstinence clinic one week after the participants stopped smoking. Participants were randomly given either glucose tablets or placebo tablets during that week. Participants who were given glucose tablets reported significantly lower ratings of their urge to smoke. His second experiment included 38 heavy smokers, defined as those who needed a cigarette within 30 minutes of waking (West, 1999). After 12 hours of abstinence, participants were given 4, 3g glucose tablets or matched placebo tablets to chew. Afterwards, they were asked to rate their urge to smoke every 5 minutes for 20 minutes. Those who consumed glucose tablets rated their urges significantly lower than those with the placebo. West (2001, experiment 3) then had 51 heavy smokers divided into three groups; those who chewed 4 glucose tablets (the high glucose group), those who chewed 2 glucose tablets and 2 placebo tablets (the low glucose group), or those who chewed 4 placebo tablets (the no glucose group). The procedure was the same as with the first study described and the findings were replicated; a dose- craving rating relationship was reported. Those in the high glucose group reported the lowest ratings of desire to smoke, the low glucose group was next, and those who received placebo tablets had the highest urge to smoke ratings.

One alternate explanation that has been suggested is that smoking abstinence comes with an increase in hunger and that this feeling that is not normally present when the cigarette has been smoked, is being interpreted as a “bodily craving for nicotine,” when it is really just hunger. A single dose of nicotine

reduces hunger. When one stops smoking, the body revises its set point and there is a change in body weight as food intake increases; one becomes hungrier without the nicotine present and it takes up to 10 weeks for the body to “revise” the body’s metabolism to the new body weight and become “set” again (Perkins et al., 2003). Consistent with this idea, it could be that with the administration of glucose, thus reducing or diminishing hunger, people might believe they are no longer craving nicotine.

Quitting smoking requires self-control to refrain from giving in to their urges. One question that the previous studies have not been able to determine is whether glucose aids in smoking cessation by reducing physical cravings for nicotine or by improving self-control. West and Willis (1998) demonstrated the effect of glucose in aiding smoking cessation with a much larger sample. Three hundred eight smokers were given either 4, 3g glucose tablets or 4 matched placebo tablets for 4 weeks following their target quit date. Participants were also either given a 15mg nicotine patch or matched placebo patch. The results indicated that the glucose group was more likely to remain abstinent after the four weeks than the placebo tablet group and those who received glucose with a nicotine patch smoked fewer cigarettes than those who received the placebo tablets with a nicotine patch. Glucose seemed to aid in smoking cessation, whether nicotine was used to reduce the physical urge to smoke or not.

While the studies linking glucose with smoking cessation are more subject to alternate explanations than the other self-control instances reviewed, most of the findings are consistent with the idea that self-control relies on glucose.

Attention Control

Attention control is important and allows us to focus on specific stimuli while ignoring other surrounding stimuli. We are exerting self-control when we focus on a single task or stimulus because we are overriding the tendency to shift our attention to the different stimuli (e.g. Shiffin & Schneider, 1977). For example, being able to retain information when studying while the television and radio are both on is possible through the exertion of self-control, thus the ability to attend to some stimuli while ignoring others. Attention control is a form of self-control, that depletes glucose levels when exerted, leaving individuals less able to exert self-control and continue controlling their attention on a subsequent attempt.

The Stroop task, a well-known attention control task has been used in studies to support the link between poor self-control and low levels of glucose (e.g. Benton, 1990) The Stroop task consists of both congruent and incongruent trials of saying the color in which a word is printed. With congruent trials, the color of the ink in which a word is printed matches the word's meaning (e.g. the word "blue" printed in blue ink). With incongruent trials, the word's meaning would not match the color of ink in which it was printed (e.g. the word "red" printed in green ink). The participant must refrain from stating the printed word and instead state the color of the ink. Benton (1990, experiment 1) assessed glucose levels before and after participants completed the Stroop task. Glucose levels were depleted in those who completed incongruent trials but not in those who completed congruent trials. These results are interpreted in terms of the relationship between self-control and glucose. That is, participants who completed the incongruent trials had to control their attention and refrain from reading the printed word, exerting self-control, which led to glucose depletion.

It should also be noted that Benton (1990) also found that an increase in glucose did not always improve attention control. He found that improvements were only seen when the individuals' glucose levels were low enough that they needed to be replenished. If they had a high level of glucose already, no changes or improvements were indicated. For example, if a glucose drink was given to participants before they completed incongruent trials, we would expect an improvement in performance, such as fewer errors on the Stroop task. On the other hand, we should not expect a subsequent change in performance for those with the congruent trials if they were given a glucose drink since they had not exerted self-control and would not have decreased glucose levels.

Benton (1990, experiment 2) found that attention was improved during a driving simulation task when administered glucose but only towards the end of the task. This suggests that the difficulty of the task may determine the amount of improvement that glucose provides. If the task is not difficult and does not require much self-control, glucose levels would not decrease to be considered low, thus the glucose would not make any difference. The more self-control required during the task, the more glucose levels

would decrease thus, the body would require glucose levels to be replenished in order to behave appropriately in a subsequent self-control task.

Gailliot et. al. (2007) also offers support to link low glucose levels and poor self-control. They assessed people's glucose levels and had them watch a video of a woman speaking on an issue and every few seconds a word or phrase flashed in the right-hand corner of the video. Half of the participants were instructed to only pay attention to the woman speaking and if they accidentally looked at the words they were to refocus their attention on the woman as quickly as possible. Others were just told to watch the video without any further instruction. Glucose levels were then assessed after the task and it was found that the glucose levels of those required to exert self-control and focus only on the woman had decreased but those who watched the video without any further instruction had no change in glucose levels. This pattern of results suggests that exerting self-control depleted glucose levels.

Current Study

Specifically, the following study looked at persistence or the ability to exert self-control by not giving up on a difficult task when glucose levels are low. It was expected that after the exertion of self-control on a video task similar to that used by Gailliot et. al. (2009), participants who were given a glucose drink would perform better on a subsequent self-control task in terms of reaching criterion on the task, completing fewer trials prior to reaching criterion, and being less likely to give up on the task prior to reaching criterion.

Method

Participants

Participants in the study included 35 undergraduate students from Concord University who were recruited on a volunteer basis; 25 females and 10 males. All participants were non-diabetic and at least 18 years of age. However, the data from one participant was not analyzed because they reported that they had eaten just prior to testing. Also, the data from two other students were not analyzed because their test period was cut short due to scheduling constraints.

Materials

Materials included an 8 oz. drink containing either lemonade sweetened with sugar, or lemonade sweetened with Splenda. A Sterile RelieOn© glucose meter, finger lancets, test strips, alcohol pads, and rubber gloves were used to assess glucose levels. A laptop computer was used to present a short video task. Participants watched a six minute video of a man speaking about the Occupy Wall Street protest. During the video, words flashed on the screen. Participants were instructed to only pay attention to the man speaking and to ignore the words that appeared on the screen and if they read any of the words, to redirect their attention back onto the man speaking as quickly as possible. This video is similar to the one used in past research (Gailliot et. al., 2007) to decrease participant's glucose levels; it is assumed to require the exertion of self-control since participants have to refrain from reading the flashing words. A laptop was also used to administer The Big Five Personality Inventory online after the video task (Oliver, 2009). A desktop computer was used to administer the configural problem solving task, where two stimuli appeared on the screen, one on the left and one on the right, and the participants had to click on the "correct" stimulus using the computer mouse. Participants were given feedback as to whether they chose the correct stimulus or not. Through trial and error, the participants should respond differently according to which stimuli are presented together. For example, when Stimulus A was paired with Stimulus B, Stimulus A was the correct choice, when stimulus B was paired with Stimulus C, Stimulus B was the correct choice, and when Stimulus A was paired with Stimulus C, Stimulus C was the correct answer.

Procedure

Upon volunteering, participants were informed that glucose levels would be assessed and that they were required to not eat for three hours prior to their appointment to avoid fluctuations in glucose levels. Participants signed a consent form and were informed that they were allowed to stop participation at any time during the study. Upon arrival, initial glucose levels were measured and only participants falling within the normal glucose range of 70-140 were allowed to continue the study (American Diabetes Association, 2012).

After initial glucose levels were recorded, all participants watched a six minute video. Glucose levels were measured and recorded upon completion of watching the video using the same procedure used in the initial assessment. The second assessment of glucose levels was used to determine whether glucose levels had been depleted after the video task.

Following the second assessment of glucose levels, participants were randomly assigned to receive either an 8 oz. cup of lemonade sweetened with sugar (Group Glucose) or an 8 oz. cup sweetened with Splenda (Group Control). Sugar was used to replenish glucose levels while Splenda was used as a control because it tasted like sugar but it would not alter glucose levels. After the drink, each participant completed the Big Five Personality Inventory online in order to allow time for the metabolism of glucose in the brain.

After completing the personality inventory, participants started the second task. Participants continued until they reached criterion; they also had the option to give up and quit before reaching the criterion. Performance on the task was recorded and analyzed in terms of whether a participant reached criterion, the number of trials they completed prior to reaching criterion, and whether they gave up prior to reaching criterion.

Results

Glucose levels were assessed before and after completing the video task. The mean pre-video glucose level was 96.5313 and the mean post-video glucose level was 95.9062. A within-subject analysis was conducted and found that there was no significant difference between pre-video glucose levels and post-video glucose levels, $F(1, 30) = .250, p = .620$.

Performance on the computer task was then examined in terms of the number of trials completed, whether participants reached criterion on the task, and whether they gave up or not. The mean number of trials completed for Group Splenda was 126.9286 and the mean number of trials completed for Group Sugar was 123.722. An independent samples t-test found that there was no significant difference between the two groups, $t(30) = -.153, p = .880$.

In order to further assess any possible effect of glucose levels, we examined whether participants reached criterion or quit on the computer task. The number of participants who met criterion in Group Splenda was 8 while 6 did not. The number of participants who met criterion in Group Sugar was 7 while 11 did not. A chi-square test was conducted and found that there was no significant effect in regards to group membership and meeting criterion, $\chi^2(1)$, $p = .3009$. The number of participants who gave up in Group Splenda was 2 out of 14, while the number of participants who gave up in Group Sugar was 8 out of 18. There was a marginally significant effect in regards to group membership and giving up, $\chi^2(1)$, $p = .068$. Although it was expected that those in Group Splenda would be more likely to quit the task before reaching criterion, the results suggest that Group Sugar might actually be more likely to give up and quit prior to reaching criterion.

Discussion

The current pattern of results did not support the research hypothesis that participants' who were given a glucose drink after participating in a video task requiring self-control would perform better on a subsequent self-control task than those who receive a non-glucose drink. These results are also inconsistent with past research (e.g.: Baumeister, 2011). One major problem with the current pattern of results is that there was no significant difference between pre-video glucose levels and post-video glucose levels. This is a problem for the current study because without the decline in glucose levels, we would not expect participants to have difficulty exerting self-control to persist on the subsequent self-control task. The current task, as completed by our participants, did not result in lower glucose levels. Thus, it seems that the task did not require self-control. One factor is whether participants were actually practicing self-control during the video task or not? If participants did not follow the instructions to ignore the words and attempt to refocus their attention on the speaker if they found themselves reading the words, this could explain why the glucose levels did not drop. One way to examine this in the future would be to administer a surprise recall test on the words that appeared in the video. The extent to which participants could recall the words may suggest that they were not actually

refraining from attending to the words. Another useful measure to include in future research would be an eye-tracker to determine the number of times the participants were looking at the words and their ability to refocus and attend to the speaker. Besides the possibility that the participants were not exerting self-control during this task, it may also be that some of the participants ate prior to participating. For example, regardless of which group they were in, some participants had an increase in glucose levels after watching the video. A possible explanation could be that the participant had eaten recently; it could be that the video task did lower glucose levels but the participant was still metabolizing glucose from a recent meal.

In regards to the problem solving task, given that there was no change in glucose levels, the fact that we failed to obtain an effect when examining the number of trials and whether the participants reached criterion, was not surprising. However, the pattern of results resulting in a marginally significant difference in terms of giving up on the task, was surprising, especially since it was in the opposite direction of our original hypothesis. Since the video did not lower glucose levels, those who received Splenda should have been at a normal glucose level at the time of the second task, while those who received Sugar would have had elevated glucose levels, that is, higher than normal. It may be that not only having depleted glucose levels results in being more likely to quit (Baumeister, 2011), but also that having elevated glucose levels may result in being more likely to give up on a subsequent self-control task as well. A future study to examine this effect would be to have two groups who participate in a self-control video task that in order to reduce glucose levels and examine their performance on a subsequent self-control task. Of the two groups, one group would receive a sugar drink between the two tasks and one group would receive a Splenda drink between the two tasks. Then, two additional groups would participate in a video task that did not require self-control and would not be expected to alter glucose levels. Of the two additional groups, one group would receive a sugar drink between the two tasks and one group would receive a Splenda drink between the two tasks. It would be important to monitor glucose levels between each task. We would expect both the group who exerted self-control and received a Splenda drink to perform poorly on the subsequent self-control task as they have lower glucose levels.

We would also expect the group who did not have glucose levels reduced and received a glucose drink to perform poorly on the subsequent self-control tasks, as their glucose levels would be relatively high.

Finding ways to control glucose levels could be helpful in therapeutic settings as poor self-control may be a contributor to problems that the clients may have. If clients knew that self-control is not a static characteristic of a person but may be regulated by biological processes, solutions to these problems may be found by designing interventions to control glucose levels, either increasing or decreasing glucose levels in certain situations where the client may be required to exert self-control. It may be that in order to properly demonstrate self-control, we need to either increase or decrease our current glucose levels, thus monitoring glucose levels could become an important practice in therapy. Finding out more about glucose and the role it may play in various cognitive processes, especially in regards to self-control, may prove to have important implications in a wide array of situations.

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The Effects of Energy Drinks in Improving Cognitive Performance

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Abstract

Energy drinks typically contain caffeine, sugar, and other dietary supplements such as taurine and B vitamins. Previous research has shown that energy drinks cause changes in cognitive performance in areas such as attention, memory, and reaction time. The current study extended existing energy drink research, adding several novel conditions, including energy drinks with taurine and vitamin supplements, and controls for caffeine and sugar. Participants consumed energy drinks or control beverages and completed cognitive tests of memory and attention. Performance was then compared before and after consumption and across beverage groups. Energy drinks showed positive effects for concentration but not for memory or mood. The novel controls in the current study allowed us to understand the roles of different ingredients and the effects of energy drinks on cognition. These results help evaluate the claim of energy drink advertisements and understand the role of various dietary supplements on cognitive functioning. The positive effects of caffeine are widely known, and if energy drinks can increase cognitive performance beyond caffeine, they may become an effective substitute.

The Effects of Energy Drinks in Improving Cognitive Performance

In everyday life, people are bombarded with environmental factors that influence cognitive performance. Some of these factors are encountered unintentionally, while others are chosen deliberately. Many individuals choose to consume energy drinks as a way to potentially enhance their cognitive abilities while providing alertness and energy. These products may affect many cognitive abilities including reaction time, attention, vigilance, and other measures of cognitive performance. Energy drinks claim to provide increases in cognitive performance through both caffeine and other active ingredients. Active ingredients besides caffeine include taurine, glucuronolactone, and B vitamins. Most, if not all, active ingredients in popular energy drinks are already found in the body, and altering the normal levels may produce changes in cognitive performance, which should be examined scientifically to evaluate the claims of energy drink producers.

Energy drinks have become so popular that consumers spend approximately 3.5 billion dollars each year on them (Shute, 2007). In addition, over 500 new energy drinks have been distributed since 2006 (Malinauskas, Aeby, Overton, Carpenter-Aeby, & Barber-Heidal, 2007) They are particularly popular with teenagers and young adults ages 18 to 34. Advertising campaigns target this population to capitalize on their constant on-the-go lifestyle. A product that boasts increased alertness and energy appeals to young adults who lead busy, high-stress lives. Energy drink ads promise a decrease in fatigue and an increase in physical performance, which appeals to athletes, one of the other target populations. Due to the accessibility of energy drinks to the general public and increased advertising, in 2006 more than 30% of adolescents reported using an energy drink of some kind, (Babu, Church, & Lewander, 2008).

Limited research has examined the various claims of energy drinks. The research available has examined some of the physical and cognitive enhancement claims. Alford, Cox, and Wescott (2001) investigated the differences in participants who drank Red Bull and participants who drank various control beverages. Their study found significant differences in reaction times, mood, and physical endurance. Another study using similar amounts of caffeine and taurine found in a serving of Red Bull

obtained similar results for the physical effects. Bichler, Swenson, and Harris (2006) showed no effects of energy drinks on short term memory. However, the study did find changes in cardiovascular physiology. Overall, research into the effects of energy drinks is relatively lacking, especially considering the amount of use.

Caffeine

Caffeine is found in a plethora of everyday items such as coffee, chocolate, and sodas. Caffeine has stimulatory effects on the central nervous system. As caffeine levels increase in the brain, it acts as an antagonist on adenosine receptors (Smit and Rogers, 2000; Lieberman, 2001). The neuromodulator, adenosine, has sedative effects, producing sleepy and depressed feelings. Once adenosine receptors are blocked, the release of dopamine and acetylcholine is increased contributing to feelings of arousal and suppressing fatigue (Fredholm et al, 1999; Duinen, Lorist, & Zijdewind, 2005; Lieberman, 2001). Caffeine has various beneficial psychological effects, including cognitive enhancements and effects on mood states, which are generally consistent among participants. The cognitive abilities caffeine has been shown to improve include reaction time, visual search, memory, vigilance, and verbal reasoning (Childs & de Wit, 2008). Other subjective feelings often reported pertaining to caffeine ingestion include increased energy, alertness, and the ability to concentrate.

However, the effectiveness of caffeine depends on the dosage. The most effective dose of caffeine has been repeatedly documented in well-controlled studies with similar results, and exceeding that dose results in cognitive decline. For example, after a high dose of caffeine, about 500 mg, cognitive functioning begins to deteriorate (Kaplan et al, 1997; Childs & de Wit, 2006). For caffeine to be effective in reducing reaction times and improving attentional performance, it must be given in smaller doses, generally around 80 mg per serving, (Smit et al, 2004; Warburton, 1995). Furthermore, when individuals are slightly sleep deprived and the proper dose is administered, memory and reasoning also appear to improve (Penetar et al, 1993). Conversely, the effects of caffeine on mood are contradictory in several studies. The results reported in past research show inconsistent results of caffeine on mood across studies (Lieberman et al., 1987; Smit & Rogers, 2000).

Another line of caffeine research scrutinizes how the amount of sleep influences the effect of caffeine on cognitive performance. Sleep is governed by two processes, the homeostatic process and the circadian timing process. The homeostatic process is a period of deprivation followed by a lengthened sleep period. The levels of adenosine that are in the body change throughout the day. Adenosine collects in the basal forebrain during waking until an individual sleeps (Kalat, 2008). While sleeping, it slowly dissipates until the process is triggered again by waking. In addition, circadian rhythms operate on a 24 hour cycle, triggering sleep once during each cycle. During sleep alertness and other bodily functions and hormone secretions decrease. Circadian rhythms are regulated by the suprachiasmatic nucleus (SCN). The SCN also regulates the production of melatonin, which induces feelings of sleepiness. Circadian rhythms and the buildup of adenosine work effectively by synchronizing levels and behavior. Once the levels of adenosine are high, the SCN begins to increase melatonin levels to encourage sleep and restoration of the body (Garrett, 2009). Consuming a dose of caffeine causes fluctuations in both processes. For example, a moderate dose of caffeine has the potential to reverse the effects of sleep deprivation (Penetar, McCann, et al., 1993), most likely through its role as an adenosine antagonist. Beaumont, et al. (2001) showed similar results after administering caffeine capsules. Their participants were kept awake for a 64-hour period. During this time, caffeine or a placebo was given twice a day. The caffeine group was found to be more vigilant and alert than the placebo group. The inclusion of caffeine could potentially explain why energy drinks give users feelings of increased alertness and potential cognitive enhancements.

Taurine

Taurine is a typical energy drink ingredient that is already found in the body. It is a non-essential amino acid that acts as a neuromodulator and neurotransmitter (Huxtable, 1992). It can be found in high levels in the brain and the heart tissue of mammals. Few human studies have looked at the direct link of taurine to memory improvement, but it may be correlated to memory function through modulation of N-methyl-D-aspartate, an amino acid, receptors as seen in Saransaair and Oja's research (1993; also Bichler, Swenson, & Harris, 2006). N-Methyl-D-aspartate mimics the action of glutamate. This neurotransmitter plays a key role in long term potential and is important for learning and memory. Alford, Cox and

Wescott (2001) compared the effects of Red Bull, a taurine-rich energy drink, with a placebo control group. Their study showed subjective alertness and concentration increase in the experimental group. The authors also noted that the improvements they found were similar to findings in caffeine research. Other research that has focused on the levels of taurine that cross the blood-brain barrier concluded that a dietary increase of taurine may not make a difference in total concentration. Only small amounts of taurine ever reach the brain due to strict regulation and control in the body (Woojae, 2003). Because of the regulation, most energy drinks have taurine levels below the amount expected to deliver benefits. A physiological function of taurine is to protect against glutamate excitotoxicity, thereby protecting memory and learning.

Other Ingredients

Other additives often found in large doses in energy drinks are B vitamins. The type and amount of each B vitamin found in specific brands of energy drinks differ widely. The most commonly used are B3, or niacin, B6, and B12. Past research has linked vitamins B12 and B6 with increased cognitive performance and mood because of their role in brain metabolic pathways (Calvaresi & Bryan, 2001). Some past research shows that having a deficiency of B12 can lead to memory impairment, personality changes, and psychosis (McCaddon, 2006). These vitamins also are hypothesized as playing a role in the neurotransmitter systems involved in neuropathologies, cognitive impairments, and affective or mood disturbances (Calvaresi & Bryan, 2001; Mischoulon, 1996). Furthermore, B12 deficiency can result in damage to the spinal cord (National Research Council, 1989; Russell, Batten, & Collier, 1900). Damage to the spinal cord could result in numerous cognitive disabilities including longer reaction times. An additional B vitamin important to the central nervous system is B6. Vitamin B6 is essential for the production of adrenaline, dopamine, serotonin, and other neurotransmitters (Huskisson, Maggini, & Ruf, 2007). Also, impaired cognitive functioning, as well as Alzheimer disease, has been associated with a low blood concentration of vitamin B6 (Malouf, Grimley, & Aersa Sartre, 2003). Niacin B3 is required for the body's creation of some of the different forms of vitamin B6 (Huskisson, Maggini, & Ruf, 2007), making it essential to have in the body. However, little research has examined the effects that B vitamins

can have on cognitive performance among healthy participants. Most research surrounding B vitamins has focused on their use with the elderly and their physiological functions in the body.

Another frequently included ingredient of energy drinks is glucuronolactone, a type of simple sugar found in the body. It is a metabolic byproduct formed of glucose, which assists in supplying energy to the central nervous system (CNS). Glucuronolactone is found in the connective tissue of animals and is responsible for regulating the formation of glycogen (Heidemann & Urquhart, 2005). Glycogen can be converted to glucose to satisfy the body's energy needs. Since the CNS depends on a constant supply of glucose, it is extremely dependent on glycogen for its energy. This makes the cooperation of glucuronolactone and glycogen essential to maintain a functioning CNS (Heidemann & Urquhart, 2005).

Cognitive Effects

Energy drinks are frequently advertised by touting increased cognitive effects. Common ads suggest the user will acquire increased alertness and energy. For a fast-paced and sleep deprived society, the promise of decreased fatigue is an amazing cognitive feat. Energy drinks may affect process of attention, including signal detection, and memory, either short term memory (STM) or long term memory (LTM).

Signal detection is the ability to focus and remain vigilant while searching for, or attempting to detect, a stimulus. It involves a great deal of conscious attention, or the continuous evaluation of the environment to decide what is important. Signal detection involves four potential processes: hits, misses, false alarms, and correct rejections. In a hit, something happens and it is accurately detected. A miss is the opposite; something happens and is not detected. If nothing happens but a positive response is made, it is called a false alarm, and a correct rejection is when nothing happens and no response is made. Signal detection is important in activities such as security guard jobs, baggage screening, and some video games, as well as basic visual and listening tasks in daily life. Since energy drinks are marketed to increase alertness during the workday, users with jobs involving signal detection may benefit from the effects of decreased reaction times and increased hit rates, which could improve job performance. If energy drinks can provide enhanced performance, they could aid in providing better and faster signal detection, which

in the case of baggage screening could increase efficiency and safety.

Energy drinks may also affect selective attention, the idea that individuals attend to some stimuli while necessarily ignoring others. If energy drinks increase attention abilities, then individuals may be able to focus more on certain stimuli. However, they may instead make it easier to focus on multiple things at once, decreasing focused concentration. For example, many students study in places that are noisy and distracting. If energy drinks increased selective attention abilities, the environment a student studies in might affect the individual's ability to focus on the material to a lesser degree.

Energy drinks may also impact memory. Atkinson and Shiffrin (1968) described different modes of memory with different time lengths for storage. These included sensory memory, short term memory (STM), and long term memory (LTM). Sensory memory is the first step to storing a memory. Sensory memory stores an immense amount of information but only for a brief period of time, about one to three seconds. When information is retained, it is transferred to STM. Miller (1956) discovered the capacity of STM to be about five to nine items for most people. This information is then transferred through consolidation into LTM. If energy drinks can increase memory abilities, they may be able to increase the amount of information in STM or increase the amount of information that is transferred to LTM. For example, studying after consuming an energy drink could provide better retention of material and recall later.

Another potentially interesting effect of energy drinks may involve the formation of false memories. Previous research on caffeine and false memories by Capek and Guenther (2009) showed an increase in correct recall with caffeine, but also demonstrated an increase in number of false memories recalled using the task and word lists used by Roediger and McDermott (1995). If caffeine does increase the number of false memories, a type of false alarm, it could be detrimental to the process of accurate memory. Since energy drinks include a large amount of caffeine as a main ingredient, negative effects such as false memories could be a side effect. If significantly more hits, or true memories, are recalled however, the benefits may still outweigh the ill effects.

One of the most often cited studies of energy drink effects was performed by Alford, Cox, and

Wescott (2001). There were three experiments with different control conditions in each. Five control groups were included in the third and final study. This study provided evidence of enhanced choice reaction time (CRT) in the first experiment, enhanced subjective alertness and CRT in the second, and improved memory for number recall and enhanced concentration in the final experiment. The authors also examined the physical changes in their participants. The results of this study became the building blocks of energy drink research. However the study by Alford, Cox, and Wescott (2001) did have several flaws. The participants in this study were screened for moderate caffeine use, but not for excessive or no use, which could have affected. Generalizing the results to anyone outside the age range of 18-30 years is not possible either. This study only used college students. Since cognition changes from childhood, adulthood, and old age each age group could produce different results independently. Additionally, the authors refrain from describing in full the tasks used to test their participants. Without a detailed description of the tests, the reliability and validity of the measures is suspect, and it will be difficult to replicate this study to further support the findings. Furthermore, this study only tested one specific energy drink. The results may not generalize to the hundreds of other types that rely on vitamin supplements or other active ingredients.

The aim of the current study is to extend the study by Alford, Cox, and Wescott (2001). This study will include further controls such as an additional energy drink group, measures of attention, and tests of memory. It will examine whether energy drinks containing taurine and vitamin supplements could enhance cognitive performance above and beyond caffeine. If an increase in cognitive performance is seen in the caffeine control group, then supplements are not responsible for the effect. However, if cognitive performance is lower in the caffeine control group, then energy drinks may be a method for increased functioning. This study hopes to clarify the effects of energy drinks on cognitive performance, as well as if drinks including taurine and other vitamins enhance cognitive performance more than those excluding them.

Method

Participants

Participants were 40 undergraduate students, who were recruited from introductory classes and received extra credit for completing the experiment. They were healthy with no known allergies and were instructed not to participate if they were taking medications that interact with caffeine or taurine or if they were diabetic. All participants read and signed a consent form that explained they would be receiving either a caffeine drink, sugared drink, or energy drink. They were warned of the possible side effects and were assured that they could stop the experiment at any time.

Materials

This study employed a variety of cognitive tests. Cognitive functioning was assessed using a cognitive battery including tests for reaction times, concentration, and a memory task. The concentration task was a digit cross task presented on paper. The task included single digits in rows, and participants were instructed to mark through a certain digit. They were given 90 seconds to cross out as many digits as they could.

Memory tasks included two measures of digit span, forward and backward, and a false memory task. In the forward digit span, participants recalled as many digits as they could in order from a list read to them at the pace of one digit per second. They were given two trials of each number of digits (two trials at 4 digits, two at 5 digits, etc). When participants missed both trials with a particular digit number, they were scored as remembering the number of digits of their last correct answer. The backward digit span worked similarly, but participants were instructed to recall the digits in the reverse order from their presentation. The false memory task included six word lists from the Deese, Roediger, and McDermott (DRM) false memory task (Roediger & McDermott, 1995) to measure verbal memory recall. Participants were read a list of 15 words. Participants were asked to recall as many of the words as possible within 30 seconds. Each list had a theme designed to cause participants to falsely recall a word that was not present. Participants were scored on words correctly recalled and on if they had falsely recalled the target item.

The Profile of Moods States-Bipolar (POMS-BI) was administered to test for mood and alertness

(Lorr & McNair, 1988). The POMS-BI consisted of six scales of mood categories: composed/anxious, agreeable/hostile, elated/depression, confident/unsure, energetic/tired, and clearheaded/confused. The POMS-BI is a list of 72 adjectives, and participants rate each one based on how much they feel that the word describes them at the moment on a scale from 0, meaning Not at All to 3, meaning Very Much.

Finally, subjective posttest questions were administered to determine if characteristics of the drink affected any of the results collected. These questions included how much did you enjoy your beverage and how much did you think the video affected your post-test scores.

Three nine-ounce beverages were used in this study. The energy drink (ED) condition received nine ounces (1 serving) of Full Throttle Energy Drink. It contained 81mg of caffeine and 16g of sugar. The caffeine control group received a nine ounce cup of Taster's Choice Instant coffee. It contained approximately 81.25mg of caffeine and approximately 16g of sugar added. The sugar control group received a combination of four ounces of carbonated water plus five ounces of cranberry cocktail juice. No caffeine will be given to this group, but five ounces of juice contained approximately 17.5g of sugar.

Procedure

The experiment involved three steps, a pretest, a relaxing video, and a posttest. After all participants signed and returned consent forms, the participants completed pretest packets, including demographic questions, the POMS-BI, the digit cross concentration task, the false memory task, and forward and backward digit span tests. Participants completed each task as a group, and then sat quietly between tasks.

Once all participants finished the pretest packets, they walked to another room to receive their drinks. All beverages were served in clear cups labeled with either A, B, or C. The beverages were served by a research assistant so that the other researcher was blind to the participants' conditions. Participants were instructed to consume their beverages within five minutes. The participants were allowed to have a drink of water afterward but nothing else. They reported to the original room and watched a 30 minute relaxing video to allow digestion of the beverage. They were instructed to do nothing but watch the video. When the video ended, the participants completed the posttest, which was identical to the pretest. Once

they were finished, the participants were free to leave.

Results

POMS-BI

The Profile of Mood States Bipolar (POMS-BI) was used to measure participants' mood before and after beverage consumption. The POMS-BI consisted of six scales of mood categories: composed/anxious, agreeable/hostile, elated/depression, confident/unsure, energetic/tired, and clearheaded/confused. To analyze the POMS-BI data, six mixed factorial analyses of variance (ANOVA see Table 1) were performed on the subscales with type of beverage as the between subjects factor and pre-test/post-test as the within subject factor.

For the composed/anxious category, there was no interaction between beverage type and test time, $F(2, 37) = .80, p = .923$. The main effect of test time was approaching significance, $F(2, 37) = 3.710, p = .062$. There was no main effect of drink type, $F(2, 37) = 1.411, p = .257$. Participants' composed/anxious scores did not vary by drink type, but participants became more anxious at post-test compared to pre-test.

For the agreeable/hostile category, there was no interaction between drink type and test time, $F(2, 37) = .221, p = .803$. The main effect of test time was significant, $F(2, 37) = 30.774, p = .000$. There was no main effect of drink type, $F(2, 37) = 1.287, p = .288$. Participants' agreeable/hostile scores did not change due to drink type, but participants became less agreeable at post-test than pre-test.

For the elated/depression category, there was no interaction between drink type and test time, $F(2, 37) = .135, p = .874$. The main effect of test time was significant, $F(2, 37) = 73.338, p = .000$. There was no main effect of drink type, $F(2, 37) = 1.002, p = .377$. Participants' elated/depression scores did not change due to drink type, but participants became less elated post-test compared to pre-test.

For the confident/unsure category, there was no interaction between drink type and test time, $F(2, 37) = .072, p = .931$. The main effect of test time was significant, $F(2, 37) = 77.914, p = .000$. There was no main effect of drink type, $F(2, 37) = 1.235, p = .303$. Participants' confident/unsure scores did not change due to drink type, but participants became less confident post-test compared to pre-test.

For the energetic/tired category, there was no interaction between drink type and test time, $F(2, 37) = .526, p = .595$. There was no main effect of test time, $F(2, 37) = 2.894, p = .097$, or of drink type, $F(2, 37) = 2.317, p = .113$. Participants' energetic/tired scores did not change due to drink type or test time.

For the clearheaded/confused category, there was an interaction between drink type and test time, $F(2, 37) = 3.992, p = .027$. Also, there was a main effect of test time, $F(2, 37) = 59.183, p = .000$. There was no main effect of drink type, $F(2, 37) = 2.067, p = .141$. Participants who consumed energy drinks became more confused, participants who consumed coffee became the most confused, and participants who consumed juice also became confused. Since the energy drink group became the least confused, the additional vitamins and taurine in the energy drinks could be preventing the levels of confusion seen in the other groups.

Auditory Short -Term Memory

The digit span forward (DSF) and digit span backward (DSB) tasks were used to measure auditory short-term memory before and after beverage consumption. The DSF/DSB were scored by the maximum number of digits correctly recalled. To analyze the DSF and DSB data, two mixed factorial ANOVAs were performed with type of beverage as the between subjects factor and pre-test/post-test as the within subjects factor.

For the DSF task, there was no interaction between beverage type and test time, $F(2, 38) = .174, p = .841$. There was no main effect of test time, $F(2, 38) = .425, p = .518$, and there was no main effect of drink type, $F(2, 38) = .053, p = .948$. Participants' mean number of digits recalled did not change due to drink type or post-test compared to pre-test.

For the DSB task, there was no interaction between beverage type and test time, $F(2, 38) = 2.098, p = .137$. There was a main effect of test time, $F(2, 38) = 7.379, p = .010$. There was no main effect of drink type, $F(2, 38) = .176, p = .839$. Participants' mean number of digits recalled did not change due to drink type, but did increase post-test compared to pre-test (see Figure 1).

Concentration Task

The digit cross task was used to measure participants' concentration before and after beverage

consumption. A mixed factorial ANOVA was performed with type of beverage as the between subject factor and pre-test/post-test as within subject factors. There was an interaction between beverage type and test time, $F(2, 38) = 4.532, p = .017$. There was a main effect of test time, $F(2, 38) = 17.360, p = .000$, and there was also a main effect of beverage type, $F(2, 38) = .121, p = .886$. Participants who consumed energy drinks correctly crossed more digits at the posttest, participants who consumed coffee correctly crossed about the same number of digits at the posttest, and participants who consumed juice correctly crossed the most digits at the posttest.

Verbal Recall and False Memory

The Deese, Rodeiger, and McDermott (DRM) false memory task (Deese, 1959; Rodeiger & McDermott, 1995) was also used to measure auditory short-term memory and false memories before and after beverage consumption. Two mixed factorial ANOVAs were performed for recall and for target false memory with type of beverage as the between subject factor and pre-test/post-test as within subject factors.

For the DRM mean number of words recalled from the lists, there was no interaction between beverage type and test time, $F(2, 37) = 1.644, p = .207$. There was no main effect of test time, $F(1, 37) = 2.29, p = .139$, and there was also no main effect of beverage type, $F(2, 37) = .575, p = .567$. Neither test time nor drink type affected mean number of words recalled.

For the DRM mean number of target words, or false memories, recalled, there was no significant interaction, $F(2, 37) = .107, p = .899$. There was no main effect of test time, $F(1, 37) = .068, p = .796$. There was no main effect of beverage type, $F(2, 37) = 1.128, p = .334$. Neither test time nor drink type affected mean number of false memories.

Discussion

My hypothesis that consuming energy drinks would lead to increased cognitive performance was partially supported with the improvement seen in participants' auditory short-term memory and concentration. However, consuming energy drinks may have actually caused decreased performance for verbal memory. Marginally more false memories were reported in the energy drink group, which follows

the pattern reported in the literature for caffeine. Additionally, the data failed to support that energy drinks cause improvement in participants' mood states. Past research has shown increased mood after energy drink consumption. While participants were expected to feel more alert and energized, the participants in the current study felt less agreeable and less clearheaded over time. Caffeine literature reports various benefits, cognitive and physiological, such as increased reaction time and mood state effects. The dosage of caffeine is crucial for beneficial effects to occur. If the dosage is too high or too low, then cognitive performance is lower. Furthermore, the caffeine in energy drinks may alter adenosine levels, reversing sleepiness. The B vitamins and additional supplements may have increased cognitive performance as well. Literature shows B vitamins can improve short-term memory in the elderly (Malouf, Grimley, & Aersa Sartre, 2003). The cognitive improvements from these supplements range from decreased fatigue to increased vigilance. This could benefit jobs that include signal detection, such as airport security. How the supplements such as caffeine, taurine, and B vitamins interact were addressed in the current study to a greater degree than in past research.

The improvement in auditory short-term memory and concentration was shown by the energy drink group as well as the juice group. It may be that glucose consumption played a role in improving these cognitive tasks. Past research shows that participants with normal glucose levels who complete simple cognitive tasks deplete their glucose levels over time, decreasing test scores. It is possible that simply consuming the sugar alone provided fuel for the participants to improve in concentration and short-term memory. Adding a water control in future studies could allow for a more direct comparison of all the components. If glucose consumption is driving the effect, it may be possible to obtain positive cognitive effects by drinking juice, eliminating the extra chemicals and preservatives found in energy drinks and sodas.

Another possible cause for the mixed results is the serving size of the energy drink participants consumed. This study used the recommended serving of energy drink listed on the Nutrition Information label. However, many people consume double that serving when they consume a full can at a time, since one can equals two servings. Future research could use several serving sizes ranging from one to three to

compare the amount of energy drink necessary to see significant improvement. If cognitive effects are only found with large portions, the cognitive improvements may not be worth the possible health concerns and risks of consuming several servings of caffeine, vitamin supplements, sugar, and other additives.

Another potential issue in this study was the group assignment. Although the groups were randomly assigned, there appeared to be baseline differences between groups in auditory short-term memory and other tasks. These differences may reflect participant intelligence, motivation, or other dispositional or situational factors. A larger sample size, randomly assigned should solve the problem.

Overall, energy drinks do enhance some cognitive performance. However, this experiment left participants feeling less clearheaded over time. While the benefits from consuming energy drinks may be cognitive enhancement, the possible side effects may negate the benefits. Future research should compare energy drinks to sugar and water controls to potentially provide a healthier alternative.

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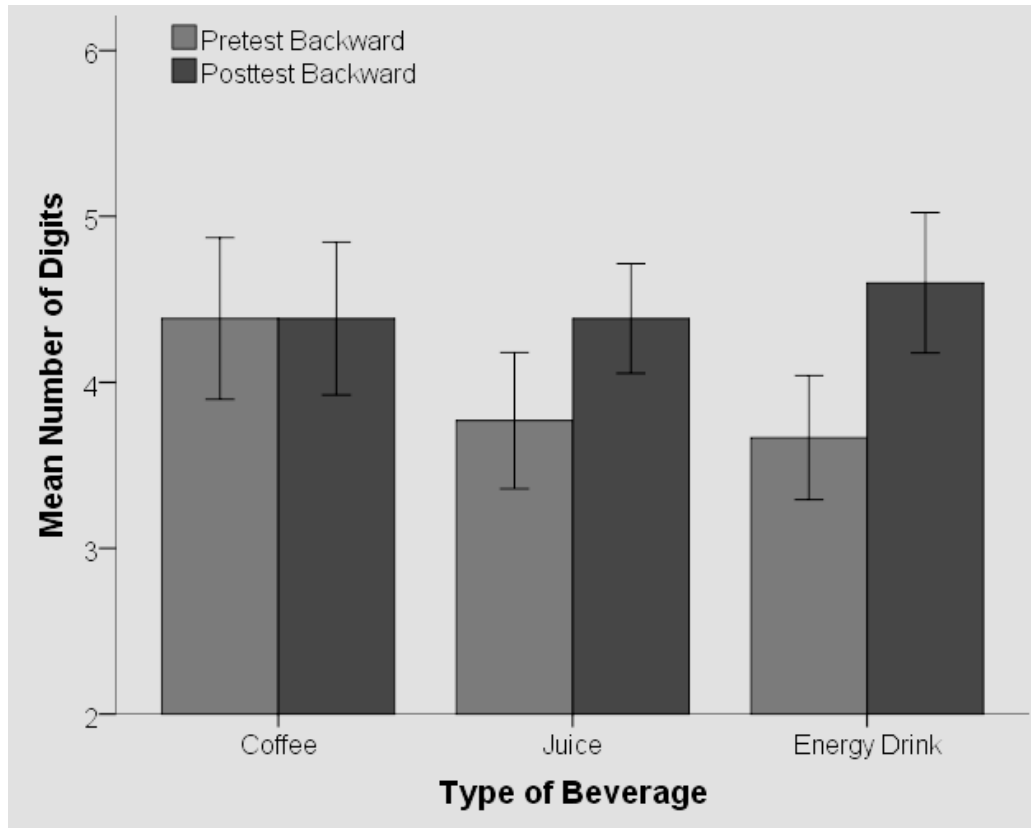
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Table 1. Means and Standard Deviations for Pretest and Posttest by Beverage Type

		Digit Span Forward		Digit Span Backward		Digit Cross		Word Recall		False Memory	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Coffee	Pre	5.11	2.09	4.22	1.72	54.89	15.89	22.55	2.74	21.33	2.29
	Post	4.89	2.02	4.11	1.76	56.11	16.36	1.33	1.23	.78	0.97
Juice	Pre	4.80	1.81	4.10	1.52	48.40	17.54	21.90	4.86	21.70	3.34
	Post	4.90	1.96	4.50	1.08	58.00	16.94	1.60	0.843	1.30	0.68
Energy Drink	Pre	4.78	1.72	3.67	1.23	51.75	10.04	23.77	4.15	20.50	4.78
	Post	5.38	1.50	4.63	1.69	59.63	12.761	1.44	1.13	1.00	1.07

Figure 1. Mean number of digits recalled in the Digit Span Backward task.



Beyond Postmodernism: Searching for the Next Literary Period

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The nature of literature is to reflect and examine humanity. The nature of humanity to be dynamic, and thus our literature must change as we change. Throughout history, societal change has resulted in varying literary trends, each of which mirrors the climate that shaped it. Postmodernism has long been considered to be the most contemporary of these literary trends. It is the movement that brought us writers like Samuel Beckett, Thomas Pynchon, and Kurt Vonnegut. The works of these authors demonstrate a societal atmosphere of great uncertainty – even meaninglessness – achieved by deconstructing language and character to their most minimal elements. The late twentieth century, so imbued with feelings of anxiety and hopelessness, is accurately represented by these works, whose characters demonstrate those same anxieties through their inability to communicate as they wander through fruitless attempts at achieving some type of understanding. While this style embodies the emotional climate of its era, however, it creates a problem for more contemporary writers, who are forever faced with the responsibility of building on the eras before them, and finding new ways to use their language. Postmodernism deconstructs any foundations new writers could hope to build from, in terms of language and character. How can writers, who inherit the legacy of postmodernism, possibly progress further? Beyond this terminus, can there be a new literary period? If not, do we simply regress to the patterns of former eras? If there is a new era, what might it look like? In search of an answer to these questions, I have come to the conclusion that from the terminus of postmodernism, there have risen many new literary trends, none of which stand alone as new eras, but all of which, when examined together, demonstrate a movement we may call Post-Postmodernism, characterized by an emphasis on the preferences and expressions of individuals, who build literature around themselves.

The exact starting point of postmodernism is debatable, but scholars place its beginning around the late 1950's (Hoberek 235). Some credit James Joyce as the first Modernist to cross over into Postmodern styles of writing, with works such as *Ulysses* and *Finnegan's Wake*, while others site the British poet and playwright Samuel Beckett as the first true Postmodern writer, bending all literary traditions with works like *Waiting for Godot*, *Malone Dies*, *Lessness*, and *Krapp's Last Tape*. The list stretches onward to include writers like Thomas Pynchon and Kurt Vonnegut. These writers, and others

of the postmodern period, characterized their literary era by deconstructing the essence of everything that previous writers had used to communicate or create characters. (Green 22-25) A definition of Postmodernism itself is by nature illusive, because

to speak of postmodernism... is to recognize that the term is always at variance with itself, that definitions of postmodernism, whether as a new epoch or as a coherent stylistic practice, have struggled to name their object, or to match evidence to periodizing assertion. (Green 20).

Green's statement deals with postmodernism's identity as a collection of traits which can be pinpointed when they tend to appear in patterns, such as the tendency of postmodern writers to experiment with narrative forms, but which inherently focus on ideas of entropy and meaninglessness, thus resisting solid definitions. Postmodernism carries no predictably consistent characteristics, because its identity centers on the lack of identity or purpose. Despite the daunting nature of defining postmodernism, however, there exists a general sense of what it encompasses, and various writers choose to focus more on some aspects than others. One definition of postmodernism comes from John McGowan:

Postmodernism refers to a distinct shift in the way that humanistic intellectuals... view the relation of their cultural work to society at large. The various themes, postures, and stylistic hallmarks of postmodernism can, I believe, be traced to a heightened anxiety about what impact intellectuals have on a world that appears increasingly inimical to the values promoted in the arts and in intellectual work. ... Postmodernism marks a particular despair about the possible success of these schemes.(McGowan 1)

This definition focuses highly on intellectualism, expressing fears of the blurring of high-brow and low-brow boundaries, which would cause both value sets to lose their respective separate identities. This fear can be applied to more than intellectualism, as it mirrors once more the postmodern anxiety over the blurring of boundaries between individuals and society, again diminishing the distinctiveness of both. Indeed it speaks to the fact that one of postmodernism's most certain traits is that it blurs all boundaries,

leveling everything – especially individuals – into an entropic state, in which identity and communication become unattainable.

For the purposes of my examination, I have focused on the ways in which these writers deconstruct language and character, specifically, because I feel these are two characteristics which will be most easily tracked in the shift toward contemporary literature and which will demonstrate the most evident degrees of change, should there be change.

In order to discuss the sense in which they practiced this deconstruction, we must first understand what ‘deconstruction’ is. Deconstruction refers to the literary theory, associated with Jacques Derrida in the 1960’s, that all language, once taken apart and reduced to its most minimal, essential elements, has no center. . The theory can be summarized by the idea that in order to understand words, we must understand that words define themselves in opposition to each other. For instance, we know that a chair is a chair because it is not a cat, a wall, a cloud, etc. Yet, when we look at ‘chair’ itself, the word ‘chair’ and the thing it represents are separate – thus, words are inherently conceptual. They are not what they represent, and exist purely as mental constructs, understood through the knowledge that they exist as they are because they are not anything else.*(citation) Thus, words are not ‘things’ themselves, but rather, representations of things. Furthermore, because they are defined in opposition to each other, and because they are only defined by their opposites, they exist in a loop of contradictions, defining themselves off of other undefined words. Language, to the Deconstructionist, is like a galaxy revolving around a black hole.

In just the same way as deconstruction theory, Postmodern characters and language revolve around a blank center. Samuel Beckett’s works demonstrate this concept best, as he deliberately takes characters out of any identifiable time or place, strips them to their most basic actions , and dilutes their language into its most primitive, regressive form. In works like *Waiting for Godot*, for example, the entire plot centers around two characters speaking in very unfocused sentences, often forgetting each other, their own names, or why they are there, as demonstrated by the following passage:

Vladimir: And you are Pozzo?

Pozzo: Certainly I am Pozzo.

Vladimir: The same as yesterday?

Pozzo: Yesterday?

Vladimir: We met yesterday. (*Silence.*) Do you not remember?

Pozzo: I don't remember having met anyone yesterday. But tomorrow I won't remember having met anyone today. So don't count on me to enlighten you.

(Act 2: Scene 1)

In the moments where they do recall what they are doing, we see that they are waiting for a figure – Godot – who never shows up, and who may never show up – or may have never existed at all. The play strongly suggests that Godot is a representation of the absence of God, which furthermore isolates the characters to their single, endless frame of existence with no goal or guiding principle. The tragedy of these two characters stems from their complete isolation from any sort of certainty. They do not know how long they have been there, or what got them there. (quote) Through half of the play, their language makes no sense to the reader or to each other. In fact, they spend most of their time arguing about meaning or talking past each other completely. By the end of the play, they have contemplated hanging themselves several times, but either forget to, or fail in the attempt, implying that they cannot even be released into a state of death, because death would be a definite state of existence. This demonstrates the postmodern idea of existence without a center; the characters exist only in the sense that they are in opposition to their universe, incapable of defining themselves within it because the things on which they try to found their identities are absent. In a scene in which Estragon is trying, to no avail, to remove his boot, the following discussion occurs:

Estragon: (*giving up again*) Nothing to be done.

Vladimir: (*advancing with short, stiff strides, legs wide apart*). I'm beginning to come round to that opinion. All my life I've tried to put it from me, saying, Vladimir, be reasonable, you haven't tried everything. And I resumed the struggle. (*He broods, musing on the struggle. Turning to Estragon.*) So there you are again.

Estragon: Am I?

Vladimir: Glad to see you back. I thought you were gone forever.

Estragon: Me too.

(Act 1: Scene 1)

Vladimir and Estragon speak to each other, but are each speaking in terms of their own personal struggles rather than really carrying on a conversation. Estragon is absorbed in attempting to achieve an impossible goal, and Vladimir has given up on trying to achieve anything – demonstrating that postmodern lack of direction and communication. They are characters caught in a loop that revolves around absence. In Beckett's other works, his characters are nearly always placed in situations where they do not remember their names, or origins, or the purpose of being there. They speak in tattered, nonsensical, or vague language, so that they cannot fully express what they actually mean, and cannot understand each other. For example, the first paragraph of Beckett's *Lessness*:

Ruins true refuge long last towards which so many false time out of mind. All sides
endlessness earth
sky as one no sound no stir. Grey face two pale blue little body heart beating only up
right. Blacked out
fallen open four walls over backwards true refuge issueless. (Beckett197)

His characters are taken out of time, space, and self-awareness, living in realms where they are, perhaps, just around the corner from making sense of something, but never arriving at it. They are characters caught in a loop that revolves around absence, as we see with Vladimir and Estragon, who revolve around Godot's absence, or the central figure of *Lessness*, whose incoherency gives us only fragments of a possible concept. This is the essence of postmodern writing. In his book *Late Postmodernism*, Jeremy Green describes it thusly: "The ideal postmodern novel, it seems, aspires not to be a novel at all. Instead, it works to represent a social reality" (Green 26). The social reality he describes is one in which individuals feel isolated, purposeless, and unguided, and it is reflected in the literature of those individuals, as demonstrated by the appearance of those same traits in the works of writers like Beckett. Whether it is the absence of clear meaning, or the absence of traditional narrative forms and linguistic

structures, postmodernism places its emphasis on the concept of nothingness; people, the worlds they inhabit, and the things they say, adhere to no rules, have no inherent meaning, and are in their essence chaotic ramblings through which we might think we see patterns, although there are none there.

We see this continued after Beckett in other postmodern authors. Thomas Pynchon, for instance, gives us incredibly shallow or undeveloped characters which are caught in situations forever moving them toward various states of entropy. Pynchon's character Oedipa in *The Crying of Lot 49*, for example, sets off on a quest to discover a mysterious organization, but spends the majority of the novel either alone or with people she cannot identify with, trust, or understand. She does not particularly care about finding the answers; neither does she particularly care about anyone in her life, forming brief and shallow relationships, lying about her identity, and continually wandering alone. The same is true for Bret Easton Ellis's character in *American Psycho*. Ellis plunges us into a mind which cannot separate reality from fiction, is intent on destruction and chaos, and which, above all, is focused on covering up the sociopathic emptiness of his personality with artificial coverings (hair products, expensive clothes, the right social connections, etc.). The character is immediately set apart from normal experience because he is incredibly rich, but also because he lives in a world in which he is a brutal serial killer – although the reality of that world is highly questionable. The character, furthermore, spends long sections obsessing over which shoes to wear with which jackets, and the brand names of minute things in his rooms, often going off onto tangents that are nearly impossible to follow because they intentionally bore the reader, disassociating us further, or because his thoughts begin to appear in stream-of-consciousness forms that lurch and ramble so unpredictably that we are not sure exactly what he is trying to explain.

Postmodernism, then, takes away everything characters have, including most importantly the ability to communicate with themselves or others, and leaves them floating in a very undirected existence that mimics the emotions of purposelessness in the society that spawned them. The deconstruction of language and character in Postmodernism reflects a real-world society in which individuals feel little or no sense of identity, and have no confidence in their ability to communicate with others. When these characteristics are infused into literature, they create a style that emphasizes incoherence. This trend

poses a struggle for contemporary writers, because they must now face the task of building from the platform Postmodernism left them. It is a platform that does not leave much to build from, because once you have deconstructed every structure, allowed every impermissible or impossible strategy, and brought characters to their most minimal elements, what is there left for writers to do?

The first solution to this problem could simply be to stop using words to tell stories. This sounds far-fetched, but is more common than it seems. The immediate solution is to use pictures; however, this raises the question of whether a story told through pictures is still literature. A new genre of literature answers that question. The rise of the graphic novel, especially within the past few years, challenges the assumption that literature must be made out of words alone. Works like *Maus* and *Persepolis*, for instance, are not only respected as forms of graphic art, but are taught in many college literature classes alongside 'regular' literature. The graphic novel is just as valid a storytelling platform as literature, and "the genre itself is more and more seen as a new form of literature. ... it has now become perfectly thinkable that the next version of the Norton Anthology may include pages by Chris Ware" (Baetens 78). Just as any new literary movement, serves as "broadening of the novelistic field, which now can encompass works that are wordless, [forcing] us to rethink our most basic definitions of the meaning of once self-evident notions such as text, novel, and literature" (Baetens 82). Granted, many graphic novels still rely on some text to tell their stories, but the majority of the story is told through images, using text to reinforce it, much the same way traditional literature would use illustrations to enhance its points. In a graphic novel, a completely new layer of considerations emerges which forces the reader to examine the content in a new light. In addition to the traditional concerns over language and character, the graphic novel introduces "tension between ...content and style ... [and thus] the graphic novel can increase our awareness of the possible polyphony of the narrative voice" (84). We cannot, in other words, simply consider a graphic novel the same way we consider a traditional novel. The tension Baetens describes rests in the dynamic between the visual image presented to the reader and the content of the story itself. We must consider the visual along with the narrative, and incorporate a dual set of cues – both textual and visual – in order to fully analyze the story. It is not enough for the reader of *Persepolis* to read the words

“We found ourselves veiled and separated from our friends” (Satrapi 4). Instead, the writer intends for us to see the last looks exchanged between the boys and girls as they are sorted by gender into different classrooms – the last instance of their interaction together as students. There is more going on, though, than a simple illustration of textual events. To analyze this work, we must consider the colors Satrapi chooses (black and white through the entire novel), when/how those colors are used (increasingly dark as the main character moves from childhood to a dangerous and tormented adulthood), when words are and are not included in the frame, and how the art itself is done, among other factors. The depth of thought and style involved in graphic novels separates them from the ranks of typical comic strips and cartoons the same way that literary depth separates a well-wrought novel from a Hallmark card. The only difference between the language of a novel and the pictorial language of a graphic novel would be the method of communication – text versus image. This raises the question of whether images provide any deviation from the terminus of language presented by Postmodernism (if we accept that pictures are a valid form of language themselves). It can be argued that the graphic novel deliberately opposes the notion of textual language, and sets itself up as a separate solution to the terminus by emphasizing the idea that communication is possible after all. Communication, in this solution, exists on a level in which individuals connect to each other through the shared experience of reacting to the same image, rather than attempting to react to traditional language. They are able to connect to each other through the shared experience of seeing the image, rather than trying to navigate the doomed verbal and textual messages that postmodernism deconstructed. . The graphic novel relies on the idea that images communicate where words cannot. They are both forms of language, but images are more universal than texts; they create and communicate a message without as much fear of mismanaging it with words. Thus, it seems, graphic novels have paved the way for a revolution in literature that escapes the deconstruction of language and character left behind by the postmodernists. If this is the answer to postmodernism’s deconstruction of language, then it would appear that graphic novels mark the period after postmodernism. But there is an inherent problem in this kind of thinking. Although these novels rely on images instead of words, they are still telling stories in either the style of postmodernism or previous periods. For instance, in Paul

Atkinson's article "The Graphic Novel as Metafiction," he describes the graphic novel as containing one of those primary postmodern characteristics, in that "there is a questioning of fictional boundaries and the condensation into a single fictional text of ontologies that logically should not co-exist, or be allowed to interpenetrate" (109). The ontologies, here, being the concepts of boundaries between the real world and fiction, which metafiction blurs. Metafiction is a trope of postmodern writing, "which brings the act of reading the book – something the narrator should have no knowledge of – into the book itself" (109). Graphic novels approach metafiction in more than their stylistic choices, though. They contain another trait that both distinguishes them from traditional literature and unifies them with postmodern practices. Just as in the works of Beckett and other postmodernists, the graphic novel plays with the awareness of time and space in that "there is a sense in which the past, present and future coexist. ...there is an opportunity ...for the viewer to preview the whole page" (112). In a traditional novel, the reader can look at any point on the page they wish, but there remains a sense of the order in which the text on the page should be perceived. In a graphic novel, the reader is confronted by panels that may interrupt, overshadow, or rearrange each other, so that even if they are attempting to read the story chronologically, certain images can jump forward before others, blurring the continuum of a page's events. Thus, the reader is suspended in that very postmodern state of uncertain time and space. In this way, graphic novels prove themselves to have a few more unique tools at hand than conventional literature, but they still use those tools for postmodern purposes. Even graphic novels which do not behave in a particularly postmodern fashion are still following the trends of previous literary periods. The stories still carry all the marks of traditional narratives, as with modernism, or the scattered, satirical, deconstructed methods of postmodernism. In this sense, then, they are not a representation of a new literary era, but a new face pasted on a previously existing style. In fact, the more contemporary books you pull off of a given shelf (such as *Specimen Days*, *Beloved*, or *A Man Without A Country*), the more you notice that they tend to still follow either postmodern or modern styles of writing. Is there, then, simply a terminus or a regression in the works of contemporary writers? Have they been left with nowhere else to turn?

Researchers who have been looking into the possibility of a new literary era have made a few key observations which indicate something new is indeed on the rise..One of these indications is the current blend of literature and everyday life through technology and media. This link is explored by Andrew Hoberek in the article “After Postmodernism” in which he observes that postmodernism’s behaviors - those traits of deconstructed identities, communication flaws, etc. – have bled into mass culture. They are all around us now, and thus they no longer describe the newest ideas and mindsets of our world. What was once the stuff of literature is now an ordinary component of our existence. For instance, we live in a hyperconnected universe, fueled by the internet, shooting messages and information back and forth in ways that were once the stuff of science fiction, so closely mirroring postmodern concepts of centerlessness and entropy that such concepts have become normal states of existence. Hoberek points out the observation of many critics that once the trends and patterns of a literary era bleed into mass culture this way, it is a sign that those trends are no longer in power, and he believes that “the postmodern style epitomized by Pynchon no longer provides a self-evident organizing principle for recent writing” (237). Hoberek states furthermore that “Postmodern writers ... enjoyed a notorious and wild ride of radical challenge to institutionalized art and its generic categories ... but... [their methods] no longer worked by the 1990s” (233). That is to say, they became cliché tropes which spoke for an outdated societal mindset. Alan Kirby’s article “Successor states to an empire in free fall” reaffirms the death of postmodernism with a view that also links postmodernism’s downfall with its adoption by mass culture. Kirby writes:

postmodern characteristics thrive in the best-selling novels of Jasper Forde and the juvenile comedy of Family Guy... postmodernism's heyday is over; its reign has ended. Muted and mutating, its traces and echoes linger on in the culture. Its shadow falls over us from behind. But it is no longer the best place to go to get a handle on the world that we live in. (Kirby, *timeshighereducation.Co.UK*).

This claim relies on the idea that for a literary movement to be considered contemporary, it must behave dynamically, acting at odds with the culture around it to create patterns and tendencies different from

those already dominating society. Absorption of a movement by society is evidence of its stagnation, and it ceases to be current. This, according to Kirby's argument, is what has become of postmodernism. Everything - novels and television, billboards and music – embodies recognizable postmodern styles – and this indicates the era's loss of cutting-edge transformation. However, Hoberek goes further than to repeat the mantra that postmodernism is dead. Instead, he suggests that the new era – the post-postmodern era – has taken an aspect of postmodernism and made it into something new – and the aspect it has taken is “the blurring of high and mass culture” (Hoberek, 237). Things such as high-brow and low-brow art, which were once sharply divided by class boundaries now merge into each other's territory. Hoberek argues that our current era takes that postmodern principle and uses it to amass resources, rather than to demonstrate deconstruction. Specifically, Hoberek notes a “tendency to confer literary status on popular genres ... [while] from the opposite side of the cultural divide, authors with recognized high-cultural cachet now increasingly make forays into popular genres” (Hoberek, 238). This includes the jump in which the graphic novel “suddenly finds itself elevated to the status of literature” (Hoberek, 238), as well as an upward shift in the status of science fiction, juxtaposed with writers like Bharati Mukherjee, Cormac McCarthy, John Updike, and Philip Roth, writing genre-fiction like thrillers, political novels, and romances (Hoberek, 238). It is because of this that works like Kurt Vonnegut's science fiction stories are read academically alongside his more typically ‘literary’ works, like *Slaughterhouse 5*. It must be granted that postmodernism also blurred boundaries like these. The difference is our contemporary readiness to do so. Postmodernism broke the boundaries with the attitude that the boundaries did not matter. Our post-postmodern society breaks the boundaries with a kind of consumptive enthusiasm, an eagerness in individuals to experience many forms equally, thereby elevating all statuses rather than deconstructing them. For instance, by broadening our definitions of literature, we supply ourselves with a wider variety of ways to communicate. Anything with the potential to help us connect becomes valuable, whereas in postmodernism, the more attempts at communication were attempted, the more they were devalued as futile. We are eager now to find a way past our previous communication failures, through any means possible. Furthermore, this does not stop at literature, as Jeremy Green discusses in *Late Postmodernism*.

We can see the divisions mixing all across our world. The world, it seems, has lost the intense focus it once had on delegating status-symbols:

No longer is it necessary to argue that one kind of cultural activity is superior to another: reading Dante is no better than watching a soap opera. Culture can now be understood and enjoyed without appeal to evaluative criteria founded on aesthetic disinterestedness.
(Green 41)

This is not to say that there is no standard with which to measure art, but rather that the arts are “obliged to either mount elaborate defenses of their specialness, or must accept that they are just one more item on a full menu of consumer choices” (Green42). Green goes on to say that this trend is not necessarily a turn for the better. Because our culture has become so highly integrative, undefined, and commercialized, “the novel’s future lies at best in survival on the margins of an image-based culture” (Green 45). It is important to note that this statement could be used to either explain the rise of graphic novels in the literary world as a symptom of that ‘image-based’ commercial culture, or to identify the graphic novel as literature’s attempt to find its niche in that culture – the latter demonstrated by the anxieties of writers like Green over the state of literature’s cultural relevance. Indeed, Green spends much of *Late Postmodernism* discussing the possibility that literature is, in fact, dead, relying on the styles of former eras or on the whims of mass culture for its content and substance (Green, 45-77). He focuses specifically on the phenomenon of Oprah’s book club, which embodies the essence of the problem . The club “fulfilled this demand for fictional texts that could be read as transparent commentaries on widely shared problems” (Green, 85), while at once becoming “a new form of public sphere in which important matters of race, morality, the body, and sexuality... are given public expression” (Green, 87). It puts literature into the hands of an audience “lacking the cultural authority and prestige that would allow participation in other spaces of political discussion” (Green, 87), and thus performs that ultimate act of blending high and mass culture, producing two possible effects: one, that the overall quality of literary substance and discussion drops, or two – that “reading is beneficial to the reader and to the culture in general” (Green, 83) and thereby raises the suitability of the masses to discuss literature. These ideas, of course, center on the ideas

of those who believe that reading ‘high literature’ requires a certain amount of training or ‘worthiness’ and the public, being generally less trained/ worthy, either devalues high literature or is improved by contact with it. Because both are possible and neither is dominant, , literature remains in a limbo caused by our society’s hyperactive readiness to broaden experience by blending status levels and genres.

This limbo, though, illustrates a different point about the mixing of literature and mass culture. Green emphasizes a concept that appears to be dominating contemporary literature – the focus on utopia.. Specifically, he discusses novels in which the characters find themselves at odds with mass culture’s ideals of physical and material perfection, encouraged to blend into the “pressures of social objectification” (Green, 202) in order to uphold the utopian standards presented by the media. Those ideals do not simply concern beauty and wealth. They also concern a false sense of community, a “tension between autonomy and solidarity” (Green, 202) in which the individual is encouraged to “adopt the rhetoric of community, of belonging, togetherness, shared history, stability, care, and concern” (200), but at the same time must “retreat into internal exile” (Green, 202) in order to retain individual identity. Green uses examples from Evan Dara’s book *The Lost Scrapbook* to demonstrate this phenomenon. In describing the novel’s focus on comparing individuals to electrons, which are both particles and waves at the same time, Green tells us:

This situation functions as an analogy for the problem of social knowledge with which the novel engages: the retreat into internal exile as a way of resiting the pressures of social objectification (hypostatic roles and functions, and statistical identification) has the unfortunate consequence of separating and so disempowering the exiles, rendering them social particles. The extremes of disempowerment involve the reduction of individuals to the status of hostages, those held purely for their exchange values in a quantitative trade-off. But the novel’s characters and its form both raise a utopian protest in favor of joining up atomized particles into waves, linking particular desires into collective articulation.

(Green 202)

This implies that the individual must do what Green perceives literature to be doing. We must exist today between realms of consumption by society and individuality or worth. Our society demands that we be plugged into it constantly, sharing our thoughts, and interacting both socially and electronically. For example, we are required by our work and social environments to express our identities through sites like Facebook so that we can learn about each other, and must keep our cell phones ready at all times in case someone needs to contact us. At the same time, society places heavy focus on the need to retain/form individual identity separate from mass culture. We are expected to express our individuality through the clothes we wear, the places we eat, and the music we listen to. Even on Facebook, where we are so blended and shared with others, we are supposed to identify what makes us unique and post our individual thoughts. Society wants us to behave as highly separate members of a highly unified whole. We, like our literature, are in limbo.

If this is true, then what does mark the new literary era? One person with an answer is Nicoline Timmer, with her book *Do You Feel It Too?* Timmer's focus is on "the narrative construction of the self" (Timmer 74) – that is, the ways in which literature is used to examine or represent one's personal identity. This is a turn away from the overwhelming focus on the way literature represents society, although not divorced from the concept. Rather, the literature Timmer examines studies the question of where the individual fits into society and how he/she retains or expresses identity in that society. The suggestion throughout the book is that the individual is on a kind of rebound, suffering the psychological trauma of a mind trying to reclaim the identity and communication deconstructed by Beckett's lonely gibberish and Pynchon's entropy. She discusses this in terms of three symptoms with descriptive, yet unusual, names specifically: "lack of decision making tools; it hurts, I can't feel anything; [and] a structural need for a we" (Timmer 301-303). These three symptoms are descriptions of the problems faced by current characters.

The first symptom (lack of decision making tools) deals with the idea that contemporary characters find themselves at a loss because they are ill-equipped to handle the decisions they encounter. Addressing this symptom, she concludes, "Confronted with a plethora of possibilities and freedoms, the

self in these novels continually threatens to implode to the point of indecision and passivity” (Timmer 302). That is, in these novels, “the more freedom people have to act as they please, the more passive they seem to get”(Timmer 306). She describes this with the phenomenon of self-help groups in particular, because they exemplify the ways in which people are driven to make the best of their lives but are given an overwhelming abundance of options with which to do so (Timmer 307). Alan Kirby describes this phenomenon in the context of the current real-world communication surge, saying, “Hypermodernity, our contemporary state, begins when modernity's promises of limitless individualism and freedom from social obligations and structuring conventions are finally fulfilled” (Kirby). From this stems a modern reaction of depression because “an increase in options makes people expect more, plus, if they fail to get the very best, they have only themselves to blame” (Timmer 310). This would be best demonstrated by the example of a student who has great potential to do a variety of things, but because they are faced with so many possibilities and no tools with which to choose among them, they end up doing nothing at all. Even if this student does do something with one of those options, they are still doomed to feel unaccomplished because there will always be something more they could have achieved, and they alone are held responsible for not making the choices that would have led them to ultimate success. We see, then, that Timmer’s observation shows a progression away from postmodernism. Postmodern characters could not interact with their environment because either they or it were too insubstantial for interaction. In contrast, contemporary characters are too overwhelmed by options for potential interaction to interact successfully. Granted, this contemporary trend still represents an inability to communicate, but , it demonstrates it from the opposite end of the spectrum. It indicates an attempt to progress, whereas postmodernism made no such attempt. Instead of recognizing the inherent pointlessness of endeavors, contemporary characters over-emphasize the necessity to make as many endeavors as possible. Our characters demonstrate an equal but opposite reaction to the deconstruction of postmodernism. Rather than focusing on the ways in which people fail to communicate or form identities, contemporary characters obsess over the ways in which communication and identity might be achieved. They recognize the problem and see avenues around it, but are defeated by the multitude of avenues presented to them..

Contemporary characters are further examined by Timmer's next symptom (*it hurts, I can't feel anything*). She makes a point of comparing the emotional state of postmodern characters to those of contemporary ones, finding that "postmodern conceptions of the self... appeared to be divorced from feelings... [whereas] the selves in contemporary novels are overwhelmed by feelings they can hardly make sense of" (Timmer 302). Her most important observation about this deals with why the symptom exists:

The problem of 'it hurts, I can't feel anything' has to do with the fact that the selves in these novels find it difficult to appropriate feelings, while feeling them nevertheless. This confusion about where to situate feelings points, as I explained earlier, to insecurities about what exactly are the limits of the self, or to the question of how to delimit the self. Ideas about what is private and 'inner' versus what is public and 'outside' or 'other' appear to be changing, and this, I believe, is very much related to the second symptom. (Timmer 303)

This discussion centers on the idea of the individual's confusion between their inner world (emotional, mental) and the outside world. This is essential to examining the contemporary era. It is an idea John McGowen's discusses in his analysis of the ongoing battle between autonomy and uniformity, which further represents the rebound Timmer's book analyzes – the resurgence of individual reconnection with society. As McGowen says, "In the absence of foundations, principles of legitimation are going to have to come from within the social whole, not from some magical exterior" (McGowen 279). That is to say, for concepts of communication and identity to become legitimate or real, those concepts have to be formed by society. Individuals searching for these concepts on their own cannot, as demonstrated by Timmer, figure out which options would help them achieve their goal. Individuals need connection to society in order to examine their emotional conflicts and form their personalities. There is, then, an agreement that the contemporary character is not only hyper-connected to society, but necessarily so, in order to reclaim individual identity.

This is further explored in Timmer's third symptom, 'a structural need for a we,' which stems – yet again – from that desire to escape the mental states left over by postmodernism's deconstructions.

Timmer describes the specific malady of these characters thus:

It is their solipsism – a particular form of solipsism moreover: without a self-secure solipsist present. These fictional figures have the feeling of being imprisoned in their own minds, a feeling of being cut off somehow from the world and others, while at the same time they don't seem able to trust this private mind as a stable and secure compass that could direct the self in its course through life. (Timmer 305)

Timmer and others pay heavy focus on the character Hal in *Infinite Jest*, widely considered to be a primary example of the post-postmodern novel, in which the solipsism Timmer describes becomes evident repeatedly. Hal, most notably, is a young genius, but due to a childhood accident, is unable to speak. Another character in the novel is reduced to an anxiety attack in a room with boarded up windows as he tries to decide whether to answer the phone or the door. This solipsism, however, is not so extraordinary. It could be just another description of the postmodern era. The key difference lies in the fact that contemporary characters like Hal are seeking an escape from their solipsistic existences, not wallowing in them. This attempt at escape, however futile, again demonstrates movement and progress from the terminus of postmodernism. It represents an era which, overall, "attempts to re-humanize the subject" (Timmer 305). In other words, the contemporary era attempts to revitalize characters by returning a sense of humanness to them through searches for communication and identity, whereas postmodernism de-humanized its subjects by deconstructing them. So after all this time, we finally have a solid description of a post-postmodern characteristic – an era of re-humanization.. This, however, is not much of a discovery, because – as discussed – every era is necessarily a reaction to the one before it. This simply explains what the reaction looks like. The important question to consider is that of how these modern characters are managing their battle for identity and connection.

The connection between the articles and books discussed here is that they all note the phenomenon of mass culture's influence on contemporary writing, and vice versa. Combined with

Timmer's suggestion of the need for a 'we,' it becomes evident that these phenomena are dependent on each other. That is, the blending of mass culture and literature (such as in the forms of graphic novels and genre fiction discussed earlier) indicate that contemporary individuals and the characters that represent them are attempting to escape the emptiness and entropy of the previous era through frantic forms of mass-communication. Literature is not the isolated and narrowly defined field it once was. Rather, it spreads into everything – and lets everything spread into it – from high culture to Oprah's book club, from science fiction to the technology surrounding our everyday lives, all of which we are ready to accept as new and varied forms of literature, as previously discussed. This is best exemplified by the rise of technology as a type of literature. Kirby describes this phenomenon as digimodernism, which is “the critical event in contemporary culture [of] the profound and shattering encounter between computerisation and the text. Its most recognizable form is a new kind of digitised textuality - onward, haphazard and evanescent - that disrupts traditional ideas about authorship and reading” (Kirby). Timmer describes a world in which everyone feels the lack of communication left by postmodernism but cannot communicate that lack in any specific term, leading to the existence of individuals who, unlike postmodern ones, feel the weight of the emptiness surrounding them and thus are tempted toward solipsism, but seek avenues out of it, unlike their postmodern predecessors. She offers an escape route, which separates this era from the postmodern one: the fact that, unlike postmodern individuals, contemporary individuals do not simply recognize that feeling of absence. Rather, they recognize those feelings and use them for communication, rather than letting such feelings rob them of communication. For example, instead of sinking into solipsism, these individuals create massive forms of social media to connect to other people and express their thoughts. They also write and buy self-help books, join support groups, or write blogs sharing their emotions. They are able to connect via the attempt to express and explain the lack of direction and unity they feel. Even if the attempt to understand or communicate the feeling is unsuccessful, the attempt is what matters. Postmodernism would not make such an attempt to move past the emptiness. It would simply display it, over and over, emphasizing the lack of escape, as demonstrated by the futile attempts of

Beckett and Pynchon's characters – characters created for the purpose of demonstrating inescapable emptiness. This modern era is characterized by its attempt to escape that void.

The attempt, then, becomes its own era characterizes of literature. As mentioned, mass culture plays a key role in the attempt to communicate. Literature is a more broad category than ever before, accepting myriad forms which are almost infinitely accessible to anyone who has something to express. You can draw pictures or write novels, but you can also create websites and blogs, use instant chat, share your emotional state through outlets like Facebook or Twitter – all at a constant, available rate, viewable by just about anyone – a kind of “narrative endlessness” (Kirby). Recognizing the need to communicate, modern society has made everything its medium. There is an inherent need for community and communication in our society, which has become a kind of literature fueled by expanded methods through which we can communicate constantly. of expanded methods of communication. It is a literature that represents itself perfectly because it stages itself as narrator, subject, listener, and critic. Raoul Eshelman describes it as the era of “performativism” (Eshelman, anthropoetics.ucla.edu), in which readers are made integral emotional participants in the work, as compared to the postmodern desire to communicate no emotion whatsoever to the reader; indeed, to communicate emptiness:

Where deconstruction and the flip-flopping narrative strategies of postmodernism try to show that the performative and the literal are interchangeable functions of a larger discursive context over which we have no control, performatism makes the performative mode into a present, more or less compulsory aesthetic fact in the mind of the beholder.

(Eshelman).

The contemporary era is the age of confessional novels in which a main character spends time discussing his/her life and viewpoints. It is the age in which anything can be considered literature, and in which anyone can sit down and create a story – because we must. Because we need to communicate to escape solipsism. But overall, it is because there must be a movement forward from the previous era, which is being sought desperately and ubiquitously, through any means possible.

If we look at this increased focus on the individual as an important, influential, communicative subject, combined with the fact that nearly anyone can write and be read, then it appears that we have become the new characters, and the way we speak to each other has become the new language. That is, we have added a branch to our literary experience in which we are able to examine ourselves through mass networking like blogs and Facebook, becoming virtual versions of ourselves in order to connect with others and better identify ourselves through communication with them. We are the ones who give these self-descriptive texts their meaning, and the primary use of the meanings we find is their application to our own lives. Literature today, then, acts however the individual desires it to. It follows any trend, but none in particular. Above all, it reflects an individual-centered society attempting to reaffirm individual worth and purpose through mass communication and expression. It is the backlash against the postmodernist era in which the individual had no specific drive, no relationship to the world, and no way to express him/herself. Our contemporary literature seeks to lift itself from the gaps left by the previous era, by finding a way to draw us out of solipsism through massive assertion that the individual opinion not only matters, but can be shared easily and constantly. Furthermore, because every individual enacts this self-expression, society becomes at once a unified identity of expressionists and a sounding board for unique individuals, in which the individual agrees to join this mass identity to reclaim aspects of their individuality.

It is the responsibility of contemporary writers to progress from the foundations of their predecessors. This progress is not only necessary for the continued expression and examination of individuals and cultures, it is inevitable. Every literary era, just like every individual work of literature, is a reflection of the world around it, and as such, it will change as the world around it changes. Defining any literary era is difficult except in retrospect, because as each one forms, it begins as a nebulous and reactionary step away from the era before it, and so many of the works will retain traces of the former era, or have seemingly scattered and undefined characteristics of their own. However, scholars, readers, and mass culture agree that the era of postmodernism no longer applies to contemporary writing or experience. Today's characters are created through a limitless array of means, from graphic novels to

blogs, and they speak overwhelmingly through personal confession, although they may use the linguistic patterns of previous eras. They are not only fictional in narratives in the traditional sense – they are now also the narratives of the characters we put forth to represent our emotions and mindsets via mass-communication outlets like Facebook – outlets which we are ready to accept as forms of literature, due to the blurring of high and low cultures. We are able to construct ourselves as characters in one mass literary event over the internet. We are able to absorb mass culture as part of our creative endeavor, just as mass culture absorbs and displays creative works. As Timmer describes us, we are characters seeking to redeem our identities and escape the solipsism brought on by lack of communication. We are all seeking to progress from the void with which postmodernism became saturated. There is something that needs to be expressed – some emotional state – perhaps all emotional states, if every individual is as important and influential as this large communicative culture suggests them to be – and the contemporary literary era is preoccupied with discussions of that state in order to arrive at a better understanding of how society and the individual fit together without destroying each other's worth or meaning. It would seem that we have entered into a new version of Pynchon's entropy; not one in which all energies become one, even and level and thus nonexistent, but rather a kind of unity in which every individual attempts to work as an organ in a larger unit, expressing itself and attempting to communicate in order to achieve an understanding of identity. Anything is a character. Anything is a language. The important thing is expression – an escape from the void – with whatever can be used, and as often as possible.

Breaking the Mold of Team Teaching

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Breaking the Mold of Team Teaching

Team teaching is a term that is widely used and carries several different definitions in the field of education. Every classroom, every school, and even every group of teachers use team teaching a little differently than the next. But that is part of the beauty of team teaching, it is flexible. Team teaching is a format for instruction that combines the experiences, thoughts, and creativity of two or more teachers. The concept of team teaching has been in practice for a great numbers of years in classrooms all over the world while some of the definitions of team teaching date back as far as the 1960s. The concept is growing, changing, and developing with the times. Today team teaching is evolving to fit the educational needs of generations of learners in the 21st century.

According to Tompkins (1969) team teaching is an impressive undertaking as it gives two or more teachers the responsibility for the education of a group of students. The model is often used to meet the needs of students in the general education classroom so they are not required to leave the classroom for additional resources. One definition of the term from Trump and Miller (1968) states that two or more teachers come together to plan, instruct, and evaluate students in one or more subject areas. Trump and Miller go on to say that the students may be of elementary or secondary age, and learning takes place in settings of large group instruction, small group instruction, and independent study. This definition is very thorough but defining the term is only part of the process of teaching content, as most educators know. What is truly needed to help get the information across is an accurate model of what you are attempting to teach. According to Mary-Jane Eisen (2000) accurate models for the team teaching format are frequently drawn from higher education settings.

When the model is used in classrooms at elementary levels it is traditionally the case that one general education teacher is providing instruction while the other teacher(s), who may be special education teachers, roam about the room observing students. According to Gloria Lodato Wilson there are a number of procedures that the co-teacher must use if he/she is not the sole instructor teaching

material (2008). The teacher who is not providing main instruction should roam about the room observing students, cue them when necessary, and even target students who may need additional instruction or clarification on the activity (Wilson, 2008). In these instances Wilson explains that the co-teacher is largely helping in classroom management since they are observing student behavior, responses, and work (2008). Going beyond just observing, the co-teacher may pair up with students for a short period to clarify things for them, may form a mini-group of students that can help one another, and could even interject a different solution or approach to the problem that the student might not have otherwise gotten (Wilson, 2008).

As stated in many definitions of team teaching, collaboration is essential to the planning and successful delivery of the content instruction. McDaniel and Colarulli (1997) explore the aspects of collaboration as they describe team teaching in higher education settings. McDaniel and Colarulli (1997) suggest four dimensions of collaboration can be used to determine the status of a team of instructors. Those dimensions are: degree of curricular integration, degree of faculty-student interaction, degree of faculty autonomy, and degree of student engagement. The authors denote that the degree of integration is meant to foster the ability of students to assimilate knowledge at the undergraduate level, something most students might not encounter until graduate school (1997). The degree of interaction, as defined by the McDaniel and Colarulli (1997), enhances student learning through different degrees of expertise and experiences of the individuals involved in the community of learners. The authors also make a valid point with the degree of student engagement by stating, students must not be passive spectators in instruction but instead be engaged, active participant in their learning (1997). Lastly, the degree of autonomy may be the most difficult for instructors because it requires time, respect, compromise, effective communication, and punctuality.

Team teaching lends itself to a number of advantages for not only the students but also the teachers involved. Bill Johnston and Bartek Madejski explain that for instructors the format of team

teaching is effective because it puts the creativity of more than one mind into lesson creation and planning (n.d.). The instructors also benefit because two or more teachers working together can prepare more material in less time than just one teacher could independently (Johnston and Madejski, n.d.). The students on the other hand, get an excellent experience observing the teachers working collaboratively, which in turn inspires them to work cooperatively with one another (Johnston and Madejski, n.d.). The students are also exposed to ideas and theories from more than one professor on more than one issue.

The many advantages of co-teaching are accompanied by challenges as well such as varying levels of involvement, vying for authority, and integrating educational philosophies. Varying levels of involvement lead to instructors contributing less than the necessary amount of time to the planning or structure of team teaching. Teachers may find it difficult to determine the appropriate level of involvement with both students and other instructors involved in the course since every instance of team teaching is unique. Instructors may also feel a power struggle when team teaching leadership roles may change and leave instructors uncertain of their role. Instructors may feel resistance to give authority of their classroom to another instructor if they are accustomed to managing their own classroom. In this situation it is important for all instructors involved to maintain an equal amount of respect from the students. The factor of differing educational philosophies is important because if it is not acknowledged early in the collaboration the benefits of the product may be undermined (Reynolds et al, 2010).

When looking at the effects of co-teaching the classroom both general as well as special educators say that this practice reaches more students than traditional methods while providing fun and additional care for the students (Kohler-Evans, n.d.). When Kohler-Evans surveyed teachers from fifteen urban and suburban districts in and around Seattle, Washington, she found that seventy-seven percent of the teachers admitted that they felt co-teaching directly influenced student achievement (n.d.).

Kohler-Evans's survey also revealed that all of the teachers in that seventy-seven percent stated that students made academic gains and that the impact on student's achievement was positive (n.d.).

Breaking through the traditional definitions of team teaching that have been around for years has led to the creation of a course known as Educational Psychology Assessment and Technology. This unique team teaching, collaborative course exists at Concord University in Athens, West Virginia, the brainchild of three Education professors, Dr. Anita Reynolds, Dr. Charles Grindstaff, and Dr. Terry Mullins. These instructors brought together three professional education courses in Concord University's curriculum of study for Education majors in both Elementary and Secondary fields. The three courses at Concord that came together to form this collaborative effort are Educational Psychology, Educational Assessment, and Educational Technology; hence how the unique course got its name Educational Psychology, Assessment, and Technology (EPAT).

The course formed the by three professors, EPAT, is a hybrid course that combines instructional aspects of classroom lecture, online modules, and field hours completed in local public schools. The instructors worked together from the beginning of the organization of the course to align instruction, activities, and assessments for all three individual courses. Some material in the three respective courses found common ground, allowing the professors to create fifteen modules that identified the broad concepts of each course while still allowing them autonomy (Reynolds et al, 2010). The instructors designed the course so that weekly instruction rotated through the three individual courses while maintaining the principle that the content would be integrated in the on-site field placement hours. Dr. Anita Reynolds, Dr. Charles Grindstaff, and Dr. Terry Mullins established fifteen modules that dictated instruction for the course of the semester, those modules include:

Week Number	Content
1	Educational Technology and its Relationship to Learning
2	The Development of the Whole Child

3	Accountability in the Classroom
4	Creating a Classroom Newsletter Using Word Tools
5	Learning Theories
6	Lesson and Test Design
7	Creating an Online Webquest
8	Classroom Management and Motivation
9	Performance Based Assessment
10	Teaching in the Interactive Classroom
11	Diversity in the Classroom
12	Interpreting Test Results
13	PowerPoint Presentation Reviewing Field Placements
14	Differentiated Instruction
15	Final Online Examination

(Reynolds et al, 2010)

The online modules provide PowerPoint presentations of the weekly lectures, instructional outlines, and topic DVDs for students to use for review and study. Students can navigate through the information and resources in the modules at their convenience when they are not in the classroom. The online component of the course also includes weekly journal discussions where students are required to post about the week's topic and its relation to their field experience hours in the public schools. The students then read and respond to the posts of two other students in each weekly discussion. This gives the students an opportunity to share their experiences with one another while giving the instructors a chance to evaluate the progress of students.

To achieve the twenty-five hour field experience requirement, students are placed in groups in three different schools with each group managed by one of the course's instructors, a practice not usually found in on-site placements in Education courses at Concord University. Students are usually placed on an individual basis and may not even have another student from their course at the same school. Furthermore, course instructors usually do not travel to the schools to observe students since

they are in various places. By grouping students in the public schools, students were able to interact with each other about their experiences, and it was convenient for the instructors to observe the students in classrooms as if they were all in one school. The instructors of EPAT believe this helps to place more emphasis on in-field training and the ability to connect theory to practice that other courses may not be able to provide (Reynolds et al, 2010). That conjecture is supported by evidence from Boyer in his book titled *College: The undergraduate experience in America*; Boyer explains that students see the content of one course and how it relates to others courses and this allows them to make connections. He goes on to state that these connections provide students with a more integrated view of knowledge and a more authentic view of life (1987).

Evaluation of EPAT

In order to measure student's feelings and opinions about EPAT, a questionnaire was administered to students in higher level Education Courses that had most likely completed some if not all of the three Education courses contained in EPAT. Some of the students were a part of the EPAT program while other students were enrolled in the three courses separately that are included in EPAT. Students participating in the survey completed 12 questions in which they rated their response on a Likert Scale of 1 through 7. The rating scale numbers relate their answers from strongly disagree (1), to agree (4), to strongly agree (7) as evident on the included questionnaire. The questions on the survey can be classified into two basic types: experience and opinion. Six of the twelve questions asked were about student's actual experiences regarding the three Education courses in order to determine the differences between EPAT students and non-EPAT students. The purpose of the opinion questions is to gauge student's thoughts about the components of the structure of EPAT without specifically identifying them as such. The remaining six questions asked were about student's opinion concerning the effectiveness of the course structure of EPAT, even if they had no experience in the EPAT course. The purpose of the experience questions is to determine if EPAT students feel they are getting quality

experiences from the course compared to the beliefs of non-EPAT students who took stand-alone courses. There were three courses selected in which to survey students and those were: Education 309 Understanding Reading Problems: Assessment & Instruction, Special Education 309 Strategies for the Inclusive Environment, and Early Education 304 Early Education Curriculum, Methods, & Materials.

For each of the following questions, please circle the number that best fits your response.

	Strongly Disagree			Agree			Strongly Agree
I feel comfortable integrating assessment into my lesson plans.	1	2	3	4	5	6	7
I feel that field placements would be more successful if the supervising teacher could observe the students in the public school setting.	1	2	3	4	5	6	7
In past field placements I have felt like a part of the classroom community.	1	2	3	4	5	6	7
I feel that field placements would be more effective if you could start them at the beginning of the semester instead of part way through.	1	2	3	4	5	6	7
I feel comfortable integrating technology into my lesson plans.	1	2	3	4	5	6	7
I feel that field placements would be more effective if time was provided for visiting the schools during the course schedule.	1	2	3	4	5	6	7
After completing field placements I have had the opportunity to discuss my experiences with my peers.	1	2	3	4	5	6	7
I feel that field placements would be more effective if there were collaboration between my course professor and my cooperating teacher.	1	2	3	4	5	6	7
I feel comfortable implementing differentiated instruction in the classroom.	1	2	3	4	5	6	7
I feel that completing weekly journals of the field experience would be more effective than completing one collective journal at the conclusion of the field placement.	1	2	3	4	5	6	7

I have a clear understanding of integrating theories learned in course work to practices in the classroom.	1	2	3	4	5	6	7
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Please check all that applies to you:

I have completed the collaborative course EPAT(Educational Psychology Assessment and Technology)

I have completed Educational Psychology as a stand alone course

I have completed Educational Assessment as a stand alone course

I have completed Educational Technology as a stand alone course

What is your expected graduation date? _____

Among these three courses there were forty-eight total students that completed the survey. The 48 student's surveys were then divided into groups based on completion of relevant courses.

Classification	Number of Students
Completed EPAT	10
Completed all 3 courses contained in EPAT as stand-alone courses	30
Completed 2 of the 3 courses contained in EPAT as stand-alone courses	6
Completed 1 of the 3 courses contained in EPAT as a stand-alone course	2
Total	48

There were 48 students that completed the questionnaire but only 21% of the students had completed EPAT. This small turn-out could be the result of EPAT being a relatively new course; it had only been in practice for 5 semesters at the time the data was collected. The 21% response from EPAT students may also be related to that fact that the questionnaire was administered to only 3 courses. Since students in the Education Program at Concord University complete courses at various different times in their program of study, EPAT students did not necessarily have to be in any of those 3 courses at the time data was collected. Some EPAT students may not be to those classes in their progression of courses and some may even be past them.

Of the 48 students that completed the survey, 92% rated at least four of the six components of the EPAT course between agree and strongly agree. There were three statements that were opinion based, centered around the structure of EPAT that received the most strongly agree responses. The components of EPAT that both EPAT and non-EPAT students rated positively were: "I feel that field

placements would be more effective if you could start them at the beginning of the semester and not part way through”, “I feel that field placements would be more effective if time was provided for visiting the schools during the course schedule”, and “I feel that completing weekly journals of the field experience would be more effective than completing one collective journal at the conclusion of the field placement”.

Only 21% of the questionnaires were completed by EPAT students and none of those students rated any of the survey questions with a 1, meaning they did not strongly disagree with any of the statements. These results suggest that all of the EPAT students agree that the components of the EPAT course are effective. Furthermore, the EPAT students responded to all of the experience questions with a four-seven, which means agree to strongly agree. These responses suggest that all of the EPAT students had quality experiences in the course even though they were unaware that the statements were targeted towards them.

EPAT students highly rated two of the statements related to their experience in Education courses, and those are: “I feel comfortable integrating assessment into my lesson plans” and “In past field placements I have felt like part of the classroom community”. EPAT students could have rated both of these experience statements high because of the structure they experienced in the course. The course caused them to simultaneously learn about assessment while learning about lesson planning; begin exposed to both at the same time may make it easier for the EPAT students to feel comfortable with these concepts. The EPAT students may also be more likely to feel like a part of the classroom community since they are consistently in the classroom at the same time every week and fit into the classroom's routine.

A higher percentage of EPAT students than students that did not complete EPAT agreed that they had effective experiences with components of Education courses that are not specific to the EPAT course. Non-EPAT students who completed stand-alone courses would have experienced field

placements at a number of different locations. In these field placements the students may have had experiences that were pleasant but could also have had students that were less than optimal. These field placement variables would not exist for EPAT students because they were all in three central locations with their course professor in the school with them.

The evidence gathered suggests that the consensus of the 48 students surveyed agree that the structure of the EPAT course is effective and can provide quality experiences with components of Education courses that are not specific to EPAT alone. The course integrates three concepts that are extremely important components of the real classroom, and are becoming more essential at time progresses. Being exposed to these practices early in their Educational courses at Concord University can help better prepare them for student teaching and involvement in the classroom.

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Kaitlin Huffman

Phylogenetic Analysis of *Desmognathus fuscus* to
Clarify Colonization History in West Virginia

Dr. Wise

Abstract

Desmognathus fuscus is a semi-aquatic salamander belonging to the family of Plethodontidae and commonly found throughout the Appalachian Mountains. However, little research has been conducted to examine the phylogeny and colonization history of the species in West Virginia. Dougherty (2011) conducted research in which the colonization history of the species in eastern West Virginia was thought to follow a west to east pattern as all of her Atlantic-drainage specimens emerged within a single well supported clade. However, she did not have enough data to support this hypothesis with high confidence as she sampled relatively few non-Atlantic populations. To expand investigation of this hypothesis, I collected *D. fuscus* salamanders from additional Ohio drainage locations across eastern and southern West Virginia. I extracted DNA from the specimens and amplified the genes *cytb* and *ND4* by PCR. The hypothesis of west to east colonization pattern is supported in this paper.

Introduction

Plethodontid salamanders are prevalent across the eastern United States with the most diverse region being that of the Appalachian Mountains where the genus *Desmognathus*, commonly known as the Dusky Salamander, is readily found (Tilley, 1997). Specifically, the southern Appalachian Mountains provide the Plethodontidae family immense variety of habitat use resulting in high species richness and diverse life histories (Kozak, et al, 2002). The family Plethodontidae consists of 68% of the known salamander species, and recent phylogenetic studies have resulted in rearrangement of the family's subdivisions (Bruce, 2007). The *Desmognathus* genus, a clade of nineteen recognized species, is an example of this as it has posed many systematic difficulties for herpetologists. This is due to the extensive range in which its species can be found, as well as the lack of external meristic characteristics between the species causing them to be similar morphologically (Kozak, et al, 2002; Karlin & Guttman, 1986; Juterbrock, 1978). Kozak et al. (2002) further suggests current taxonomy misjudges present species-level diversity.

Throughout the Appalachian Mountains, *Desmognathus* has been found distributed along both aquatic and terrestrial habitats with one species, *Desmognathus fuscus*, being found in stream-side, terrestrial environments (Rissler and Taylor, 2002). This occurs due to the fact *Desmognathus* is believed to reach maximum species richness in such stream-side environments as large streams can provide dispersal corridors (Petranka, 1998; Tilley 1997). The feeding of *Desmognathus fuscus* specimens found underwater is primarily on aquatic specimens, yet they have been found to feed on prey such as stonefly nymphs, annelids, and centipedes (Hamilton, 1932). The species is found to possess sexual dimorphism in the number of dorsal folds and possesses the greatest dimorphism at sexual maturity (Juterbrock, 1978).

Mitochondrial DNA can be used determine genetic variation within populations, classify evolutionary divergent populations, and evaluate the conservation value for populations and regions from an evolutionary and phylogenetic perspective, and therefore be used in aiding with the reconstruction of genealogical relationships (Moritz, 1994; Mueller, 2006). Various studies examining the genetics and

systematics of *D. fuscus* have been conducted (Karlin & Guttman, 1986; Tilley, 1981, 2008; Jones, 1986; Barbour et al, 1969). However, no detailed population-level work has been conducted on West Virginia.

Dougherty (2011) compared haplotypes of *cytb* and *ND4* sequences for *Desmognathus fuscus* in order to elucidate phylogeny in Ohio River and Atlantic Ocean watersheds in West Virginia. She made a preliminary finding which suggested the colonization history of *Desmognathus fuscus* followed a west to east pattern due to the fact her Atlantic-drainage specimens were part of a single clade. However, Dougherty (2011) had sampled relatively few non-Atlantic populations and a few of these populations emerged within this clade as well. To expand investigation of her hypothesis, I collected *D. fuscus* salamanders from additional locations across eastern and southern West Virginia with the majority coming from the Ohio drainage.

Materials & Methods

Specimen Collection:

An associate and I collected *Desmognathus fuscus* specimens at various Atlantic Ocean and Ohio River watershed locations across eastern and southern West Virginia; most of which consisted of intermittent rocky stream beds. I collected specimens by turning over rocks and leaves. Once collected, specimens were identified visually, and stored at -70° C.

DNA extraction:

An associate and I used a DNeasy Tissue DNA Extraction Kit (Qiagen, Valencia CA) to extract DNA from the individual salamanders according to manufacturer's protocols.

Polymerase chain reaction & gel electrophoresis:

I used PCR kits (Invitrogen) to amplify mtDNA for *cytb* and *ND4* genes, following the manufacturer's protocol. I then conducted electrophoresis using a 1% agarose gel containing 0.002% ethidium bromide and subjected it to electrophoresis for 40 minutes at 100V. I visualized the DNA using a Photodoc system (BioRad, Hercules CA).

PCR Cleanup:

I conducted pre-sequencing cleanup using an ExoSAP Mix created from 0.250 μ L Shrimp Alkaline Phosphate, 0.025 μ L Exonuclease I, and 9.725 μ L distilled deionized water. I added 2 μ L of the ExoSAP mix to 5 μ L of each PCR sample and incubated at 37 $^{\circ}$ C for 30 minutes and then 95 $^{\circ}$ C for 5mins in a thermocycler.

Sequencing:

I sent the PCR products to the University of Chicago DNA Core (Chicago, IL) for sequencing and analyzed the chromatograms using version 14.0 of Finch TV.

Data Analysis/ Statistical Treatment:

I used the DNAPARS of version 3.69 PHYLIP to perform maximum-parsimony and bootstrap analysis.

Results

Maximum-parsimony and bootstrap analysis

A phylogenetic tree containing bootstrap analysis of combined *ND4* and *cytb* genes is shown (Fig. 2). A well supported clade (83% bootstrap value) included all of the Atlantic Ocean watershed specimens. Some genetic structure is seen in the phylogenetic tree generated as members of the same populations appear to cluster together. However, no deep structure is present.

Discussion

The fact that no deep structure is present indicates that historically there is a lot of gene flow within the population and few barriers for movement are present in spite of rivers and ridges. In many cases, members of the same population tend to cluster together, but this does not occur in all instances.

The preliminary findings by Dougherty (2011) suggested that the colonization history of *Desmognathus fuscus* followed a west to east pattern as all of her Atlantic drainage specimens emerged within a single clade along with a few non-Atlantic specimens. My research supported the hypothesis concluded by Dougherty as all my Atlantic drainage populations emerged within one well supported

broad clade (bootstrap value of 83). However, many non-Atlantic specimens emerged within this clade as well which is not surprising as deep structure is not present.

Also, highly divergent haplotype lineages consisting of mostly New River drainage specimens are present suggesting a possible origin of the species in the New River Valley and a dispersal pattern from the south along the river. However, specimens from additional locations are needed to support this hypothesis as an oversampling of New River specimens occurred which increases the chances of finding rare haplotypes in the region and biases the suggestion that these populations are the oldest.

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Figures & Tables

Table 1: List of specimen sites collected by Ashley Dougherty with the code as they are listed in trees for phylogenetic analysis, location in which collected, and site name

Code	County	Location	Site Name
AD A	Monroe	Vicinity of Moncove Lake	Greenbrier watershed
AD B	Monroe	Near Waiteville	James watershed
AD C	Mercer	Concord University campus (Athens)	Bluestone watershed
AD D	Monroe	Near Turkey Creek	Upper new river watershed
AD S	Wyoming	Near Pineville	Gyandotte watershed
AD T	Hardy	Near lost river/lost city	Cacapon watershed
AD U	Tucker	Near Parsons (Hwy 219)	Cheat watershed
AD V	Randolph	Near Mill Creek (Hwy 219)	Tygart Valley watershed
AD W	Hardy	Near Junction of Hwy 259 with VA border	Shenandoah watershed
AD X	McDowell	Near Welch	Tug fork watershed
AD Y	Grant	Near Mt Storm (Hwy 50)	N. Br. Potomac watershed
AD Z	Pochahontas	Near Slatyfork off Hwy 219	Elk watershed

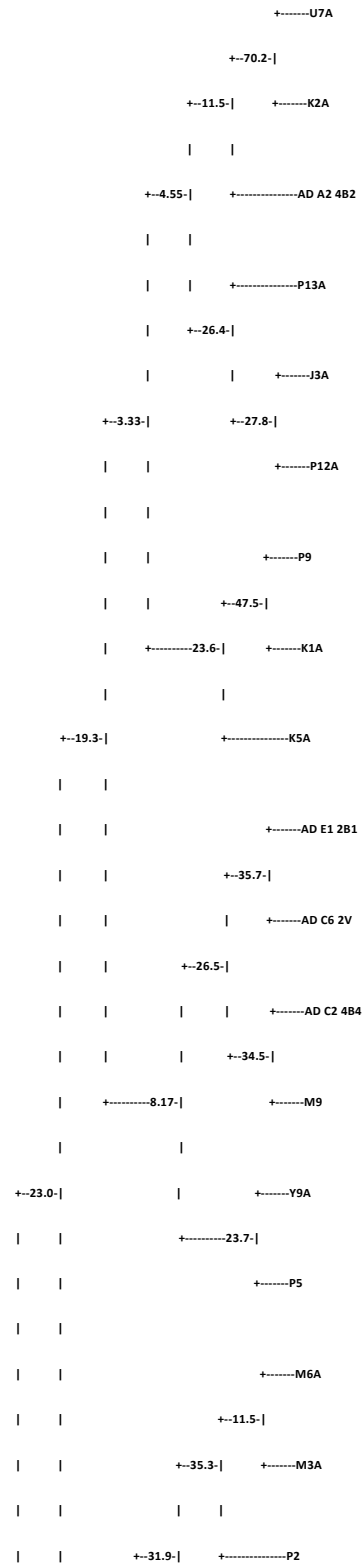
Table 2: Mitochondrial DNA primers used. Information taken from Dougherty (2011).

Amplicon	Size (bp)	Primer Name	Sequence (5'-3')
cytb	23	MVZ15	GAACTAATGGCCCACACWWTACG
	25	cytb2	CCCCTCAGAATGATATTTGTCCTCA
ND4	32	ND4	CACCTATGACTACCAAAGCTCATGTAGAAGC
	26	Leu	CATTACTTTTACTTGGATTTCACCA

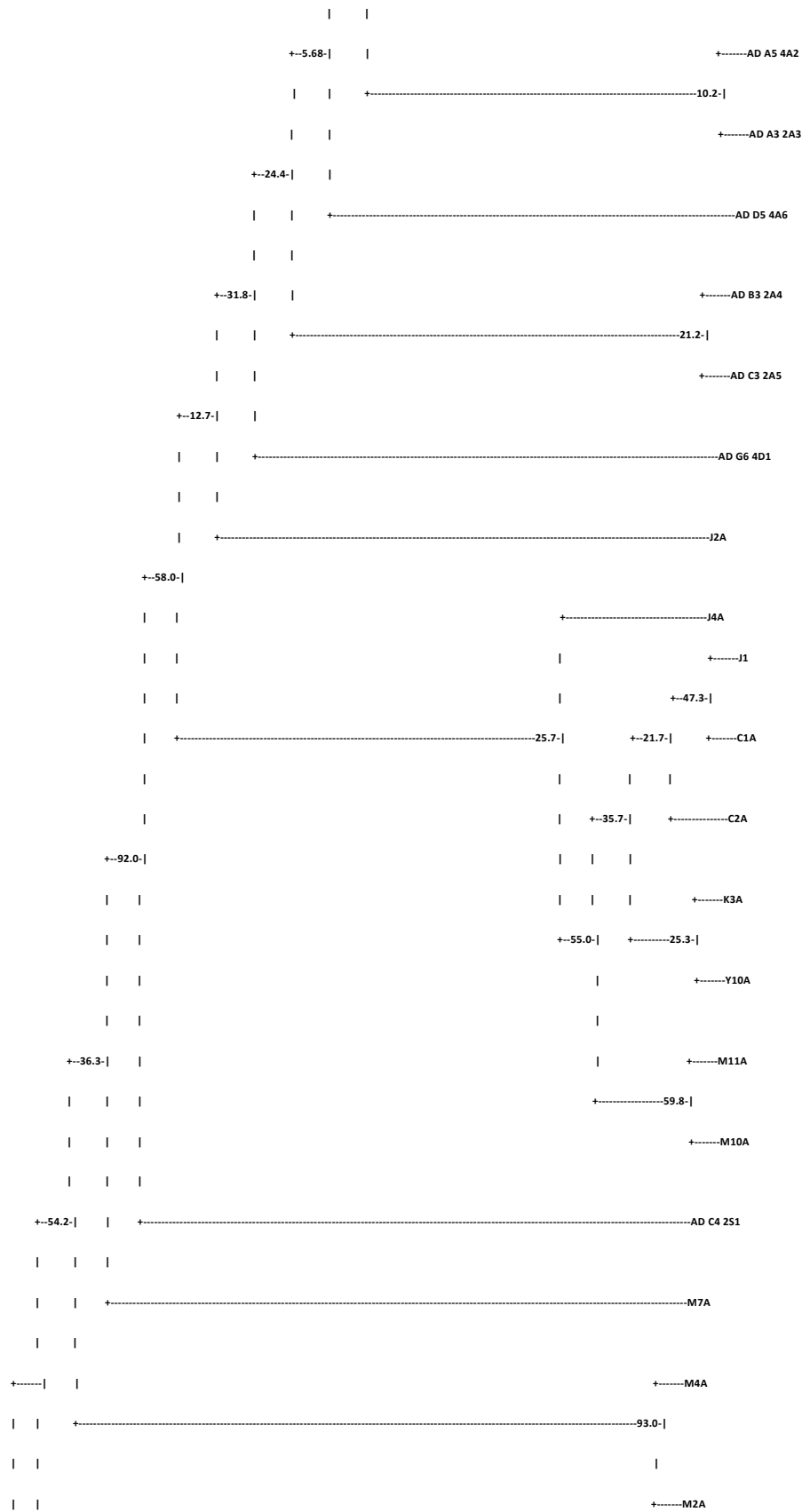
Figure 1: Sample sites of *Desmognathus fuscus* in West Virginia.



Figure 2: Phylogenetic tree generated by maximum-parsimony analysis of *ND4* and *cytb* combined sequence; bootstrap percentages are shown at each node



		+-21.3-			+-----P1A
			+-----23.2-	+-----35.2-	
					+-----M8A
					+-----K4A
					+-----P6
				+--39.7-	
		+-23.3-			+-----P11
				+--82.7-	+--8.33-
					+-----P3
			+-----69.1-		
					+-----P8
					+-----P10
		+-53.0-			+-----AD F4 2Y1
				+-----23.5-	
					+-----AD F3 2W4
					+-----AD D2 4C1
				+--16.8-	
					+-----AD F2 4C3
		+-79.3-			+--61.6-
				+-----80.4-	+-----AD E3 2B3
					+-----AD G2 4C4
				+-----34.1-	
		+-83.0-			+-----AD E2 4C2
					+-----AD G3 2W1
				+-----85.9-	
		+-68.0-			+-----P7
					+-----AD A4 2W3
		+-9.87-			
					+-----AD C1 2A7



| ←-----M1A

|

←-----M5A

Resistance to Reading in Literacy Courses at Concord University:

How can Professors engage students to the text?

Chassity Kennedy

Mentor: Dr. Ambryl Malkovich

There is a rising resistance to reading occurring within the students' academic world. When you think of the words "resistance to reading and classroom engagement," you may envision a student being disruptive or not paying attention in class and a teacher trying to get through to this student. However, this is not a teacher versus student scenario. Resistant reader, reluctant reader, and alliterate are terms used to describe the epidemic Universities are encountering with their students (Lenters 2006). A resistant reader refuses to read academic materials, a reluctant reader is a student that leery of reading assigned texts due to some preconceived notions about the material, and an alliterate reader is a student that possesses the ability to read but does not exercise it.

Reading resistance and classroom engagement is not a new issue. Professors assign reading for a reason. They want their students to learn and retain as much information as possible. Professors see there is a benefit in reading assignments. But, professors are not only asking students to read the text. They want them to interact with texts, ask questions, close read, and investigate. Then, talk about their findings in class discussions. Clearly, this much exposure to material gives students a well-rounded perspective on whatever the subject may be. Professors know that when students resist they cheat themselves of what they could be learning. Though not all students resist and many students participate in class discussion. What can be done to encourage the students that do not read and participate? How can professors at Concord University motivate their resistant students to read and engage with assigned reading materials? According to researchers on the topic, the best way to attack the problem is to find the causes. Though some believe that this resistance is associated to college aged students living on their own for the first time and not juggling school, work, and their social life very well, and this may be true for some students; researchers believe the reluctance to academic reading derives from a lack of interest in the material, lack of book choice, lack of university level preparedness, identity issues, and an absence of digital media to supplement the text.

An obvious answer to why students would not read is that they simply are not interested in the material being assigned. As seen through experts, such lack of interest in reading texts is developing during the middle school years. *The Journal of Adolescent and Adult Literacy* published an article,

“Reading resistance in middle school: What can be done,” in 2002 by Marianne Baker, a reading specialist, containing an interview she conducted with a middle school student. Baker found that the students were not interested in the materials being assigned and were not given little choice in texts (364). In Baker’s interview the student was asked, “When you have to make a forced selection, do you sometimes not like any of them?” The student replied, “A lot of the time. I pick the one I hate the least (364).” Although this is the opinion of one middle school student, his answer summarizes the thoughts and feelings that many secondary level students display. As a result, students often develop negative feelings and attitudes towards the readings being assigned in class, transforming them into reluctant readers.

According to expert Arthea Reed, there are three stages of literacy: unconscious enjoyment stage, egocentric interest stage, and aesthetic interest stage (14). The public school system has the development of the enjoyment stage taken care of with the help of the United States government stepping in with literacy programs like Reading First (Wise 2009). Currently, reading programs are in place for grades K-3 (Wise 2009). However, programs like this do not continue at the secondary level or university level. For some students, this may cause a language barrier in their reading, a lack of comprehension skills, and/ or many other difficulties reading. It is apparent that resistance to reading begins in the formative years. College and Higher Education students need the same encouragement, specialized instruction, and persistence that educators provide to elementary level students. Literacy programs, such as those implemented at the elementary level, need to continue after the primary stage of reading or the unconscious enjoyment stage. It is important that programs that promote this type of guidance, encouragement, and instruction be extended to secondary students and adult students. These programs improved the scores of fourth graders; however, the scores of the twelfth graders were stagnant, showing little or no growth (Snow, Moje 2010). This stunted development later results in college students lacking college-level literacy skills (Snow, Moje 2010). As said by professionals, continued literacy training beginning at the secondary level and up to adult will help the development of the students’ reading skills,

transforming resistant readers into avid readers. A lack of continued secondary level learning of literacy, however, manifests in many college students to be reluctant, resistant, or alliterate to academic materials.

Although researchers have proven that some university level students have negative feelings and reluctance towards academic reading in literacy courses, there is also evidence that they do read material that interests them. Marc Aronson, an editor of *Young Adult Literature*, argues that young adults are reading. Aronson explains:

I say that because a second's thought will show that teenagers, especially boys, read a great deal. How could they install new programs, pass driving tests, select precisely the right clothing and look, know all about their favorite teams, stars, musicians, and even writers if they weren't constantly reading? (101)

Unfortunately, not all university level reading is interesting to all students. However, if students want to have a successful college career, then they must force themselves to read what is being assigned. Arson maintains, "Analyzing how school reading and writing resemble the reading and writing that young people choose to do every day may help us design more meaningful, engaging, and accessible school-based reading and writing tasks" (68). Therefore, students and professors can work together to bridge the gap between reading for enjoyment and academic reading.

In addition to students of these studies, Concord University students have expressed their lack of interest in assigned reading materials. As a student, I daily hear the complaints of my fellow classmates regarding reading assignments. I actually witnessed a student pay another student to read an assigned text and give a summary of the reading. Because there is required reading across disciplines, this resistance and reluctance obviously poses a problem for university professors. If the problem lies with a lack of interest, then how can professors combat it in their classrooms? As stated in a 2006 article, "Resistance, struggle, and the adolescent reader," by Kimberly Lenters, a teacher of early literacy and doctoral student in the department of Language and Literacy Education, it is important to listen to the student's voice (138). Her research reveals that not only is there a lack of interest in the material but also a lack of purposeful reading and the opportunity for self-determination (Lenters 2006). Lenters suggests that using

interesting material, implementing purposeful reading, and providing an opportunity for self-determination, will result in students being less resistant to reading. This entails the professor being willing to step away from the textbook occasionally and allow students to use literature of their choosing to supplement the lessons. For example, *Hamlet* could be used to study Sigmund Freud's Oedipus complex in a psychology course; or, in various branches of science, professors could use *Dr. Jekyll and Mr. Hyde* or *Frankenstein*. The possibilities are limitless.

Nonetheless, it goes without saying; in academia, there is an obvious tug-of-war scenario between students' interests and assigned texts. For example, English Professors typically assign texts that students are unfamiliar with or have preconceived ideas that they will not understand the syntax of the story to read due to the requirements of the curriculum. Professors, being advocates of their field, often find that the reactions from students towards these texts are negative. The English Journal published an article, "English Teachers are from Mars, Students are from Venus," states, "we often assume they're like us when we select readings, and we're surprised, disappointed, frustrated, or mad when they don't like what they read, or worse, when they won't read at all" (Crowe 1999). "If we ignore their interests and needs, they'll ignore our literature and may very well turn into lifelong nonreaders" (Crowe 1999). Crowe makes a valid argument. For example, many English professors detest Stephanie Meyers' *Twilight* series books. On the contrary, these books are very popular among college students. Implementing main stream or popular texts along with the required readings create an environment that is tailored to the needs and interests of the students and meets University requirements simultaneously. Crowe advocates that students need to have some choice in their reading selections. Allowing students an opportunity to occasionally choose a book that parallels or enhances their understanding of an assigned text, may result in students becoming less reluctant to read the literature being assigned, revealing to them the value in historical literature as well as main stream works.

While incorporating student chosen texts in the agenda would produce positive results, it could also be unfeasible. Professors are constricted by time, required curriculum, and resources. In order for students to meet required curriculum reading and be allowed room to choose texts, professors could allow

students to use these texts in essays and class discussions to draw parallels, compare and contrast with assigned texts, and so on. Arthea Reed, author of *Reaching Adolescents: The Young Adult Book and the School*, declares, “You will be able to reach another goal of the English or language arts curriculum, helping students define their personal values and understand the values of others” (402). Collectively, this would provide students an opportunity to use their favorite books along with assigned texts to gain a wider scope of the content, point-of-views and opinions, writing styles, and vocabulary.

In addition to a lack of interest and book choice, the reading skills and abilities of university level students can pose a problem to their taking part in reading and class discussion. Within a classroom, students’ reading abilities at the university level will differ. According to Reed, there are three categories of reading abilities: poor readers, capable readers, and reluctant readers (30). Depending upon the reading ability of the student, there may be an obvious language barrier to the text. A language barrier may automatically cause a student to resist reading the assigned text. Students may have difficulty decoding, comprehending, transacting, and constructing meaning of literature above their reading level (Malin 2010). How can professors help struggling readers?

Some researchers believe incorporating reading guides to supplement unfamiliar literature help students’ abilities to develop through the use of annotations, giving more meaning to the texts. Moreover, reading the texts aloud can enhance understanding providing students with an audio aid to demonstrate how the text should sound or is meant to be read. Visual aids also help students to envision the text and gain better concept of the material. The use of familiar literature that parallels difficult texts will aid readers as well because it uses language that is easier to understand. Furthermore, if students are resisting reading because they are having trouble comprehending the text, then assigning a familiar literature that is an equivalent to a more difficult read may encourage the students to at least read the easier version of the text. If students can understand the text, then they will be motivated to read and participate in class.

In the spirit of motivation, student-based reading programs and activities will further enforce reading encouragement. Universities can develop student-based reading programs and activities. There are many programs that can be made available for students. Such programs include book clubs, book

readings by authors, book talks, and student choice awards. Reading activities increase students' success by "creating effective literacy environments with high student engagement" (Walker-Dalhouse, Risko 2008). The International Reading Association is an advocate of such reading activities. The IRA publishes the "Young Adults' Choices" list annually for secondary level students in the *Journal of Adolescent and Adult Literacy*. According to the IRA, "the goals of the project are to encourage young people to read; to make teens, teachers, librarians, and parents aware of new literature for young adults; and to provide middle and secondary school students with an opportunity to voice their opinions about the books being written for them" ("2008 Young Adults' Choices" 235). Perhaps, a similar program at the college or university level would prove just as effective. These activities encourage out-of-class reading which is practice for assigned reading, and it is fun for the students. Reading practice will help struggling readers to become better. Unfortunately, in the age of Ipods, Smartphones, Facebook, and other distracting technological advances, there are some students that will still resist no matter how enthusiastic the literacy program may be. For the most part, making reading fun will increase student reading and will help in literacy courses.

Although finding creative ways to make reading texts fun can be encouraging to students and enhance their abilities, some may still refrain from class assigned reading and engaging in class discussions. In his article, "Metamorphosis hurts: Resistant students and myths of transformation," Bronwyn T. Williams, a professor at the University of Louisville, contends that many young adults fear that partaking in the reading of some literature may change who they are (2006). An example of this type of fear may be a Christian student refusing to read literature about Muslim culture. Some students fear that certain texts may change deeply imbedded thoughts and opinions; therefore, changing who the student is all together. Change can be frightening; however, gaining knowledge of other cultures, theories, and beliefs enriches students throughout their lifetime. Learning to critically think and analyze literature of all genres from all walks of life will provide individuals with an open-mind and a well-rounded prospective of the world around them. Professors and peers can assure one another that this type of change is a positive one. After all, university studies are meant to challenge thoughts and opinions.

Once a student breaks through this type of barrier, they can then have a deeply conscious and educated reason for their beliefs.

To further encourage students to come out of their shell, so to speak, professors must keep in mind that some students do not take criticism very well. When college students partake in literacy courses and analyze literature, they are vulnerable to judgment and reticence from peers and professors. Bronwyn says that many students will look at a grade on a paper as a judgment of their personalities, identities, and experiences (Williams 2006). Constructive criticism must be treaded delicately because the goal is to encourage students to constantly challenge themselves not reinforce any insecurities.

With constructive criticism in mind, this brings us back to the point that negative feelings and attitudes towards reading render resistance in literacy courses. Some students may have experienced humiliation from a teacher or their peers while reading aloud or discussing literature. This causes a wariness to participate in literacy courses (Williams 2006). Some students have not been exposed to an environment where reading is encouraged; therefore, they are reluctant to read. Negative experiences in literacy courses will result in a resistance to reading. Universities and professors can work together to develop guidelines for criticism that gently direct students to greatness without making them feel inadequate.

Furthermore, a student's academic environment is vital to ensuring their success, making the accessibility to assigned texts another possible cause to resistance. Media can play a rather large role in this aspect of student learning. Being the digital age that it is, gaining access to a text should not be a problem with the rise of the ebook and online formats. Conversely, the media of the literature can be another means for motivation and encouragement. Some students may enjoy reading from a Kindle rather than the traditional book. However, many professors still encourage the traditional book format. Also, digital reading, being another means of literature, is often cheaper and quicker to obtain.

Digital technology not only makes the reading materials easier to possess, but it can also be used as tool in the classroom. Programs such as Blackboard and WebCT could be implemented in literacy courses. Class discussions of assigned texts can be discussed in posts, online tests can be administered,

and extra assistance can be found in the learning modules. Students have more of an opportunity to do group work online. In addition to the many options for students, professors can use discussions, quizzes, and group work as a formative assessment of how well the students are grasping the content. Some researchers believe implementing digital technology in the classroom in the form of Blackboard, WebCT, Moodle, or PowerPoint slides can pose possible solutions to the resistance to reading because this approach not only provides reading materials and reading aids but it also promotes interactions between classmates that to encourage reading.

After reading the research of reading resistance professionals, I initially concluded that the best way to address resistance to reading at Concord University was to merge digital technology and online programs into the traditional classroom. Blackboard, WebCT, and other online programs provide students a way to communicate with classmates digitally, thus, creating a buddy system. Not only would a merge such as this promote student reading and participation, but it also benefits professors. As stated by Joseph Feustle in his article, "Extending the Reach of the Classroom with Web-Based Programs," "Teachers can make assignments-such as do the exercises on certain pages in the text, attend a lecture, or watch a certain program on television, for example- and verify not only which students did them and when, but also how well they carried out their assignments without having to use classroom time assessing student work done outside of class" (2001). The research is clear that students are reading material that they find interesting, but they refrain to read assigned texts that they find uninteresting. Students can use an online buddy system to help each other through difficult texts. My prediction is that students at Concord are resisting the material being assigned because they find it uninteresting and hard to comprehend; however, students will find the comments and analysis of their peers very interesting. Students will feel more comfortable posting questions to their peers regarding assigned texts than to ask aloud in class. Merging an online program with the traditional classroom can prepare students for class discussions of assignments. This can eliminate the awkward silence that professors experience when they begin to ask questions about assigned texts due to students' lack of understanding or lack of interest in the text or lack of reading the text. It goes without saying that some students will resist no matter what is

done to encourage reading. Nevertheless, in any case, an online buddy system, such as can be utilized through Blackboard, could reduce reading resistance at Concord University.

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METHODS & RESULTS OF THE PILOT TEST

Method

A survey was administered to two sections of Concord University's English 101 class to determine some of the causes for reading resistance. A unit was designed that required a reading and merges the use of Blackboard. The students had to post one comment or question regarding the reading and reply to seven or more of their classmates. There was a survey administered after the unit to measure the reading response from the students.

Subjects

The subjects of this study derived from two sections of Concord University's English Composition and Rhetoric 101 course consisting primarily of freshman 18-19 years old.

Apparatus (or Research Instruments/Tools)

The apparatus of this study was in the form of a survey, and then a unit merged with Blackboard to make postings, and a survey administered at the end to measure the success or failure of the unit.

Procedures

The responses from the students on the surveys and the unit were evaluated to determine whether peer involvement altered the resistance to reading in a university level course.

Results

The results of this experiment were inconclusive.

Discussion

I observed that the students' responses to the text in the discussion thread were in-depth. However, the students were indifferent to the fact that the unit was online. To them, it was just another assignment. Therefore, further research must be conducted.

METHODS & RESULTS OF THE SURVEY

Method

A survey was administered to students in participating freshman and sophomore level general studies courses. The survey contained a section on demographics, reading practices (both leisure and assigned), and ranking of the causes of resistance and possible solutions. 100 students were surveyed in three sections of freshman and sophomore level general studies courses. These students were predominately 18-20 years of age and in their first or second year of college. Participation in the survey was voluntary; however, some professors offered extra credit to the participating students. The research was administered by me, the student researcher, under the direction of my mentor, Dr. Malkovich.

Subjects

The subjects of this study derived from three sections of Concord University's Freshman and Sophomore level general studies courses, consisting primarily of freshman 18-19 years old.

Apparatus (or Research Instruments/Tools)

The apparatus of this study was in the form of a survey consisting of 3 sections: Demographics, Reading Practices, and what students believe would motivate them to read and engage in assigned texts.

Procedures

The survey was then analyzed using a Chi-Square test which showed certain responses were occurring significantly more than others.

Results

The Demographics Section showed the average age of the subject was 19. There was a 3:2 female to male ratio, and all of the students were full time. 93% of the students were traditional, and 57% lived on campus and 39% live less than an hour away from campus. 44% worked part-time showing that more than half were unemployed. This information shows there is nothing significant demographically that would stand in the way of students' study time or reading assignments. The reading practices or non-

assigned reading section revealed that 64% of students sampled say they use the internet as a means for non-assigned reading. 55% of these students prefer reading a traditional book, while, 20% favor an e-book format. The genre of choice was fiction. This proves that students are reading. In Figure 1, the chart reflects the responses of students' assigned reading practices. On a positive note, the survey revealed that 56% of the students sampled feel that they read assigned texts MOST OF THE TIME, and none of the students said that they NEVER read; however, 45% responded that they felt that they read assigned texts either SOMETIMES or RARELY. It is ALARMING that almost HALF of the students surveyed feel that they do not read texts as frequently as they are assigned to. Additionally, Figure 2 reflects the top reasons students say they do not read assigned materials. According to the survey, 43% of the students sampled said that book choice caused them to resist reading. 17% did not feel ready for university level reading, and 44% of the students felt they did not have enough time to read all their assignments. Surprisingly, 4% claimed that they did not have access to the books required for class. Their explanation for not having the book was that they could not afford it.

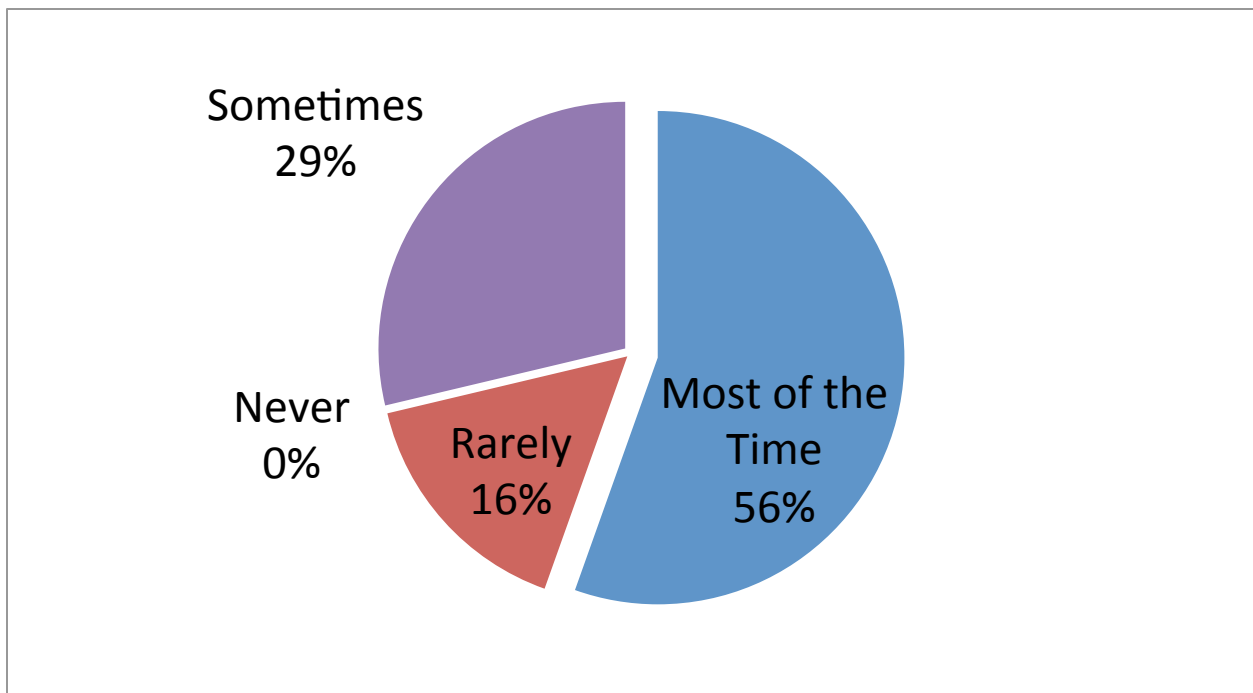


Figure 1 How often are Concord Students Reading Assigned Texts?

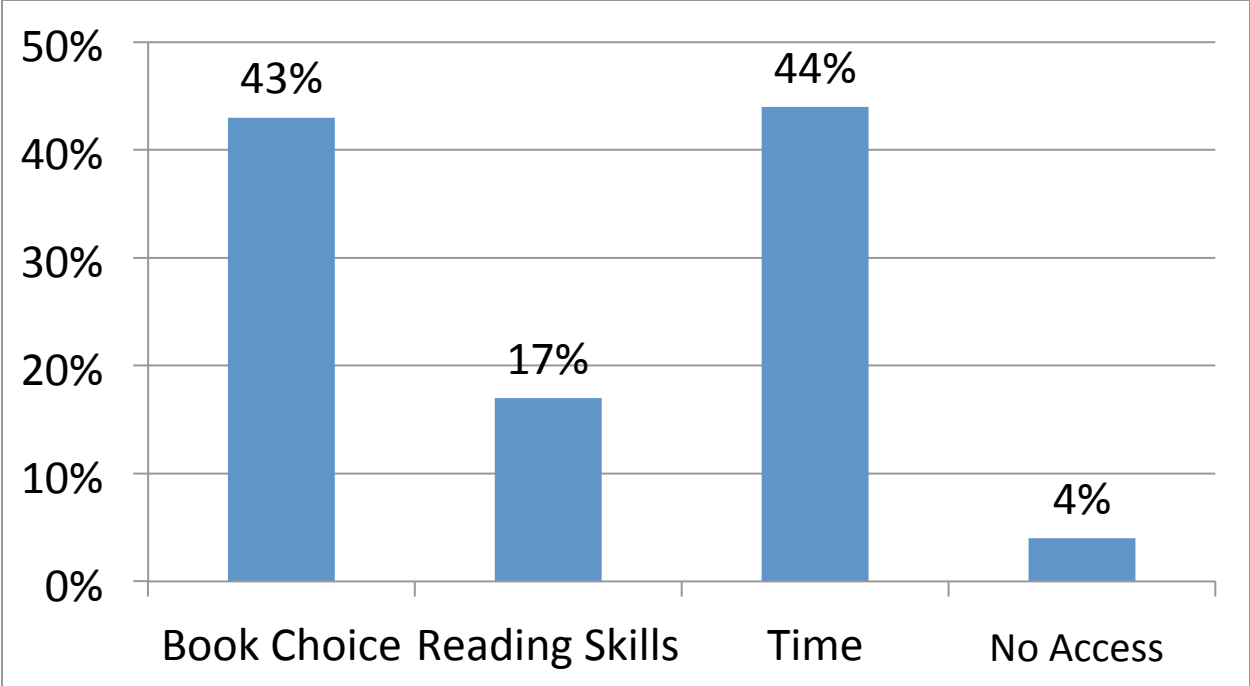


Figure 2 Top Answers for Causes of Reading Resistance

Conclusion

Based on the survey, I would suggest that professors of Concord University incorporate reading aids that supplement assigned texts. 63% of the students surveyed responded that they were more willing to read and engage with assigned texts when reading aids such as notes, PowerPoint slides, Blackboard or Moodle, or an equivalent digital means were provided by professors. Also, merge digital technology with the traditional classroom. 54% preferred reading aids in digital format and notes to supplement the text. Include texts that interest students when possible. Investigate. Ask your students what they like to read and try to provide opportunities for students to use those texts to supplement what they are learning in your class. Also, look for signs of struggling readers. Try to watch for signs of students that are struggling with their reading and comprehension. They may not be ready to do what the course requires them to do or they may need a tutor. Try not to assign more reading than the students can handle. Judging how much assigned reading is too much is hard because some students are great readers and others are not. Discovering whether the assignments are too much for the class as a whole would have to come from trial and error and getting to know your students. Additionally, create a safe environment. Provide students with an environment where they don't have to be afraid of sharing their thoughts and opinions in the classroom. As a student, I know that I am more apt to participate in a class when I feel as though my opinion is valued and not ridiculed.

APPENDIX

Demographics Data

	1	2	3	4	5	6	7	8	9
Sex:	Female	Male	Unknown						
Race:	White/ Caucasion	African- American	Hispanic	Asian	Native American	Other/Non- White	Unkown/ NA		
Marital Status:	Single	Married	Unknown						
Major:	Bus	Edu/HP	FA	Interdisciplinary	Lang/Lit	Natural Sci	Soc Sci	Non-Traditional Program	Unknown/NA
Hometown:	In-State	Out-of-state	Unknown						
Student Type:	Traditional	Non-traditional	Unknown						
Resident Status:	On-Campus	Commuter	Unknown						
Drive Time:	> 1 hour	1 hour	2 hours	< 2 hours	Unkown				
Parent:	No	Yes	Unknown						
College Hours:	> 12 hours	12 hours	13-15 hours	<15 hours	Unkown				
Employment:	Employed	Unemployed	Unknown						
Work Time:	Full-Time (40+ hrs)	Part-Time (>40 hrs)	Unknown						

Average Age	Total 1	Total 1	Total 1	Total 1	Total 1	Total 1	Total 1	Total 1	Total 1	Total 1	Total 1	Total 1
19.77319588	63	90	95	15	72	93	57	39	95	0	48	2
	Total 2	Total 2	Total 2	Total 2	Total 2	Total 2	Total 2	Total 2	Total 2	Total 2	Total 2	Total 2
	37	3	4	25	28	7	43	3	5	2	52	44
		Total 3	Total 3	Total 3				Total 3		Total 3		Total 3
		2	1	5				1		36		54
		Total 4		Total 4				Total 4		Total 4		
		1		0				0		62		
		Total 5		Total 5				Total 5				
		0		5				57				
		Total 6		Total 6								
		2		29								
		Total 3		Total 7								
		2		17								
				Total 8								
				0								
				Total 9								
				4								

Question 1: How often do you read for entertainment each week?						
(Books, magazines, newspapers, internet, or any reading material that is not a part of a class assignment.)						
1-Never	2-Rarely	3-Sometimes	4-Most of the time			

Response	Total	Expected
1	6	25
2	26	25
3	46	25
4	22	25
Total	100	100

Chi-Squared 0.00%

Question 2: What do you read for entertainment?									
1 Favorite Book	2 Magazine	3 Internet	4 Newspaper	5 Other	6 Don't Read	7 Scientific Articles			

	Total	Expected
Response 1	36	22.57143
Response 2	28	22.57143
Response 3	64	22.57143
Response 4	16	22.57143
Response 5	6	22.57143
Response 6	6	22.57143
Response 7	2	22.57143
Total	158	158
	Chi-Squared	0.00%

Question 3: Which format or media do you prefer?				
1 Traditional book	2 Kindle	3 Nook	4 Other	5 No Preference

	Total	Expected
Response 1	55	21.8
Response 2	14	21.8
Response 3	6	21.8
Response 4	15	21.8
Response 5	19	21.8
Total	109	109
	Chi-Squared	0.00%

Question 4: What genre do you mostly read?
Please list the book(s) or author(s) you usually read.

	Total	Expected
Response 1	13	18.85714
Response 2	10	18.85714
Response 3	10	18.85714
Response 4	28	18.85714
Response 5	12	18.85714
Response 6	15	18.85714
Response 7	44	18.85714
Total	132	132
	Chi-Squared	0.00%

Question 5: If you DO NOT read for entertainment, why?				
1 don't like it	2 No time	3 no access to reading materials	4 Other	5 N/A

	Total	Expected
Response 1	9	20.4
Response 2	22	20.4
Response 3	0	20.4
Response 4	3	20.4
Response 5	68	20.4
Total	102	102
Chi-Squared		0.00%

Question 6: As a student at Concord University, how often are you assigned to read?						
1 Never	2 Rarely	3 Sometimes	4 Most of the time			

	Total	Expected
Response 1	0	25.25
Response 2	16	25.25
Response 3	29	25.25
Response 4	56	25.25
Total	101	101
Chi-Squared		0.00%

Question 7: Do you feel that you were prepared for university level reading?				
1 Not at all	2 Somewhat	3 Mostly	4 Absolutely	

	Total	Expected
Response 1	6	25
Response 2	22	25
Response 3	45	25
Response 4	27	25
Total	100	0
Chi-Squared		0.00%

Question 8: How often do you read what is assigned?			
1 Never	2 Rarely	3 Sometimes	4 Most of the time

	Total	Expected
Response	0	25
Response	15	25
Response	40	25
Response	45	25
Total	100	100
Chi-Squared		0.00%

Question 9: What is the number one cause for you to not read an assigned text?				
1 Not Interested	2 Difficulty Understanding	3 No Time	4 No Access to Text	5 Other

	Total	Expected
Response 1	43	23.8
Response 2	17	23.8
Response 3	44	23.8
Response 4	4	23.8
Response 5	11	23.8
Total	119	0
Chi-Squared		0.00%

Question 10: When reading an assigned text, what methods do you use to help yourself to engage or better understand what you are reading?

	Total	Expected
Response	44	21.3333333
Response	19	21.3333333
Response	33	21.3333333
Response	9	21.3333333
Response	14	21.3333333
Response	9	21.3333333
	128	128
Chi-Squared		0.00%

Question 11: What reading aids are provided or available to you from your professors to help you to engage or better understand assigned texts?				
1 Text Notes	2 Website Guides	3 Blackboard/ Online Assist.	4 Other	5 Nothing

	Total	Expected
Response 1	51	23.6
Response 2	9	23.6
Response 3	31	23.6
Response 4	4	23.6
Response 5	23	23.6
	118	118
Chi-Squared		0.00%

Question 12: Please list a reading aid that either a professor used in your class or you would like for a professor to offer that encourages you to read and engage in assigned texts.						
1 Digital Aids (Blackboard/ PowerPoint)	2 Handouts to supplement texts	3 Teaching Assistant/ Tutor	4 Reward System	5 Other	6 No Comment	

	Total	Expected
Response 1	29	18.5
Response 2	25	18.5
Response 3	9	18.5
Response 4	4	18.5
Response 5	10	18.5
Response 6	34	18.5
	111	111
Chi-Squared		0.00%

Question 13: In your opinion, what could professors do to promote reading of assigned text:

1 Book Choice	2 Annotations	3 Online/ Digital Help	4 Media	5 Other	6 Nothing	

	Total	Expected
Response 1	40	22.16666667
Response 2	47	22.16666667
Response 3	12	22.16666667
Response 4	14	22.16666667
Response 5	7	22.16666667
Response 6	13	22.16666667
	133	133
	Chi-Squared	0.00%

Question 15: Below you may add any additional comment to this topic.

1 Book Choice	2 Digital/ Online Aid	3 Workload/ Time	4 Genre	5 Media	6 No comment	7 Other

Optimization and Construction of Bulk-heterojunction

Polymer–Fullerene Composite Solar Cells

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Abstract

Using polymer-based donor materials (P1) with C70-Fullerene derivatives (PCBM) in a bulk-heterojunction architecture and by varying the parameters during the construction of the solar device, a relatively high efficiency was obtained. By varying the thickness of the active layer, solvent being used for the active layer, the ratios in the active layer, along with using lithium fluoride as an anti-hole blocking layer, an efficiency of 0.48 % was obtained. By changing the parameters of the solar device's construction an increase of 0.36% was seen from previous fabrications.

Introduction

The uses of solar devices have long been thought of as feasible alternatives to help relieve the use of fossil fuels.^{1,4} Today's most efficient solar devices are made for a silicone based monocrystalline or polycrystalline films, which are very costly and hard to produce, with an efficiency reaching upward of 4-5%.⁴ However, the area of organic photovoltaic devices has become increasingly popular. This is due to their lower cost in fabrication and their ability to be made flexible as well as ridged. In addition there are many different types of architectural devices that can be produced.^{3,4} Common belief is that the bulk-hetrojunction architecture will yield great results³ due to it's' ability to be made in monolayers, bilayers, ect...

In the recent history the bulk-hetrojunction solar devices have been made with highly conjugated polymers with PCBM.¹⁻⁴ For the best results, a device that uses PCBM as the acceptor material should use a polymer with a gap of 1.5 eV, which has been computationally calculated, between their lowest unoccupied molecular orbital (LUMO) orbitals.⁴

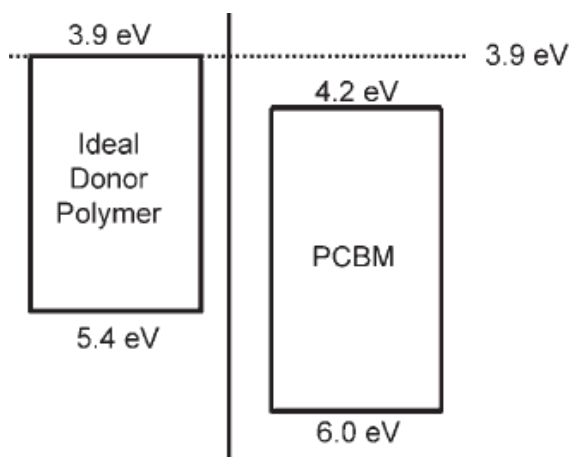


Figure 1. Energy difference between an ideal donor polymer and the acceptor polymer PCBM

The architecture of the device would be as follows: glass, indium tin oxide (ITO), Poly(3,4-ethylenedioxythiophene) poly(styrenesulfonate) (PDOT:PSS), active layer, lithium fluoride, and aluminum.^{1,3,4}

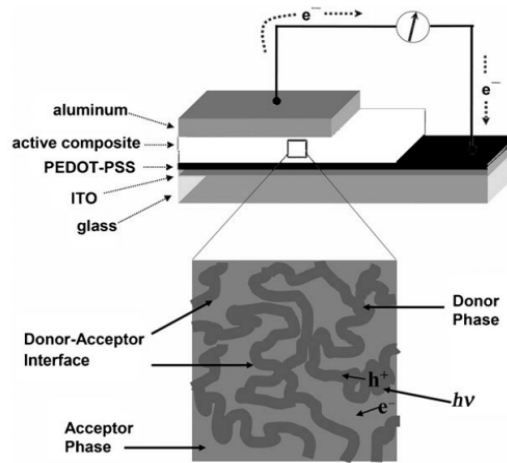


Figure 2. Architecture of most bulk-heterojunction solar devices.⁴

The active layer is comprised of a donor polymer¹⁻⁴, in this experiment P1, and an acceptor, [6,6]-phenyl-C₆₁-butyric acid methyl ester (PCBM). The mechanism that the devices are believed to go through is the fluorescence resonance energy transfer (FRET) mechanism.

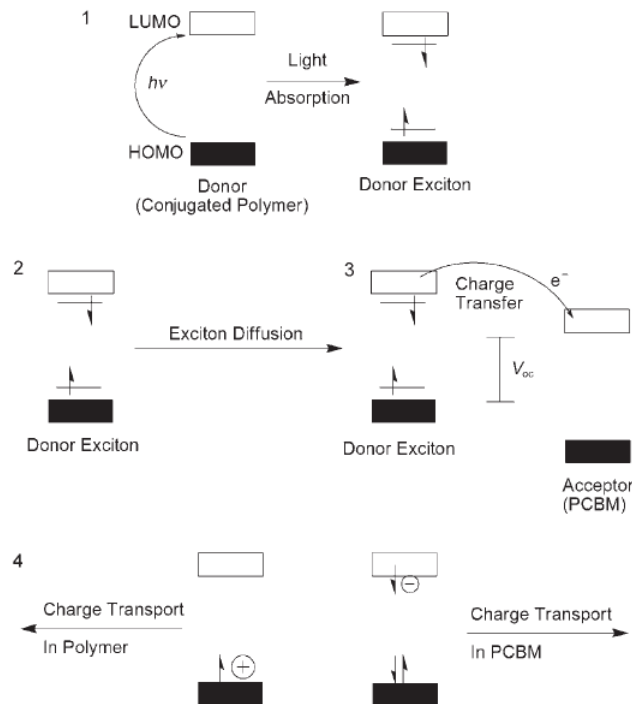


Figure 3. Illustration of the FRET charge transport system⁴

The FRET mechanism works via a photon of light is absorbed by the polymer. The photon absorbed then excites an electron from the polymers' highest occupied molecular orbital (HOMO) to its' LUMO. Then there is energy diffusion between the donor and the acceptor, which excites an electron to the LUMO in the acceptor material, which creates a 'hole'. With this 'hole' created, the electron in the LUMO of the donor relaxes into this 'hole ', which as the electron relaxes to this lower energy state it emits energy which keep the mechanism in succession.⁴

In this work, it is expected that through varying certain parameters in the construction of bulk-hetrojunction devices the efficiency can be increased. These devices will be built using PCBM and the polymer P1 in the active phase. It is hoped that by varying the thickness, ratio, and solvent of the active phase the devices efficiency will increase. Also the addition of a hole blocking layer, lithium fluoride (LiF),^{1,3} will be tested to see the effect on the devices efficiency.

2. Experimental

2.1 Preparation of Glass substrates

Each device substrate is 2.5 cm. by 2.5 cm. in dimension and has indium tin oxide (ITO), or tin-doped indium oxide, on one face. Each substrate is cut by a glass cutter from a 1 m x 1 m. sheet. Once each substrate has been cut, it is cleaned.

Once the substrate is cleaned, an active area around 11 mm wide is masked off using an adhesive non corrosive tape. The substrates are then placed in a beaker and dyed by pouring powdered black ink, mixing the slides and ink in water is next. The beaker is then emptied and 12 M HCl is poured over top the glass slides, enough to cover. Allow the slides to sit in the HCl for 30 s. The beaker is then rinsed with water. Remove the adhesive tape and store in chloroform.

2.2 Solution mixtures

The mixtures of the [6,6]-phenyl-C₆₁-butyric acid methyl ester (PCBM) and the P1 are by weight percent. 40 mg of PCBM and P1 are used to make the each solution for each substrate. Ratios of PCBM

and P1 are used to total 80 μL . Both PCBM and P1 are dissolved in chlorobenzene to give the best morphology.

2.3 Substrate cleaning for use

The substrates are placed in a beaker with chloroform placed in an ultrasonicator. The substrates are sonicated for five minutes. The substrates are then scrubbed with methanol, until no visible traces of dust or dirt is visible. The substrate is then blown dry using nitrogen. Acetone is then used to scrub the substrates like before and dried in the same manor. Lastly the substrates are then cleaned via a plasma cleaner for three minutes.

2.4 Coating of the Substrates

The substrates are placed on an vacuum spin coater. Substrates are then blown dry with nitrogen gas to remove any dust particles. Forty μL of Poly(3,4-ethylenedioxythiophene) poly(styrenesulfonate) PDOT:PSS is then deposited evenly on then substrate and are then spin coated at 3500 rpm. The substrate is then annealed at 140°C for 15 min. The substrates are then cooled to room temperature. Once cooled the active layer (Figure 4.) is then spin coated onto the substrate at a differing speed and the annealing process may be skipped or modified from the fifteen minutes at 140°C from before.

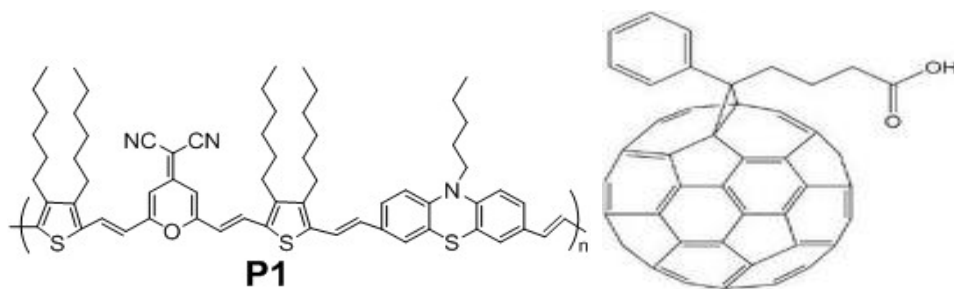


Figure 4. Structures of the donor polymer (P1) and the acceptor polymer (PCBM)

2.5 Vacuum Plating of the Substrates

The substrates are placed into a four device shadow mask and are placed inside the vacuum chamber. A 3 g bar of aluminum is paced into one of the spring electrodes; a gram of LiF will be placed into the adjoining electrode.

The pressure was reduced to 1×10^{-3} Pa for LiF and/or 1×10^{-5} for aluminum. When to proper pressure, evaporate the LiF before the aluminum, if LiF is being used in trial. Apply a current of 20 mA to evaporate and plate the LiF layer. To plate the aluminum apply a current of 40 mA. For the LiF allow the rate of evaporation to be around 20 counts per second change are the monitoring detector, and for the aluminum allow around 50-100 counts per second.

3. Results and Data

All devices were tested in inert atmosphere of N_2 using a Keithley 2400 Source Meter in the dark, to test for dark current, and under simulated AM 1.5 illumination (100 mW/cm^2) by Solar Simulators (SCIENCETECH SS-0.5K) to record the current and voltage characteristics of device. With the device characteristics the efficiency can be found.

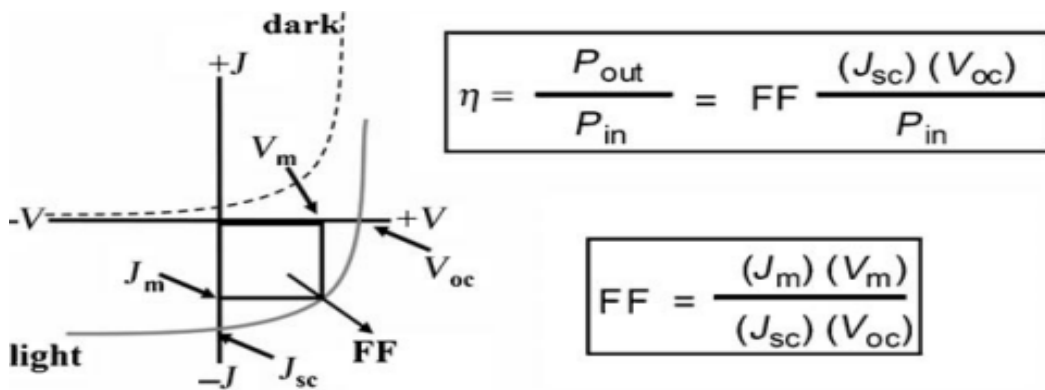


Figure 5. Calculating the efficiency of the devices. V_{oc} - Open circuit voltage – or inbuilt voltage. J_{sc} - Closed circuit current. FF - Fill factor – a ratio of the maximum obtainable power and the theoretical power. J_m - the current where the central maximum of the IV curve is parallel to the voltage axis (X axis). V_m – the voltage where at the central maximum of the IV curve is perpendicular to the current axis (Y axis).

As seen in figure 5. the efficiency can be found by multiplying the fill factor by the ratio of the $(J_{sc})(V_{oc})$ by the initial power.

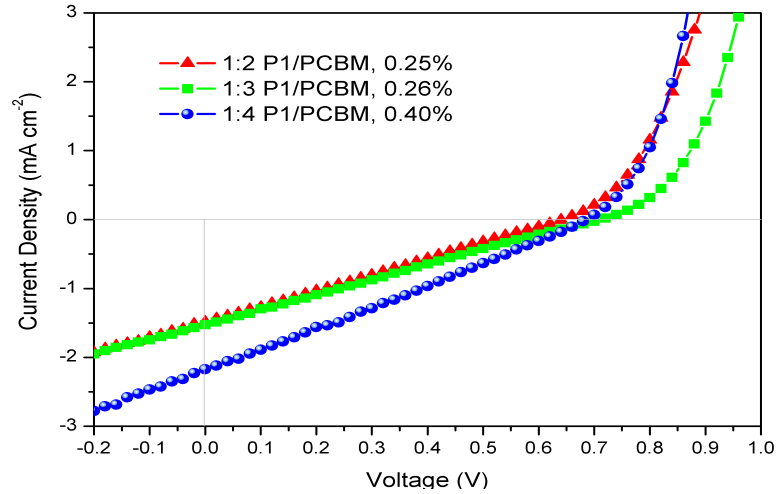


Figure 6. The purpose of this figure was to find the ideal ratio of P1 to PCBM. All mixtures were spin coated around 2000 rpm for 30 sec. The ratio for the 1:2 yielded an 0.25% efficiency. The ratio of 1:3 ratio yielded an efficiency of 0.40% efficiency. The optimum ratio was found to be 1:4 with an efficiency of 0.40%.

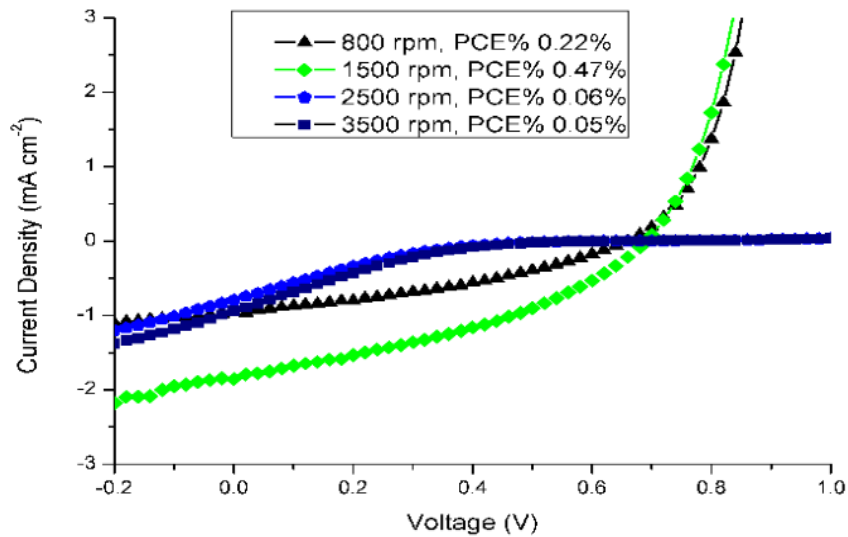


Figure 7. This figure shows the efficiency of solar devices with varying active layer thicknesses. The higher the rpm the thinner the active layer will be. The 800 rpm trial gave an efficiency of 0.22%, which is much

lower than the 0.40% efficiency from the previous trials. The 1500 rpm trial gave the best efficiency at 0.47%, which is an overall improvement of 17.5%. Both the 2500 rpm (0.06%) and 3500 rpm (0.05%) trials gave drastically decreased efficiency.

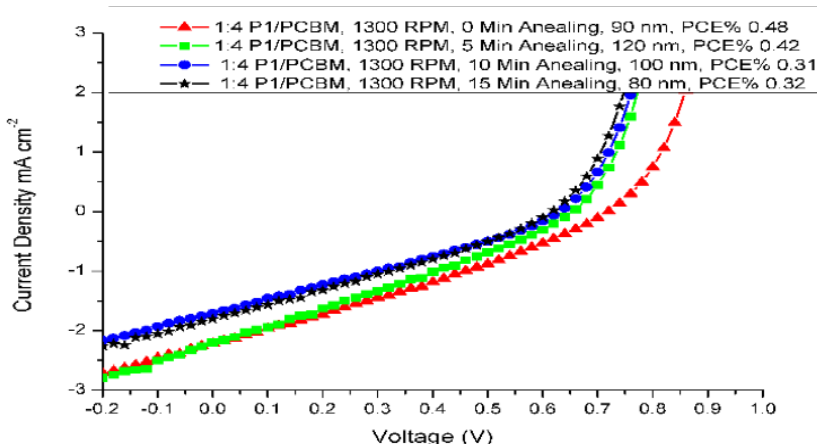


Figure 8. In this figure, the addition of a charge transfer layer (LiF) and the time of annealing of the active layer was seen to have an effect on the devices efficiency. The first trial resulted in the greatest efficiency, without annealing, of 0.48% and an active layer thickness of 90 nm. The second trial had a 5 min annealing time, which caused the active layer to thicken by 30 nm, gave a efficiency of 0.42%. The third trial yielded an efficiency of 0.32%, with an annealing time of 10 min and a active layer thickness of 100 nm. The fourth trial had an annealing time of 15 min with an active layer thickness of 80 nm; this trial yielded a efficiency of 0.32%.

Discussion

As seen figure 6 the best ratio for the P1 and PCBM was found to be a 1:4 ratio by weight. This indicates that the donor polymer P1 is somewhat efficient at electron transfer with the PCBM, i.e. the band gap between the HOMO of P1 and the LUMO of the PCBM is not ideal. For an ideal band gap the ratio would be a 1:1 ratio; with this it can be said that the band gap is greatly larger than the 1.5 eV that is ideal.

With the ideal ratio for the active layer the optimal thickness needed to be found. By spin coating at various speeds this was achieved. The speed was determined best by running trials at the

lowest speed possible on the spin coater and by increasing the speed by increments of 1000 rpm (figure 7). As expected there was a bell like curve, however, the latter part of the curve was a very fast drop off. This drastic drop in efficiency could be lessened by more trials with smaller differences in speeds. However, with this being said the local maximum was still obtained and there was no need to run more trials at the higher speeds. The best speed was found to be at 1500 rpm.

With the addition of a charge transfer layer (LiF) it was hoped to increase the mobility of the charge to the anode in the device. Along with the addition to the charge transfer layer being added the active layer was annealed at the same temperature with varying times (figure 8). In these trials there were problems with the spin coater and the desired speed could not be obtained, however, a speed of 1300 rpm was obtained, which is relatively close to the optimum speed. Even though the speed was slower the addition of the LiF layer did slightly increase the efficiency, by 0.01 %, of the devices. If the optimum speed could have been obtained, it is likely the device would be much more efficient. The annealing of the active layer seemed to disrupt the morphology of the devices. As time went on the active layer followed a bell shape, getting thicker and then thinner in the end. The change in the thickness due to the annealing hurt the efficiency of the devices greatly.

Conclusions

Using the bulk-heterojunction solar cell architecture with the donor polymer P1 and the acceptor polymer PCBM, efficient solar devices were created. Controlling the solvent being used for the active layer, the thickness of the active layer, the ratios in the active layer, and the addition of a charge transfer layer, a solar device can be further optimized. With this being said, the previous efficiency of the devices made from these polymers went from 0.12 % to 0.48 %, and increase of 0.36%.

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**Kinematics and Petrology of the No Name Fault System,
Glenwood Canyon, Colorado**

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Abstract

The No Name fault system has been mapped multiple times since 1963 when it was originally mapped by N. Wood Bass and Stuart A. Northrop. This study focuses on the geology of the No Name fault system, located at the margin of the White River uplift in western Colorado. The trend of this fault system is E-W trend which is atypical of most Laramide structures. This study found that the area had undergone compression which created the thrust fault in the northern portion of the fault system. It was also found that the compression combined with the thrust fault created the No Name reverse fault.

Introduction

The geology of the area around and in Glenwood Canyon is one that has not been studied in any detail for more than forty years. The area of the canyon has undergone multiple episodes of deformation which has shaped the rocks now exposed in the canyon. The canyon itself was formed by the down cutting of the Colorado River all the way into a basement granite to a depth of approximately 366m below the surrounding White River uplift. Additional deep exposures were created by the tributaries of No Name and Grizzly Creek, which provide a window into the tectonic past of the area. At the western end of the canyon near Glenwood Springs two, large faults can be traced along the bottom of the canyon. These two faults are herein referred to as the No Name fault system(Kirkham et al, 1995). At this location, the No Name fault system has been completely exposed and the hanging wall crops out as a result of erosion of the foot wall and a thick zone of fault gouge. This makes it very easy to take measurements directly off of the fault plane as well as being able to sample the fault slip surface. The fault slip surface is exposed for a distance of nearly 100m along strike and is buried by late Paleozoic sedimentary rocks to the NE and SW. Past studies have concluded that the No Name system bounds a structural graben (Kirkham et al, 1997). This suggests that the fault system formed as a result of extension. New data presented here shows that the No Name fault system formed as a result of compression and is a reverse fault, rather than a normal fault.

Geologic Setting

The Grizzly Creek shear zone to the north of the No Name fault(fig.1) runs nearly parallel to the trace of the No Name fault system. Both the No Name fault system and the Grizzly Creek shear zone have an E/W to NE/SW trend (Allen & Shaw 2011). Along with having the same trend, both the No name fault system and the Grizzly Creek shear zone dip to the northeast(Allen & Shaw 2011). The No Name fault system and Grizzly Creek shear zone are both compressional structures with the No Name fault system forming during the reactivation of the Grizzly Creek shear zone during Laramide uplift of the White River plateau. Both the No Name fault system

and the Grizzly Creek shear zone coincide with a left step in the Grand Hogback monocline which lies to the west north west of both of these structures(Allen & Shaw, 2007, 2011). This implies that the Grizzly Creek shear zone is a long-lived weakness that initiated during the Mesoproterozoic intracontinental tectonism (Allen & Shaw 2011). The No Name fault cuts through four sedimentary units and one igneous unit juxtaposing igneous basement rock against much younger units. The amount of vertical displacement on the fault is nearly 366m. In the area directly around the fault, the igneous basement has been shattered and shows four different zones of varying tectonic deformation. Rocks that were caught in the fault plane have been ground into a gouge with a grain size very similar to that of clays.

Tectonic history

The No Name fault formed during the Laramide Orogeny. During this event the Farallon plate was subducted approximately 15km to the west of the study area. The subduction of this plate resulted in compressional basement uplift far from the subduction zone. These uplifts are bound by faults that commonly have a north south trend. The White River uplift, however, has an anomalous trend in the east west direction. This is in part represented by the No Name fault.

Lithology of Rock Units in the Study Area

Supracrustal gneiss

The oldest rock unit in the area is a Precambrian heterogeneous metamorphic rock unit that primarily consists of biotite-muscovite gneiss and mica schist. The rock contains large amounts of fine-grained quartz, alkali feldspar, plagioclase, and as much as 35% biotite and muscovite around schistose areas of the unit. Mineralogically, the unit locally contains garnet and sillimanite, as well as local biotite replacement with chlorite (Allen & Shaw, 2011). This unit is thought to have formed more than 1.75Ga (Allen & Shaw, 2011) based on granitoids that intrude the gneiss around the Grizzly Creek shear zone (Allen & Shaw 2007). It has been intruded with a megacrystic granite. Even though it has been greatly replaced, regoliths of the gneiss are still present in the area around the No Name fault.

Megacrystic Granite

A Precambrian megacrystic granite is present in the foot wall of the No Name fault. The unit is bimodal with an equigranular matrix consisting of 0.1-1cm anhedral plagioclase, orthoclase, quartz, and biotite. Trapped inside of the matrix are tabular megacrysts of orthoclase that range in size from 2cm up to 8 cm. The age of the granite was found to be 1.741 ± 0.01 Ga using a LA-ICP-MS (Laser Ablation Inductively Coupled Plasma Mass Spectrometry)(Jones *et al.* 2007; Kirkham, *et al.* 2008). The unit has a composition of 20-30% plagioclase, 25-35% orthoclase, 15-25% quartz, and 15-20% biotite. Orthoclase megacrysts define local trends with a NW strike and comprise up to 20% of the rock unit(Allen & Shaw; 2011).

Sawatch-Dotsero formations

For the purpose of this study, the Cambrian Sawatch Formation and Cambrian Dotsero Formation were mapped as a single unit. The Sawatch is the thickest of the two units, being nearly 183 meters thick. On both weathered and unweathered surfaces, the unit is a gray to white in color. The unit is distinguishable by two thick white parallel bands of quartz arenite near the top(Fig.2). It classifies as a quartz arenite due to its medium to coarse interlocking angular quartz grains. The Sawatch is well indurated and forms steep cliffs. The Dotsero Formation is a graybrown, sandy shale with local dolostone beds. It generally forms slopes above near vertical Sawatch cliffs. It has an approximately thickness of 31 meters. This gives the combined map unit a total thickness of 214 meters.

Manitou Formation

The Lower Ordovician Manitou Formation is a sedimentary unit consisting of a sandy carbonate. The formation has an orange color on weathered surfaces and tends to form cliffs above the tree covered slopes of Dotsero . The thickness if the formation is approximately 62 meters.

Chaffee Group

The Devonian Chaffee Group consists of two formations. The thinner of the formations is

the basal Parting Sandstone which is only 6-12m in thickness. It is white in color on both weathered and unweathered surfaces with shale interbedded. The thicker of the formations is the overlying Dyer Formation. This formation is a gray-black, thin bedded, matrix-supported limestone and dolostone that locally contains fossils and small intraclasts. The Dyer can easily be distinguished from the overlying Leadville Formation by a distinct glassy noise that is made when two pieces strike each other. The Dyer Formation is approximately 55 meters thick, giving the entire group a thickness of nearly 61-67 meters.

Leadville Formation

The Mississippian Leadville Formation is a gray, medium-course grained, sucrosic limestone interbedded with chert that varies in color. Due to regoliths, the formation may have a reddish color when it weathers. Most forms cliffs when exposed at the surface. The formation has a total thickness of approximately 61 meters. Although the formation has an irregular thickness due to paleokarst. Some of the paleocaves have been filled in and fewer have been eroded back out.

Belden Formation

The Pennsylvanian Belden Formation is composed of mostly shale interbedded with meter-scale beds of sandstone, conglomerate, and micrite limestone. The formation has a tan to dark gray color on weathered faces. It forms highly vegetated slopes above the underlying Leadville cliffs.

Methods and Sample Preparation

Field mapping for this study began in June of 2012 during Concord University's GEOL 404 summer field course. Followup-mapping and sample collection was completed in early August of the same year. Six samples were collected near the fault or from within the plane of the No Name fault. Samples NN-1 and NN-2 were taken from an agglomeration of spary limestone that had been caught between the foot wall and hanging wall. Sample NN-1 has a tan color on fresh surfaces and a white color on weathered surfaces. Sample NN-2 has a darker

weathering color and is prominently black. Samples NN-3, NN-4, and NN-5 are all from the same granite body. All three of these samples show a distinct variation in the character of physical deformation that varies with distance from the fault. NN-3 is a friable orange/black granite that is rust colored on weathered surfaces. This sample contains quartz, feldspar, biotite, and white mica that is conspicuous in hand sample. In this location, the granite breaks easily into large fragments when grasped by hand and shatters when struck with force. Sample NN-4 is a pulverized granite that is tan/white-black in color. Due to the pulverization, it is difficult to distinguish fresh colors from weathered colors. The entire outcrop area around this sample is highly friable and breaks into many small pieces with very little force. This sample contains the same minerals as sample NN-3 (quartz, feldspar, biotite, white mica). NN-5 is a friable orange, white, and black-weathering granite containing quartz, feldspar and biotite. This sample and the area around it is slightly less fractured than the sample NN-3 location. Sample NN-6 is a light gray-white fault gouge that was found adjacent to the fault plane. The sample is extremely friable and consists of clay to silt sized grains.

All samples except NN-1 and NN-2 were made into thin sections at Concord University.

Samples NN-1 and NN-2 were commercially prepared by National Petrographic Services. Due to closely spaced fractures and high friability of samples NN-3, NN-4, NN-5 and NN-6, they were all mounted in hot-set epoxy prior to cutting and grinding. All thin sections were ground and polished to the standard 30micron thickness and left uncovered for x-ray fluorescence analysis.

Petrology and Geochemistry

Both of the limestone samples (NN-1,2) that were in the fault zone were observed to have undergone conspicuous weathering and were altered to mostly a light-brown clay that shows no birefringence. Calcite in the samples shows > 3rd order birefringence and a distinct rhomboidal habit. Large grains of calcite are restricted to veins that cut across a matrix of ground calcite.

The lack of a luster on the feldspars as well as the low potassium (K) content in sample NN-5 suggests that they have decomposed into clays. Point analysis was done on this sample and

the concentration by mass in the matrix was found to be 65.7% silicon, 22.4% aluminum, and 4.3% iron. Other elements are present but in lower concentrations. In a feldspar grain these same three elements were found to have concentrations of 80.9% silicon, 14.1% aluminum, and 0.5% iron (Table 1.). Because samples NN-3, NN-4, and NN-5 all came from the same granite body and only differed due to physical deformation, only sample NN-5 was examined through this means. Samples NN-3 and NN-4 were not examined in this way. The iron is prominent only in areas where there are fractures or in close proximity (Fig.3). Silica in sample NN-4 is most prominent in the feldspars.

Sample NN-3 has undergone very little weathering or feldspar decomposition compared to samples NN-4,5. Both silica and potassium have very well defined edges with little intrusion beyond them. Potassium makes up ~70% of the entire sample with silica at ~20% and iron at ~10%. The sample has undergone less physical deformation as well, which is evidenced by the reduced volume of fractures throughout the sample. Iron is localized in throughgoing fractures where potassium is depleted. Feldspars show early stages of decomposition to clays.

Sample NN-6 was taken from the fault gouge. XRF point analysis of the sample illustrates a high concentration of silica (Table 1). These concentrations were as high as 89.3% in some areas with other elements such as iron potassium and aluminum having concentrations of less than 10% each

This data was compared to a sample that had been taken from the same place and analyzed using a ICP-MS by ALS Chemex in 2008 (J.L. Allen, Unpubl. Data, 2008). Comparing the two data sets shows that SiO₂ varies less than 5% for the matrix of the rock but in the feldspar it varies as much as 15%. Although for Al₂O₃ this trend is reversed. In the matrix of the rock Al₂O₃ varies by almost 6% but for the feldspar it varies by 3%.

Cross-sections and Kinematics

Slickenlines on the Leadville Formation on the fault face show that the No Name fault

moved in a WNW direction with a dip of $\sim 57^\circ\text{N}$ (Fig 4.). The over all displacement of the fault is $\sim 366\text{m}$ with the NE side up and the SW side down. In the footwall, a syncline has formed that parallels the fault(Fig 1.). The Leadville Formation creates a dipslope on the hanging wall which is part of a broad monocline along the margin of the White River uplift. The dipslope of the Leadville Formation increases at the northern margin of the fault system. The No Name fault system is composed of two faults that parallel each other and have trapped a block between them. The block between these two faults has been caught in two splays of one larger deep seated fault(Fig 5.). This interpretation differs from past interpretations (Bass and Northrop 1963, Kirkham et al. 1997) in that the faults have moved in differing directions. In past interpretations the two faults moved in the same direction. The block caught in the system moved down along its northern margin and up along its southern margin.

Discussion

Original interpretations of the No Name fault system by N. Wood Bass and Stuart A. Northrop in 1963 displays the No Name fault system as two parallel vertical faults. The northern fault in this interpretation is mapped in correctly with the wrong side having moved down and leaving behind a piece of the Belden Formation. Later interpretations by Kirkham(1997) show the fault system consisting of a vertical fault to the northeast and the No Name fault dipping $\sim 40^\circ$ to the northeast. The displacement of the northern fault has been corrected and the Belden Formation has been removed to adjust for this correction. Kirkham et al(1997) connects much of the faulting in the area surrounding the No Name fault system to evaporite dissolution causing the overlying units to collapse forming a graben. The area of the No Name fault system that was studied showed no signs of having been caused by evaporite dissolution. There are no salt units present at the No Name fault where the Precambrian basement is exposed and it is apparent that the fault itself continues into the basement unit. The interpretation from this study shows both the No Name fault and the fault to the north as dipping at $\sim 40^\circ$ to the north east. The syncline that formed along the No Name fault is also present and the monocline that forms the dip slope of

Leadville is visible as well. The final adaptation of this model is that both faults connect at depth becoming one large listric fault.

Erslev, (2005) suggests multiple different ways that uplift in the Rocky mountains may have occurred(fig.6). The findings from this study that the No Name fault system may be a combination of tilted block structures and crustal buckling and detachment. The findings of this study show similarities in Erslevs second order anticlinal structures.

Conclusion

This study shows that the No Name fault system consists two faults that were formed in a compressional setting. A reverse fault formed as a response to a block that is caught between them. A NE-SW oriented stress compressed the block causing it to rotate. The thrust fault formed causing the northeastern part of the entire block to move and more strain be placed on its southern margin. As the stress continued to be applied the southern margin of the block, faulted creating the No Name fault.

Acknowledgments

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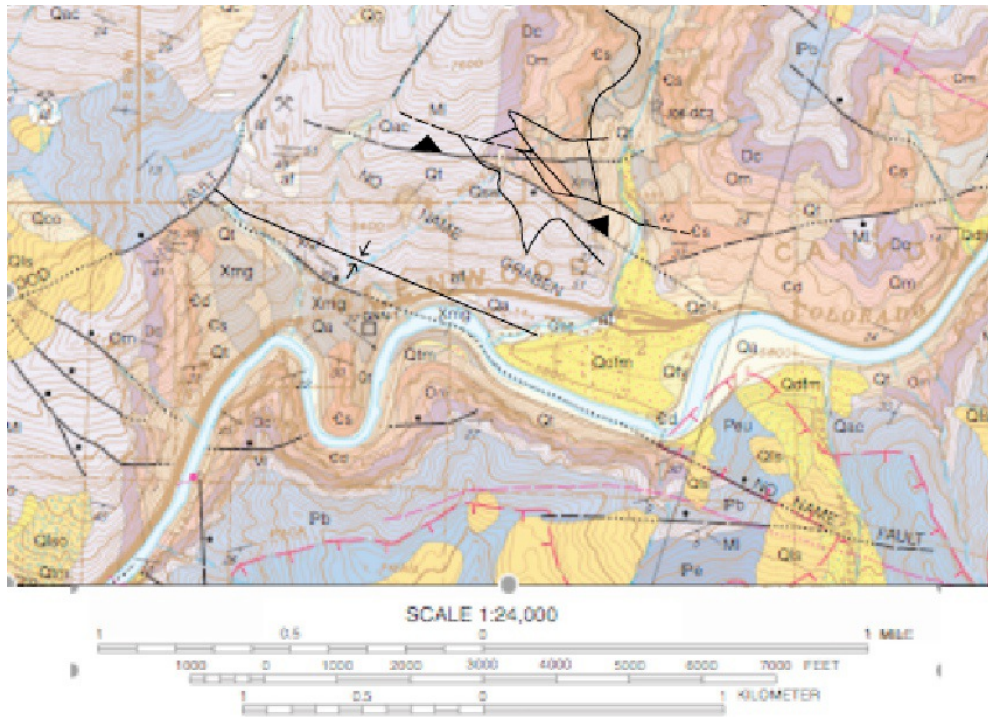


Figure 1: Geologic map of the No Name fault system and surrounding area. Map modified from Kirkham et al., 1997.



Figure 2: Photo of the Sawatch-Dotsero formations. The two bright lines seen near the center of the formation mark the upper most portion of the Sawatch and are near the base of the Dotsero.

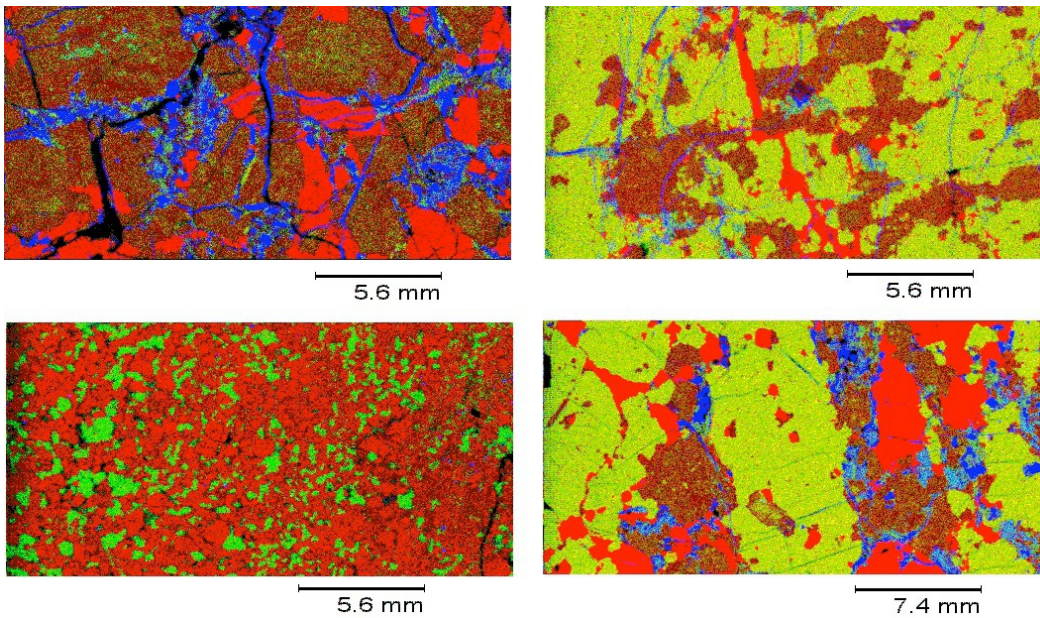


Figure 3: Xrf mapping of samples NN-3/11 (bottom right), NN-4/11 (top right), NN-5/11 (top left), and NN6/11 (bottom left). Red represents silicon, green represents potassium, and blue represents iron.

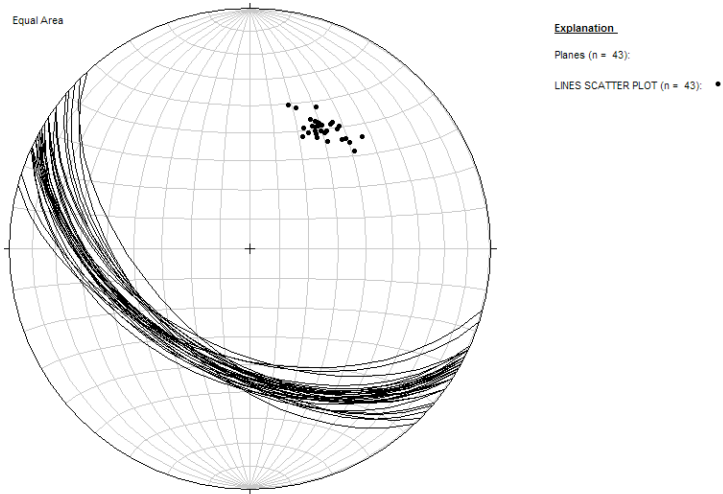


Figure 4: Stereonet showing strike and dip of rake of slickenlines on the No Name fault, and the corresponding poles to the great circles.

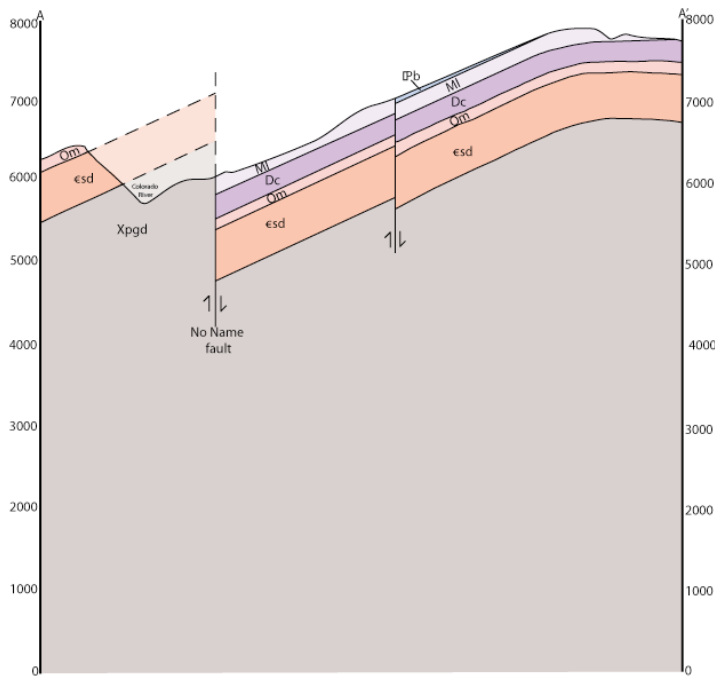


Figure 5a: Cross section through the No Name fault, created using data from Bass and Northrop, 1963.

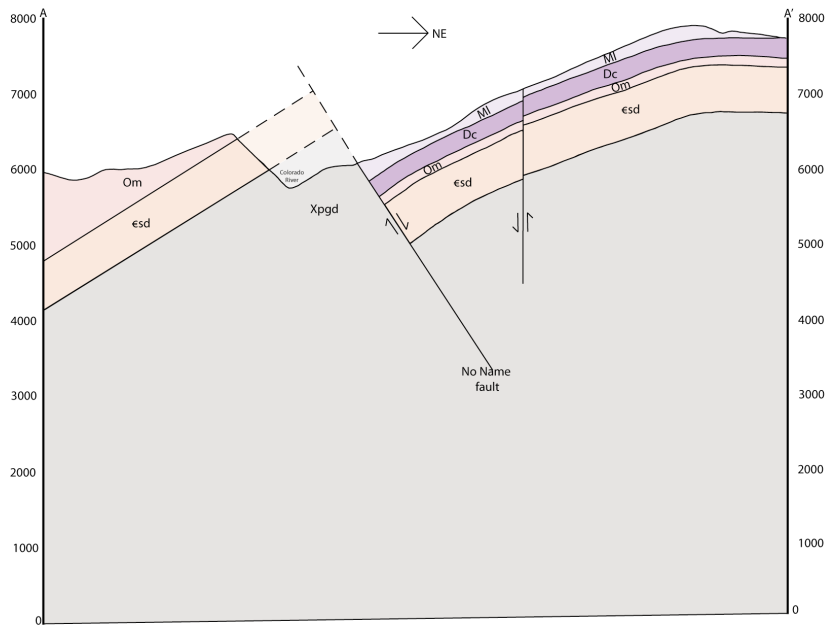


Figure 5b: Cross section through the No Name fault, created using Kirkham data, 1997.

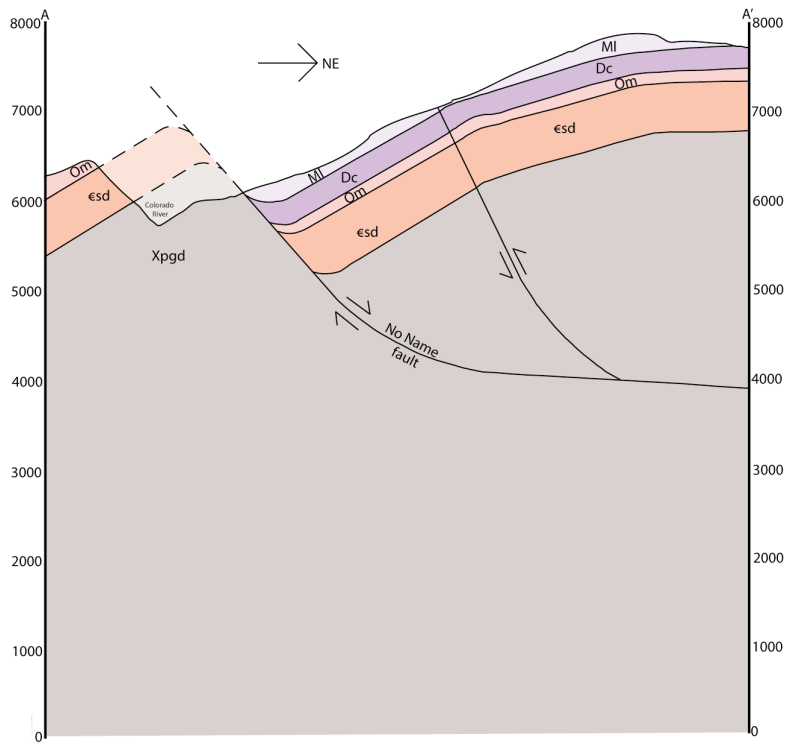


Figure 5c: Cross section through the No Name fault, constructed from the findings of this study.

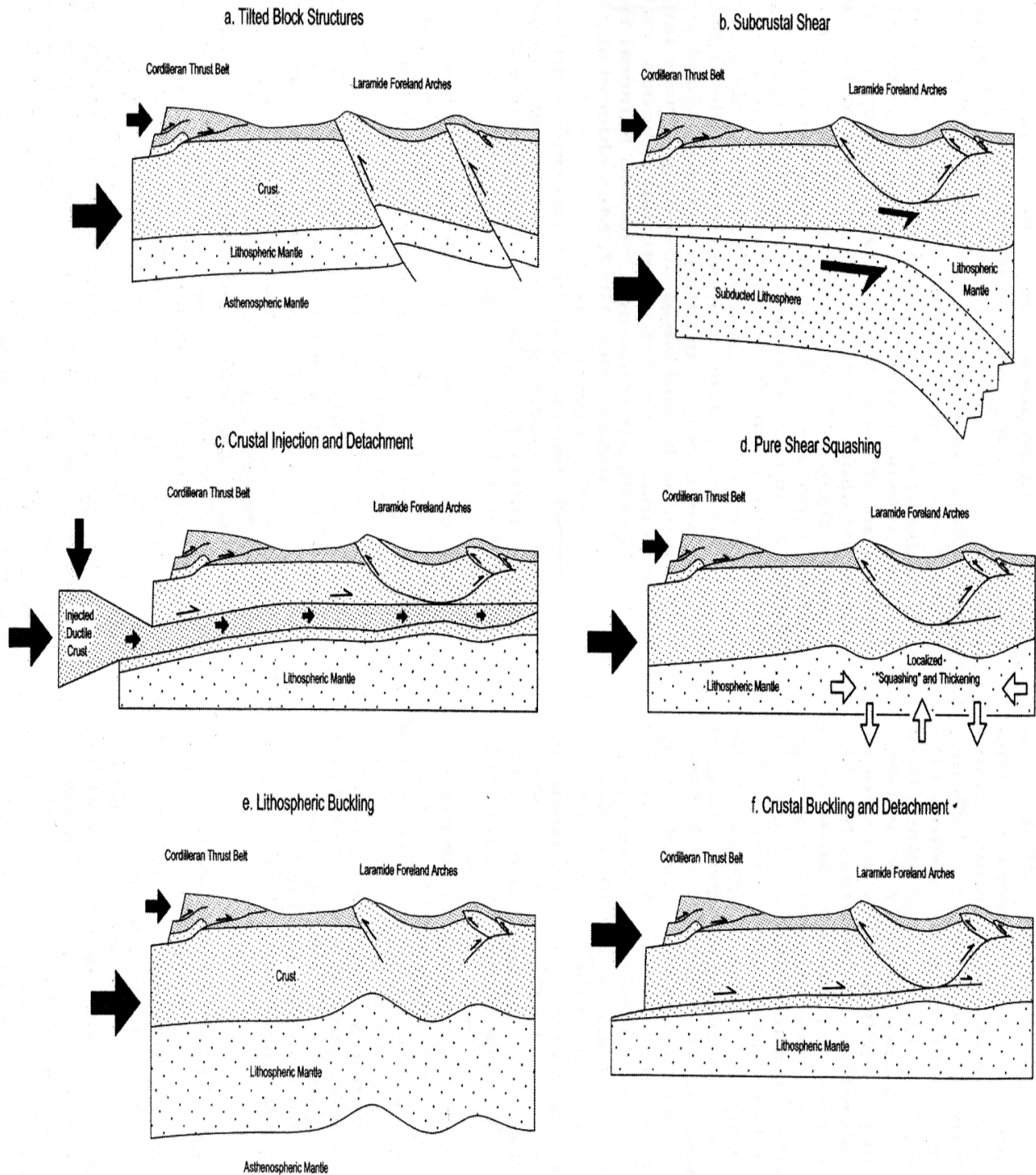
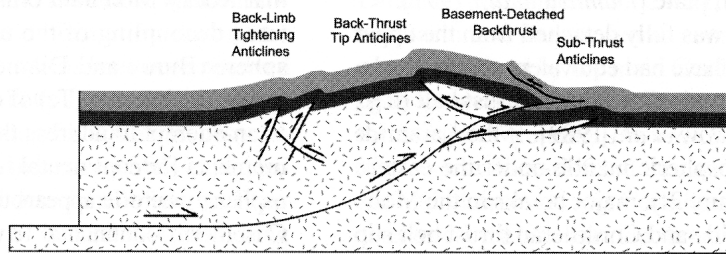


Figure 6a: Erslev's (2005) models explaining the formation of faults in the Rocky Mountain region accounting for spaces that were created in earlier models.

Basement-Involved, Second-Order Anticlinal Structures



Restored Section

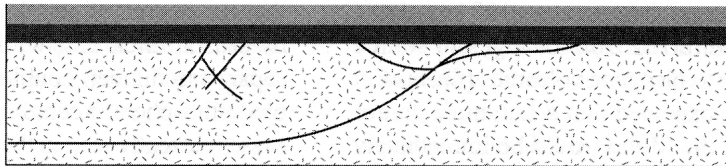


Figure 6b: This model of Erslev (2005) closely resembles the geometry of the No Name fault system as shown by this study.

Table 1

Sample NN-5/11 (matrix)

Element	%
SiO ₂	65.71
Al ₂ O ₃	22.355
K ₂ O	0.532
CaO	3.464
TiO ₂	2.947
Fe ₂ O ₃	4.258
Total	99.296

Sample NN-5/11 (feldspar)

Element	%
SiO ₂	80.892
Al ₂ O ₃	14.141
K ₂ O	2.414
CaO	1.978
Fe ₂ O ₃	0.475
Sr	0.099
Total	99.99

Sample NN04 (Megacrystic granite(Allen, 2008))

Element	Normalized%	Original%
SiO ₂	66.13	63.8
Al ₂ O ₃	17.16	16.55
K ₂ O	5.23	5.05
CaO	1.94	1.87
TiO ₂	0.81	0.85
FeO ₃	6.26	6.04
MnO	0.58	0.06
P ₂ O ₅	0.36	0.35
MgO	1.97	1.9
Na ₂ O		2.84
Total	100.44	99.31

Sample NN2-04 (Megacrystic Granite(Allen, 2008))

Element	Normalized%	Original%
SiO ₂	69.51	65.4
Al ₂ O ₃	16.74	15.75
K ₂ O	2.94	5.05
CaO	1.75	1.64
TiO ₂	0.83	0.78
Fe ₂ O ₃	5.9	5.58
MnO	0.053	0.05
P ₂ O ₅	0.34	0.32
MgO	1.91	1.8
Na ₂ O		2.77
Total	99.973	98.93

Sample NN-6/11 (fault gouge)

Element	%
SiO ₂	89.4
Al ₂ O ₃	2.2
K ₂ O	8.2
TiO ₂	0.06
Cr	0.04
FeO ₃	0.43
Ce	0.12

Table1: Compositional makeup of samples NN-5/11, NN-6/11 and unpublished data from 2008 samples NN04 and NN04-2.

Differential Effects of Norepinephrine on *In Vitro* Growth of Pathogenic Bacteria

Teona Music

Mentor: Tesfaye Belay, PhD

Senior Research Paper submitted as partial requirement for the Completion of McNair
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Abstract

It is well documented that the gastrointestinal tract environment during stressful conditions produces high level of stress hormones such as norepinephrine (NE) (noradrenaline) which are important in the establishment infection in a host. Studies have indicated that norepinephrine enhances the in vitro growth and production of virulence factors of microbial pathogens, but the mechanism(s) involved in its growth enhancement effect is/are not well defined. The purpose of this study was to i) examine the responsiveness of gram-negative and gram-positive bacteria to NE in the presence of serum with or without iron; ii) identify and characterize genes responsible for enhanced growth in the presence of NE. We hypothesized that norepinephrine has differential effect in vitro growth of Gram positive or Gram negative pathogens in the presence or absence of iron. Growth of initial inoculum density (approximately 10 to 100 CFU/ml) of *Salmonella*, *Staphylococcus aureus*, *Streptococcus pneumoniae*, and *Escherichia coli* cultured in standard American Petroleum institute (SAPI) medium containing 30% adult bovine sera in the absence of NE (control) or in the presence of 0.0001 M norepinephrine was examined. The growth of the same species in serum-free, iron-deficient apotransferrin-containing (APO) or iron-saturated holotransferrin-containing (HOLO) SAPI medium in the absence of NE (control) or in the presence of 0.0001 M NE were also tested. The rate of growth of each species was determined by measuring absorbance readings at 595 nm at 2 h interval over 18 h and colony counts after 24 h growth on solid agar. Over all, addition of norepinephrine resulted in increases in growth compared to controls but had the greatest enhancing effects on growth (more than 2 logs) of cultures of *Salmonella* or *E. coli*. Growth kinetics of *S. aureus* or *S. pneumoniae* was also enhanced in the presence of norepinephrine, but not to the same degree as was the growth of gram negative bacteria. *S. aureus* growth was only moderately affected by NE treatment, and there were significant differences in growth (about 1 log). The growth of bacteria in APO was inhibited in with/out NE compared to cultures containing HOLO in the presence of NE. The results suggest that norepinephrine can enhance growth of pathogenic bacteria, which may contribute to development of pathogenesis; however, there is no uniform effect of norepinephrine on bacterial growth.

Introduction

Research has been done on the growth of pathogenic bacteria for many years. The largest area of research is done between the differences between Gram positive (+) and Gram negative (-) bacteria. The main difference between the two bacterial groups is in cell wall structure. Both gram positive and gram negative bacteria contain peptidoglycan in the cell wall covered various other layers (18). In Gram positive bacteria, the peptidoglycan is on the outside layer. In Gram negative bacteria, the outer membrane is more complex, with the peptidoglycan on the outside of the inner layer membrane. Because of this, the two groups are affected differently when placed under various conditions. There are other differences in the two such as in gram positive bacteria which contains no lipoproteins and has teichoic acids. In gram negative bacteria however, there are lipoproteins attached to the polysaccharide backbone but no teichoic acids are present. Both bacteria include many species and both can cause serious health issues. Some examples of the gram positive bacteria are *Staphylococcus aureus* which can cause many diseases including MRSA, and also Toxic Shock Syndrome, and *Streptococcus pneumoniae* which causes a variety of infections; ranging from ear to lung infections. Some examples of the gram negative bacteria are: *Escherichia coli* which can cause bloody diarrhea, urinary tract infection and septicemia. Another example is *Salmonella spp.*, which causes food poisoning, septicemia, and zoonotic disease.

One of the ways researchers have detected differential growth of these bacterium is by the addition of NE, HOLO, and/or APO. Norepinephrine is a catecholamine which is able to enhance bacterial growth, motility, and virulence of bacterial pathogens via specific binding receptors (9). In fact, in a comparative growth test done with Epinephrine, Dopamine, and Norepinephrine, norepinephrine exposure had the most potent ability among the catecholamines to stimulate bacterial growth (9). So why exactly does NE have such a positive

effect on bacterium growth is not known. According to research done at Texas Tech University's Health Science Center, The catecholamine Norepinephrine enhances the pathogenic bacteria by transferring iron from host binding proteins (1). It is also stated that even though there is proven growth on both Gram (-) and Gram (+) bacteria, the growth of Gram (-) is often higher. In the body, Norepinephrine is a neurotransmitter hormone that is produced in the body during stressful situations.

APO and HOLO are bovine transferrines. Transferrines are iron-binding blood plasma glycoproteins that control the level of free iron in biological fluids (11). They are often referred to as a growth factor (14). When the transferrin is not bound to iron it is known as 'apo-transferrin' (11). APO is iron-deficient where as HOLO is iron saturated and is often used for growth enhancement. Because APO-transferrin is iron-deficient, it often has no effect or can even inhibit the growth process. For example, research done with *K. pneumoniae* in an Ohio State University lab showed the bacteria had an inhibited final growth when APO-transferrin was added (6).

During stressful situations in the body, particularly in the gastric tract, NE is released to the site of the infection. This Norepinephrine enhances bacterial growth, speculated for the acquisition of iron from transferrines and lactoferrins, such as the previously mentioned HOLO and APO. Then again in a New York lab, a test of the effects on NE with the addition of transferrin was done. The ending result was the growth of *K. Pneumonia* in the iron-deficient APO-transferrin containing medium was severely restricted (2). HOLO transferrin has an opposite effect, however. In the same test done at the New York lab proved that the growth of *K. pneumonia* cultured in iron-saturated HOLO transferrin containing medium was enhanced (2). Most of the studies that have proved all of these theories were done with Gram (+) and Gram (-) bacterium. Gram (-) bacteria have many extra layers and the "more complex outer

membrane" (1). This, in addition of the acquisition of iron in the serum because of NE, makes the growth effects higher in this group because of the higher need for NE.

The significance of this research was that norepinephrine enhances the *in vitro* growth and production of virulence factors of microbial pathogens, but the mechanism(s) involved in its growth enhancement effect is/are not well defined. The hypothesis tested was that Norepinephrine has differential effects in the *in vitro* growth of gram positive or gram negative pathogens, in the presence or absence of iron.

The specific aims or goals of the research were to examine the responsiveness of gram-negative and gram-positive bacteria to norepinephrine in the presence of serum, with or without iron. Also, to identify and characterize genes responsible for enhanced growth in the presence of norepinephrine.

Materials and Method

The materials used to complete the research were four bacterial organisms. These organisms were the gram positives, *Staphylococcus aureus* and *Streptococcus pneumoniae* and the gram negatives, *Escherichia coli* and *Salmonella spp.* Three different media: LB Broth, Nutrient Agar, and Standard American Petroleum Institute (SAPI). SAPI is a poor medium used to examine the effect of NE in presence of serum.

Bacterial Inoculum Preparation

One day prior to the experimental day, stock culture of each bacterium was added into 10 ml TSB and incubated at 37 °C for overnight growth. During the day of experiment, the cultures were washed twice using phosphate buffered saline (PBS) by centrifugation at 2000 rpm for 5 minutes. Then the bacterial pellets were resuspended in 10 ml of PBS. A 1:10 serial dilution was made in 6 tubes to approximately determine the bacterial inoculum at zero time.

Preparation of SAPI

Adult bovine serum (sterile), chemical salts and glucose was purchased from Sigma and Aldrich Inc (St. Louis, MO). Standard American Petroleum Institute (SAPI) medium was preparing by combining 2.77 mM glucose, 6.25 mM NH_4NO_3 , 1.84 mM KH_2PO_4 , 3.35 mM KCl and 1.01 mM MgSO_4 , adjusted to a pH of 7.2 .

Preparation of SAPI-serum medium for bacterial inoculation

SAPI medium supplemented with 30% adult bovine serum medium was prepared by combining SAPI (69%) with bovine serum (30%) and 1.0 ml HEPES buffer (1%). Then a 10^{-4} M norepinephrine was added to 10 ml SAPI-serum medium. A volume of fresh 100 ul of bacterial inoculum (10-100 cells) cells was inoculated into SAPI-bovine serum with NE or without NE. Concentrations of initial inoculums were confirmed by plating and the counts were expressed as colony-forming units (CFU) per milliliter. Cultures were incubated at 37°C for growth and direct plate counting was performed at different time points.

RNA Isolation, cDNA synthesis and PCR Amplification

Total RNA was isolated from *Chlamydia trachomatis* infected monolayer cells grown in the presence of absence of cortisol or norepinephrine as above, using Qiagen Rneasy Mini Kit (Valencia, CA) following the manufacturer's instructions. First Strand cDNA Synthesis Kit and Brilliant SYBR® Green QPCR Master Mix of Stratagene/Agilent Technologies (Santa Clara, CA) were used to synthesize and amplify cDNA following the manufacturer's instructions. mRNA levels and data analysis was performed by using the PCR and multiplexing applications of Mx3000P system. PCR products were gel electrophoresed and DNA level intensity was performed using DNA Image Analyzer software (BioRad). mRNA levels of target genes were standardized using internal control.

Experimental Design

Three different experimental designs were performed. Differential bacterial growth of *Salmonella*, *E. coli*, *S. aureus*, and *S. pneumoniae* with or without NE in SAPI medium was determined by colony counts on solid medium or by measuring Optic Density (absorbance) at 595 nm at 2 h intervals. Expression of iron-harvesting genes of *E. coli* and *S. aureus* in the presence and absence of NE was determined by use of Polymerase Chain Reaction (PCR). Holo and Apo were included as iron saturated or iron deficient containing serum respectively.

Results

In preliminary experiments, a growth curve of *four bacterial pathogens* during first 24 hours was performed to determine the optimum growth conditions for subsequent experiments. A single colony was transferred to fresh TSB medium and incubated at 37°C overnight. The standard growth curve fit was prepared by plotting the corresponding bacterial counts at different time points. Counts were expressed as colony-forming units (CFU) per milliliter.

The effects of norepinephrine on the different isolates were investigated. As shown in **Figure 2** growth was higher in gram negative bacteria than Gram positive **Figures 1** and **3**. In agreement with the colony counts, optic Density readings of the gram negative were higher than that of the gram positive.

As shown in **Figures 7** and **8**, Iron-acquisition gene expression was diminished in the presence of norepinephrine both in gram positive and gram negative bacteria, suggesting that the genes were suppressed due to the presence of NE to harvest iron from the serum to the bacterial need. These results showed that the genes were more expressed in bacterial culture without the presence of NE to harvest iron.

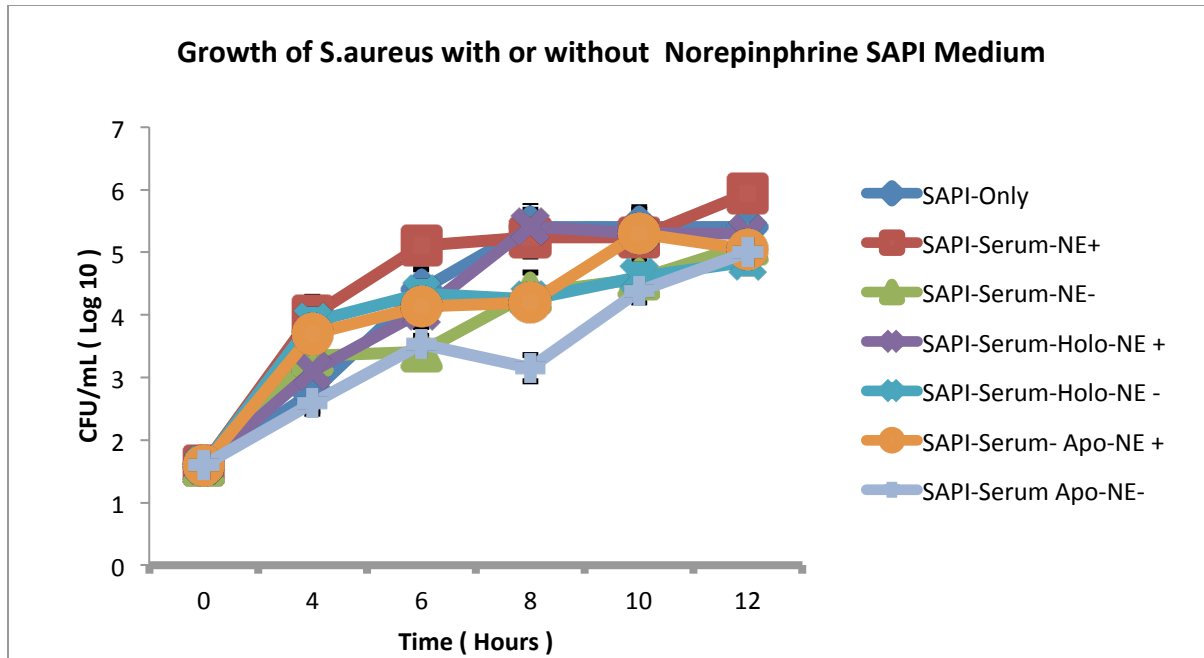


Figure 1: Growth of *Staphylococcus aureus* in serum-Standard American Petroleum Institute (SAPI) supplemented with or without norepinephrine determined by plating on solid medium. Data at each time point represents the mean of two or more readings plus/minus standard deviation.

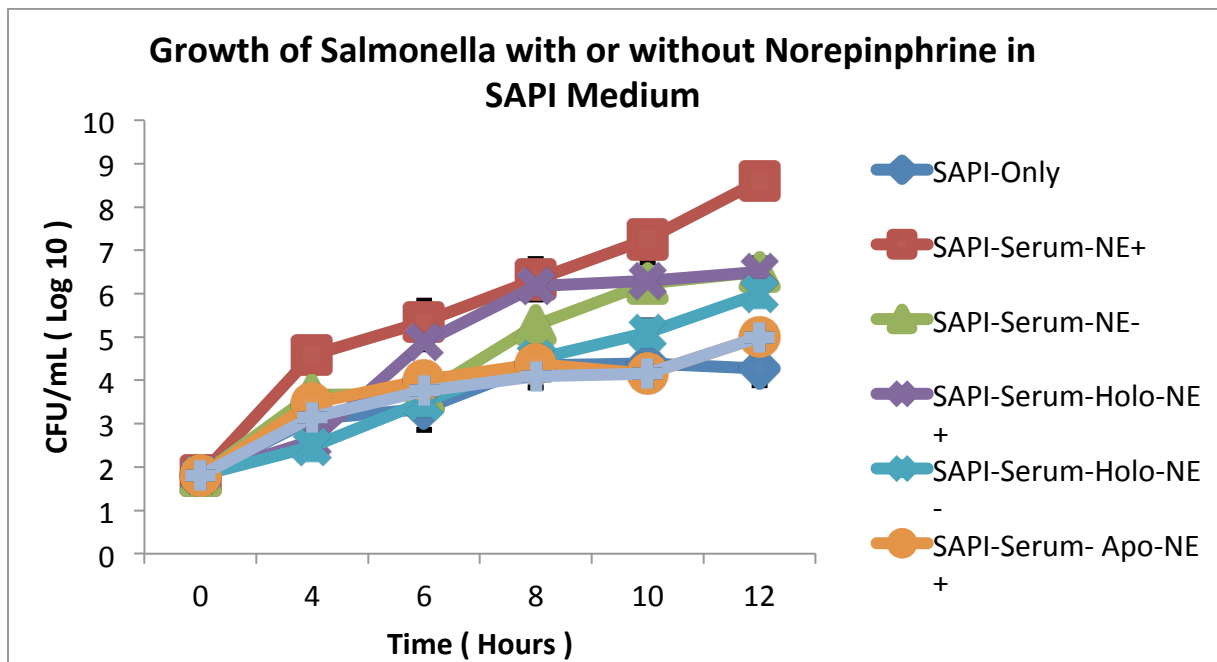


Figure 2: Growth of *Salmonella* in serum-Standard American Petroleum Institute (SAPI) supplemented with or without norepinephrine determined by plating on solid medium. Data at each time point represents the mean of two or more readings plus/minus standard deviation.

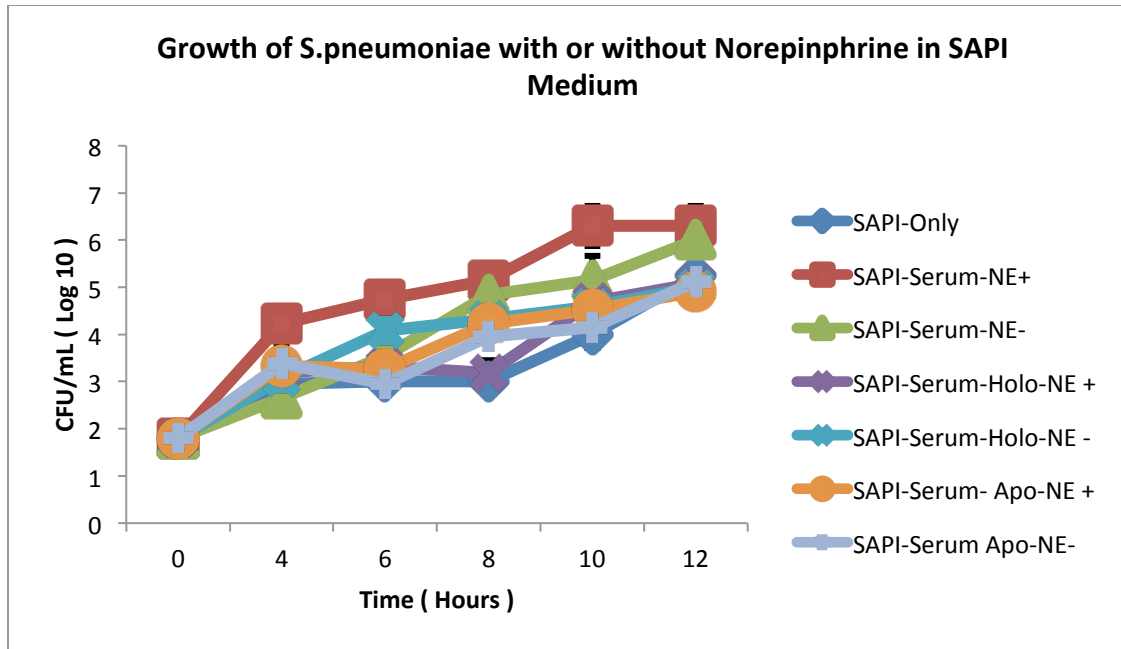


Figure 3: Growth of *S. pneumoniae* in serum-Standard American Petroleum Institute (SAPI) supplemented with or without norepinephrine determined by plating on solid medium. Data at each time point represents the mean of two or more readings plus/minus standard deviation.

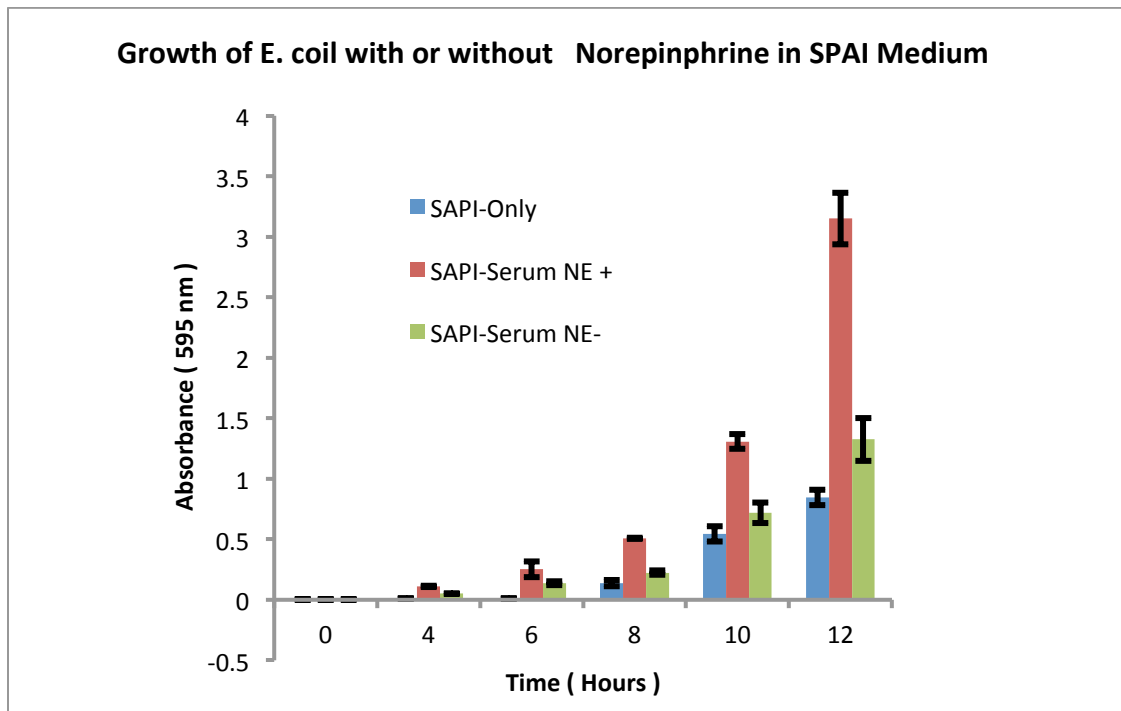


Figure 4: Growth of *Escherichia coli* in serum-Standard American Petroleum Institute (SAPI) supplemented with or without norepinephrine. Data at each time point represents the mean of two or more readings plus/minus standard deviation.

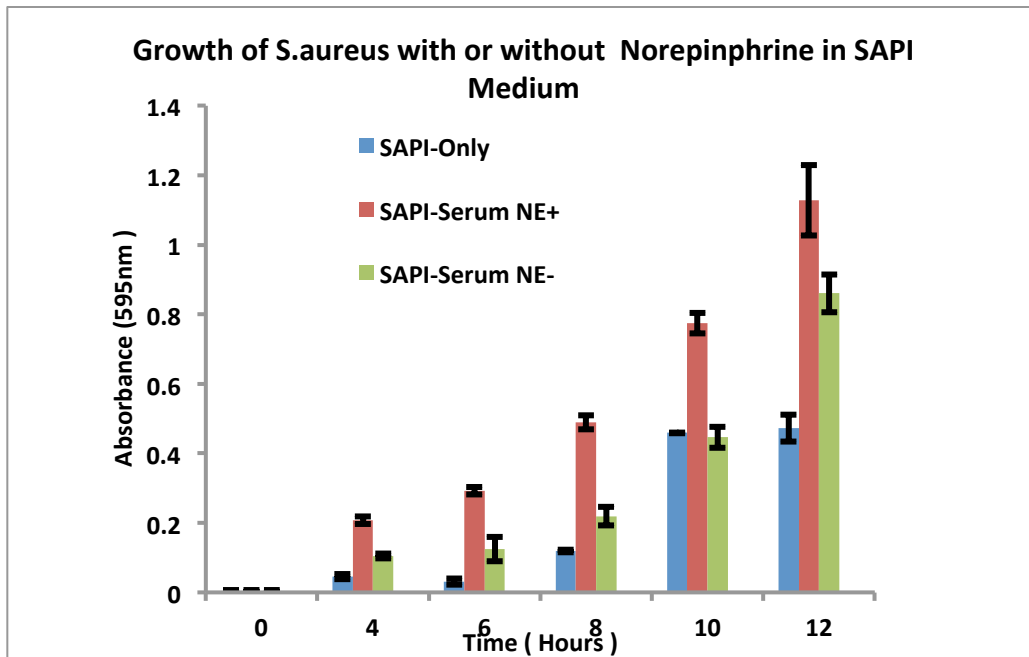


Figure 5: Growth of *S. aureus* in serum-Standard American Petroleum Institute (SAPI) supplemented with or without norepinephrine determined by measuring absorbance readings. Data at each time point represents the mean of two or more readings plus/minus standard deviation.

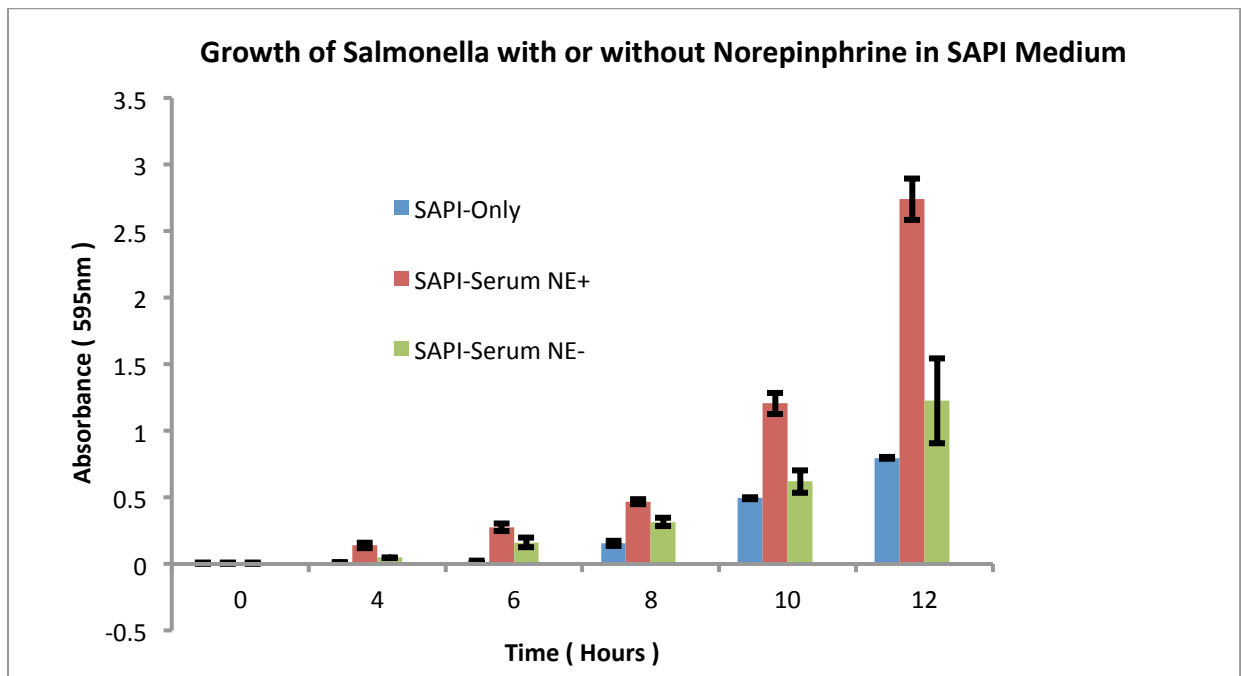


Figure 6: Growth of *Salmonella* in serum-Standard American Petroleum Institute (SAPI) supplemented with or without norepinephrine determined by measuring absorbance readings. Data at each time point represents the mean of two or more readings plus/minus standard deviation.

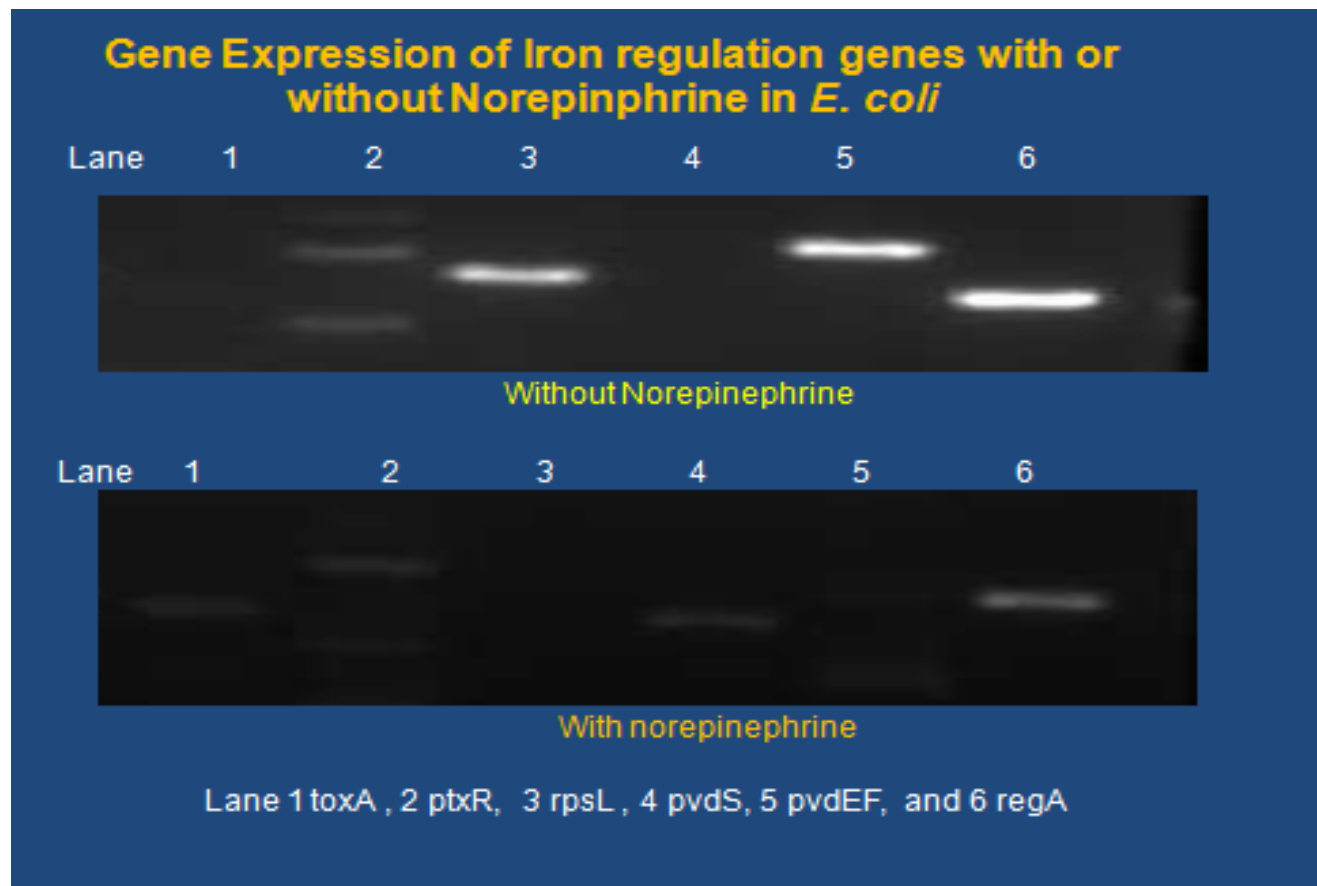


Figure 7: Expression Profiles of *Escherichia coli* genes of related to iron-acquisition in the SAPI medium, supplemented with serum with or without NE. mRNA levels and data analysis was performed by using the PCR and multiplexing applications of Mx3000P system. PCR products were gel electrophoresed and DNA level intensity was performed using DNA Image Analyzer software (BioRad). mRNA levels of target genes were standardized using internal control.

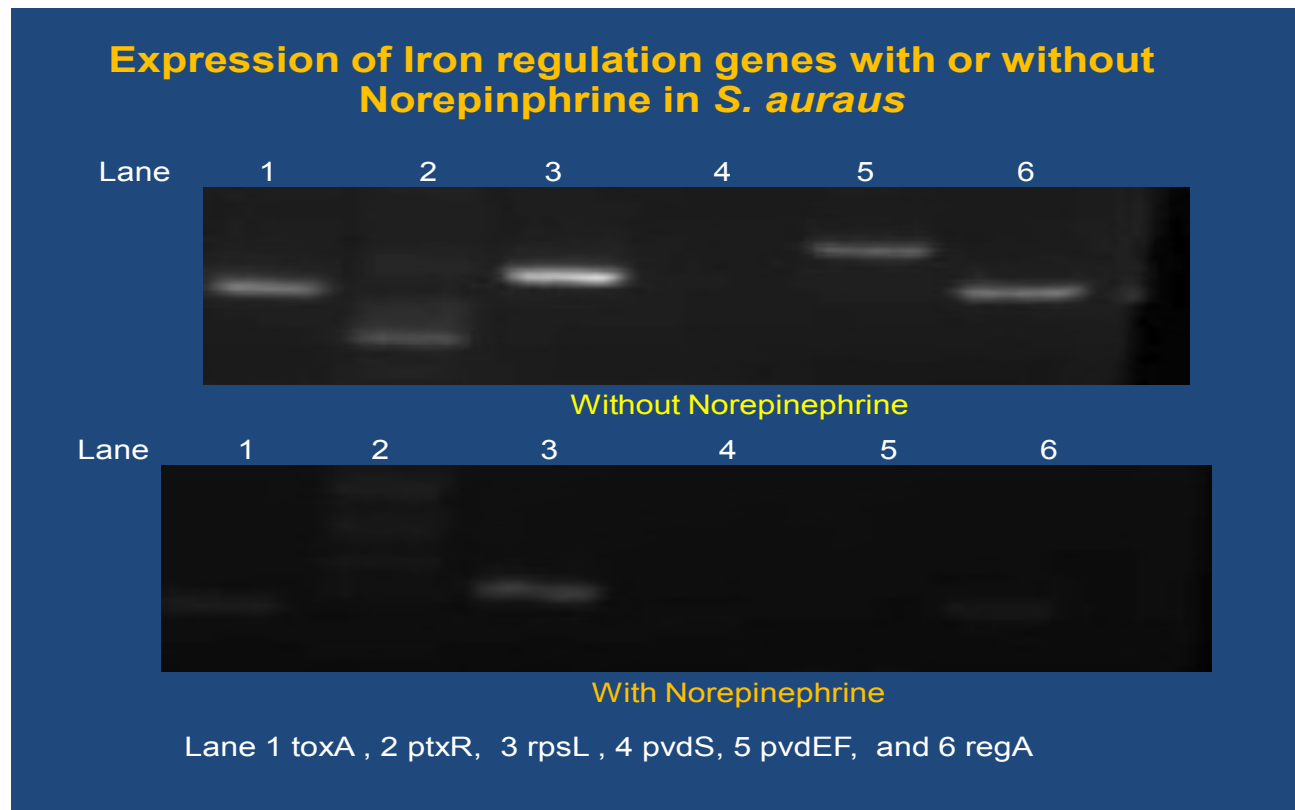


Figure 8: Expression Profiles of *Staphylococcus aureus* genes of related to iron-acquisition in the SAPI medium, supplemented with serum with or without NE. mRNA levels and data analysis was performed by using the PCR and multiplexing applications of Mx3000P system. PCR products were gel electrophoresed and DNA level intensity was performed using DNA Image Analyzer software (BioRad). mRNA levels of target genes were standardized using internal control.

Discussion and Conclusions

Studies have shown that NE enhances growth of many pathogenic bacteria. In this study, a volume of 100 ul of fresh bacterial inoculums (10-100 cells) was inoculated into 10 ml SAPI-bovine serum with NE or without NE. Norepinephrine at the concentration of 10^{-4} M was added to the bacteria-SAPI-serum medium for prolonged incubation. Concentrations of initial bacterial inoculums were confirmed by plating and the counts were expressed as colony-forming units

(CFU) per milliliter. Cultures were incubated at 37°C for growth and direct plate counting was performed at time intervals.

In summary, the research showed that gram negative bacteria show an increase in growth in the presence of Norepinephrine. Gram positive bacteria show an increase in growth in the presence of norepinephrine as well, but not at the extent of the Gram negatives. Also, the gene Expression of both Gram negatives and Gram positives of Iron regulation genes in the presence of norepinephrine were distinctly reduced. In conclusion, Norepinephrine may play a key role in enhancing the growth of pathogenic bacteria and expression of virulence factors.

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Cognitive and Mood Effects of Binaural Beats

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Abstract

Is it possible to induce different cognitive states by listening to tones over headphones? Binaural beats are auditory tones that are presented at different pitches to each ear. They seem to produce changes in the brain that result in changes to moods, bodily states, and cognition. Past research on binaural beats and cognitive functioning has focused on populations suffering from cognitive deficits. The current study examined the effects of beta binaural beats that should induce alertness and theta beats that should induce relaxation in populations without memory or attention problems. Listeners completed tests of memory, attention, and mood. Listening to beta wave-inducing beats resulted in increased performance on the Attention Task/CPT. Participants who listened to beta wave-inducing beats recalled fewer words than other participants. Binaural beats seem to produce benefits typical populations as well as the atypical populations reported in previous studies. Binaural beats could be used as a quick, inexpensive method for increasing concentration.

Cognitive and Mood Effects of Binaural Beats

Binaural beats are a curious phenomenon in which sound impulses are played into each ear at different frequencies which the listener interprets as a single sound. Binaural literally means “two ear”, and the difference in frequencies across the ears triggers cortical changes throughout the brain, altering the overall pattern of brain activity and resulting in changes in cognition, mood, clinical symptoms, and physiology.

Binaural beats are composed of pure tones and rarely occur in the natural environment. They must be artificially created using sound editing software or similar electronic methods. Binaural beats must use relatively low pitched tones in order to be heard by humans. The normal frequencies that humans can hear are between 90 and 1500 Hz. The beats that are best perceived are around 440 Hz. To be most effective, the difference between the two separately presented tones should be between 1 and 30 Hz (Oster, 1973).

While brain wave frequency patterns change naturally in the brain throughout a typical day, they can also be manipulated using binaural beats. Delta waves are the slowest and highest in amplitude, occurring below 4 Hz and are associated with sleep (Colrain et al., 2010). Theta waves are between 4-7 Hz and are associated with meditation and deep relaxation, like hypnotic relaxation and occur in short bursts (Cantero, 2003). Alpha waves, between 8-13 Hz, occur during times of wakeful relaxation, drowsiness, and calmness (Domino et al., 2009). Beta waves, between 14-38 Hz, occur when an individual is actively thinking, problem-solving, concentrating, or when paranoid. Beta waves can be recorded over the sensorimotor cortex in humans (Lalo et al., 2007). Finally, gamma patterns, 40 Hz and above, are involved with higher mental activity, including awareness and perception (Hughes, 2008). Gamma frequencies are also shown during short term memory matching of recognized stimuli (Herrmann, Frund, & Lenz, 2009).

The claim that most experimenters make is that the simultaneous sounds entering each ear resonate with the brain, forcing brain wave patterns to follow the same frequency. For example, a 505 Hz tone and 515 Hz tone will produce a binaural beat with a frequency of 10 Hz, which is a frequency near

the middle of the alpha range. This potential of the brain to synchronize brain wave patterns by following the frequency of an external stimulus is called the frequency following response (FFR). Matching particular wave ranges may have potential therapeutic applications. The behaviors associated with different wave patterns are correlational, which means that producing the frequency patterns may result in the correlated behaviors. That there is a causal relationship between the wave patterns and the behaviors is a necessary assumption for binaural beats to have an effect on human behavior. However, it may instead be the case that engaging in the correlated behaviors results in the associated frequency pattern, and altering wave frequency patterns might have no effect at all on behavior.

Brain wave patterns are measured using electroencephalography (EEG), the recording of electrical activity along the scalp. EEG measures electrical fluctuations caused by ionic current flows within the neurons of the brain, reflecting the summation of the synchronous activity of millions of neurons (Niedermeyer & da Silva, 2005; Klein & Thorne, 2006). Using electrodes placed along the scalp, EEG records the brain's spontaneous electrical activity over short periods of time (Abou-Khalil & Misulis, 2005). Oscillations at various frequencies are shown by scalp EEG, some with characteristic frequency ranges that are associated with different states of brain functioning, such as alert wakefulness and sleep stages (Whittingstall & Logothetis, 2009).

The ability to synchronize brain wave frequencies to a particular wave range have been used in many marketing tactics, some which are back by empirical research, and others that are more likely to be hoaxes. This basic brain response to auditory stimuli has become the basis of large industry that produces "enhanced" meditation music (music overlaid with binaural beats) which is touted to directly affect brain waves. Some of the more outlandish claims of binaural beats include abilities of astral projection, telepathy, increased weight loss, decreased hair loss, and even increased sex drive (The Unexplainable Store, 2000-2011). Unsurprisingly, these claims have little to no scientific evidence backing them up.

One of the most recent and most widely-known of these beat-selling companies is I-Doser, which specializes in CDs, MP3s, and an I-Doser Application for PCs. They claim that their auditory tones can alter consciousness in a manner that simulates moods and experiences that mimic recreational drugs and

sexual sensations. I-Doser claims that their products bring on induced states including mood lift, euphoria, sedation, and hallucination. Many users boast on the website's forums that the beat doses have vivid, similar effects to actual drugs (I-Doser, 2011).

A great deal of research has been done on the interactions of drugs and EEG's. Individual drugs can have very different effects on brain wave frequencies. Some tested drugs, that can also be found as doses on I-Doser, and their effects include: opiates, like heroin and morphine, increase alpha activity; amphetamines (such as Adderall) and methylphenidate (Ritalin) tremendously decrease delta and theta wave patterns; and marijuana tends to increase alpha wave patterns while decreasing beta frequency (Braverman, 1990). Barbiturates have also been tested, producing a slowing of EEG background activity and an increase in beta activity (Domino, French, Pohorecki, Galus, & Pandit, 1989; Feshchenko, Veselis, & Reinsel, 1997). Some drugs, like neuroleptics, have effects on multiple brain wave patterns. The main effect of neuroleptics is to increase delta and theta activity, while decreasing both beta and alpha activity (Itil, 1977; Merrin, Fein, Floyd, & Yingling, 1986; Bo, Ongini, Giorgetti, & Savoldi, 1988). An overdose of anticonvulsants, like Dilantin, greatly enhances the slower delta and theta frequency (Braverman, 1990).

While the I-Doses do use beats to match the frequencies of the brain wave patterns caused by real drugs, drug use involves more than merely changing brain wave patterns, including neurotransmitter effects throughout the nervous system. There are some doses named directly after certain drugs, some named after wave frequencies, and others imply the effects without specifying which frequency will be induced. Labels are likely to play a major role, including expectancy effects and causing users to feel what they expect, especially if they enter into a meditative state and more susceptible to suggestion. Listeners would then actually be responding to the labels not the beats themselves, making I-Dosing simply a placebo effect.

The placebo effect refers to a sham medical procedure in which patients will experience perceived or actual effects of the artificial treatment. Placebos often serve as controls in experiments and can, at times, have surprisingly strong effects. Placebos were first used in a medicinal context during the

18th century and were defined as "any medicine adapted more to please than to benefit the patient" (Shapiro, 1968). They were in widespread medical use until the 20th century where the deception involved in their use created ethical tension (Newman, 2008).

The placebo effect phenomenon is closely related to the perception and expectation the patient has. That is to say, if the treatment is thought to be helpful, it may have positive effects, but if it is viewed as harmful, it may have negative effects, which are referred to as "nocebos" (Craen, Kaptchuk, Tijssen, & Kleijnen, 1999). Placebos can act through classical conditioning where the recipient has been conditioned to respond a certain way to the real treatment and will, thus, respond in the same manner with the sham treatment (Voudouris, Peck, & Coleman, 1989). It has also been shown through functional imaging, increased activity occurs in the anterior cingulate, prefrontal, orbitofrontal and insular cortices, nucleus accumbens, amygdala, the brainstem periaqueductal gray matter (Oken, 2008; Scott, Stohler, Egnatuk, Wang, Koeppe, & Zubieta, 2008; Lidstone & Stoessl, 2007), and the spinal cord (Goffaux, Redmond, Rainville, & Marchand, 2007; Matre, Casey, & Knardahl, 2006; Qiu, Wu, Xu, & Sackett, 2009; Zubieta & Stohler, 2009) during placebo analgesia.

Though a long time has passed since its inclusion in modern medicine, the placebo effect is still relatively poorly understood and lacks stable statistical evidence. Hróbjartsson and Gøtzsche (2001) conducted a systematic review of clinical trials that involved assignment to either a placebo or a no treatment group to examine of the quality of evidence supporting placebo treatments. They found little evidence that placebos had strong clinical effects, though they showed possible small benefits in studies with continuous subjective outcomes and for the treatment of pain.

Previous research with binaural beats has found greater effects of binaural beats than placebo. The brainwave entrainment procedures show clear effect in clinical, cognitive, mood, and physiological research.

Clinical Effects

Binaural beats have been shown to exhibit positive effects on self-reported psychological measures, especially for anxiety and depression. Wahbeh, Calabrese, and Zwickey (2007), asked

participants to complete a number of psychological measures including the Beck Depression Inventory-2, the State-Trait Anxiety Inventory, the Profile of Mood States (POMS), the Tellegen Absorption Scale, and the World Health Organization-Quality of Life Inventory. Pre- and post-intervention measurements were taken. Participants listened to a CD with delta wave-inducing binaural beat frequencies daily for 60 days. A significant decrease of trait anxiety and an increase in quality of life was found. These results could be accredited to the correlation of delta wave-inducing beats and sleep. Studies show that those who get regular, high-quality sleep have lower levels of anxiety and depression when compared to those who get irregular sleep (Gillin, 1997; Taylor, Lichstein, Durrence, Reidel, & Bush, 2005).

Supporting those results, studies have shown a reduction in pre-operative anxiety in patients using delta-wave inducing beats. Padmanabhan, Hildreth, and Laws (2005) used delta wave-inducing beats embedded in music to decrease anxiety in patients scheduled to undergo general anesthesia for surgery. To test this, patients were asked to complete a State-Trait Anxiety Inventory self-evaluation questionnaire before the operation to collect a baseline measure. Participants were randomly allocated to one of three groups: a Binaural Group who received 30 minutes of binaural beats masked with music; an Audio Group who received the same music as the former group but without the binaural beats; and a No Intervention Group who received no specific intervention. At the end of the 30 minutes, participants completed only the STAI-A portion of the STAI questionnaire for a second time. After converting scores to percentages, the Binaural Group had a mean decrease in anxiety of 26.3% compared to the 11.1% in the Audio group and 3.8% in the No Intervention Group.

Similarly, Chuter, Allan, and Laws (2007) also tested anxiety in patients in the pre-operative period. Participants were assigned to listen to 'Holosync' audio, which consisted of binaural beats masked with music, or music of their own choosing for up to an hour preceding surgery. Using the Visual Analogue Anxiety Scale (VAAS), anxiety levels were observed before the music, after the music, and immediately before induction in the operation theatre environment. VAAS scores were similar before listening to the music, but differences between the Binaural Group and the Music group occurred after they listened to the audio and before operation, with significantly lower anxiety scores in the Binaural

Group.

Cognitive Effects

Some studies provide potential applications for cognitive functions using binaural beats. Factors such as memory, attention, and performance have been observed using binaural beat stimulation. Some methods seem more effective than others depending upon the wave frequency used. For instance, listening to theta wave-inducing beats has been shown to result in a significant decrease in immediate verbal memory recall (Wahbeh, Calabrese, Zwickey, & Zajdel, 2007) while using beta wave-inducing beats results in an increase in free recall memory (Kennerly, 1994).

A decrease in memory and attentional focus occurs in most aging seniors. Methods to enhance these factors have become a priority. Research has demonstrated that neurocognitive decline in seniors over 65 years is connected to deficits in alpha frequency brainwave activity. McMurray (2006) compared the effect of alpha tones on measures of neurocognitive function and brainwave activity in a sample of healthy, aging seniors. Using the Mini Mental State Examination (MMSE), forward and backward digit span memory tasks, Conners' Continuous Performance Test 3.0 (CPT), and EEG recording, McMurray found that participants in the binaural beat phase, compared to the non-binaural beat phase, exhibited significantly higher attentiveness levels on the CPT, higher memory functioning on the forward and backward digit span tasks with a greater improvement on the backward spans, and higher alpha frequency.

Kennerly (1994) found significant results between the control and experimental groups using the digit span and digit symbol that suggests an increased ability to pay attention to tasks at hand. The experimental group, who listened to music containing binaural beats during the tasks, showed significantly higher scores in both of the aforementioned WAIS-R subscales compared to the control group, who listened to music only. This study prompted further empirical research in using binaural beats to improve academic performance, especially among Attention Deficit Hyperactive Disorder (ADHD) populations.

Kennel, Taylor, Lyon, and Bourguignon (2010), tested binaural beats on children and adolescents

with ADHD in order to reduce symptoms of inattention. While listening to beats in the beta range, the participants completed the Children's Color Trails Test, the Colors Trails Test, and the Test of Variables of Attention, while the parents completed the Homework Problem Checklist. Although the only statistically significant effect they found regarding binaural beats was the effect of time on the Color Trails Test, most parents and adolescents reported that listening to the CDs was helpful in reducing inattention while completing homework assignments. This may have been due to the soothing background music, but there is evidence that children with ADHD have an overall increase in theta activity and a decrease in beta activity when compared to their peers (El-Sayed, Larsson, Persson, & Rydelius, 2002).

McMurray (2004) looked into specifically enhancing beta activity in individuals with ADHD. Her method involved five phases: phase one involved having the participants diagnosed with ADHD focus on a toy; in phase two, they listened to a CD containing no binaural beats; in phase three, they completed a modified version of the Conners' Continuous Performance Task 3.0 (CPT) while still listening to the CD; in phase four, they listened to a CD containing beta tones and music; and in phase five, they once again completed the CPT. During all five phases, the participants' EEG-activity was recorded. McMurray found beta frequency to be significantly higher during phase four than during phase two. Participants also exhibited a significantly higher attentiveness level during the binaural beat phase than during the non-binaural beat phase using the CPT. This particular study offers statistical evidence that binaural beats can have a positive effect on vigilance, memory, and other measures of attention.

Lane, Kasian, Owens, and Marsh (1998) actually compared the effects of two binaural beats instead of comparing binaural beat audio and empty audio. Participants completed a continuous performance vigilance task, once while listening to beta tones and second time while listening to theta/delta tones. A significantly larger number of targets were detected when listening to the beta tones than listening to the theta/delta tones. More false alarms were produced in the theta/delta exposure than in the beta condition. This study offers evidence of the different effects that binaural beats can have on vigilance task performance.

Mood Effects

The Profile of Mood States (POMS) is a relatively popular, very easy-to-administer questionnaire to use in testing the effects of binaural beats. Most studies find some sort of significant results in its use depending on the frequency of beats used. Using theta wave-inducing beats has shown an increase in the depression subscale (Wahbeh, Calabrese, Zwickey, & Zajdel, 2007). Combined theta and delta tones were observed to increase scores for the confusion/bewilderment, fatigue/inertia, and depression/dejection POMS subscales while scores for depression/dejection decreased while listening to beta tones (Lane, Kasian, Owens, & Marsh, 1998). Conflicting study, however, has found delta waves to have a decrease in total mood disturbance including decreases in the subscales of tension/anxiety, confusion, and fatigue with increases only in depression and vigor (Wahbeh, Calabrese, & Zwickey, 2007).

Physiological Effects

Aside from these psychological effects, binaural beats have also shown some evidence for physiological effects. Research for this phenomenon is fairly new so studies are scarce. What studies have been conducted, however, offer hope for further future research which one day may lead to a new line of audio treatment for simple physiological dysfunctions, or perhaps be geared toward more complex remedies.

For example, the use of delta wave-inducing tones has been observed to produce a decrease in dopamine and insulin-like growth factor-1 (IGF-1) (Wahbeh, Calabrese, & Zwickey, 2007). Dopamine reductions have been associated with anxiety improvements (Hamner & Diamond, 1996; Wahbeh, Calabrese, & Zwickey, 2007), and IGF-1 has been claimed to slow the aging process while listening to binaural beats due to a rise in the growth hormone (Clemmons, 2001). Wahbeh et al.'s observation of a decrease in IGF-1 while listening to binaural beats, however, is contrary to this slower aging claim.

Research has supported the use of binaural beats in alleviating physiological dysfunctions. In a study by David, Naftali, and Katz (2010), participants deemed appropriate for *Tinntrain*, a highly individualized, multi-factorial treatment for tinnitus, underwent binaural beat therapy. Using an alpha frequency, along with the self-selected background nature sounds and music and a male or female voice

for guided imagery for extra relaxation, participants were given the *Tinntrain* program to use at home for up to 6 hours a day for 3 months. A re-evaluation found a reduction in tinnitus disturbance all participants.

Previous studies have observed binaural beats' effects on anxiety and depression levels, memory, attention, and performance, mood, and physiology functions such as effects on certain neurological chemicals and decreases in bodily disturbances such as a ringing in the ears. This current study will use methods based on the research of McMurray (2004), Kennel et al. (2010), and McMurray (2006) and will examine mood, memory, and attention. Their studies use only aging and ADHD populations. The current study will observe a college undergraduate population with typical memory and attention functioning to test if binaural beats will have the same benefits as they do with populations with deficits in memory and attention.

Method

Participants

Participants were 20 undergraduate students from Concord University. They reported having no history of hearing of speech disorders and no history of attention deficit disorder/attention deficit hyperactivity disorder (ADD/ADHD).

Materials

Binaural Stimuli. Three audio files were created using relaxation music that included instrumental music with non-linguistic vocal sounds. For the Audio-only group, only the musical track was used. For the Beta Frequency group, two sound frequencies were overlaid onto the musical track, one at 430 Hz and one at 456 Hz. For the Theta Frequency group, the frequencies overlaid were 430 Hz and 435 Hz. The frequencies were mixed at a percentage of tones to audio that made them not immediately obvious to listeners.

Profile of Mood States – Bipolar. The Profile of Mood States is a psychological rating scale used to assess distinct, fluctuating mood states. The POMS – Bipolar (POMS-BI) version specifically determines an individual's status for therapy or can be used to compare mood profiles associated with

various personality disorders (Halloran, Murphy, Webster, 2002). In a nonclinical setting, it can assess mood changes produced by techniques such as psychotherapy or meditation. The POMS-BI consisted of six scales of mood categories: composed/anxious, agreeable/hostile, elated/depression, confident/unsure, energetic/tired, and clearheaded/confused. Participants were given 72 adjectives antonyms, with 12 adjectives in each category, and rated each one on a scale of 0-3 on how much they did or did not relate to the word at that moment.

Continuous Performance Task. The Continuous Performance Task (CPT) is a neuropsychological test that measures an individual's sustained and selective attention and impulsivity. Participants completed a single trial of this task. The trial consisted of 150 upper and lowercase letters which were presented on the screen one at a time for half a second each with one second pause between each letter. Participants were instructed to press the space key any time a lowercase 'x' appeared on the screen. Pressing the space key when a lowercase 'x' appeared was considered a hit and not doing so was considered a miss. If they pressed the space key when any other letter was on the screen, this was counted as a false alarm. If they did not respond to the other letters, this was counted as a correct rejection. Hit reaction time was also measured.

Word List Recall. Participants were given a working memory task for verbal short span memory. This type of memory is what allows individuals to remember what they hear or read long enough to use the information either right then or by transferring it to long-term memory. Participants completed three trials of this task. Each trial consisted of 10 words that flashed on the computer screen, one word at a time for one second with a one second pause in between each word. At the end of each trial, they completed three simple math problems as a distracter task before typing as many words as they could from the previous list.

Word List Recognition. Participants completed a task to measure the ability to recognize written words from short-term memory. Participants were given a list of 35 words and had 2 minutes to memorize as many words as they could from the list. Words were then presented on the screen one at a time, some words from the previous list and some novel words, and they had to indicate if the word was

old or new by pressing O or N keys on the keyboard.

Forward and Backward Digit Span. Digit span tasks are often used to measure short-term memory. The objective is to remember as many digits as possible. For the Forward Digit Span, participants were presented with a series of digits, beginning with three digits. The digits were presented one at a time on the screen for one second each with one second breaks in between each digit. Once all digits had been presented, they had to immediately recall them in the order they had been given. The length of the longest list of digits a participant remembered was recorded.

The Backward Digit Span is similar to the Forward Digit Span, except that instead of recalling the digits as they were given, participants recalled the digits in their reversed order. For instance, if they were given the numbers 7, 1, 2, they had to respond by entering 2, 1, 7 to get it correct. The length of the longest list of digits a participant remembered correctly in reverse was recorded.

Procedure

Participants were assigned to one of three groups: the Beta Frequency Group, the Theta Frequency Group, or the Audio-only Group. Participants began to listen to the audio assigned to their group and watched a fifteen minute slideshow of neutral images to hold their visual attention and prevent them from falling asleep. After the slideshow, while continuing to listen to the audio, they completed the series of tasks, beginning with the POMS – BI to measure their mood, then three trials of a continuous performance task (CPT) to measure attentiveness, and three word list recall, one word list recognition, and finally forward and backwards digit span tasks to measure their verbal and numeric short term memory.

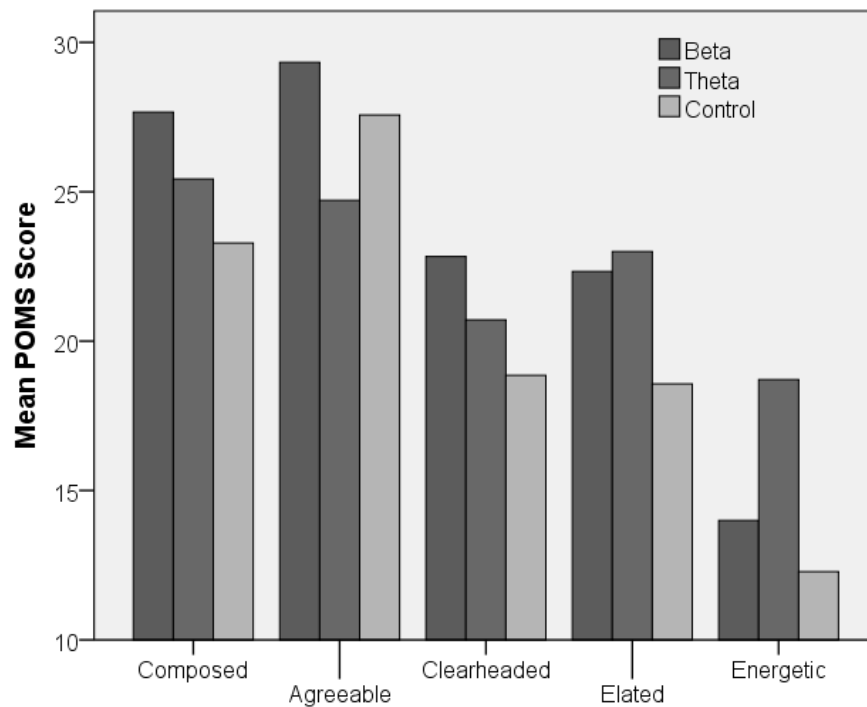
Results

Mood

The POMS-BI was used to measure participants' mood after watching the slideshow. Of the 72 adjectives, 39 were reverse-scored, meaning the typical scoring of 0-3 is reversed. If the participant answered with 0, the reversed score is 3. If they answered 1, the reversed score is 2, and so on. Seven of the 72 adjectives had combined scores, meaning the scores from two adjectives were summed together.

The remaining 26 adjectives were scored normally. Higher scores meant the participant agreed that they felt much like the describing adjective, and lower scores meant the participant agreed that they felt much unlike the describing adjective.

To analyze the POMS-BI data, six one-way analyses of variance (ANOVA) were performed with audio group as the dependent variable. The POMS categories showed no significant differences among groups (see Table 1 for ANOVA), but the patterns of non-significant differences were potentially interesting (see Table 2 for means and standard deviations). The Beta Group showed higher composure, agreeableness, and clear-headedness as compared to the Control Group and Theta Group.



Concentration

The CPT was used to measure participants' selective attention and impulsivity after the slideshow. Six factors were measured in the CPT. Hits were measured by how many times participants successfully pressed the space bar key when a lower case 'x' appeared on the screen. Misses were measured by how many times participants failed to press the space bar key when a lower case 'x' appeared on the screen. Correct rejections were measured by how many times participants succeeded to

not press the space bar key when any letter other than a lower case 'x' appeared on the screen. False alarms were measured by how many times participants pressed the space bar key any letter other than a lower case 'x' appeared on the screen. Reaction time was measured by how fast participants pressed the space bar key when a lower case 'x' appeared on the screen. d' is calculated as the relationship of hits to false alarms using the standard scores of each. Thus $d' = z(\text{hits}) - z(\text{false alarms})$. If the number was greater than 0, there were relatively more hits than false alarms. If the number was less than 0, there were relatively more false alarms than hits.

To analyze the CPT data, six one-way ANOVAs were performed with audio group as the independent variable (see Table 3 for ANOVA). For the CPT hits, misses, false alarms, correct rejections, and reaction time, there was no significant difference found among groups. However, the CPT d' , there was a trend of differences among groups, $F(2, 16) = 2.467, p = .116$. Because of the small number of subjects in each group, exploratory comparisons among groups were performed. These analyses come with an increased risk of Type I error, but they may provide interesting material for future research.

Contrast tests were performed for the CPT d' , comparing the Theta Group to the Beta Group, the Theta Group to the Control Group, and the Beta Group to the Control Group. For the Theta Group versus Beta group, there was no significant difference found among groups, $t(16) = 1.097, p = .145$, and for the Theta Group versus Control group, there was no significant difference found among groups, $t(16) = 1.218, p = .121$. However, for the Beta Group versus Control group, there was a significant difference found among groups, $t(16) = 2.209, p = .021$, with the Beta Group ($M = .8722, SD = .98455$) having a significantly higher d' score than the Control group ($M = .6179, SD = 1.165$).

Memory

The Word List Recall task was used to measure participants' verbal short-term memory after the slideshow. Higher scores meant the participant recalled more words, and lower scores meant the participant recalled fewer words. To analyze the Word List Recall data, a one-way ANOVA was performed with audio group as the independent variable. For the Word List Recall total words recalled

from all three trials, there was no significant difference found among groups, $F(2, 17) = 1.262, p = .308$.

The Word List Recognition task was used to measure participants' verbal short-term memory after the slideshow. Higher scores meant the participant recognized more words from the list, and lower scores meant the participant recognized fewer words from the list. To analyze the Word List Recognition data, two one-way ANOVAs were performed with audio group as the independent variable. For the Word List Recognition of old words, there was no significant difference found among groups, $F(2, 15) = .453, p = .644$. For the Word List Recognition of new words, there was no significant difference found among groups, $F(2, 15) = .567, p = .579$.

The Forward and Backward Digit Span task was used to measure participants' numeric short-term memory after the slideshow. Higher scores meant the participant recalled more numbers in their correct sequence, and lower scores meant the participant recalled fewer numbers in their correct sequence. To analyze the Digit Span data, four one-way ANOVAs were performed with audio group as the independent variable. For the Digit Span Forward Consecutive numbers recalled, there was no significant difference found among groups, $F(2, 17) = .592, p = .564$. For the Digit Span Backward numbers recalled, there was no significant difference found among groups, $F(2, 15) = 1.135, p = .348$.

Discussion

The first hypothesis about cognitive effects was that the Beta Group would perform better on the attention task than the Control Group and Theta Group, and the results seem to support this hypothesis. There was a significant difference found among groups in the CPT d' . Beta-wave inducing beats may lead to an increase in concentration abilities.

The other hypotheses were that the Beta Group would perform better on the memory tasks than the Control Group and Theta Group, which were not supported. There were no significant differences among groups found in the memory tasks. In fact, in the Word Recall task, participants who listened to beta wave-inducing beats recalled fewer words than other participants. This may suggest that listening to beta wave-inducing beats leads to a decrease in short term verbal memory.

It was also expected that the Beta Group would have higher scores in the Agreeable/Hostile and

Clearheaded/Confused POMS categories. There were no significant differences found among groups, but the results began to show trends which support previous findings. The Beta Group showed higher composure, agreeableness, and clear-headedness as compared to the Control Group and Theta Group which may reflect the previous literature in which beta wave-inducing beats have been correlated with concentration, paranoia, and hyperactivity (Jemmer, 2009).

These results support the results of McMurray's (2004) ADHD study in that beta wave-inducing beats increase levels of attentiveness. She concludes that binaural beats can have a positive effect on vigilance, memory, and other measures of attention. This can be due to the brainwaves aligning with the induced frequencies, thus resulting in the correlated, positive states.

These results do not support McMurray's (2006) study on memory deficits in senior citizen populations which found that binaural beats increase memory functioning. In that study, subjects served as their own control where each participant listened to audio both with and without binaural beats, but in the current study, a separate group served as the Control Group. McMurray (2006) also used alpha wave-inducing beats within her audio to increase memory functioning as opposed to the use of beta wave-inducing beats in the current study. Beta waves have been associated with paranoia and anxiousness while alpha waves are associated with relaxation. Memory may be impaired while in states of paranoia and anxiousness as opposed to being relaxed.

This study did not have a large number of participants, so increasing the sample size in the future could change most of the trends into more significant findings. Additionally, the music participants heard was non-linguistic vocal audio. This may have been distracting for the participants, so a use of non-vocal, perhaps classical, music may have given better results. I would have liked to use all four types of binaural beats, as opposed to just the two used here. Using all four types may have shown more significant differences among the groups in each task participants completed. Others might have had participants serve as their own control, first listening to audio-only and completing the tasks, then have them listen to music containing binaural beats and again complete the tasks. This may have showed greater individual change in mood, attention, and memory.

Future research should examine if beta wave-inducing beats are only helpful for individuals who are lacking typical memory and attention, such as the ADHD and senior populations. More research is needed to determine specific effects binaural beats have on the typical population. It would also be helpful to look outside of the college-aged population to compare results across age groups. The undergraduates used in my study may have been burdened with the stress of assignments and long class days, potentially affecting their attention and memory performance.

In conclusion, beta binaural beats have a generally positive effect on attention and a negative effect on memory. Binaural beats may also have an effect on mood. With more intensive research to support these results, binaural beats could be used in the typical population for those wishing to increase concentration, memory, and alleviate negative moods.

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Table 1. ANOVA for the POMS-BI

	<i>F</i>	<i>df</i>	<i>p</i>
Composed/Anxious	0.631	2, 17	0.544
Agreeable/Hostile	0.643	2, 17	0.538
Elated/Depressed	0.482	2, 17	0.626
Confident/Unsure	0.272	2, 17	0.765
Energetic/Tired	0.940	2, 17	0.41
Clearheaded/Confused	0.958	2, 17	0.403

Table 2. Means and Standard Deviations for the POMS-BI for each condition

	Beta Beats		Theta Beats		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Composed/Anxious	25.35	6.87	25.42	8.03	23.28	7.15
Agreeable/Hostile	27.10	7.30	24.71	10.79	27.57	5.59
Elated/Depressed	21.25	8.78	23.00	10.59	18.57	8.82
Confident/Unsure	22.05	6.50	23.14	6.14	20.57	7.32
Energetic/Tired	15.05	9.02	18.71	10.12	12.28	8.36
Clearheaded/Confused	22.70	5.15	20.71	3.86	18.85	5.55

Table 3. ANOVA for the Continuous Performance Task

	<i>F</i>	<i>df</i>	<i>p</i>
Hits	0.577	2, 16	0.573
Misses	0.577	2, 16	0.573
Correct Rejections	1.078	2, 16	0.364
False Alarms	1.078	2, 16	0.364
Hit Reaction Time	0.925	2, 15	0.418
<i>d'</i>	2.467	2, 16	0.116

Table 4. Means and Standard Deviations for the Continuous Performance Task

	Beta Beats		Theta Beats		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Hits	10.800	5.805	9.000	5.033	7.142	6.593
Misses	22.200	5.805	24.000	5.033	25.85	6.593
Correct Rejections	117.000	.000	116.714	.755	116.428	.786
False Alarms	.000	.000	.285	.755	.571	.786
Hit Reaction Time	105.102	25.751	84.843	42.888	81.058	22.657
<i>d'</i>	.872	.984	.132	1.239	.617	1.165

The Perception of Beauty

Rachel Wyrick

Mentor: Mr. Jack Sheffler

“I am warned by the ill fate of many philosophers not to attempt a definition of beauty”(qtd. In
Armstrong and Bedell, 306)

Beauty is a word that has been debated and aroused interest of many people, from philosophers to artists to scholars. Beauty is something enticing and pleasurable, yet difficult to define because it varies within time and culture. Many have attempted to decipher the riddled code that is beauty and have their own theories of what qualifies as beauty. The pursuit of beauty is part of the human condition. What is beauty? What determines what we judge as beautiful? Some of the greatest minds have raised these questions, such as Plato who attributed beauty to love. Ruth Holliday and Jacqueline Sanchez Taylor discuss the history of beauty and state that Plato was one of the first original and analytical theorists of beauty. His idea of beauty is reflected in his use of the word *callos* meaning “beauty as it is experienced through the five senses and to denote that which is morally noble”(180). Plato's perception linked moral goodness and physical beauty. Aristotle was more concerned with function and form meeting the delicate balance that is aesthetically pleasing, yet is designed so that it can perform its goal well(Humm). Others believe beauty to be a numeric expression, bi-product of sexual selection, emotion, harmony of all parts, wholeness, and outer reflections of inner qualities. One thing remains the same; beauty is a human experience that has encouraged and shaped the form and content of man.

“The interplay of beauty, reproduction and evolution can be viewed as a grand cosmic dance”(Burke, 75)

Evolution is about sex, or more specifically reproduction. Reproduction is survival, it is the continuance of the human race. What aids in survival or improvement of life, tends to be perceived as beautiful because it is ingrained as something helpful and necessary. In evolution, function always proceeds form(numeric expression ,Atiyeh and Hayek) therefore what is favorable will survive. We always seek out what is beneficial (health), especially in a mate. In Descent of Man and Selection With Relation to Sex Darwin expresses that the plumage of a peacock was not a survival advantage but a reproductive advantage(140). The elaborate colors and designs are a sign of health not only because

“beauty is a physiologic burden that only a strong body can support”(Alam and Dover 796), but the pathogen-resistance theory of beauty states that beauty is a signal for a mate that is pathogen-free(Mitton, 479). Size and shape, Bilateral symmetry, and clear skin are main indicators of a human free of acquired or hereditary disease(Alam and Dover, 796) . Beauty is a physical indicator of good genes or health and evolution pivots around selecting the correct mate to ensure not only your genes, but the most advantageous genes fit for survival.

Leading research indicates that beauty perceptions are but biological bi products of evolution at work. That there is a beauty standard not influenced by society or media but holds true in any culture. A study done interviewing 10,000 people of 37 cultures indigenous to 6 different continents suggested similar attributes are universally deemed physically attractive (on beauty Alam, Dover; 797). Society may influence beauty standards but certainly did not create them. The ground breaking evidence of this innate sense of beauty was indicated through studies that used infants to determine visual preferences between individuals. In the experiment, Langois et al. presented pictures of people that were previously rated on attractiveness, ranging in age, gender, and culture, to two sets of infants grouped by age. One group being 2-3 months old and the other 6-8 months old. They were presented with two photos at a time, one that was rated more attractive always paired with one that was rated less attractive. The children looked at the attractive person's photo significantly longer in an overwhelming amount of instances. This indicated that there is an underlining biological preference that is not arbitrary and determined by nurture but rather a natural guideline that dictates beauty(23, 363-369).

Babies themselves are proof of morphology influencing health and survival. The irresistible cuteness that every person who has laid eyes on a child has experienced, is impossible to deny. The need to cradle and coo over them is no accident. They trigger a care response which is a major advantage to them in their vulnerable state. Their brains and nervous systems develop almost fully in the womb, however their tiny limbs and features need more time and care to develop independancy.

They need protection and these small features illicit tender feelings which form a connection and instinct to ensure that protection(Wolf 32; Fink and Neave 317; Duuren et al. 212; Honn and Goz, 7). The same concept applies to other animals as well. The cuteness produces caring feelings and deters predators from harming them. Nancy Etcoff author of Survival of the Prettiest, discusses how infants are relevant in research of the evolution of beauty when she says, “Babies teach us that responses to physical beauty are automatic, and irresistible, that they start early and run deep”(39). Babies have miniature hands and feet, round faces, big eyes, soft hair and skin, and tiny delicate noses and chins which not only guarantee their survival but are aesthetically pleasing, especially in adult females.

Sexual maturity is the time when males and females start to differentiate. Their secondary sex hormones kick in and their similar boxy figures begin to change and develop into the familiar and distinctive figures we know as male and female. Men start to gain muscle mass, their voices drop to a deeper tone, their skin darkens, facial hair and pubic hair thickens and darkens, and they lose fat from their faces creating more dominant and masculine features. Girls store fat in the hips and breasts (preparing them for the ability to rear children), pubic hair thickens and darkens, their skin lightens, and lips plump(Wolf, 57). All of the changes aid in security of the human race by attracting mates (the best possible) to be able to reproduce and ensure that not only will our genes pass on, but that the offspring have the best chance of mating and reproducing as well.

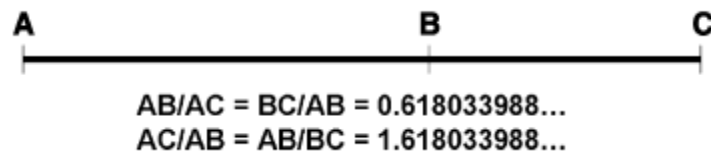
Males and females are biologically different. They think, perceive, and react, differently. What they want in a mate directly corresponds to this physical and psychological difference(Alkon, 57). They desire different things. Males are primarily focused on good genes (and therefore physical looks) because they want to ensure the survival of their offspring, whereas women are more concerned with his ability to protect and provide. Both men and women are concerned with looks especially in short term relationships, but men want more short term or casual partners than women therefore, physical attributes are more important to them(Wolf, 63). The male wants to spread his seed and establish his

genes in a future generation. What happens after procreation is of some concern, but not as much as for women. The female is put in a position that leaves them vulnerable and desperate for someone to defend and support them and their child. This indicates that while mate selection focuses on good genes, a female considers dependability and strength of the utmost concern because if the mother is not properly protected then both her and the offspring may fail in passing on their genes. This sets up not only the difference in preferences in men and women but the way they think about mating in general which influences their entire personalities. These ingrained perceptions are reflected in the personalities of modern men and women. It explains the dichotomy between how men and women think. Women tend to look for long term relationships. They tend to be more clingy, romantic, and emotionally attached. Men tend to look for short term and physical relationships, are less committed, and care more about physical appearance.

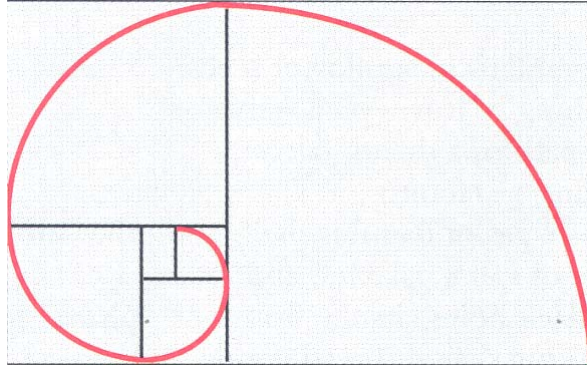
Most studies agree that standards of beauty revolve around youth and symmetry. Many facial features that men find desirable in women indicate youth. Men prefer smooth skin, large wide-set eyes, prominent cheekbones, thin eyebrows, small chin and nose, and full lips (Alam 796; Hönn 13) which are all characteristics of infants. The thin eyebrows open the eyes, making them seem bigger and therefore more child-like. A small nose and chin and full lips are more proportionate to a child's face. However, body preferences are not childlike but indicate sexual maturity. A hour glass figure informs the observer that the woman is able to bear children. Youth is desired because it is the time when one is most healthy and fertile, which makes one a good candidate to pass on the male genes. With youth comes the increased chance that the woman is not already pregnant, which is a desired trait. The nulliparous state was rare in females because once they reach sexual maturity, they find a mate and produce as many offspring as possible. They remain continuously pregnant or breast feeding and therefore the majority of their life they are infertile. The best way to assure that a female is fertile is to seek a mate that is young. According to Donald Symons, males want to be the father of all of the female's children. He wants to

pass on his genes as much as possible, which means continuously impregnating her all of her fertile years(Etcoff, 72). All of these preferred features aid in reproductive success, therefore they have withstood time.

Symmetry is another trait proven to be pleasing and beneficial. Symmetry signals health and the genetic quality through the ability to withstand “environmental and genetic stresses”(Rhodes, 659). The human fetus develops bilaterally. Any mistakes in DNA or genetic makeup interrupt this development manifesting itself in subtle to extreme disruptions in symmetry depending on the severity. Facial asymmetries can be characteristics of disease(Rhodes, 659), as earlier stated with the pathogen resistance theory of beauty. Consequently, symmetry is a good indicator of genetic health and lack of abnormalities and disease. Rhodes et al. Conducted a study in which pictures of subjects faces were modified to be perfectly symmetrical in respect to their vertical axis's. The pictures were then rated, and the perfectly symmetrical faces were found to be more attractive(Hönn, 11). Symmetry is a bi product of sexual selection because it signals good mate quality. The instinctive (and still present) appeal of symmetry and youth in a mate establishes desired and beneficial genes and weeds out the defective genes that will not aid in the survival of man. Beauty, in terms of how it our perceptions have evolved, is



really just an indicator of good health and therefore good genes which seeks to better our species.



“The fairest thing we can experience is the mysterious. It is the fundamental emotion which stands at the cradle of true art and science. He who knows it not and can no longer wonder, no longer feel amazement, is as good as dead, a snuffed-out candle”(qtd in Livio Golden Number).

The golden ratio (golden number, golden section, divine section) or phi, as named after the Greek sculptor Phidias, is a numeric relationship that appears throughout nature. It represents the ratio that would occur if a line was divided into two parts in such a way that the smaller section is to the larger section as the larger section is to the whole or 1.618;1(Atiyeh, 209). It is thought to be the ratio that is most aesthetically pleasing to the human eye. It dictates ideal proportions in many things including the human body and especially the human face.

Measuring proportion seems to go back as long as the ancient Egyptians. It is thought that they used similar proportions in their architecture and were aware of its pleasure. They then inspired the Greeks and Romans, who were interested in these ideal proportions for their idealistic sculptures. The golden ratio was first recorded by the Greeks and Pythagoreans(Atiyeh, 212). After being recorded, it was thought mainly to be the ratio that artists used for ideal proportions and did not seem particularly interesting until it started showing up in numerous natural phenomena and geometric propositions. It was found in the arrangement of sunflower seeds, the spiral of seashells, leaf arrangement, the human mandible and its growth rate, the spiral of DNA, some black holes, and spiral galaxies(Livi,o Golden Number; Atiyeh, 213). It suddenly became an interesting and very mysterious number. Not only is it an

irrational number but it is said to be “mathematically the most irrational number”(Livi, o Golden Number). It is the only number that creates its own reciprocal when subtracted by units(Atiyeh 213).

The golden ratio gave way to the golden rectangle that is formed by the length to the width being proportionate to phi or the golden ratio. When a square is cut off of the golden rectangle, curiously enough, it leaves a rectangle of the same proportions and this can continue leaving smaller and smaller golden rectangles. It is the only rectangle that repeats the proportion in this manner. Connecting the points of the successive squares being cut off results in the logarithmic spiral as seen throughout nature.

Today, this ratio is used in a magnitude of things and proves reliable for ideal proportions of the human body. The proportion, symmetry, and spacing of features can be measured to show relations to the golden ratio. Using phi, one can determine numeric relationships in the face and body that are pleasing and use that as a cannon for detecting a aesthetically pleasing face or body. “Beautiful faces, for example, have ideal facial proportions directly related to the divine proportion found the width of the mouth to be phi times the nasal width. When the width of the mouth is 1, the distance between the outer corners of the eyes is phi. The width of the head at the temples, again, is phi times the distance between the outer corners of the eyes. Vertically, the height of the forehead from hairline to eye pupils is 1, where the height of the face from pupils to chin is phi”(Atiyeh, 213). This ratio is yet another expression of beauty and shows that through evolution, nature set up certain guidelines that are instinctively pleasing to the eye and mind.

“There are no homely women, only careless ones(Estee Lauder qtd. in Rosen, 37)

Beauty, in a more social sense, started out as something rare. It was confined within the tribe, where there may be a few women considered beautiful but extreme beauty was scarce and seldom seen. The lack of extreme beauty made it precious, important, and desired because it was so unusual. However, as civilization grew and developed, so did our ability to replicate (or create) this beauty for all

to see. Suddenly, that rare beauty became more common because the technology allowed man to sculpt and paint and recreate this vision, making it a frequent sight. Once the pictures of beauty became popular, so did the ideal form. Men started to not only seek out but expect beauty and women started imitating and pursuing beauty. It was the beginning of the beauty obsession. Beauty was no longer confined to the tribe, but was now seen throughout this early art, setting up the idealistic standard that was perfected by the artist. Beauty or this ideal beauty was still an attainable goal but as our civilizations and societies grew, giving way to the media, this ideal became less and less attainable.

The media is largely responsible for the exact standard of beauty as well as the obsession with beauty. They are the “universal yardstick”(Atiyeh, 209) to which we measure beauty. The media dictates what is perceived to be attractive through its influence. It has always pushed ideas onto the viewer in order to make them a consumer. However, the beauty industry really made a leap after World War Two with magazines. At a time when women were encouraged to leave behind their new found freedom of being a part of the workforce, and return to their household duties, these magazine took advantage of the bored housewife. The ads in magazines started off selling household products to appeal to the housewives. Upon realizing the success and the dependability of these women as customers, they then shifted their focus from household products to an ever grossing product: beauty. They started off like any ad; trying to persuade the viewer to purchase the product, however competition lead them extremes.

With the plethora of messages and advertisements that people were bombarded with on a daily basis, the images of beauty became more extreme to shock and amaze so that they were more memorable(Wolf, 66-79). New Technology allowed them to push the limits and perfect the images seen in advertisements. They took an extreme beauty (which even though is rare, has already become the standard because of it is familiarity) and airbrushed and Photoshopped them to a new and unachievable beauty. This set up a more exaggerated and irrational ideal of beauty which was now seen daily. The

proportions and ideal beauty now virtually unattainable for real women. However, these advertisements still leave people to believe that with their product these standards are possible while in reality, they keep the standards out of reach so that the consumer is continuously buying these products in hopes of reaching that goal.

This once again, changed the expectations that men had of women and that women had of themselves. The advertisements in other words, set up the consumer to fail. The goal is not feasible and must tell the person that they are not good enough in order to sell their products. It is a business that relies on self-hatred. The beauty industry depends on making people feel inadequate so that they have to buy their product to feel beautiful and become socially acceptable. This concept breeds psychological, physical, and sexual shame and leads to obsession of artificial beauty and one's failure to meet its criteria.

“Beauty is not the note of our great men.”(Woolf, 29)

Although the perception of beauty is based on innate and/or subconscious thoughts, throughout time our minds have evolved to think critically. Our lives are not solely based on what is evolutionarily beneficial but based on calculated choice. We now have the ability of higher thought, which not only separates us from other animals but allows us to reason and think abstractly. Our species has been able to make decisions that we feel aid us long-term that go against impulses such as monogamy, assisted reproduction, contraceptives, gay marriage, and voluntary childlessness. We can train ourselves to see the beauty in things that are not just beneficial or ingrained but moving(Etcoff, 233-245). This intelligence now plays a pivotal role in beauty. With advances in thought and technology we do not need physical markers of genetic quality and as intelligent beings seek more than just unusual beauty or good genes. We have the ability to observe beauty as a culmination of multiple influences not just their genetic make-up or grooming habits. Beauty can now be something more than physical beauty.

Society has lead us to believe that the physical aspect is most important and is what matters because it is profitable. Industries are the backbone of this thought and encourage the obsession with purely physical attributes because it increases sales. People have been influenced by this beauty scam because of the way that our society treats its desirable looking people. Success is determined by one's physical appearance. Beauty is unconsciously widely accepted for other positive attributes which stems from Plato's thought of what is beautiful is good. "Beautiful people are considered friendlier, more intelligent, more interesting, and more socially competent"(Hönn, 7). Studies have found that above average looking workers earn 10-15% more(Mobius and Rosenblat, 222), they are more likely to be excused for misbehavior, their work is evaluated better, they elicit positive personality attributions, and receive special treatment(Rhodes 218). We judge people and their character by these physical standards that in reality have no correlation because those other characteristics have no physical markers. We have allowed society to demean beauty with very strict narrow-minded guidelines. Our intelligence enables us to see the beauty in things that we, above all, appreciate. Beauty is our ability of higher thought which should be valued, not only physical attributes but all attributes viewed collectively making up an interesting and beautiful balance.

Interpreting

Through my research I rediscovered a movement that I felt paralleled not only my own thoughts and tendencies as an artist, but my area of research: Art Nouveau. Its sweeping circular and undulating lines were enticing and entrancing. The designs perfectly balanced although asymmetrical. The figures soft and alluring. They really accentuated the human forms as opposed to exploiting them. The vines and flowers wrapping around, actually accenting and exuding its form. I found them comforting. However, more than anything, they are beautiful and that is my over riding theme.

Art Nouveau (French for "new art") is a international movement. Unlike other movements, it originated in many different countries at approximately the same time frame. It Dominated European

design. Art Nouveau is a style that has many roots from the Pre-Raphaelites movement to the Arts and Crafts movement, Gothic Revival to Celtic revival, Oriental-ism to Symbolism(Madsen,12). The french claim to be the actual origin of Art Nouveau because of the artist Viollet-le-Duc who thrived in the 1860's, however much of his decorative art was common with the church at the time. America produced the most Art Nouveau pieces than any other country, however most was destroyed(more than any other movement proportionally).France was the epicenter of the movement because of their belief to be the start and the opening of L'Art Nouveau in 1895, which was named after a term coined by Octave Maus in 1881(Johnson, 630-36).

American skyscraper architect Louis Sullivan was a strong frontrunner for Art Nouveau in 1880. He was a product of the Arts and Crafts movement, particularly the the decorative style of William Morris. He insisted that "Form follows function"(Johnson,632) meaning that the way that an object appears should be indicative and complimentary of its function. Charles Rennie Mackintosh, one of the greatest artists of the Arts and Crafts movement, was a major leader of Art Nouveau which proves that the Arts and crafts movement was the basis or start of Art Nouveau. It was about the desire to soften the advance of machinery by embellishing with organic forms often from nature. Art Nouveau is very much about the immense range of materials and wide category of functional and practical work. It brought art of high quality into homes, much like the Arts and Crafts movement.

The work of the Art Nouveau movement ranges wildly. Because of this, many of the Predominant artists of the Art Nouveau movement were masters of many different materials and processes. Henry van de Velde was one of the first to express the Art Nouveau style in nearly all decorative designs. Anything was fair game. Pottery, Textiles, metalwork, posters, furniture, and labels. From the Paris railway entry of Hector Guimard to the glass work of Louis Comfort Tiffany, the architecture in Barcelona of Antonio Gaudi to the paintings and illustrations of Gustoff Klimt. Victor Horta, a Belgian architect, who is known for introducing Art Nouveau through architecture.

Other influential artists of the movement include Aubrey Beardsley, a child prodigy raised in Brighton, who worked primarily in black and white and introduced the tall lanky female figures not unlike his own. He along with Henri de Toulouse-Lautrec, made some of the most well known and original posters and some of the first artistically inclined graphic design of the movement. He along with Henri de Toulouse-Lautrec, made some of the most well known and original posters and some of the first artistically inclined graphic design of the movement, which has greatly influenced not only my work, but my view of graphic design.

Material

As stated above, the Art Nouveau movement emphasizes the content through the form. No matter what the material, it is molded and shaped into an organic expression of the function of the object. The soft and organic shapes are not to reject the modern world and advancements but to envelope them in a traditional world of art.

My interest in a multitude of media is shared with the artists of this movement. I enjoy working with many different materials and have spent the majority of my time testing and working through problems with materials. I have always enjoyed expressing myself in any medium I have tried. I fall in love with every process. They are all unique and have their own qualities that are at times useful and at other times irritating.

I really enjoy the act of methodically drawing something or tracing out a pattern. There is something almost meditative and calming about it. It keeps your hands busy and allows your mind to wander. I started by hand drawing and sketching compositions and ideas but quickly learned how technology can quicken a testing process and therefore switched to digitally drawing through Adobe Illustrator and Photoshop. However, if I want a loose or hand-drawn quality I will scan drawing in or use a tablet to transfer that quality.

The advantage of the digital altering, other than the previously mentioned, is the ease at which you can alter it. Printing it is almost as versatile as digitally editing it. The paper type, weight, and color all affect the final presentation. The ability to make multiples and many variations adds to the diversity of materials, not to mention all of the different materials one can print on. The first piece “Euphoria” was printed on everything from old weathered brown card stock to layers of vellum strategically stacked so that with the right lighting, all aspects were visible. That began the usage of light as a material. The lighting was in my mind, and all materials thought of or in development later were believed to accent the light.

I then incorporated the idea of clay. I attempted recipes for slip casting vintage bottles to serve as a canvas for my graphically inspired designs. The idea was for the light to shine through the translucent porcelain displaying my designs as decals on the front. However, due to problems with slip calculations, I have begun casting in aluminum while research continues. Ideally, the aluminum will provide a beautiful juxtaposition of machine and nature just as the Art Nouveau pieces did.

Pattern

I have always been fascinated with the elegant patterns of fabrics and wallpapers. Its symmetry and proportions are pleasing to the eye, much like my research indicates. They have a similar effect as the meticulous drawing as I described before. I like to think of them as equally rewarding for the artist who made it. They are a way to lose yourself in thought. They are appealing, beautiful, and comforting. They are an escape from the realistic and one of the first ways to work abstractly.

I use many different patterns in my work. I overlay, stamp, and create patterns. They are usually like layers of lace as part of the composition. They are feminine and everything natural and organic.

They are interesting because at the very least, they distract the viewer. They don't have to necessarily feel what the artist was feeling or what the artist intended to portray. Patterns are decorative and functional. They are, on their own, beautiful and elaborate. They really reveal much

about the generation or society at the time it was created. They have personality and reflect every bit as much as a photo. They are stories repeating themselves as history does.

Figures

Art Nouveau pieces utilized the influence of symbolism. The decorative designs were just as beautiful as they were informative. The popular symbols were obviously related to nature and were not unusual for the times.

The human female form was quite often recognized in many of the movements pieces, especially the early graphic design. The body types used were derived from the classical bodies of the Pre-Raphaelites. The figures were often very soft and womanly. Reminiscent of mother nature as another nod to nature. They were sensual with half lidded eyes, pouty lips, narrow shoulders, and wider hips.

I very much appreciate the form that was commonly used , mostly because of its apparent absence from my generation. It was an elegant and sophisticated form. It expressed the sensuality of women without disgracing the form. It utilized the characteristics of the female form without hiding, altering, or exploiting it. It puts women and their roles on a pedestal, honestly enjoying the form aesthetically.

I really wanted the same effect. I felt that this was what modern portrayals lack. And because of this, I used old vintage stock photos to portray my figures. I searched for more variety, other than the very European look, but was limited. I wanted the body to caress the composition as the plants caress the forms. The erotic nature of humans as expressed through women as a crucial part. The figures are just another way of masking my ideas in beauty to attract the viewer and they unveil themselves in layers that quietly wash over, just as other works of the movement.

Individual pieces

“Euphoria” was the first piece I created. It is a very asymmetrical design which is in character of the movement because, through its composition, it is harmonious and balanced as is true to the movement. The photo of the figure that I found inspired the piece. I was searching for the body type that would emote the ideas I was trying to display as well as a less guarded and demur attitude.

The figure seen in the piece is seated, nude, on a sculptural pedestal. She is smiling, looking slightly up to the left, arm raised as if receiving something. The comfort and ease of the figure is alluring and sensual. She appears to be open and receptive; welcoming. And possibly most importantly, not just content, but happy.

Behind the figure, a series of common decorative cutouts have been made to a wall of morning glory flowers (Convolvulaceae family). I chose this particular flower because of its silent strength. Morning glories are common to many flower beds and are known for their many colors and climbing vines. However, they contain a hallucinogenic compound called LSA, lysergic acid amide(similar to LSD but less potent). It contains a euphoric chemical in it’s inconspicuous flowers.

I have always been interested in unique or interesting plants, ones that are as complex as humans. The plants that practically have emotion, or give emotion. I pull from the traditional use of plants and use them as my symbols. The more you know about the plants the more you can read into the piece. Knowledge is key, just as it was for me.

The next piece I completed was “Belladonna”. I was inspired by the plant this time, which I had come to learn was a seductive and harmful plant. Atropa Belladonna was used by women in Renaissance times as a beauty product. They would apply it to their temples and underneath the eyes to dilate their pupils, making them bigger and therefore making their eyes seem big and sparkly, an effect considered attractive. The effects of the plant are also harmful, causing visual distortions, inability to focus on near objects, and increased heart rate, yet was still used for a extended amount of time.

This piece commentates on the extremes that are sought and used to obtain that impossible goal of beauty or perfection. The figure is a portrait of a solemn looking woman. She seems almost vacant, or unsure. I altered her pupils, making them large and shiny as they would be if she were dosed with the plant. The design is fairly symmetrical and therefore almost static, at a standstill, or stuck. All the colors are faded, worn. Every intention is to make the viewer have what the woman portrayed does not; awareness, clarity, knowledge.

“Ivy” was the piece that nodded to the origins of my dangerous plant fascination. In the work, the soft nude female form appears to be casually standing or leaning in a frame wrapped with poison ivy. The frame is a drastic vertical frame that mimics the form of a body in width and proportion. It is very decorative, but abstractly so. Only really blobs of color insinuating detail, as if almost out of focus.

The figure reaches up, displaying the red rash down her arm, on her hands, hips and feet that I digitally created on her. This is where the poison ivy normally leaves its angry marks on my own body, which is there more than not. I am very sensitive to urushiol, the chemical compound that reacts as a deterrent against herbivory. The fascination crept into my mind when I made functional ceramic pieces that had the poison ivy and oak plants etched on their surface, forcing you to touch the plant. Again I played with knowledge, if you knew the plant by sight, you got the joke. I was forcing everyone else to touch this beautiful swirling plant that seemed at the time to be the bane of my existence. However, I realized that this was actually a remarkable accomplishment for a stationary thing that people barely think of as living. Its defense mechanism was amazingly strong and vindictive. For something so small and delicate, it was not passive. It can protect itself, even from far more complex beings. So began the juxtaposition of their beauty and strength as well as the comparison of these qualities to those of human beings, women in particular.

“California Poppy” was completely inspired by the stock photo I found. I fell in love with the woman who was obviously taking life by the horns, living life, and simply enjoying herself without restraint. She is carefree and rebellious, sprawled out on this table with her skirt thrown back and record player behind her. She is enveloped in the music, in my mind it is what is delivering her to such bliss or euphoria. It is a drug, just like the two opium plants placed beneath her. It automatically reminded me of my mother and I decided to make this an homage to her.

The poster is filled with text and decorative designs that are custom of the movement but also create a type of beautiful chaos. The white oleander plants behind the figure represent that beautiful but deadly quality that is represented in most of my works.. The opium plant was chosen because my mother struggled her entire life with drug addiction. The plant is not being glorified, but used as a comparison because my mother was one of those alluring yet dangerous women, just like opium. It can be just as destructive as it can be helpful. A small fragile beautiful plant that can destroy. Euphoria and danger, that was my mother.

This piece really represents the difference between passion and obsession. Anything can be a drug and anyone can be drawn into it. My mother had several, I have one. That is why I created this work and why I am writing about it today.

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