Ashley R. Wilson, MALLEABLE VIEW OF INTELLIGENCE AS INTERVENTION FOR STEREOTYPE THREAT: OVERCOMING MATH UNDERPERFORMANCE IN WOMEN (Under the direction of Dr. Marion Eppler) Department of Psychology, December 2009.

When challenging math tests are described as diagnostic measures of ability or when gender differences are salient, stereotype threat causes women to underperform compared to men.

In her theory of achievement motivation, Dweck asserts that implicit theories of intelligence affect responses to challenge. People who view intelligence as fixed believe they are born with an amount of intelligence that cannot change, whereas those who view intelligence as malleable believe it can increase. Encouraging students to adopt a malleable view enhances performance, but can this intervention override the negative effects of stereotype threat for women performing math tasks?

A 2 (stereotype threat vs. gender fair) x 2 (fixed vs. malleable view) ANOVA compared women's performance on math tasks. Implicit theory of intelligence was manipulated by reading an article about intelligence. In the stereotype-threat condition, threat was heightened while the gender-fair condition minimized threat.

No significant main effects or interactions were present, suggesting no differences in math performance across experimental groups. The implications of this and the potential reasons for it are discussed.

MALLEABLE VIEW OF INTELLIGENCE AS INTERVENTION FOR STEREOTYPE THREAT: OVERCOMING MATH UNDERPERFORMANCE IN WOMEN

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CHAPTER 1: INTRODUCTION

During a 2005 speech, Lawrence Summers, the then president of Harvard University, spoke of discrepancies between men and women in science, technology, and other math-related fields (Halpern et al., 2007). He suggested men outnumber women in these fields because men have an innate ability to succeed in areas that require advanced levels of mathematical ability. This statement sparked a debate about the causes of sex-related differences in math achievement.

Sex Differences in Math Achievement

In 2007, the editors of *Psychological Science in the Public Interest* published an article as a direct response to the ongoing debate sparked by Lawrence Summers (Halpern et al., 2007). The authors examined various factors that could contribute to sex differences in math achievement. They concluded that early experience, biological factors, educational policy, and cultural context all have an impact on the number of men and women who engage in advanced areas of math and science.

As one example of cultural context, the researchers cited evidence that stereotype threat plays a role in sex differences in math achievement. By making an existing stereotype about a group salient, such as men outperforming women in math, self-doubt and other underlying processes can undermine the performance of that group. Stereotype threat could have negative impacts on

women's math performance in actual test settings, thus contributing to gender disparities in math performance.

In fact, stereotype threat not only causes differences in math performance but also influences women to avoid math and to pursue a domain in which they are immune to stereotype threat, such as reading and writing. Davies, Spencer, Quinn, and Gerhardstein (2002, study 2) exposed participants to gender-stereotypical commercials that portrayed women being overly concerned and excited about trivial aspects of life, such as celebrating a new acne medication by jumping on the bed, or to neutral commercials that depicted no humans. Participants were then asked to help develop a new standardized test which consisted of math and verbal problems. In actuality, the researchers were assessing participants' preferences for type of problem in addition to performance.

Regardless of which commercial condition men were in, they attempted more math problems in comparison to verbal problems (Davies et al., 2002, study 2). Women in the neutral commercial condition also attempted more math problems in comparison to verbal problems. In contrast, women who viewed gender-stereotypical commercials attempted significantly more verbal problems than math problems. Women in the neutral commercial condition also performed better on the math problems than the verbal problems; however, women who viewed the gender-stereotypical commercials performed better on the verbal problems. Women who viewed the gender-stereotypical commercials also

underperformed on the math problems in comparison to women who viewed the neutral commercials. These findings suggest that stereotype threat not only undermines women's math performance, but also can lead women to avoid math. By avoiding math, women do not risk personally confirming a negative stereotype about their group. By simply exposing women to a gender-stereotypical set of commercials, women chose to avoid math problems and favored verbal problems. These findings implicate stereotype threat as a factor in sex-related differences in math achievement.

Another factor related to cultural context is the influence of peer relationships and school interactions on math achievement (Halpern et al., 2007). Peer relations and school interactions help shape attributions about ability, academic performance, and self-efficacy beliefs. These attributions directly relate to Dweck's implicit theories of intelligence (Dweck, 1986, 2002). Individuals either view their own intelligence as a malleable or fixed quality and the differing views lead to differences in motivational goals, behavior, and performance. These implicit theories of intelligence are cultivated by interactions with parents, other students, and teachers' feedback in the classroom, which may help explain differences between men and women's math achievement. For example, teachers give different feedback to boys and girls that tends to orient girls towards a more fixed view of intelligence (Dweck, Davidson, Nelson, & Enna, 1978).

Although Halpern et al. (2007) outlined numerous possible reasons for the disparity between men and women in math-related domains, they did not address possible interactions between stereotype threat and implicit theories of intelligence. The purpose of the current study is to combine these two areas of research by using an intervention that manipulates women's general views of their own intelligence while under stereotype threat.

Effects of Stereotype Threat on Academic Performance

Stereotype threat occurs when individuals are in a situation in which they could validate a negative stereotype pertaining to the group to which they belong (Steele, 1997; Steele & Aronson, 1995). Stereotype threat can be viewed as a self-evaluative threat, meaning that individuals' actions could be judged and possibly self-fulfill negative stereotypes about their group. For individuals to experience stereotype threat they do not need to believe in the actual stereotype, only know that it exists and they are in a situation where the stereotype could become relevant. Some examples of social groups that face stereotype threat are women in math, African Americans in assessments of intelligence, and the elderly in memory tasks.

According to Steele (Steele, 1997; Steele & Aronson, 1995), the prevalence of stereotypes in society increases the likelihood for certain individuals to feel that not only is the stereotype true of them, but other people will also see them in that stereotypical way. Susceptibility to stereotype threat comes from identifying with a particular domain, such as math, and the ensuing

concern about fulfilling the negative stereotype it regards, such as men are better than women at math. Stereotype threat causes feelings of inadequacy, self-doubt, low expectations, and anxiety. When stereotype threats pertaining to academic domains occur, decreases in intellectual performance are seen. Steele states that this underperformance occurs because being in the stereotype-threat situation redirects attention. Instead of focusing on performing the current task to their full ability, focus is directed towards being concerned with their performance validating a negative stereotype about their group. Being in a continual stereotype-threatening situation can cause individuals to engage in disidentification. Disidentification occurs when individuals stop evaluating themselves in relation to the stereotype domain by removing this domain from their identity. This is a self-protection process which can be harmful when dealing with domains such as intellect and academics.

Recent research proposes that standard measures of performance are biased against minorities in academic domains and women in mathematical domains because of the situation in which they are assessed. Current research suggests these students are experiencing stereotype threat because of the testing situation which leads to their underperformance. A meta-analysis conducted by Walton and Spencer (2009) examined the relationship between stereotype-threat conditions and stereotyped and non-stereotyped students. Included in the meta-analysis were studies that manipulated the presence (stereotype-threat conditions) or absence of stereotype threat (safe condition).

The researchers then assessed the performance between the stereotyped and non-stereotyped students on the relevant measures; for example, women who took a math test or African Americans who were measured on academic performance. The researchers found that stereotyped students who were tested under safe conditions outperformed non-stereotyped students in safe conditions. As expected, stereotyped students in the stereotype-threat conditions performed the worst. These results suggest that minorities and women are not lacking ability in certain areas, but the situations in which they are tested are activating relevant stereotypes and leading to their underperformance.

Spencer, Steele, and Quinn (1999) investigated conditions and instructions that produce stereotype-threat effects. In the first study, the researchers tested the hypothesis that compared to men, women underperform on difficult math tests but perform equally well on easy math tests in a normal test setting. Previous research attributed women's performance decrement on difficult math material to the activation of stereotype threat. This study used a sample of men and women who identified very strongly with math and had a strong math background. The difficult test material was taken from the advanced GRE exam in mathematics and the easy test material was taken from the general quantitative section of the GRE exam. This study replicated the findings from previous research. Women who took the difficult math test performed worse than all of the other groups: men who took the difficult test and both men and women who took the easy math test.

Spencer et al.'s (1999) second study showed that women's performance was more strongly affected than men's when the gender stereotype for math performance was made salient. All participants in this study, males and females, took a difficult math exam that was divided into two parts in a within subjects design. As before, the participants in this study were highly motivated in math and had a strong background in math. In the stereotype-threat half of the exam, participants were told that the test had produced gender differences in the past. This stereotype-threat condition aimed to induce the stereotype about women's poorer math ability. In the non-stereotype-threat half of the exam, participants were told that the test had not shown gender differences in the past. This gender-fair condition aimed to make the stereotype about women's math ability irrelevant.

On the half of the test that women were explicitly told produced gender differences in performance, they greatly underperformed in comparison to men. But on the half of the test that women were told had never produced gender differences in the past, they performed equally as well as men taking the same test. By simply qualifying the test as gender neutral, women's underperformance on the test was completely eliminated. The results from this study provide evidence of the effects of stereotype threat and how women's performance on difficult math tasks can be affected by simply making them aware of the stereotype regarding their gender.

In their final study, Spencer et al. (1999) explored the effects of stereotype threat for participants who had a weaker background in math. The researchers used a wider variety of problems which made the test easier, and they compared two stereotype-threat conditions: a gender-fair condition (the same as in study two) and a control condition that had no mention of gender in reference to the test. The control condition was added to determine whether typical testing conditions produce stereotype threat that negatively impacts women's math performance. Women in the control condition underperformed compared to men in the same condition; however, women in the gender-fair condition performed equally as well as the men in the same condition. These results suggest that the gender-fair condition actually decreases stereotype threat and women's math performance is improved. Although the control condition did not mention gender and math performance, stereotype threat was still evident. By just engaging in a math task with men present, women presumably felt threatened and their underperformance provides evidence of the effect of stereotype threat.

The results of these studies show that performance differences on math tasks between men and women occur under several conditions. In normal test settings with men present and without mentioning gender, women underperformed in comparison to men on a difficult math test. However, when the test was easy, there were no differences in performance. When women were told that a test had previously produced gender differences, a decline in performance was also present when compared to men. When the test was

qualified as gender-fair, performance decrements disappeared. By increasing test difficulty and making gender differences salient, women's math performance suffered because of an increase in stereotype threat. However, there are other ways of maximizing stereotype threat to increase differences in performance.

Stereotype-Threat Activation Cues and Removal Strategies

Nguyen and Ryan (2008) examined stereotype-threat effects on test performance of women and minorities. Across 151 published and unpublished studies, this meta-analysis helped to define key concepts and clarify underlying factors involved in stereotype threat. Stereotype-threat effects result when certain activation cues make a group aware of negative stereotypes pertaining to the group. These activation cues were classified into three categories: blatant, moderately explicit, and subtle. A blatant stereotype-threat activation cue explicitly expresses the negative stereotype about the in-group's inferiority within the targeted domain. The negative stereotype becomes relevant through a conscious mechanism. Telling women that men outperform women on math-related tasks is an example of a blatant activation cue. A moderately explicit stereotype-threat activation cue expresses differences in group performance but does not indicate in which direction these differences are seen. Describing a math task as producing gender differences is a moderately explicit activation cue. A subtle activation cue uses indirect methods that do not mention the stereotype to activate stereotype threat, such as describing a test as a diagnostic measure

of ability. The negative stereotype becomes relevant through an implicit mechanism.

Stereotype-threat removal strategies are used to reduce negative stereotypes in order to improve test performance. Explicit stereotype-threat removal strategies eliminate the negative stereotype about the group and replace it with information that actually favors the group. Telling women that a math test is gender-fair and stating that African Americans perform better than Caucasians in an intellectual domain are explicit removal strategies. Subtle stereotype-threat removal strategies do not directly address the stereotype but focus on other factors that could affect performance. Describing a task as a problem-solving exercise instead of a diagnostic test or explaining that performance on a task will not be evaluated are examples of subtle removal strategies. Removal strategies are effective in improving the underperformance of specific groups that are susceptible to stereotype threat.

After identifying stereotype-threat activation cues and removal strategies, Nguyen and Ryan (2008) assessed how these strategies affected women and minority performance under gender-based and race-based stereotype threat. The researchers also examined the relationship between performance, test difficulty, and identification with the subject. When people are highly identified with a particular domain, it is a part of their identity. They care about their performance in the domain and strive to do well. For women, the subtle stereotype-threat activation cue created the largest negative effects on performance, followed by

blatant explicit and then moderately explicit cues. When using removal strategies to reduce stereotype threat, explicit removal strategies were more successful than subtle removal strategies. Women who moderately identify with math were more severely affected by stereotype threat compared to women who highly identify with math. However, women who have low-identification with math were the least affected by stereotype threat. When faced with difficult test material, minorities experienced larger decrements in performance when compared to women. Thus, it is clear that stereotype threat can have negative effects on women partaking in activities in a mathematical domain; however, it is still unclear what underlying mechanisms are causing this underperformance.

Underlying Processes Involved in Stereotype-Threat Effects

Researchers have tested several hypotheses to determine what processes may be at the core of women's underperformance in math while experiencing stereotype threat (Cadinu, Maas, Rosabianca, & Kiesner, 2005; Johns, Inzlicht, & Schmader, 2008). Negative thoughts have been implicated as a possible mediator between stereotype threat and women's performance. Cadinu et al. (2005) randomly assigned women to a stereotype-threat or a no-threat condition. Participants in the stereotype-threat condition were told that there were significant differences in the scores obtained by men and women in logical-mathematical tasks (moderately explicit cue). Participants in the no-threat condition were told that there are no differences in scores obtained by men and women in logical-mathematical tasks (explicit removal strategy). After this

manipulation, participants then took a seven problem math test with a time limit for each problem. They were instructed to write down any thoughts they were having before proceeding to the next problem.

Consistent with previous findings, women in the stereotype-threat condition had significantly fewer correct responses to the problems compared to women in the no-threat condition. Participants in the stereotype-threat condition also showed a significantly higher number of negative math-related thoughts. When comparing performance on the first and second halves of the test, Cadinu et al. (2005) found that the groups did not differ in performance on the first half of the test; however, participants in the stereotype-threat condition showed a significant decrease in performance on the second half of the test. Taken together, these results show that the decrease in women's performance under stereotype threat may be caused by intrusive negative thoughts that occur while working on a stereotype-relevant task. The fact that the decline in performance was only on the second half of the test suggests that participants under stereotype threat immediately have negative thoughts and these negative thoughts accumulate and inhibit later performance.

Another potential underlying cause of stereotype threat was suggested by Johns et al. (2008, study 1). They investigated decreased working memory and the suppression of anxiety in women under stereotype threat. Female participants were either in a stereotype-threat-induced situation or a control situation in which gender and stereotypes were not mentioned. In the stereotype-

threat situation, the male experimenter explained that the purpose of the study was to collect data on mathematical aptitude tests (subtle activation cue). In the control situation, the participants were told the purpose of the study was to complete problem-solving activities (subtle removal strategy).

Johns et al. used a dot probe task to measure participants' suppression of anxiety under two conditions. In the dot probe task, two words are presented on a computer screen and then one word is replaced by a dot. The presented words were either neutral or anxiety related. In the first condition, the reaction time measure was described in neutral terms that did not include anxiety in order to implicitly measure participants' anxiety level. In the second condition, the reaction time measure was explicitly described as an instrument to appraise anxiety levels. Increased reaction times in the second condition would suggest that participants attempt to suppress anxiety by actively redirecting their attention. Participants completed a reading-span task to assess their working memory capabilities. Participants were first presented with a word that they would have to recall then asked to count how many vowels were in the ensuing sentence. At the end of a series of these word-sentence trials, the participants were asked to recall as many of the words they were asked to commit to memory as possible.

Reaction times from the dot probe task revealed interesting results (Johns et al., 2008). Women in the stereotype-threat condition and a neutral dot probe task description directed more attention towards the anxiety-related words, indicated by shorter reaction times to these words. However, women who were in

the stereotype-threat condition and an anxiety dot probe task description had a slower response time when identifying anxiety-related words. This pattern of response indicates that women under stereotype threat were experiencing increased levels of anxiety but attempted to suppress their expression of anxiety when they were explicitly told the task was measuring this condition. Women in the problem-solving condition showed no differentiation in the direction of their attention towards the anxiety-related words and neutral words regardless of how the dot probe task was described. This means that women generally do not show a tendency to shift attention away from anxiety-related words when thinking their anxiety levels are being assessed. These results suggest that stereotype threat may activate an effort to suppress anxiety and attention to this suppression may hinder executive functions.

For the working memory task, women in the stereotype-threat condition recalled fewer words compared to women in the control problem-solving condition. These results suggest that stereotype threat causes depletion in working memory processes. With the depletion of working memory combined with an effort to suppress anxiety, executive functioning and processing is reduced. This slowed executive functioning appears to be a potential cause of women's underperformance when under stereotype threat.

In a follow-up study by Johns et al. (2008, study 2), an intervention utilizing emotional suppression attempted to improve performance of women under stereotype threat. They hypothesized that suppressing emotion causes a

depletion of executive resources, therefore decreasing performance on tasks. All participants were told that they would be taking a test that was diagnostic of their math abilities and would indicate their strengths and weaknesses in the area of math (subtle stereotype-threat activation cue). There were three conditions. In the threat only condition, the participants received no further direction. In the emotion regulating conditions, suppression and reappraisal, the participants were told to engage in a second task simultaneously while taking the math test. In the suppression condition, participants were told to conceal all thoughts and emotions they had while thinking about and taking the test, and to behave as if they were feeling nothing at all. In the reappraisal condition, participants were told to be objective when taking the test and have a neutral attitude as they were thinking about and taking the test, and consider the test analytical in nature and not emotionally relevant. After the instructions, participants completed a Stroop task and then a math test. Participants in the reappraisal condition performed significantly better on the Stroop task and on the math task than participants in the suppression and threat only conditions. These results suggest that by reappraising emotions and being objective during a task can reduce the negative effects produced by stereotype threat. Asking participants to engage in active suppression of emotions during both tasks depleted necessary executive resources and undermined performance. By changing the way individuals regulate their emotions, effects from stereotype threat can be lessened or heightened.

The results from these studies implicate negative thoughts, suppression of anxiety, emotion regulation, and a reduced working memory as contributing factors to stereotype-threat effects. By understanding these mechanisms and their properties, possible interventions may be designed to help students in stereotype-threat situations overcome the potential causal effects.

Effects of Implicit Theories of Intelligence on Academic Performance

Different qualities that individuals possess can make them more susceptible to stereotype-threat effects. For example, individuals may be at greater risk for stereotype-threat effects when they hold a fixed view of the domain in which they are engaging (Aronson & Steele, 2005). Individuals who hold a fixed view tend to interpret experiencing difficulty and failure as a lack of ability and low intelligence. The impact of fixed and malleable views of intelligence originates from Carol Dweck's (1986, 2002) theory of achievement motivation. In this theory, Dweck emphasizes connections between implicit beliefs about intelligence, motivational goals, and achievement behavior. People view their own intelligence as either a fixed entity or as a malleable quality. Those who view intelligence as fixed believe that intelligence cannot be developed and the amount of intelligence that you possess will not change, whereas those who view intelligence as malleable believe that intelligence can grow, change, and be cultivated. These implicit views of intelligence lead to the implementation of performance goals or learning goals.

Individuals who believe intelligence is fixed adopt performance goals (Dweck, 1986, 2002). Performance goals are associated with gaining favorable judgments of performance. The overall rationale of the fixed perspective is to look smart even if learning and academic gains have to be sacrificed. They try to avoid negative judgments' from others concerning their intelligence. People who view intelligence as malleable often pursue learning goals (Dweck, 1986, 2002). With learning goals, individuals are concerned with increasing their knowledge and competence. The objective associated with the malleable view is to master new skills even if the material is difficult and risky.

Individuals with these opposed implicit views of intelligence conceptualize effort and failure differently (Dweck, 2002). When intelligence is presumed to be fixed, failure is an indication of low intelligence. Individuals with a fixed view also believe that effort is a sign of low intelligence because if they have to exert effort to learn the material, then they must not be smart. In contrast, individuals with a malleable view consider failure to mean low effort and poor strategies. For them, effort activates and uses intelligence. This differentiation of beliefs and goals leads to the formulation of distinct motivational and behavioral patterns.

Individuals' beliefs concerning their intelligence and ability orient them towards either documenting the adequacy of their ability, a "helpless" pattern, or developing their ability, a "mastery-oriented" pattern (Dweck, 1986; Dweck & Leggett, 1988). The maladaptive, helpless pattern is characterized by avoiding challenges and impaired persistence when facing difficulty and failure. Because

of this maladaptive pattern, individuals fail to establish, maintain, and strive toward practical and valuable goals that are potentially within reach. The adaptive, mastery-oriented pattern is distinguished by seeking and engaging in challenges and showing perseverance during difficult tasks and after failure. This pattern helps establish, maintain, and achieve personally motivated and challenging goals. Several studies have tested Dweck's implicit theories of intelligence in real-world academic settings to illustrate important differences in performance for the two views of intelligence.

Blackwell, Trzeniewski, and Dweck (2007) used students' implicit theories of intelligence to predict achievement across a difficult academic transition. The first study was a longitudinal design which followed four waves of entering junior high students for two years. This cohort of students was chosen because Dweck's theory states that differences between the malleable and fixed views of intelligence are most evident after the individual experiences difficulty or failure. These students were making the transition into junior high school and were going to be experiencing new and more difficult subject matter, especially in math. This difficult transition often leads to a visible decrease in math grades, so these students were ideal for this study. At the beginning of their 7th grade year, the students filled out questionnaires assessing their theory of intelligence, goals, beliefs about effort, and helpless versus mastery-oriented responses to failure. Their achievement outcome was assessed as they progressed through the 7th and 8th grades by way of their math grades for that particular year.

A malleable view of intelligence at the beginning of junior high school predicted higher math grades earned at the end of the second year of junior high school. The malleable view was also positively associated with positive effort beliefs, learning goals, low helplessness attributions, and positive strategies. According to Blackwell et al., it is these positive associations which lead to improved grades. A malleable view of intelligence appeared to buffer students from academic decreases that are typically seen during a difficult academic transition.

Mangels, Butterfield, Lamb, Good, and Dweck (2006) used undergraduate's views of intelligence to compare performance and learning-relevant feedback. The participants in this study completed a theory of intelligence questionnaire to determine which theory they personally adopted. They then took a test that consisted of general knowledge questions. After answering, the students received two types of feedback. Performance-relevant feedback consisted of a green asterisk accompanied by a high-pitched tone indicating a correct answer or a red asterisk accompanied by a low-pitched tone indicating a wrong answer. Learning-relevant feedback consisted of presenting the correct answer to the question on the computer screen. After this portion of the test, a brief period elapsed and the student began a second phase of testing which was a surprise retest on all of the questions that the student initially answered incorrectly on the first test.

The performance scores on the first test were similar across the malleable and fixed intelligence groups. Despite this, individuals viewing intelligence as malleable showed greater improvement on the retest portion of the test compared to individuals viewing intelligence as fixed. Both groups corrected the majority of their errors committed on their first test; however, malleable theorists corrected significantly more errors than fixed theorists did. According to Dweck, individuals adopting a malleable view of intelligence show improvement on performance after experiencing various forms of failure. In this experiment, the malleable intelligence group rebounded after answering questions wrong and increased their performance in comparison to the fixed intelligence group on the retest portion. Malleable theorists are more focused on learning goals and fixed theorists are more focused on performance goals. This is evidenced by the results that the malleable intelligence group had greater improvement and corrected more errors on the retest compared to the fixed intelligence group because the learning-relevant feedback was more important than the performance-relevant feedback.

Several studies demonstrate how adopting a fixed view of intelligence can impair academic performance. However, when intelligence is viewed as malleable students show a more adaptive reaction to failure and can persevere through difficult tasks. Developing a successful intervention using implicit theories of intelligence requires understanding of how these theories are initially formulated.

Underlying Processes of Implicit Theories of Intelligence

The shaping of implicit theories of intelligence starts during childhood, and is illustrated in studies of differential treatment of boys and girls in the classroom. Dweck, Davidson, Nelson, & Enna (1978) examined sex differences in evaluative feedback from teachers to students within the classroom. Over a five week period, observers recorded feedback given to the students. This feedback was coded into several categories: positive or negative and contingent or noncontingent. Contingent feedback was then categorized as conduct or work related. Work-related feedback was then broken down as being contingent on intellectual aspects of the task or nonintellectual aspects. For negative evaluations, less than 1/3 of feedback concerned intellectual aspects of work for boys; however, more than 2/3 of feedback concerned the quality of performance for girls. When considering work-related criticism, for boys, about half of this criticism referred to inadequate intellectual performance. For girls, almost all of work-related criticism was related to inadequate intellectual performance. Learned helplessness exists when failure is perceived as overwhelming. This perception is associated with attributions of failure to uncontrollable factors, such as lacking ability, and is accompanied by a decrease in performance following difficulty or failure. Because of the differences in the contingencies of evaluative feedback and the clear attributions made by teachers towards boys and girls in the classroom, girls may be influenced to view failure feedback as indicating a

lack of ability. According to Dweck, this feedback orients students towards adopting a fixed view of intelligence.

To further investigate the findings from the observational study, Dweck et al. (1978) conducted an experimental analysis of these feedback contingencies. Teacher-boy and teacher-girl contingences of work-related criticism observed in the classrooms were recreated in an experimental situation. Children were taken individually from the classroom and were instructed to complete solvable and unsolvable word puzzles. Both boys and girls in the recreated teacher-boy condition received failure feedback that was explicitly addressed to the correctness of the solution and failure feedback that was explicitly addressed to a nonintellectual aspect of performance. There was a teacher-girl condition in which failure feedback was addressed specifically to the correctness of the solution. The teacher-boy condition modeled the failure feedback received by boys in the first study which focused on correctness and nonintellectual factors. The teacher-girl condition modeled the failure feedback received by girls in the first study which focused mostly on the correctness.

The results of this study show that most children, both boys and girls, in the teacher-boy condition did not view failure feedback on the task as reflecting a lack of ability; rather, an insufficient amount of effort was the more frequently endorsed reason. Conversely, boys and girls in the teacher-girl conditions overwhelmingly interpreted the failure feedback as an indicator of lacking ability. Overall, it is apparent that children who receive solution-specific failure feedback

are far more likely to view subsequent feedback as indicative of ability compared to children who receive feedback that is often solution irrelevant.

These two studies demonstrate that the pattern of evaluative feedback given to boys and girls in the classroom can result directly in girls' greater tendency to view failure feedback as indicative of their level of ability. The latter study illustrates that the variable use of negative evaluations observed in the classroom plays a powerful role in how children interpret negative feedback. This evaluative feedback to students potentially is one of the ways that lead children to develop malleable and fixed views of intelligence, which has been shown to be crucial in later academic development. This feedback becomes increasingly important during periods of academic difficulty, such as the increasing difficulty of math during the progression of school. This feedback may not only be related to the development of a specific view of intelligence in general, but also to a malleable or fixed view of math in particular.

Effort and ability attributions play a major role in distinguishing the malleable and fixed views of intelligence. Hong, Dweck, Chiu, Lin, and Wan (1999) investigated the relationship between implicit theories of intelligence and effort versus ability attributions of undergraduate students in a series of studies. The first study consisted of two seemingly unrelated separate phases. The first phase of the experiment began by the participants taking an implicit-theories measure to identify them as adopting a malleable or fixed view of intelligence. In the second phase of this study, participants took a conceptual ability test

concerning abstract reasoning. This test was administered with only two participants in the room with the experimenter. After finishing their tests, a printout containing two falsified bar charts depicting their scores was presented. All the participants saw the same bar chart in which one participant clearly scored below the other. After examining the bar chart, the participants filled out a test-evaluation questionnaire which actually measured their attitude towards effort and ability attributions.

Dweck's theory of achievement motivation was validated. Participants' effort attributions were successfully predicted by which implicit theory of intelligence they adopted. Malleable theorists made stronger effort attributions to explain their performance on the ability task. Fixed theorists attributed their performance on the ability task to ability. This study helps establish a link between theories of intelligence and attributions. The next study aims to answer, how do these attributions affect behavior?

In their second study, Hong et al. (1999) used Dweck's theory of achievement motivation to predict that students holding a fixed view of intelligence would be less likely to take corrective, remedial action concerning academics. Fixed theorists believe that intellectual ability cannot be changed; therefore remedial action would presumably not be useful. However, if remedial action was pursued and no changes were seen in performance, then this would confirm their lack of ability. Participants at a Chinese University were asked to fill out a questionnaire concerning their English proficiency and previous English

grades. This questionnaire stated that English proficiency was very important in academic success. Participants were then asked how likely they would be to take a remedial course shown to be effective in improving English proficiency. Based on their answers, the participants were classified into two groups: high-previous-performance group (grade of A or B) or low-previous-performance group (grade of C or below). The participants then filled out an implicit theory measure to determine their view of intelligence.

The low-previous-performance group was more likely to want to engage in a remedial course than the high-previous-performance group. There was not a difference in likeliness to engage in a remedial course between the fixed and malleable group within the high-previous-performance group. However, within the low-previous-performance group, individuals with a malleable view of intelligence were more inclined to engage in a remedial English proficiency course compared to individuals with a fixed view of intelligence. These findings show that adopting a specific view of intelligence can lead to differences in behavior; such as, how identifying with the fixed view can lead to the avoidance of receiving help.

In their final study, Hong et al. (1999) manipulated participants' view of intelligence to explore the causal relationship between implicit theories of intelligence and the behavior accompanied by experiencing setbacks. To manipulate the participants' view of intelligence and orient them to a fixed or malleable view, they first read an essay that described a malleable or fixed view of intelligence. After reading the article, the participants were asked to

summarize the article and state the evidence within the article which was most convincing concerning intelligence. The participants then had to take an intelligence test consisting of 12 questions, and they received feedback following completion of the problems. Half of the participants were told they got seven answers correct and this was satisfactory performance compared to others. The remaining participants were informed they only got three questions correct and this was unsatisfactory performance compared to others. After receiving feedback, the participants were given the option to participate in a tutorial exercise which they were told had been shown to be effective in improving scores on the intelligence test or to perform an unrelated task. Those who chose the tutorial were assumed to favor remedial action. After participants indicated their choice, they filled out a questionnaire regarding their preference for challenging tasks which measured whether they were mastery or helplessness oriented. They were also asked to what extent they attributed their performance to effort or to intellectual ability.

The participants who received unsatisfactory feedback and read the fixed view essays were less likely to take the remedial tutorial compared to those who read the malleable essay. When given satisfactory feedback, most participants in the fixed and malleable conditions wanted to take the tutorial. Thus, individuals with a fixed view do not generally want to avoid the remedial tutorial, only when receiving unsatisfactory performance feedback. When given unsatisfactory feedback, individuals who read the malleable intelligence essay made stronger

effort attributions towards their performance compared to individuals who read the fixed intelligence essay. When given unsatisfactory feedback, individuals who read the fixed intelligence essay attributed their performance to their intellectual ability more often than individuals who read the malleable intelligence essay. However, after receiving satisfactory feedback, participants reading both essays attributed their performance more to ability than to effort. When participants were asked their preference for engaging in an easy task or a challenging task, participants in the fixed condition preferred an easy task more than the malleable condition.

Students who adopt a fixed view of intelligence attribute their poor performance to their lack of ability demonstrating that they believe failure is an indication of low ability and intelligence. However, those adopting a malleable view attribute their poor performance to their lack of effort, meaning they believe if they work harder they can still achieve success. This exemplifies how those with a malleable view seek challenging activities and show persistence through difficult tasks. The results from these studies demonstrate differences in attributions and behavior resulting from the differing views of intelligence.

Interventions Involving Implicit Theories of Intelligence and Stereotype Threat

Both stereotype-threat situations and adopting a fixed view of intelligence result in negative performance effects. Johns, Schmader, and Martens (2005) conducted a study to determine whether informing women about stereotype

threat could be used be used as an intervention strategy to help improve women's performance on math tasks in threatening situations. Undergraduate students completed a set of difficult GRE math problems in three different conditions. In one condition, the problems were described as a problem-solving task (subtle removal strategy). Another condition described the problems as a math test (subtle stereotype-threat activation cue). A final condition described the problems as a math test, but also taught the participants about stereotype threat. They were informed about what stereotype threat was and how women's performance on math tasks could be negatively affected in certain situations. When the problems were described as a problem-solving task, men and women performed equally well; however, when the problems were described as a math test, women performed worse than men. When the problems were described as a test and the participants were taught about stereotype threat, women once again performed equally as well as men. An intervention that enlightens women about the concept of stereotype threat and the situations that it occurs in could lessen the negative effects produced by stereotype threat.

A meta-analysis conducted by Walton and Spencer (2009) focused on stereotype threat and interventions in actual school environments. The meta-analysis only included studies that utilized interventions that were aimed at reducing stereotype threat and that used actual classroom performance as a dependent measure. All studies included focused on reducing stereotype threat in the classroom for African American students. The researchers found that

African American students who participated in a stereotype-threat reducing intervention outperformed Caucasian students who participated in the same intervention and Caucasian students who were in the control conditions who did not receive stereotype-threat reducing information. African American students in the control conditions not receiving stereotype-threat reducing information performed the worst of all the groups. These results show that threat reducing interventions could play a crucial role in the performance of stereotyped individuals. With more interventions that target different existing stereotypes pertaining to academic areas, the gap in test scores could be decreased and the classroom environment made less threatening.

As a follow-up to their initial longitudinal study, Blackwell et al. (2007) performed an intervention to teach a malleable theory of intelligence to 7th grade students. After the intervention, effects on classroom motivation and achievement were assessed in comparison with students in a control group. The intervention consisted of eight 25-minute periods, one per week, which began in the spring term of 7th grade. In the sessions, both the experimental group and the control group were taught the physiology of the brain, study skills, and antistereotypic thinking through science-based readings, activities and discussion. In addition, the experimental group was also taught that intelligence is malleable and can be developed. The key message for the experimental group was that learning changes the brain by forming new connections and students are in charge of this process.

After the intervention, 27% of students in the experimental group were spontaneously cited by their teachers as showing positive change, such as increased motivation and effort accompanied by increasing grades, compared with only 9% in the control group. The sample as a whole showed decreasing grades, but this decline was eliminated for those in the experimental condition of the intervention. Students who endorsed more of a fixed view of intelligence at the beginning of 7th grade reaped the most benefit from the malleable view intervention. This intervention shows that by orienting students towards a malleable view of intelligence, improved grades and positive changes in the classroom can be achieved.

Separately, researchers have investigated stereotype threat and implicit theories of intelligence. Their findings from this research have produced a greater understanding and a wealth of information concerning both of these topics. Both of these topics help explain the differences in performance in math between men and women and both can be manipulated to increase performance. Aronson, Fried, and Good (2002) combined both of these theories to examine if manipulating African American students' views of intelligence could alter the effects of the stereotype they experience in academic settings.

Aronson et al. (2002) used an intervention involving African Americans' views of intelligence to examine stereotype-threat effects of academic success. Included were three groups of African American and Caucasian students, male and female. This intervention did not focus on gender, but on race, specifically

African American students. The intervention was important because of the underperformance of African American students compared to Caucasian students in academic domains. One group participated in a malleable pen pal program intervention. This intervention was designed to change their attitudes about intelligence and aimed to teach them to internalize the notion that intelligence is expandable and malleable. Two control groups were also utilized. One control group also participated in a pen pal program intervention. This intervention was designed to orient students towards a multiple view of intelligence, where intelligence is not a single unit but consists of many different abilities. The multiple view of intelligence is an alternate manipulation that simulates the fixed view in a more ethical manner. The other control group did not participate in any type of intervention. These groups were chosen so that the researchers could determine if the results of the experiment were from the malleable view of intelligence intervention, rather than just participating in a pen pal program intervention.

The students in both intervention groups were told that this study consisted of several sessions involving a long-distance mentoring program for at-risk middle school students and an unrelated study pertaining to psychological measures and grades. During the first session, which included mixed gender and race groups of two to five participants, the experimenter introduced herself as a worker for the pen pal program and explained that the purpose of the program was to exchange letters between at-risk middle school students and college

students. The college students were to give the younger students encouragement to be successful and overcome struggles and eventually find success. The participants were told they would be answering one letter from a seventh grader who was from a poverty stricken community and could really use the support of an older role model. The actual purpose of the letter writing was to help bolster the view of intelligence of each pen pal condition. After reading their assigned letter, participants were given instructions on how to reply and these instructions varied by condition.

Participants in the malleable pen pal condition were asked to encourage their seventh graders to work hard through the difficult time they may be experiencing and to stress that intelligence is capable of growing with mental work. They were also told that this message is particularly important to young struggling students and that convincing them to see intelligence as expandable may increase their chances of remaining in school and putting effort into learning. After receiving this message, the participants watched a video clip that focused on the brain and intelligence being capable of growing and making connections continually through life.

Participants in the control pen pal condition were told that intelligence is not a single entity but composed of several different abilities and that viewing intelligence as a single entity is a mistake. It could lead struggling students to give up on education because they view themselves as failures on a global level, but by convincing these students of different types of intelligence, they may

continue to learn in an attempt to find and develop their particular domains of strength. After receiving this message, the participants then watched a video clip that discussed how psychologists are beginning to view intelligence in this same way, as being comprised of many different abilities.

Although these techniques together may have helped change the participants' attitudes about intelligence, several other techniques were used to bolster the messages received from the pen pal intervention. Polariods of the participants were taken and clipped to their letters. Participants were also asked to use personal examples from their own lives when writing their letters. Repetition was also used. After writing their initial letter, they wrote another letter with the same message to a different pen pal. They also reworked their letters turning them into speeches. These speeches were then audio-recorded to use in future interventions with struggling children. They also had to listen to their recorded speeches twice. Because of the combination of tactics use to impart the desired view of intelligence, it seemed logical that by the end of this process the participants in both conditions of the pen pal intervention should be familiar with the theory of intelligence they were assigned.

Several days following the intervention, the participants filled out a measure assessing their belief in malleable intelligence as a manipulation check. Several weeks later, their views were reassessed along with other measures. This included their enjoyment of academics, their identification with academics, and measures assessing their experience of stereotype threat. Several days after

the intervention, participants in the malleable pen pal condition reported viewing intelligence as more malleable than the control condition. Participants in the non-intervention control condition did not see intelligence as more malleable then participants in the control pen pal condition. This suggests that the malleable intervention successfully altered their views of intelligence in the correct direction. The main concern of this study was the longevity of this malleable attitude change and whether this attitude change would influence participants' reaction to stereotype threat and change their academic attitudes and performance. To assess the effectiveness of the longevity, attitude measures and transcripts were collected at the end of the academic term, which was nine weeks after the initial intervention.

At the end of the academic term, the malleable intervention attitude change was still in effect, and the differences between the malleable pen pals' beliefs and the participants in the two control conditions widened. Overall, African American students in all three conditions viewed intelligence as more malleable than white students. African Americans also reported enjoying academics less than white students; however, African Americans in the malleable pen pal condition reported enjoying academics more than African Americans in both control conditions. For white participants, their identification to academics did not change with the intervention. When using the participants' transcripts, controlling for initial GPA and SAT scores, African Americans obtained higher grades in the malleable pen pal condition compared to both control conditions. Regardless of

which pen pal condition they were in, African American students reported perceiving more stereotype threat. So although African American students viewed intelligence as more malleable, it was not because the intervention reduced the experience of being judged in a stereotypical way in academic settings. The malleable pen pal intervention helped to change their behavior and reactions to a threatening environment. This suggests that the malleable pen pal intervention was responsible for the increase in academic achievement.

Overall, the results of this study suggest that the performance deficits seen in African Americans experiencing stereotype threat in academic settings can be prevented by orienting them towards a malleable view of intelligence. The malleable pen pal intervention resulted in African Americans enjoying academics more, valuing academics more, and an improvement in their grades. Also compared to white students, African Americans in the malleable pen pal condition adopted the malleable view more strongly. Their malleable beliefs were more pervasive and salient even after nine weeks had passed. The malleable pen pal intervention also helped white students, but not to the degree in which African American students were positively affected.

Although implicit theories of intelligence have been utilized as an intervention before, they have not been used concerning women and math achievement. My study manipulated women's views of intelligence under stereotype threat while completing math problems. Because stereotype-threat effects can be viewed as a form of difficulty or failure, adopting a malleable view

of intelligence should reduce the negative performance effects resulting from stereotype threat for women in math.

CHAPTER II: REPLICATION OF STEREOTYPE-THREAT EFFECTS

A pilot study was conducted that focused on inducing stereotype threat in women in the math domain. Being able to replicate the performance decrement effects of stereotype threat seen in the literature is critical before introducing an intervention. Manipulating implicit theories of intelligence would serve no purpose if women's performance did not show the negative effects while under stereotype threat when compared to control and gender-fair groups. This study aimed to use several different techniques to heighten stereotype threat and to establish performance differences between the group conditions. This study used three conditions. A stereotype-threat condition used blatant stereotype-threat activation cues to induce stereotype threat. A gender-fair condition used explicit removal strategies to reduce stereotype threat. A control condition used no activation or removal strategies.

Method

Participants. Sixty students (47 women and 13 men) participated in this study. Most of the students were completing the study to receive extra credit in a course, and the rest of the students were fulfilling a research participation requirement for their introductory psychology course. Because men's performance should not be affected by stereotype-threat manipulation and because few men were available to participate, their data were excluded from all analyses. The women ranged in age from 19 to 44 years old (M = 21.98, s =

4.69). A majority were sophomores and juniors (66%). Their self-reported grade point averages (GPA) ranged from 1.35 to 3.75 (*M* = 2.72, *s* = .59). The participants were also asked to indicate their SAT-M scores as an indicator of their math ability. Of the 47 women, 19 reported their scores. The range of SAT-Math scores reported was from 320 to 780 (*M* = 554.21, *s* = 99.68).

Materials. Participants in the gender-fair and stereotype-threat groups completed a reading comprehension task (Appendix A, pp. 75-78). The control group did not complete a reading task. The gender-fair group read information that provided evidence that men and women perform equally well on math tasks. For example, men score an average of 580 on the math section of the SAT compared to women's average score of 560.

This information helped to heighten feelings of equality in math performance for the women. The stereotype-threat group read information that provided evidence that men consistently outperform women on math-related tasks. For example, from 2003 through 2008, just 18% of PhD's in mathematics went to women. This information helped heighten the stereotype-threat effect by making gender differences more prevalent. The participants then completed a short five question quiz (Appendix A, pp. 79) to ensure their understanding of the material and to also act as a manipulation check.

All participants took a test which consisted of math and verbal problems (Appendix A, pp. 80-98). The test included 13 math problems and 13 verbal problems presented in a random order. These problems were taken from an SAT

review guide to ensure continuity of difficulty. The format of the test was multiple-choice and each problem had five answer options. When scoring the test, the students received one point for each correct answer and zero points for a wrong answer. After each problem, the participants were asked how much they enjoyed the problem, how difficult was the problem, and how confident they were in their answer to this problem? They answered these three questions using a five-point scale. For rating enjoyment, 1 = no enjoyment and 5 = great enjoyment. For rating difficulty of the problem, 1 = extremely easy and 5 = extremely difficult. For rating confidence, 1 = not confident and 5 = very confident. Including the actual math and verbal problems and the scales presented after each problem, the test consisted of 109 questions.

All participants completed a demographics questionnaire (Appendix A, pp. 99-102). Participants were asked to indicate their sex, birth date, year in school, current GPA, and their SAT-M score. There were also lists of math classes available in high school and college. Participants were to indicate which classes that they had previously taken. Participants were asked to rate the overall difficulty of the math problems and the verbal problems on a five-point scale (1 = very easy and 5 = very hard). They were also asked to predict how well they did on the math portion and the verbal portion (1 = very bad and 5 = very good). They also had to indicate how much they liked math, how important math is to them, and how important math is to their chosen career (1 = not at all and 5 = very important). These questions were used to gauge how much they identified

with and cared about math. They were also asked if they believed a math stereotype against women exists and if they believe that men outperform women in math. They also had to indicate how much they agreed with statements regarding their gender affecting their ability to perform, attributing their performance to the gender, and if anxiety about the stereotype about women will affect their performance (1 = strongly disagree and 5 = strongly agree).

Procedure. The participants were tested in small mixed-sex groups in classrooms. There were three conditions: a stereotype-threat condition (17 F, 4 M), a gender-fair condition (14 F, 5 M), and a control condition (16 F, 4 M). Each experimental session consisted of one condition and the conditions alternated in order to keep the number of participants in each condition nearly equal.

Following the informed consent process, participants in the stereotype-threat and gender-fair groups were given 10 minutes to complete the reading comprehension task. Next, the math and verbal test was handed out along with a blank sheet of paper to work out problems. This was the first task the control group was asked to complete. Participants in the gender-fair group were told that this test had previously produced no gender differences; men and women perform equally well on this test. Participants in the stereotype-threat group were asked to write their first and last name on their bubble sheet and to also indicate their gender. They were told that this test had previously produced gender differences; men consistently out-perform women on this test. They were also told the test was for diagnostic purposes and their scores were a direct reflection

of their ability and that their scores would be compared with all other students participating in the study. The participants in the control group were told no information regarding gender and math performance.

All participants were also told that there were scales after each problem and they needed to pay attention to the anchors of the scales to ensure they were answering the question correctly. They were given 40 minutes to complete this task.

Finally, participants completed the demographics questionnaire and then were debriefed. The experimenter explained what the experiment was about and the participants were instructed to read a debriefing sheet and ask questions. The debriefing sheet included information about stereotype threat, what conditions the experiment consisted of, the hypotheses, and identified the independent and dependent variables. This was followed by a debriefing quiz which contained a question asking the participants to identify which condition they were in (Appendix A, pp. 103-105). This question served as an additional manipulation check.

Results

Data from six of the female participants were not analyzed (5 from the control group and 1 from the stereotype-threat group) because they failed to answer a manipulation check question correctly. The three groups' SAT-M and GPA scores were compared and there were no pre-existing group differences on these measures.

A 2 (math performance vs. verbal performance) x 3 (stereotype-threat group, gender-fair group, control) mixed factorial ANOVA revealed no significant main effect for math and verbal performance, $F(1, 38) = 1.16$, $p = .29$. Participants scored no higher on the math portion of the test ($M = 8.99$, $s = .319$) than they did on the verbal portion of the test ($M = 9.35$, $s = .28$). The main effect for condition was also not significant, $F(2, 38) = .28$, $p = .77$. Participants in the stereotype-threat group ($M = 9.00$, $s = .41$) did not differ from those in the gender-fair group ($M = 9.43$, $s = .43$) or the control group ($M = 9.08$, $s = .46$). There was no significant interaction between performance and condition, $F(2, 38) = 2.60$, $p = .088$. Participants in the stereotype-threat group scored 8.60 on the math test ($s = .53$) and 9.40 ($s = .47$) on the verbal test. Participants in the gender-fair group scored 9.79 on the math test ($s = .54$) and 9.07 ($s = .48$) on the verbal test. Participants in the control group scored 8.58 on the math test ($s = .58$) and 9.58 on the verbal ($s = .53$).

Similar analyses were conducted on the rating scales following each math or verbal questions. These questions were: how much did you enjoy working this problem, how difficult was this problem, and how confident are you that you answered this question correctly? There were no significant interactions but there were significant main effects for the type of problem. In regards to enjoyment, there was a main effect for type of problem, $F(1, 37) = 6.47$, $p = .015$. Participants enjoyed working math problems ($M = 2.88$, $s = .127$) more than they enjoyed working verbal problems ($M = 2.57$, $s = .123$). In regards to the difficulty,

there was a main effect for the type of problem, $F(1, 37) = 6.29$, $p = .017$. Participants thought that the verbal problems were more difficult ($M = 2.36$, $s = .079$) than the math problems ($M = 2.12$, $s = .086$). In regards to the confidence, there was a main effect for the type of problem, $F(1, 37) = 12.49$, $p = .001$. Participants had more confidence in answering math problems ($M = 3.96$, $s = .103$) than when answering verbal problems ($M = 3.61$, $s = .089$). In all three cases, the main effect for condition was never significant.

Discussion

The primary analysis for this study showed no significant main effects or interaction; however, the interaction was approaching significance with $p = .088$. The trend of the scores was in the correct direction in reference to the stereotype-threat literature. On the math problems, the gender-fair group performed the best, followed by almost equal performance by the control group and stereotype-threat group. On the verbal problems, there were no differences in group performance. Therefore, stereotype threat was not fully induced and the results of the literature were not replicated. There are several possible explanations for these results.

Within the study, several techniques previously used in the literature were combined to heighten and enhance the stereotype-threat effect within the stereotype-threat group. They were asked to write their name and sex on their blank piece of paper. They also read facts stating that men consistently outperform women on math tasks. They were told that the test they were going to

take also produced gender differences and men outperformed women on that particular test. By combining these techniques, I believe the effect would be enhanced and stereotype threat would have an even greater effect on the women's performance on the math problems. However, the meta-analysis conducted by Nguyen and Ryan (2008) suggests that subtle threat activating cues have the biggest effect on women's performance in math and that using explicit activating cues could result in reactance. The researchers define reactance as "when a negative stereotype is blatantly and explicitly activated, it might be perceived by test takers as a limit to their freedom and ability to perform, thereby ironically invoking behaviors that are inconsistent with the stereotype" (p. 1315). My results do not directly suggest that a reactance effect is fully present, but they do suggest that by explicit activation cues may have weakened the stereotype-threat effect. To strengthen the design of my second study, explicit activation cues within the stereotype-threat group were minimized and replaced with subtle activation cues. A reactance measure was also included to assess if reactance is actually occurring, and if it is who it is affecting and why?

Results from study one showed minimal differences in math scores between the control group and the stereotype-threat group. Using Nguyen and Ryan's (2008) guidelines for defining activation cues, the control group was almost another form of stereotype threat. Nguyen and Ryan defined a subtle activation cue as an indirect method that does not mention the stereotype to

activate stereotype threat, such as describing a test as a diagnostic measure of one's ability. In the control group, the participants were told they were going to be taking a test; however, they were not told that it was diagnostic of their ability. But because their test results were so similar to the results of the stereotype-threat group, it is possible that by just describing the task as a test the participants assumed it was diagnostic and evaluative in nature and implicitly induced the stereotype-threat effect. To enhance the design and maximize differences between the groups, my second study included a gender-fair group and a stereotype-threat group.

After each problem on the test, the participants were asked to rate their enjoyment of the problem, how difficult was the problem, and how confident they were of their answer to the problem. The results of these ratings were averaged across the math problems and verbal problems. For the math problems, the difficulty ratings were low indicating that participants thought the problems were easy and the confidence ratings were high indicating that they were very sure of themselves when answering the problems. The verbal problems were used as a control because stereotype threat should not affect performance on verbal problems. The results showed there were no major differences in performance between the groups, so the verbal problems did not need to be revised; however, the math problems needed further assessment. According to Spencer et al. (1999), greater performance differences are seen when the difficulty of the test is increased. Because the difficulty and confidence ratings suggest the math

problems were easy and participants were confident of their answers, the math problems on the test may not have been challenging enough. This lack of challenge could be a reason why the performance differences were not greater between the groups and the stereotype-threat effect was not as salient as it could have been. The math problems were taken from sample problems of the SAT-M. For my second study, math problems for which a high percentage of participants answered the problem correctly were replaced with problems of greater difficulty. This increased the difficulty of the test and enhanced the stereotype-threat effect for the stereotype-threat group.

Previous research by Spencer et al. (1999) and Nguyen and Ryan (2008) suggest that the biggest performance differences result in women who are moderately to highly identified with math. Spencer et al. (1999) required women to have higher SAT-M scores and to agree with statements such as, “It is important to me to be good at math.” For study one, there were no math requirements to participate. The demographics questionnaire did address math identification with several questions: “Please rate how important math is to you on the following scale (1 = not at all, 5 = very important),” “Please rate your math ability on the following scale (1 = extremely low, 5 = extremely high),” and “Do you believe a math stereotype against women exists, true or false?” I repeated the same analyses but only included women who rated their math important and math ability as a three or above and answered true to believe in a math stereotype threat against women. The results did not change. There were no

significant main effects or interactions. Making the cut off score as a three, may not truly capture math importance and ability. It is possible that women who answered the questions as a three may not be highly identified. The mean may not indicate math identification and ability; these women may just see themselves as in the middle on both of these categories. The sample size for these analyses were already small, and by making the cut off a score of four and above on both questions further reduced the power of the analyses. For my second study, I collected data from a larger sample.

Aronson and colleagues (2002) focused on African American students in an academic domain and this study will be focused on women in a math domain. Aronson et al. also assumed that stereotype threat was present for the African American students. They made no mention of race or previous differences in academic performance in their study. Stereotype threat was not manipulated, it was only measured. My second study differed from the Aronson et al. study because there were direct manipulations of the experimental groups in reference to stereotype threat. The findings from this initial study have identified problems that were addressed and that helped strengthened the design and results of the ensuing research.

CHAPTER III: A Stereotype-threat Intervention Using Implicit Theories

The second study used an intervention that manipulated women's views of intelligence to examine what effect this would have on women's math performance when they were in a stereotype-threat situation. Women were either in a stereotype-threat group or a gender-fair group. Within these separate groups, their views were manipulated towards adopting a malleable view of intelligence or the fixed view of intelligence. By generalizing the results from the Aronson et al. study (2002), adopting a malleable view of intelligence should improve math performance in women experiencing stereotype threat. Women in the stereotype-threat group oriented toward the fixed view of intelligence should have the worst performance on the math task. Women in the gender-fair group should perform similarly well on the math problems regardless of their participation in the malleable or fixed manipulation. The verbal problems are included as a control. Because the verbal domain should not be affected by stereotype threat, scores across all conditions should be similar.

Method

Participants. Participants for the study were recruited using a computerized participant pool system. Majority of participants were undergraduate students taking an introductory psychology class have to fulfill a research participation requirement and others participated to receive extra credit in a Developmental Psychology course. In total, 125 students (92 women and 33 men) participated in this study. Men's math performance should not be affected

by stereotype threat; therefore, their data were excluded from all analyses. The women ranged in age from 18 to 28 years old (M = 21.18, s = 4.21). Overall, 73% of participants were Caucasian and 16% were African American. A majority of participants were freshmen and sophomores (85%). The participants' SAT-M scores were obtained from the registrar and used as an indicator of math ability. Of the 92 women, 64 scores were obtained. The range of SAT-M scores was from 370 to 670 (M = 524.30, s = 64.73).

Materials. All participants completed a reading comprehension and writing task that aimed to manipulate their implicit theories of intelligence (Appendix A, pp. 109-114). Participants in the malleable condition read an article describing intelligence as a quality that could be changed and enhanced throughout life with proper environmental stimulus. Participants in the fixed view of intelligence condition read a similar article stating that humans are born with a limited amount of intelligence that does not fluctuate throughout life. After reading the articles, participants then read statements from professionals that further supported their article. The professionals used personal stories and events from their lives to explain how important that particular view of intelligence is. After reading these statements, participants were asked to write their own statement using personal events from their lives to summarize the importance of the information they just read and how adopting that view of intelligence could be beneficial. After they finished writing, they took a short quiz concerning the material they just read.

All participants took a test that consisted of math and verbal problems taken from SAT practice items (Appendix A, pp. 115-121). The test consisted of 13 math problems and 13 verbal problems. The format of the test was multiple-choice and each question had five options. Following each problem was a question that asked, “How confident are you that you answered this question correctly?” The answer consisted of a Likert-type scale with 1 being “I guessed” and 5 being “100% correct.” One point was given for every correct answer and zero points for every incorrect or missing answer, so the math sum score was the total number of correct items (range = 0 to 13).

All participants completed a demographics questionnaire, identical to that of study one but with the addition of one question as a measure of reactance (Appendix A, pp. 122-126). The additional question asked participants if they worked harder on the math problems to show that men do not outperform women on math tasks. Participants were asked to rate the level of difficulty of the math problems and the verbal problems on a five-point scale (1 = very easy and 5 = very hard). Several questions were asked to gauge how important math was in their lives and careers. They were also asked if they believed a math stereotype against women exists, and if they believe that men outperform women in math. They also had to indicate how much they agreed with statements regarding their gender and performance. Finally, participants indicated which math classes they had previously taken in high school and college.

Procedure. Testing sessions were conducted in two alternating conditions: a stereotype-threat condition and a gender-fair condition which differed because of verbal instructions. However, during sessions while participants were together in the same room, they were randomly assigned to be in the malleable condition or the fixed view of intelligence condition. In the malleable view condition, participants read a research article about the changeable qualities of intelligence throughout life. In the fixed view of intelligence condition, participants read an article describing intelligence as a single limited entity. The articles were distributed in a way to ensure roughly equal numbers of participants in each group overall.

The testing sessions were held in classrooms and consisted of mixed-sex groups of students. At the start of each session, the experimenter explained that this research involved testing different cognitive abilities and they would be completing two separate tasks, a reading comprehension and writing task and a math and verbal problems task. The participants were then given an informed consent sheet that also asked their permission to look up their current GPA and SAT-M scores. Following the informed consent process, the participants were given the reading and writing task, a blank sheet of paper, and a bubble sheet. The experimenter explained that they were to read the article and the statements that followed it very thoroughly. After reading all the material, they were then to write their own statement on the blank sheet of paper using personal events from their own lives to help explain the importance and implication of what they read

about intelligence. They then took a short quiz on the material they just read. They had 20 minutes to complete this task.

Next, the participants were told that they would be taking a test that consisted of math and verbal problems. They were given a blank sheet of paper to work out any problems and told to record their answers on the provided bubble sheet. To induce stereotype threat, participants in the stereotype-threat group were told, “This test is for diagnostic purposes and will be graded. Your performance will be compared to all others that take the test. Your performance will be a direct reflection of your math and verbal ability. Please write your last name and gender on the top of your blank sheet of paper.” This is a subtle activation cue. To remove stereotype threat, participants in the gender-fair group were told, “The test you are about to take has previously shown no gender differences, men and women have performed equally well on this test.” This is an explicit removal strategy. They were then told they had 30 minutes to complete this task.

After completing the math and verbal tests, participants completed the demographics questionnaire. Participants were given 10 minutes to finish the questionnaire. Finally, the debriefing sheets and quizzes were passed out. The debriefing sheet explained Dweck’s theory of intelligence and stereotype-threat literature and the reasoning behind the study. Participants were allowed to ask any questions concerning the study. The participants read the debriefing sheets

then took a 10 question quiz on the material to ensure they understood the underlying concept of the experiment (Appendix A, pp. 126-129).

Results

Participants completed a math and verbal test as a measure of performance. Participants received 1 point for answering the math question correctly and 0 points for an incorrect or missing answer. For the 13 math and verbal problems, a math sum score and a verbal sum score was computed by totaling the number of correctly answered questions for each type of problem. Only women's data were included in the analyses because stereotype threat should negatively affect their performance and have no effect on men's performance. Two a priori one-way ANOVAs were planned to compare the four experimental groups' (stereotype-threat/malleable, stereotype-threat/fixed, gender fair/malleable, and gender fair/fixed) on their math and verbal performance separately. Experimental condition did not affect math sum scores, $F(3, 88) = .79$, $p = .50$, or verbal sum scores, $F(3, 88) = .65$, $p = .59$. Because the stereotype being investigated is centered on women's impaired math performance in threatening situations, only the math sum score was used in the following analyses. A 2 (malleable vs. fixed view) x 2 (stereotype-threat vs. gender-fair condition) ANOVA on the math sum score was employed. There were no significant main effects of view of intelligence, $F(1, 90) = .312$, $p = .58$ or threat condition, $F(1, 90) = 1.29$, $p = .26$. The interaction between view of intelligence and threat condition was also not significant, $F(1, 90) = .74$, $p = .39$.

Participants' math sum scores did not significantly differ across the malleable and fixed condition for the stereotype-threat and gender-fair groups; however, the means were in the hypothesized direction as shown in Table 1.

Table 1. *Means for Math Sum Score by Experimental Group*

	Stereotype Threat		Gender Fair		Total	
	M	*s*	*M*	*s*	*M*	*s*
Malleable	7.0	(.47)	7.1	(.47)	7.0	(.33)
Fixed	6.3	(.46)	7.2	(.48)	6.8	(.33)
Total	6.6	(.33)	7.2	(.34)		

As a manipulation check, participants answered five questions regarding the article read for the theory of intelligence manipulation; 79.3% of participants answered all five questions correctly. Of that 79.3%, 46.5% of participants read the fixed article and 53.5% read the malleable article. As a follow-up analysis, the data from the remaining 21.7% were not included and the 2 (malleable vs. fixed view) x 2 (stereotype-threat vs. gender-fair condition) ANOVA on the math sum scores was re-analyzed. However, the results did not change; there were no significant main effects for view of intelligence condition or threat condition and no significant interaction between the two.

Two questions regarding the extent to which the participants adopted the fixed view of intelligence were combined to create an entity variable. Both questions were answered on a demographics survey at the end of the experiment on a five-point scale. The scores to both questions were summed

then averaged. A higher score reflected a greater orientation to the fixed view of intelligence. A 2 (malleable vs. fixed view) x 2 (stereotype-threat vs. gender-fair condition) ANOVA on the entity variable was employed. There was a significant main effect of view of intelligence, $F(1, 90) = 56.56$, $p < .001$. The entity score for participants in the fixed view condition was significantly greater than for participants in the malleable view condition. There was also a significant main effect of threat condition, $F(1, 90) = 7.17$, $p = .01$. The entity score for participants in the gender-fair group was significantly greater than for participants in the stereotype-threat group. The interaction between view of intelligence and threat condition was not significant, $F(1, 90) = .97$, $p = .33$. This suggests that the theory of intelligence manipulation was successful; women in the fixed condition adopted a more fixed view of intelligence compared to women in the malleable condition (Table 2). Although the threat condition was also significant, $\eta^2 = .009$ suggests a small effect size whereas the theory of intelligence condition had a stronger effect ($\eta^2 = .067$).

Table 2. *Means for Entity Score by Experimental Group*

	Stereotype Threat		Gender Fair		Total	
	M	*s*	*M*	*s*	*M*	*s*
Malleable	1.6	(.19)	1.9	(.19)	1.8	(.14)
Fixed	2.9	(.19)	3.6	(.19)	3.2	(.14)
Total	2.3	(.13)	2.8	(.14)		

Table 3. *Correlations between Scores and Math Identity Measures*

	SAT-M	Math Difficulty	Math Predict	Math Like	Math Important	Math Ability	Math Career
Math Score	.254*	-.275**	.447**	.195	.219*	.142	-.028
SAT-M	--	-.119	.294*	.406**	.279*	.299*	.262*
Math Difficulty		--	-.515**	-.325**	-.202	-.474**	-.321**
Math Predict			--	.480**	.413**	.571**	.311**
Math Like				--	.614**	.601**	.560**
Math Important					--	.485**	.673**
Math Ability						--	.416**

**. Correlation is significant at the 0.01 level (2-tailed).
* . Correlation is significant at the 0.05 level (2-tailed).

Correlations between the math sum score and several questions regarding the participants' attitude toward math were analyzed (Table 3). These questions asked respondents how important math was to the individual's career and how much they liked math. These questions were used to categorize how invested they were in math. The math scores positively correlated with prediction of math performance on this test, SAT-Math scores, and ratings of math importance. The higher the participants' predicted performance, the better their actual performance was. Participants with higher SAT-Math scores and who rated math as more important had higher scores on the math test. Surprisingly, self-ratings of math ability and the math performance on the test were not significantly correlated. Participants who rated their math ability as low did rate the math test as more difficult. They also rated how much they liked math and

how important math was to their chosen career as low. The strongest positive correlation was between ratings of how much they liked math and how important math was to them, followed by the rating of math ability and how much they liked math. These correlations reflect expected results, suggest that the participants were taking the study seriously, and demonstrate the data are trustworthy.

Actual SAT-Math scores were obtained and only women were included in the analysis. Therefore, as an additional follow-up analysis, an ANCOVA using SAT-Math scores as a covariate on math sum scores was utilized to control for pre-existing differences in math ability or experience. However, there were no significant main effects for theory of intelligence condition or threat condition. The interaction between the two was also not significant.

In previous research, how important math is to the individual has played a vital role in stereotype-threat effects (Nguyen & Ryan, 2008). The more important math is to a woman, the more susceptible she is to negative performance effects during stereotype-threat situations. Participants rated how important math was to them on a five-point scale (1 = not at all, 5 = very important). In total, 33 women who rated math importance as two or lower were excluded from the analysis. The 2 x 2 (view of intelligence vs. threat conditions) ANOVA was re-analyzed. Again, there were no significant main effects or interaction between the two.

A question on the demographics sheet asked, “In our culture, many people believe in a stereotype that men have better math skills than women.” Surprisingly, only 19 of 89 participants (21.3%) agreed or strongly agreed with

this statement. Additionally, participants were also asked, “I believe that, in general, men do have better math skills than women.” Only 7 of 88 participants, (7.9%) agreed or strongly agreed with this statement. Because so few women recognized this as a cultural stereotype or personally believed in the stereotype, the 2 x 2 ANOVAs on math sum scores could not be conducted due to the diminished sample size.

A measure of stereotype-threat manipulation effectiveness was developed by combining and averaging the responses on three different questions. These questions were: “I worry that my ability to perform well on math tests is affected by my gender; I worry that if I perform poorly on this test, the experimenter will attribute my poor performance to my gender; I worry that, because I know the negative stereotype about women and math, my anxiety about confirming that stereotype will negatively influence how I perform on math tests.” The questions were rated on a five-point scale and a higher average score indicated experiencing a higher degree stereotype threat. However, this was not a sufficient measure of stereotype threat. Of 88 participants, 82 (93%) had a score of 2.33 or less, indicating minimal stereotype-threat experience. A t-test comparing the gender-fair group and stereotype-threat group on this stereotype-threat measure revealed no significant differences.

Previous literature has shown that women in stereotype-threat situations can engage in reactance. This is when women actively work harder to disprove the stereotype that men outperform women in math therefore increasing their

math scores. Participants were asked to rate the statement, “I worked extra hard on the math problems because I wanted to prove that women can perform just as well as men,” (1 = strongly disagree, 5 = strongly agree). Only 2 of 89 (2.2%) participants agreed or strongly agreed with this statement, suggesting there was not a reactance effect present.

Discussion

For this study, no main effects or interactions reached statistical significance of .05; however, the math sum score means were in the hypothesized directions as indicated in the 2 x 2 ANOVA on math sum scores. The measure of stereotype threat which was created by combining several questions addressing stereotype-threat effects indicated the stereotype-threat manipulation was not strong. Previous literature (Nguyen & Ryan, 2008) suggests that the strongest negative stereotype-threat effects are seen after subtle activation cues. The second study combined several subtle activation cues also used in prior studies to enhance the effect; for example, the math and verbal test was described as diagnostic in nature (Johns et al., 2008) and as a direct reflection of their ability, participants were asked to write their name and gender on their answer sheet (Schmader & Johns, 2003), and told their scores would be compared to all others taking the test. However, using this activation strategy did not produce a stereotype-threat situation that negatively affected participants’ math performance.

Stereotype threat and gender-fairness were manipulated solely through verbal instructions. This may have also limited the effectiveness of the manipulation. If participants were distracted or simply not paying attention, they would not have heard the instructions that were meant to induce or reduce stereotype threat, depending on condition. However, when the participants were given instructions, the room was quiet and they were not working on any tasks, so their attention should not have been diverted and the intended message should have been clear. Earlier studies also used only verbal instructions to maximize and minimize stereotype-threatening situations and achieved the intended effects (Spencer et al., 1999). In retrospect, a stronger stereotype-threat manipulation was necessary. In addition to verbal instructions, the participants needed to actively engage in an activity to help bolster the intended message. For example, women have watched videos depicting gender-stereotypical behavior to induce stereotype threat (Davies et al., 2002). By including an additional activity which goes beyond verbal instructions, more time would be invested into the manipulation by the participants and the stereotype-threat effects would become stronger.

Within each testing session, there was a higher percentage of women participating compared to men; in total, 92 women and only 33 men. Spencer et al. (1999) found that in control conditions that did not mention gender or math, with equal number of men and women present, women underperformed in comparison to men. This suggests that by simply recruiting more men and having

them present during the testing sessions, stereotype threat could be heightened and more negative performance effects would be evident.

The 2 x 2 ANOVA conducted on the entity variable showed that participants involved in the fixed view of intelligence manipulation held a more fixed view of intelligence at the end of the study; however, the main effect for implicit theories of intelligence did not reach statistical significance in the 2 x 2 ANOVA on math sum scores. This means that math scores for participants in the fixed vs. malleable group did not significantly differ. This study combined two techniques to help manipulate implicit views of intelligence. The participants first read an article about their intended view of intelligence and statements from professionals describing how the intended view of intelligence helped shape their own life. Participants then had to write their own statement using personal examples to help enhance the manipulation. Although this study utilized two tasks to help strengthen their implicit theory of intelligence, Aronson et al. (2002) had their participants engage in several repetitive tasks to help orient their participants to a more malleable view of intelligence. Their participants also read a paragraph about malleable characteristics of intelligence, they then wrote a letter to a younger student about the importance of malleable intelligence. They also watched a video clip about malleable intelligence, and then wrote a second letter with another malleable message. They turned their letters into speeches that were recorded. The participants then had to listen to their recorded speeches several times. The combination of these techniques was used to

maximize the effectiveness of the malleable view of intelligence intervention. Their participants spent several successive sessions aimed to manipulate their view of intelligence. Initially, I thought that the manipulation would be successful with the two tasks the participants were required to engage in, but ultimately, the manipulation was not strong enough and the intervention was unsuccessful.

The pilot study indicated that the math problems may have not been difficult enough. For the second study, problems that were correctly answered at a high percentage were replaced with more difficult problems. The mean math sum score was 6.9 (s = 2.2), and correctly answered questions ranged from 1 to 13. The highest potential math sum score was 13. This mean suggests that the problems were adequately difficult and there was variability of math ability represented in the study. This variability could be the result of several possible situations. The participants may have disidentified with math. Because they are women and have had to take math courses their entire academic career, potentially causing a threatening situation, they may have removed math from their identity as a self-protection measure. Their low scores may be a reflection of their lack of identification with the math domain. Previous research (Nguyen & Ryan, 2008) suggests a moderate to high identification to math produces the strongest stereotype-threat effects because a part of their identity is still invested in the mathematical domain. Participants' low scores may have also been a result of considering math as a non-important aspect. Only 29.2% of participants rated math as important or very important to them as an individual and only

28.1% of participants rated math as important or very important to their careers. Spencer et al. (1999) only used participants who considered math as very important because these women show the strongest negative performance effects when in a stereotype-threat situation. However, for my study, there was low percentage of women who considered math important so no restrictions could be placed on participant inclusion. By using only women who agreed math was important, the ANOVA still produced no significant main effects or interaction because power was significantly decreased due to the small sample size.

The second study also included a reactance measure. Research has suggested that some women placed in stereotype-threatening math situations may have increased performance to disprove the current stereotype (Nguyen & Ryan, 2008). Although, reactance has been recognized in the literature, there were no previously utilized measures of reactance. For this study, a question was constructed to explicitly measure reactance: “I worked extra hard on the math problems because I wanted to prove that women can perform just as well as men” (1 = strongly disagree, 5 = strongly agree). However, only 2.2% of participants agreed or strongly agreed with this statement, suggesting reactance was not at play here. Because this question was created for the sole purpose of this study and had never been previously used, it may not be adequately capturing the process of reactance.

Overall, this study had several limitations. Because stereotype threat was not successfully induced, the intervention involving implicit theories of intelligence

was not effective. By enhancing the manipulation of stereotype threat and implicit theories of intelligence, a more efficient design should be achieved. There were also problems concerning the degree in which women identified and classified math as important. By having a sample of women who strongly identify with math and consider it important and relevant to their lives, stronger stereotype-threat effects should be present, which would allow the implicit theories of intelligence intervention an increased chance at success. Although the intervention was not statistically successful, the math sum score means for the experimental group were in the correct direction. By addressing these limitations and strengthening the current design, a successful intervention would help lessen the negative performance effects experienced by women in threatening math-related testing situations.

CHAPTER IV: GENERAL DISCUSSION

Although implicit theories of intelligence have been used as a successful intervention for stereotyped African American students in academic domains, this has not yet been replicated for women in math. Steele (1997) states that for negative stereotype-threat effects to occur, one does not have to actually believe in the stereotype, but only know that the stereotype exists. In my second study, participants were asked, “In our culture, many people believe in a stereotype that men have better math skills than women,” to assess their knowledge of the stereotype. Only 21.4% of participants agreed or strongly agreed with the statement. This indicates that a large portion of participants were not aware of or misinterpreted the stereotype which may be the reason they were not affected by the stereotype-threat manipulation. With no prior knowledge of the stereotype, there was no anxiety involved in the testing sessions and they had nothing to disprove about women’s math abilities. When asked, “I believe that, in general, men do have better math skills than women,” to assess their personal belief in the stereotype, only 7.9% of participants agreed or strongly agreed with the statement. This suggests that within this sample, the stereotype that men are better at women in math was not prevalent. If this sample is representative of college women as a whole, perhaps this stereotype is no longer as pervasive as it once was. It is possible that women are now more immersed into higher learning opportunities and feel as if they are on a nearly equal playing field with men, and that they too have mathematical strengths. However, with the low

identification and the low importance rating this sample attributed to math, it is likely that these women just do not recognize or feel the pressure that stems from the stereotype.

Throughout the literature, performance effects caused by stereotype threat and manipulation of implicit theories of intelligence appear to be easily induced. My study actually combined several techniques which would seemingly intensify the effects, but the opposite occurred. No effects on math performance were present for either manipulation. Perhaps this suggests that fewer techniques produce greater results or that previous manipulations were implemented in a more effective fashion. It is possible that the combination of all the stereotype-threat techniques, which were induced through verbal communication, was overwhelming for the participants. They may have not listened to my entire speech which would not fully induce the effect. Because participants' theories of intelligence were manipulated through an interactive reading and writing task, this may be why the theory of intelligence manipulation was more effective. The pilot study and literature (Nguyen & Ryan, 2008) has shown that blatant activation cues are not the strongest way to induce stereotype threat. In addition, explicit removal strategies also inhibit negative performance effects more efficiently. Therefore, the second study was based upon subtle activation cues that did not mention a relationship between gender and math performance and an explicit removal strategy that rejected differences in math performance

between men and women. However, these strategies still did not produce significant results.

Because no research has previously combined implicit theories of intelligence as an intervention for underperformance seen in women in math tasks, these results offer a solid foundation upon which to build. The first step to a successful intervention would be to identify a group of women who are most susceptible to math-related threatening situations. These are the women who would experience the greatest negative performance effects and therefore benefit the most from a successful intervention. By identifying the techniques that consistently produce the largest stereotype-threat effects, the stereotype-threat manipulation would also be enhanced. If these effects cannot be reproduced, there would be no need for an intervention; meaning the stereotype-threat replication is a critical part of the experimental design. Because implicit theories of intelligence have been utilized as a successful intervention for stereotype threat in academic domains before (Aronson et al. 2002), this intervention should be applicable to an alternate form of stereotype threat of women in math. This study did not have the luxury of multiple testing sessions which utilized many techniques to help solidify the manipulation. However, future studies may want to consider the effectiveness of repetition. By steadily reinforcing the idea of a malleable theory of intelligence, academic performance improved and stereotype-threat effects were significantly decreased (Aronson et al., 2002). Because these two ideas, theories of intelligence and stereotype-threat effects

for women in math, have not been previously linked, this study identifies important implications and several limitations to be addressed with future research.

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Appendix A: Replication of Stereotype Threat Effects Materials

INFORMED CONSENT

Title of Research Study: Performance on Cognitive Tasks

Principal Investigator:	**Faculty Advisor**:
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Institution: East Carolina University	Department of Psychology, 312 Rawl Building
Address: Department of Psychology	East Carolina University (252) 328-6214

INTRODUCTION

You are being asked to participate in a research study that is Ashley Wilson's thesis project (under the direction of Dr. Marion Eppler). This research is designed to measure performance of undergraduate students on different types of cognitive tasks.

PLAN AND PROCEDURES

You will be asked to complete two different tasks. The first is a reading task in which you will read some statistics and facts and answer some questions based on the reading. The second is a test, which includes math and verbal questions and asks you to rate your attitude towards the problems. This study should take no longer than 60 minutes to complete.

RISKS AND VOLUNTARY PARTICIPATION

We foresee no risks for your participation in this study. However, participation in this study is voluntary. If you decide not to be in this study after it has already started, you may stop at any time without losing benefits that you should normally receive. You may stop at any time you choose without penalty.

POTENTIAL BENEFITS

You will receive information about psychology research and the expected results of this study at the end of your testing session. If you would like to receive a summary of the results, please include your e-mail address below.

CONFIDENTIALITY OF RECORDS

To protect confidentiality, your name or other identifying information will not appear in the data file where you're your responses to the study will be coded. The signed informed consent forms will be stored separately from all data in a secure location.

PERSONS TO CONTACT WITH QUESTIONS

The investigators will be available to answer any questions concerning this research, now or in the future. You may contact the investigators, Ashley Wilson (828-228-1097) or Dr. Marion Eppler (252-328-6214). If you have questions about your rights as a research participant, you may call the Chair of the University and Medical Center Institutional Review Board at phone number 252-744-2914 (days) and/or the ECU Risk Management Office at 252-328-6858.

CONSENT TO PARTICIPATE

I certify that I have read the information above, asked questions if necessary, and received satisfactory answers to these questions. I willingly give my consent for participation in this study.

_____

Participant's Name **(PRINT)** **Signature** **Date**

_____

Course and section number (also include instructor name and when class meets) **e-mail address**

_____

Investigator's name **(PRINT)** **Signature** **Date**

Facts Concerning Gender and Math

Gender differences in math performance are not apparent during early years of education. Boys and girls perform equally on math tasks throughout the duration of elementary school.

In a study conducted that included 2,500 students from 4th grade through 11th grade, it was found that in the cohort of students scoring above the 95th percentile, there is 1 boy for every girl. Go above the 99th percentile and the ratio remains the same, 1 to 1. Go higher, and this ratio is still comparable between boys and girls.

During middle school, when students do not have a choice in what courses they take, on average, boys have similar grades in their math courses compared to girls.

In high school, when students have more freedom to choose their courses, an equal number of men and women choose to take higher level math courses. When comparing grades in these courses, men and women had equal averages.

In an international survey, men reported that they enjoyed engaging in math tasks as much as women. Men and women also reported the same confidence in their solution after working math problems than women did.

In 2005 the Center for International Student Assessment administered an internationally standardized assessment of math. It was given to 25,000 children across the world. Based on the analysis of the results, it was determined that the global pattern shows that boys and girls had an equal performance in math.

A national level math competition, The Math Olympics, which includes gifted math students from age 16 to 18. From 1999 to 2008, 5 of the winners were males and 5 of the winners were female.

Men score an average of 580 on the math section of the SAT compared to women's average score of 560.

Data collected from public universities around America found that the ratio of men to women enrolled in advanced level math classes were roughly 1.2 to 1. This means that the enrollment of the classes was comprised of an almost equal number of women and men.

On the GRE, men score an average of 560, whereas women score an average of 550. This is a not a significant difference in gender performance.

From 2003 through 2008, 48% of Ph.D's in mathematics went to women.

In fields that utilize math daily, men are 53% of the population that choose these math-related careers. Women encompass 47% of math-related careers.

Even in older age, there are no gender differences seen in math performance. A study using older adults, whose age ranged from 55 to 70, showed no gender difference in performance. There was only a 1.3 point difference between the average scores of men and women.

Facts Concerning Gender and Math

Gender differences in math performance can be seen at a very early age. Boys start outperforming girls on math tasks as early as elementary school.

In a study conducted that included 2,500 students from 4th grade through 11th grade, it was found that in the cohort of students scoring above the 95th percentile, there are 1.45 boys for every girl. Go above the 99th percentile and the ratio grows to 2 to 1. Go higher, and the discrepancy of boys outscoring girls would only grow further.

During middle school, when students do not have a choice in what courses they take, on average, boys have higher grades in their math courses compared to girls.

In high school, when students have more freedom to choose their courses, men choose to take higher level math courses. When comparing grades in these courses, men had higher averages than females.

In an international survey, men reported that they enjoyed engaging in math tasks much more than women. Men also reported a higher confidence in their solution after working math problems than women did.

In 2005 the Center for International Student Assessment administered an internationally standardized assessment of math. It was given to 25,000 children across the world. Based on the analysis of the results, it was determined that the global pattern shows that boys tended to outperform girls in math; on average girls score 10.5 points lower than boys.

A national level math competition, The Math Olympics, which includes gifted math students from age 16 to 18. From 1999 to 2008, 8 of the winners were males. Only 2 females won the competition in 10 years.

Men score an average of 680 on the math section of the SAT compared to women's average score of only 520.

Data collected from public universities around America found that the ratio of men to women enrolled in advanced level math classes were 4 to 1. This means that 80% of the classes were comprised of men.

On the GRE, men score an average of 660, whereas women score an average of 500.

From 2003 through 2008, just 18% of Ph.D's in mathematics went to women.

In fields that utilize math daily, men are 83% of the population that choose these math-related careers. Women encompass 17% of math-related careers.

Even in older age, there are gender differences seen in math performance. A study using older adults, whose age ranged from 55 to 70, men scored an average of 15.2 points higher than women, on a 100 point scale.

Quiz on Facts Concerning Gender and Math

1. Gender differences on performance in math
   A. Do not exist.
   B. Are seen as early as elementary school.
   C. Do not appear until college years.
   D. Disappear later in life.
   E. Show that women outperform men.

2. An international survey found that
   A. Women enjoy math more than men.
   B. Women are more confident in their math skills than men.
   C. Men enjoy math more than women.
   D. Men find math problems more difficult to work than women.
   E. Men and women enjoy math equally and have a similar confidence in their answers after working the problem.

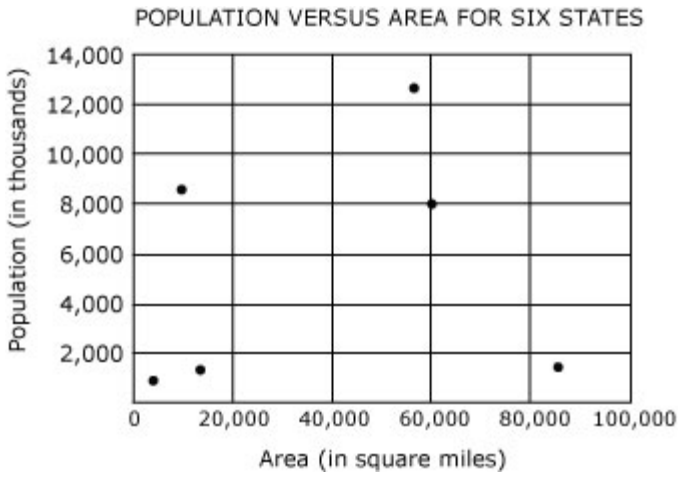
3. On standardized tests, such as the SAT and the GRE, on the math portion,
   A. Women and men's average scores were almost equal
   B. Men score higher than women.
   C. Women score higher than men.
   D. Women score higher on the SAT than men do.
   E. Women score higher on the GRE than men do.

4. Public universities around America found that in advanced level math courses:
   A. Women outnumbered men.
   B. The enrollment of genders was basically equal.
   C. There were more men enrolled than women.
   D. Professors preferred to teach women.
   E. Women were happier to learn harder concepts.

5. When adults reach the age range of 55 to 70, it is known that:
   A. Both genders' math skills rapidly decline.
   B. Men perform better at math tasks than women.
   C. Women outperform men on math tasks.
   D. Men refuse to do math tasks at this age.
   E. Both men and women perform equally as well

For this section of the study, you will be working on math and verbal problems. Please continue your answers on your bubble sheet, starting at question 6. For the math problems, there is a blank sheet of paper in which you may do your work on, if necessary. There are also additional questions after each problem which utilize scales for your answer. Please pay careful attention to what the question is asking you to answer. Also pay attention to what each end of the scale represents to ensure you give the answer that you want. You will have 40 minutes to complete this task.

6.



The scatterplot above shows the area, in square miles, versus the population, in thousands, for six states. How many of these states have a population under 10,000,000 and an area over 40,000 square miles?
A. 1 B. 2 C. 3 D. 4 E. 5

7. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

8. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

9. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

10. Because King Philip's desire to make Spain the dominant power in sixteenth-century Europe ran counter to Queen Elizabeth's insistence on autonomy for England, ------- was -------.

A. reconciliation, assured
B. warfare, avoidable
C. ruination, impossible
D. conflict, inevitable
E. diplomacy, simple

11. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

12. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

13. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident Very Confident

14. Each occupation has its own ____ ; bankers, lawyers and computer professionals, for example, all use among themselves language which outsiders have difficulty following.

A. merits B. disadvantages C. rewards D. jargon E. problems

15. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment Great Enjoyment

16. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy Extremely Difficult

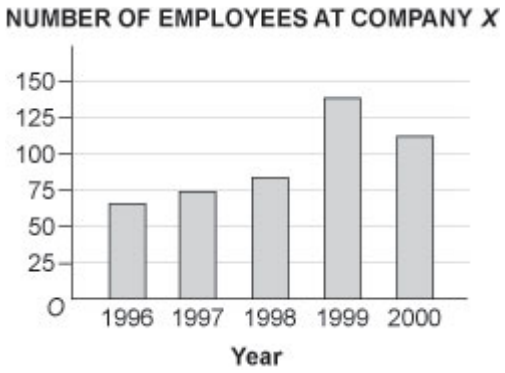
17. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident Very Confident

18.



The bar graph above shows the number of employees at Company *X* for each of the years from 1996 through 2000. Over which of the following periods was the average *rate* of increase in the number of employees at Company *X* greatest?
A. From 1996 through 1998
B. From 1996 through 1999
C. From 1997 through 1999
D. From 1998 through 1999
E. From 1998 through 2000

19. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

20. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

21. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

22. A discerning publishing agent can ------- promising material from a mass of submissions, separating the good from the bad.
A. supplant B. dramatize C. finagle D. winnow E. overhaul

23. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

24. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

25. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

26. A convenience store sells small bottles of juice for $2 each and large bottles of juice for $3 each. Ciara bought 8 bottles of juice at this store and paid $18. Some of the bottles of juice that she bought were large, and the rest were small. How many small bottles of juice did Ciara buy?
A. 2 B. 3 C. 4 D. 5 E. 6

27. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

28. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

29. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

30. The addition of descriptive details to the basic information serves to ------- the book by producing a fuller account.
A. invalidate B. objectify C. incite D. celebrate E. enrich

31. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

32. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

33. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

34. The set *S* consists of all multiples of 6. Which of the following sets are contained within *S*?
I. The set of all multiples of 3.
II. The set of all multiples of 9.
III. The set of all multiples of 12.

A. I only
B. II only
C. III only
D. I and III only
E. II and III only

35. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

36. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

37. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

38. Joshua's radical ideas were frowned on by most of his coworkers, who found them too ------- for their conservative tastes.
A. heretical B. meticulous C. precise D. incoherent E. sagacious

39. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

40. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

41. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

42. 237 x 14=

A. 3278 B. 3318 C. 4318 D. 3328 E. 2318

43. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

44. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

45. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident ... Very Confident

46. Paint : _____ :: Varnish : Floor

A. picture B. brush C. wall D. mix E. acrylic

47. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment ... Great Enjoyment

48. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy ... Extremely Difficult

49. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident ... Very Confident

50. Which of the following is equivalent to $(x)(x)(x)(x)$, for all x ?

A. $4x$ B. x^4 C. $x + 4$ D. 4^x E. $2x^2$

51. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment ... Great Enjoyment

52. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

53. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

54. Lion : Giraffe :: _____ : Oak

A. tree B. plant C. elm D. desk E. nature

55. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

56. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

57. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

58. Which of the following in not a fraction equivalent to 5/8?
A. 10/16 B. 15/24 C. 20/36 D. 35/56 E. 45/72

59. How much did you enjoy working this problem?
|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

60. How difficult was this problem?
|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

61. How confident are you that you answered this question correctly?
|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

62. 1 : 2 :: Half : _____

A. quarter B. hole C. section D. whole E. eight

63. How much did you enjoy working this problem?
|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

64. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

65. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

66. 9825 ÷ 15=

A. 650 B. 625 C. 655 D. 755 E. 653

67. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

68. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

69. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

70. Which of these numbers is a factor of 21?

A. 2 B. 5 C. 7 D. 42 E. 44

71. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

72. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

73. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

74. Ginger, over the course of an average work-week, wanted to see how much she spent on lunch daily. On Monday and Tuesday, she spent $5.43 total. On Wednesday and Thursday, she spent $3.54 on each day. On Friday, she spent $7.89 on lunch. What was her average daily cost?
A. $3.19 B. $3.75 C. $3.90 D. $4.08 E. $4.23

75. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

76. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

77. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

78. botanist: petunia:: geologist: _____

A. matter B. periwinkle C. gypsum D. coin E. energy

79. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

80. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

81. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

82. Which of the following is divisible by 3 (with no remainder)?

A. 2725 B. 4210 C. 4482 D. 6203 E. 8105

83. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

84. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

85. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

86. Define moderate

A. Embracing the extremes of behavior
B. Tending toward the mean or average
C. Going to an exaggerated length
D. Very thorough
E. Involved in an extreme sport

87. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

88. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

89. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

90. Karen is twice as old as Lori. Three years from now, the sum of their ages will be 42. How old is Karen?

A. 24 B. 12 C. 15 D. 26 E. 27

91. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

92. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

93. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

94. The teacher accused me of ____ because my essay was so similar to that of another student.
A. procrastination B. plagiarism C. celerity D. confusion E. decorum

95. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

96. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

97. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

98. If a rectangle has one side that equals 4 units and another side that equals 16 units. What is the area of the rectangle?

A. 40 B. 4 C. 64 D. 20 E. 32

99. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

100. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

101. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

102. brittle: break:: flexible: _____

A. bend B. crush C. compress D. divide E. separate

103. How much did you enjoy working this problem?

|----------|----------|----------|----------|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

104. How difficult was this problem?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

105. How confident are you that you answered this question correctly?

|----------|----------|----------|----------|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

106. The quantum theory was initially regarded as absurd, unnatural and ____ with common sense.
A. consanguineous B. discernible C. incompatible D. decipherable
E. consistent

107. How much did you enjoy working this problem?

|---|---|---|---|

1(A) 2 (B) 3 (C) 4 (D) 5 (E)

No Enjoyment — Great Enjoyment

108. How difficult was this problem?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Extremely Easy — Extremely Difficult

109. How confident are you that you answered this question correctly?

|---|---|---|---|

1 (A) 2 (B) 3 (C) 4 (D) 5 (E)

Not Confident — Very Confident

GENERAL INSTRUCTIONS: Please do not write on this survey. Code all of your responses using a #2 pencil on the computer answer sheet as directed for each section. If you have questions at any time, please ask the researcher for assistance. There are no right or wrong answers to most of the questions below. They are simply a matter of personal preference or personal opinion. We ask that you please answer all of the questions as honestly and completely as possible.

SIDE TWO OF BLUE BUBBLE SHEET

NAME: Leave this section blank.
SEX: Fill in your sex (M or F).
BIRTH DATE: Fill in the year and month that you were born as indicated on the form.
GRADE OR EDUCATION: Fill in what year/class you are at this time (1 = freshman, 2 = sophomore, 3 = junior, 4 = senior, 5 = non-degree student).
IDENTIFICATION NUMBER: Please leave blank.
SPECIAL CODES: Please fill in your current GPA at ECU in the **first 3 columns**. This does not include a decimal. Please report your GPA as 3 numbers. For example, if your GPA was 2.75, you would write 275 and bubble in the corresponding bubbles beneath it. In the **next 3 columns**, also in special codes please fill in your score that you received on the **MATH** portion of the **SAT**. Please write in your 3 digit score and bubble in the corresponding bubbles beneath it. If you honestly do not remember your score, please leave this section blank.

SIDE ONE OF BLUE BUBBLE SHEET

Now turn to the other side of the answer sheet (side numbered 1-120) and continue.

110. Please rate how difficult OVERALL the math problems on the test were:

|----------|----------|----------|----------|

A B C D E

very easy very hard

111. Please rate how difficult OVERALL the verbal and English problems on the test were:

|----------|----------|----------|----------|

A B C D E

very easy very hard

112. Please predict how well you did on the math portion of the test:

|----------|----------|----------|----------|

A B C D E
very bad very good

113. Please predict how well you did on the verbal and English portion of the test:

|----------|----------|----------|----------|

A B C D E
very bad very good

114. Please rate how much you like math:

|----------|----------|----------|----------|

A B C D E
not at all very much

115. Please rate how important math is to you:

|----------|----------|----------|----------|

A B C D E
not at all very important

116. How important is math to your chosen career?

|----------|----------|----------|----------|

A B C D E
not at all very important

117. Please rate your math ability:

|----------|----------|----------|----------|

A B C D E
extremely low extremely high

118. Do you believe a math stereotype against women exists?

True (A) or False (B)

119. Do you believe that men outperform women in math?

True (A) or False (B)

120. I worry that my ability to perform well on math tests is affected by my gender.

|----------|----------|----------|----------|

A Strongly Disagree | B | C | D | E Strongly Agree

121. I worry that if I perform poorly on this test, the experimenter will attribute my poor performance to my gender.

|----------|----------|----------|----------|

A Strongly Disagree | B | C | D | E Strongly Agree

122. I worry that, because I know the negative stereotype about women and math, my anxiety about confirming that stereotype will negatively influence how I perform on math tests.

|----------|----------|----------|----------|

A Strongly Disagree | B | C | D | E Strongly Agree

For the following questions, please bubble in the choice A if you have taken these courses in high school. If you did not take the course in high school, please leave the question blank.

123. Algebra 1 if yes: bubble in A, if no please leave blank

124. Algebra 2 if yes: bubble in A, if no please leave blank

125. Geometry if yes: bubble in A, if no please leave blank

126. Pre-Calculus if yes: bubble in A, if no please leave blank

127. Calculus if yes: bubble in A, if no please leave blank

128. Statistics if yes: bubble in A, if no please leave blank

129. Other if yes: bubble in A, if no please leave blank

For the following questions, please bubble in the choice A if you have taken these courses in college. If you did not take the course in college, please leave the question blank.

130. Intermediate Algebra if yes: bubble in A, if no please leave blank

131. College Algebra if yes: bubble in A, if no please leave blank

132. Trigonometry	if yes: bubble in A, if no please leave blank
133. Pre-Calculus	if yes: bubble in A, if no please leave blank
134. Higher than Pre-Calculus	if yes: bubble in A, if no please leave blank
135. Statistics	if yes: bubble in A, if no please leave blank
136. Other	if yes: bubble in A, if no please leave blank

Debriefing Sheet for "Performance on Cognitive Tasks"

Principal Investigator:	**Faculty Advisor**:
Ashley Wilson arw0314@ecu.edu	Dr. Marion Eppler epplerm@ecu.edu
Institution: East Carolina University	Department of Psychology, 312 Rawl Building
Address: Department of Psychology	East Carolina University (252) 328-6214

Stereotype threat: Researchers such as Aronson and Steele have examined how stereotype threat influences performance on a variety of tasks. Stereotype threat occurs when people are aware of stereotypes about their group, whether they believe the stereotype or not, and it can lead to impaired performance. For example, simply asking people to indicate their gender on an answer sheet can result in lower performance on a math task for women compared to men because of stereotypes about gender differences in math. People do worse in stereotype threat situations because they feel that their performance will confirm the negative stereotypes about their group. Previous research has also shown that reducing stereotype threat eliminates this underperformance. Stereotype threat can be reduced by making the stereotype irrelevant (not mentioning gender on a math task) or by countering the stereotype (telling people that on this particular math task, women tend to perform better than men).

Hypotheses: For this study, there are three conditions: a stereotype threat group, a gender-fair group, and a control group. The stereotype threat group receives information that there are gender differences in math performance. The gender-fair group receives information that there are no gender differences in math performance. The control group receives no information regarding gender and math. These are the independent variables being tested. Everyone's scores on the test is the dependent variable. Our hypothesis is that women will do better on the math test that was described as gender-fair and worse on the math test that was described as gender biased, whereas we expect to find no differences for men (they should do equally well on both math tests). We also expect women the gender-fair group to outperform the women in the control group in math.

Important Note:

It is extremely important that you not discuss this study with others because it may affect their behavior in our study. If students come into the study already knowing what it is about and what our hypotheses are, then they may not behave naturally. They may try harder to do well or not try at all, and this would invalidate our results. We will send you an e-mail message when we have finished the study and when a summary of the results is available. We will post a summary on the Experimentrak bulletin board outside of Rawl 130 later in the semester, and we will send you a copy of that summary if you include your e-mail address on the consent form.

Thank you again for your time, effort, and cooperation!

Print Your Name:

_____

CLASS = PSYC_____ Section _____ (this information is vital for assigning credits)

Performance on Cognitive Tasks
Ashley Wilson (Spring 2009)

_____ 130. Which condition were you in?
a. Stereotype threat group
b. Gender-fair group
c. Control group

_____ 131. Stereotype threat is:
a. when people have negative thoughts about other groups
b. when people are aware of stereotypes about their own group and this causes them to perform poorly on a task
c. when people are aware of stereotypes about other groups and this causes them to perform better than those other groups

_____ 132. Stereotype threat can be reduced by:
a. making the stereotype irrelevant to the task
b. making the stereotype important to the task
c. countering the stereotype
d. both a and c

_____133. If you are taking a math test and the instructor asks you to indicate your gender at the top of the test, what is likely to happen (based on stereotype threat research)?

a. women will perform worse than men
b. men will perform worse than women
c. there will be no difference between the performance of women and men

_____ 134. When reducing stereotype threat, what is an example of countering the stereotype?

a. telling people that on this particular math task, women tend to perform better than men
b. telling women this test is for diagnostic purposes
c. having a male experimenter

_____ 135. In this study, when the tests were described either as being gender-biased or gender-fair, this is an example of:
a. an independent variable
b. a dependent variable
c. a control variable

_____ 136. Everyone's scores on the tests are an example of:
a. an independent variable
b. a dependent variable
c. a control variable

_____ 137. What kind of information did the control group receive in this experiment?
a. that women outperform men in math
b. that men outperform women in math
c. there is no difference in performance in math between women and men
d. no information about gender

_____ 138. According to the hypothesis of this study, for women, which group's performance will be the most impaired:
a. the control group
b. the gender-fair group
c. the gender-biased group

_____ 139. Why is it important for you **NOT** to discuss this study with other students until all of the testing sessions have been completed?
a. because it may affect their behavior in the study
b. because if they know the concepts and hypotheses, they may try harder or put forth less effort to complete the tasks
c. because it would invalidate the results of the study
d. because Ashley Wilson's thesis would be ruined
e. all of the above

Appendix B: A Stereotype Threat Intervention Using Implicit Theories Materials

INFORMED CONSENT

Title of Research Study: Achievement Motivation and Academic Performance

Principal Investigator: Ashley Wilson arw0314@ecu.edu **Institution**: East Carolina University **Address**: Department of Psychology	**Faculty Advisor**: Dr. Marion Eppler epplerm@ecu.edu Department of Psychology, 334-B Rawl Building East Carolina University (252) 328-6214

INTRODUCTION

You are being asked to participate in a research study that is Ashley Wilson's thesis project (under the direction of Dr. Marion Eppler). This research is designed to measure performance of undergraduate students on different types of cognitive tasks.

PLAN AND PROCEDURES

You will be asked to complete two tasks. The first is a reading comprehension and writing task in which you will read an article and some additional statements and write a short paragraph and answer a few questions based on the reading. The second is a math and verbal task in which you will take a multiple choice test. This study should take no longer than 60 minutes to complete.

RISKS AND VOLUNTARY PARTICIPATION

We foresee no risks for your participation in this study. However, participation in this study is voluntary. If you decide not to be in this study after it has already started, you may stop at any time without losing benefits that you should normally receive. You may stop at any time you choose without penalty.

POTENTIAL BENEFITS

In return for your participation, you will receive 1 credit for your PSYC 1000 (Introduction to Psychology) class. You will also receive information about psychology research and the expected results of this study at the end of your testing session. If you would like to receive a summary of the results, please include your e-mail address below.

CONFIDENTIALITY OF RECORDS

You may be asked to write your name on some of the test materials. This material and the signed consent forms will be kept in secure location after the testing session concludes. The data files will not have any identifying information.

PERSONS TO CONTACT WITH QUESTIONS

The investigators will be available to answer any questions concerning this research, now or in the future. You may contact the investigators, Ashley Wilson (828-228-1097) or Dr. Marion Eppler (252-328-6214). If you have questions about your rights as a research participant, you may call the Chair of the University and Medical Center Institutional Review Board at phone number 252-744-2914(days).

CONSENT TO PARTICIPATE

I certify that I have read the information above, asked questions if necessary, and received satisfactory answers to these questions. I willingly give my consent for participation in this study.

_____

Participant's Name **(PRINT)** **Signature** **Date**

_____

Course and section number **Banner ID** **E-mail address**

_____

Investigator's name **(PRINT)** **Signature** **Date**

****Do you give us permission to access your official GPA and SAT scores from the ECU registrar? Your scores will remain confidential and only the experimenters will have access to the scores.**

Please initial your choice: YES _____ NO _____

Reading Comprehension Task

Instructions: Read the article carefully then answer the following questions.

Human Intelligence

Recent research suggests that the brains of very intelligent people develop no differently from the brains of less intelligent people. Studies of brains have taught us that intelligence is created when neural connections in the brain are changed in response to environmental cues. Brain scans show that there is an adaptation mechanism in the brain that allows it to grow connections in response to environmental cues. This means that a person can expand their intelligence at any time throughout life simply from environmental stimulation.

"Children of smart parents tend to be smart, but that may not be because there are smart genes and dumb genes," scientists say. Does one have to be a child Einstein to be an adult Einstein? No. Intelligence researchers at the University of Wisconsin at Madison point out that the brain is highly malleable and suggest that experience and environmental cues may play a very important role in shaping intelligence. Although the difference between smart kids and not-so-smart kids is often obvious in social, academic and psychological settings, it has been extremely difficult to identify the brain mechanisms that allow some children to excel. Research suggests that people should not assume that differences in intelligence are genetically predestined- the body's development is intimately linked to interactions with its environment.

According to recent research, up to 88% of a person's intelligence is due to environmental factors, and most of our intelligence continues to expand throughout life. This means that intelligence is malleable and that humans are capable of learning and mastering new things at any time in their lives. The brilliance of people such as Leonardo da Vinci and Albert Einstein was a result of their actions and their challenging environments, not their genes. Intelligence expands with hard work; the brain, and hence intelligence, is capable of growing and making new connections throughout life.

"The idea that we are born with a certain set of genes which 'fix' at birth our intelligence and the trajectory of our brain development is highly unlikely," researchers say. Intelligence is not a finite endowment, but rather an expandable capacity that grows, like a muscle, with mental work. It is important that we challenge ourselves every day in order to expand our intelligence.

Testimonies of Intelligence

The following statements are written by professional from various fields. They are testaments to how viewing intelligence as an expandable quality helped them throughout life and through difficult periods.

As a child I struggled with reading and writing tasks. While it seemed as if the rest of my classmates were catching on quickly and reading novels, I felt as if I had fallen behind. Instead of giving up in the face of challenge, I worked harder than ever. I spent my extra time studying my spelling words and doing grammar and writing exercises. The extra work paid off, when I reached junior high I was not only on the same level as my fellow classmates, I really started to enjoy reading. By working hard, I overcame the challenges before me and gained a great appreciation for a subject that I once struggled with.
Dr. Evan Burnett
PhD in Literature

As an elementary school teacher, I come in contact with frustrated children every day. Quite often in the face of difficulty, I hear a child say, “I’m not smart enough.” In my classroom, I try to convey a positive message about intelligence. I tell the children that working through challenges is a key part of learning and new concepts aren’t easy and making mistakes is okay. By learning from your mistakes, you are making your brain work harder and becoming smarter. I believe this message gives children a positive outlook and a better attitude about failure and challenges.
Linda Reed
4th Grade Teacher

After I retired, I felt as if I was no longer working towards any goals or ambitions. I had worked in the nursing field for 32 years before retiring. But with all the spare time I had, I wanted to learn about something else. I had always had an interest in foreign languages, but never had time to pursue it. I wanted to learn how to Spanish. The first few days were a struggle and I felt as if I were too old to take on this task. But as time progressed, I stuck with it and things became easier. At first I couldn’t even pronounce the words, but eventually I was forming sentences and even teaching my husband a few words! My perseverance through the initial hard times helped me achieve my goal of learning Spanish.

Beatrice Long
Retired Nurse Practitioner

Instructions: Now on the blank sheet of paper provided, use the article and these testaments to help you write your own personal testament about the expandability of intelligence. Be sure to include your own personal experiences with difficulty and failure and how you learned from the challenge.

Reading Comprehension Task

Instructions: Read the article carefully then answer the following questions.

Human Intelligence

Recent research suggests that the brains of very intelligent children appear to develop in a distinctive and surprising way that distinguishes them from less intelligent children. Studies of brains have taught us that people with higher IQs do not have larger brains, but we can now see that the difference may be in the way the brain develops. Brain scans show that children with the highest IQs begin with a relatively thin cortex. The cortex thickens in gifted children until around age 11 or 12, much later than in children of average intelligence, whose cortex thickening peaks by age 8.

"There is a general factor of intelligence, or *g*, that is highly heritable and defines intelligence as an overall innate ability to perform well on different measures of intelligence, which is not open to change," scientists say. Intelligence researchers point out that there is not much we can do to change the amount of intelligence we are born with. Research suggests that people of low IQ perform poorly because their brains do not adapt well to environmental stimulation.

According to recent research, up to 88% of a person's intelligence is due to genetic factors, and about 10% of our intelligence is determined during the first 3 years of life. This means that intelligence may be increased or decreased by only about 2% during most of a person's life. Great men like Mozart and Einstein were probably born, not made.

Although intelligence appears to be an innate trait, scientists have recently thought of intelligence as not a single unit but consisting of many different abilities. They categorize these abilities into 8 separate types of intelligence: bodily-kinesthetic, interpersonal, verbal-linguistic, logical-mathematical, naturalistic, intrapersonal, visual-spatial and musical. This research suggests that being highly intelligent overall does not mean you will excel in all these areas. If your ability suffers in one area, you should not try to improve your ability in that particular area, but move to another area in which you naturally excel.

Researchers are still unsure of the exact brain processes that predict intelligence, but one thing's for sure, "whatever those processes are, they are happening in different ways in children of different intellectual ability." General intelligence seems to be a finite endowment with an un-expandable capacity to grow. Although we can strive to reach our full potential, we cannot actually change the amount of intelligence we are born with.

Testimonies of Intelligence

The following statements are written by professional from various fields. They explain how viewing intelligence as consisting of separate abilities has affected their lives.

As a child I struggled with reading and writing tasks. While it seemed as if the rest of my classmates were catching on quickly and reading novels, I felt as if I had fallen behind. I decided that reading and writing just weren't for me. I had always heard that you are born with all the intelligence you will ever have. Instead of focusing on improving those abilities, I decided to spend time on something I was good at. I spent my extra time doing math problems and learning new concepts outside of the classroom. I still enjoy math and work with it every day. But I never truly gave reading and writing another shot. I did enough to scrape by and that ended up working out. By forgetting about reading and writing it allowed me to focus on what I was really good at, math.
Daniel Frank
Bank Associate

As an acting coach, I come in contact with budding stars every day. I often overhear them talking about their difficulties in school. I think back to my school days and how I struggled and just wanted to finish and move to Hollywood. I wasn't concerned with being an over-achiever; I only managed to squeak by and look at me now. I've discovered many stars and am an important figure in Hollywood. I tell my clients to not focus so much on school and just get through it and to keep their parents happy. I explain to them that they have a lot of potential in show business and focusing on that is the best thing for them. I try to tell them that if you aren't good at one thing, you're probably good at something else. By spending time on their acting career, my clients feel better about themselves and enhance their skills. I think if you aren't naturally good at something, like academics, you will probably never be good at it.
Linda Reed
Hollywood Acting Coach

After I retired, I felt as if I was no longer working towards any goals or ambitions. I had worked in the nursing field for 32 years before retiring. I always felt as if I had innate abilities that related to nursing. I had ample spare time and thought about pursuing something new in life. I had always had an interest in foreign languages, but never had time to focus on them. I wanted to learn how to speak Spanish. I thought about how hard it would be to learn Spanish, and although I had interest in it, I was never good at languages previously. So instead of learning Spanish, I decided to stick with what I know and volunteer at a nursing home. I never learned Spanish and it was much easier engaging in something that I had practiced for years.
Beatrice Long

Retired Nurse Practitioner

Instructions: Now on the blank sheet of paper provided, use the article and these statements to help you write your own personal testament about the qualities of intelligence. Be sure to include your own personal experiences with difficulty and failure and how engaging in a task you were good at influenced your life in a positive way.

Questions

1. Recent research shows that up to 88% of a person's intelligence is due to:
    a. genetic factors
    b. environmental factors

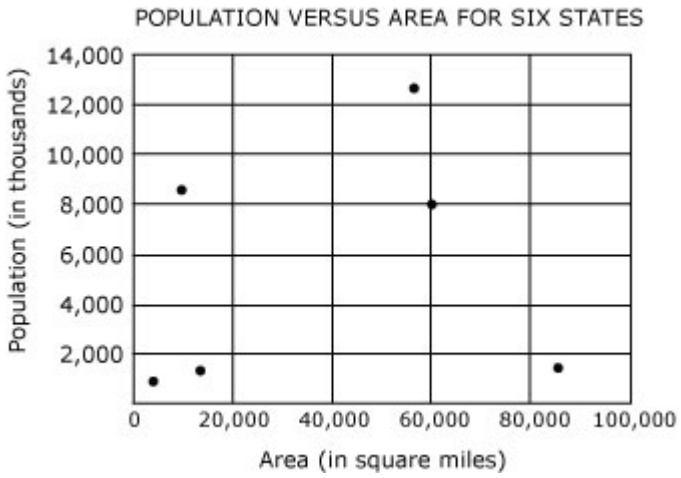
2. Researchers at the University of Wisconsin point out that:
    a. there is not much we can do to change our intelligence
    b. experience plays an important role in shaping intelligence

3. If you are not naturally great at a subject:
    a. hard work will increase your chances at success
    b. you should focus on a subject that you already excel in

4. The brilliance of Albert Einstein was probably due to:
    a. challenging environments rather than genetics
    b. genetics rather than educational experiences

5. General intelligence seems to be:
    a. a fixed capacity that cannot be changed much
    b. an expandable capacity that increases with mental effort

6.



The scatterplot above shows the area, in square miles, versus the population, in thousands, for six states. How many of these states have a population under 10,000,000 and an area over 40,000 square miles?
A. 1 B. 2 C. 3 D. 4 E. 5

7. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E
I Guessed 100%Confident

8. Because King Philip's desire to make Spain the dominant power in sixteenth-century Europe ran counter to Queen Elizabeth's insistence on autonomy for England, ------- was -------.
A. reconciliation, assured
B. warfare, avoidable
C. ruination, impossible
D. conflict, inevitable
E. diplomacy, simple

9. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E
I Guessed 100%Confident

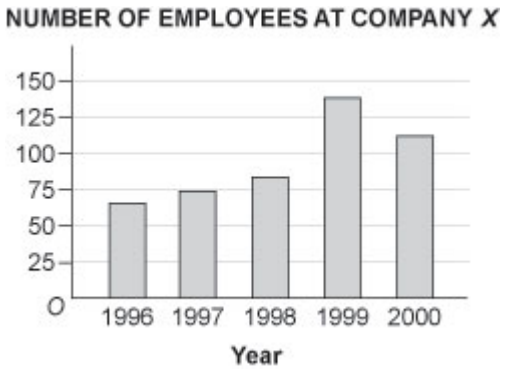
10. Each occupation has its own ____ ; bankers, lawyers and computer professionals, for example, all use among themselves language which outsiders have difficulty following.

A. merits B. disadvantages C. rewards D. jargon E. problems

11. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident



12. The bar graph above shows the number of employees at Company *X* for each of the years from 1996 through 2000. Over which of the following periods was the average *rate* of increase in the number of employees at Company *X* greatest?

A. From 1996 through 1998
B. From 1996 through 1999
C. From 1997 through 1999
D. From 1998 through 1999
E. From 1998 through 2000

13. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

14. A discerning publishing agent can ------- promising material from a mass of submissions, separating the good from the bad.

A. supplant B. dramatize C. finagle D. winnow E. overhaul

15. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

16. 35% of what number is 70?
a. 100 b. 110 c. 150 d. 175 e. 200

17. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

18. The addition of descriptive details to the basic information serves to ------- the book by producing a fuller account.
A. invalidate B. objectify C. incite D. celebrate E. enrich

19. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

20. The set *S* consists of all multiples of 6. Which of the following sets are contained within *S*?
I. The set of all multiples of 3.
II. The set of all multiples of 9.
III. The set of all multiples of 12.
A. I only
B. II only
C. III only
D. I and III only
E. II and III only

21. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

22. Joshua's radical ideas were frowned on by most of his coworkers, who found them too ------- for their conservative tastes.
A. heretical B. meticulous C. precise D. incoherent E. sagacious

23. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

24. How many years does Steven need to invest his $3,000 at 7% to earn $210 in simple interest?
A. 1 year B. 2 years C. 3 years D. 4 years E. 5 years

25. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

26. Paint : _____ :: Varnish : Floor

A. picture B. brush C. wall D. mix E. acrylic

27. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

28. In a certain year, Minnesota produced 2/3 and Michigan produced 1/6 of all the iron ore produced in the United States. If all the other states combined produced 18 million tons that year, how many million tons did Minnesota produce that year?

A. 27 B. 36 C. 54 D. 72 E. 162

29. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

30. Lion : Giraffe :: _____ : Oak

A. tree B. plant C. elm D. desk E. nature

31. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

32. If $3x - 2 = 7$, then $4x =$

A. 3 B. 5 C. 20/3 D. 9 E. 12

33. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

34. 1 : 2 :: Half : _____

A. quarter B. hole C. section D. whole E. eight

35. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

36. In a certain shop, notebooks that normally sell for 59 cents each are on sale at 2 for 99 cents. How much can be saved by purchasing 10 of these notebooks at the sale price?

A. $0.85 B. $0.95 C. $1.10 D. $1.15 E. $2.00

37. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

38. Which of these numbers is a factor of 21?

A. 2 B. 5 C. 7 D. 42 E. 44

39. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

40. Ginger, over the course of an average work-week, wanted to see how much she spent on lunch daily. On Monday and Tuesday, she spent $5.43 total. On Wednesday and Thursday, she spent $3.54 on each day. On Friday, she spent $7.89 on lunch. What was her average daily cost?

A. $3.19 B. $3.75 C. $3.90 D. $4.08 E. $4.23

41. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

42. botanist: petunia:: geologist: _____

A. matter B. periwinkle C. gypsum D. coin E. energy

43. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

44. Which of the following is divisible by 3 (with no remainder)?

A. 2725 B. 4210 C. 4482 D. 6203 E. 8105

45. How confident are you that you answered this question correctly?

A----------B----------C----------D----------E

I Guessed 100%Confident

46. Define moderate.
A. Embracing the extremes of behavior
B. Tending toward the mean or average
C. Going to an exaggerated length
D. Very thorough
E. Involved in an extreme sport

47. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

48. Karen is twice as old as Lori. Three years from now, the sum of their ages will be 42. How old is Karen?
A. 24 B. 12 C. 15 D. 26 E. 27

49. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

50. The teacher accused me of ____ because my essay was so similar to that of another student.
A. procrastination B. plagiarism C. celerity D. confusion E. decorum

51. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

52. The cost, in dollars, of manufacturing x refrigerators is $9{,}000 + 400x$. The amount received when selling these x refrigerators is $500x$ dollars. What is the least number of refrigerators that must be manufactured and sold so that the amount received is at least equal to the manufacturing cost?
A. 10 B. 18 C. 45 D. 90 E. 100

53. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

54. People from all over the world are sent by their doctors to breathe the pure, ____ air in this mountain region.
A. invigorating B. soporific C. debilitating D. insalubrious E. aromatic

55. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

56. The quantum theory was initially regarded as absurd, unnatural and ____ with common sense.
A. consanguineous B. discernible C. incompatible D. decipherable
E. consistent

57. How confident are you that you answered this question correctly?
A----------B----------C----------D----------E
I Guessed 100%Confident

GENERAL INSTRUCTIONS: Please do not write on this survey. Code all of your responses using a #2 pencil on the computer answer sheet as directed for each section. If you have questions at any time, please ask the researcher for assistance. There are no right or wrong answers to most of the questions below. They are simply a matter of personal preference or personal opinion. We ask that you please answer all of the questions as honestly and completely as possible.

SIDE TWO OF BLUE BUBBLE SHEET

SEX: Fill in your sex (M or F).
BIRTH DATE: Fill in the year and month that you were born as indicated on the form.
GRADE OR EDUCATION: Fill in what year/class you are at this time (1 = freshman, 2 = sophomore, 3 = junior, 4 = senior, 5 = non-degree student).
IDENTIFICATION NUMBER: Fill in your race (1 = Caucasian, 2 = African American, 3 = Hispanic, 4 = other)
SPECIAL CODES: Please fill in your current GPA at ECU in the **first 3 columns**. This does not include a decimal. Please report your GPA as 3 numbers. For example, if your GPA was 2.75, you would write 275 and bubble in the corresponding bubbles beneath it. In the **next 3 columns**, also in special codes please fill in your score that you received on the **MATH** portion of the **SAT**. Please write in your 3 digit score and bubble in the corresponding bubbles beneath it. If you honestly do not remember your score, please leave this section blank.

SIDE ONE OF BLUE BUBBLE SHEET

Now turn to the other side of the answer sheet (side numbered 1-120) and continue.

58. Please rate how difficult OVERALL the math problems on the test were:

|----------|----------|----------|----------|

A B C D E
very easy very hard

59. Please rate how difficult OVERALL the verbal problems on the test were:

|----------|----------|----------|----------|

A B C D E
very easy very hard

60. Please predict how well you did on the math portion of the test:

|----------|----------|----------|----------|

A B C D E
very bad very good

61. Please predict how well you did on the verbal portion of the test:

|----------|----------|----------|----------|

A B C D E
very bad very good

62. Please rate how much you like math:

|----------|----------|----------|----------|

A B C D E
not at all very much

63. Please rate how important math is to you:

|----------|----------|----------|----------|

A B C D E
not at all very important

64. Please rate how important math is to your chosen career.

|----------|----------|----------|----------|

A B C D E
not at all very important

65. Please rate your math ability:

|----------|----------|----------|----------|

A B C D E
extremely low extremely high

66. In our culture, many people believe in a stereotype that men have better math skills than women.

|----------|----------|----------|----------|

A B C D E
strongly disagree strongly agree

67. I believe that, in general, men do have better math skills than women.

|----------|----------|----------|----------|

A B C D E
strongly disagree strongly agree

68. I worked extra hard on the math problems because I wanted to prove that women can perform just as well as men.

|----------|----------|----------|----------|

A B C D E
strongly disagree strongly agree

69. I worry that my ability to perform well on math tests is affected by my gender.

|----------|----------|----------|----------|

A B C D E
strongly disagree strongly agree

70. I worry that if I perform poorly on this test, the experimenter will attribute my poor performance to my gender.

|----------|----------|----------|----------|

A B C D E
strongly disagree strongly agree

71. I worry that, because I know the negative stereotype about women and math, my anxiety about confirming that stereotype will negatively influence how I perform on math tests.

|----------|----------|----------|----------|

A B C D E
strongly disagree strongly agree

72. People have a certain amount of math ability, and you can't really do much to change it.

|----------|----------|----------|----------|

A B C D E
strongly disagree strongly agree

73. You can learn new math skills, but you really can't change your basic math ability.

|----------|----------|----------|----------|

A B C D E
strongly disagree strongly agree

For the following questions, please bubble in the choice A if you have taken these courses in high school. If you did not take the course in high school, please leave the question blank.

74. Algebra 1 if yes: bubble in A, if no please leave blank

75. Algebra 2 if yes: bubble in A, if no please leave blank

76. Geometry if yes: bubble in A, if no please leave blank
77. Pre-Calculus if yes: bubble in A, if no please leave blank
78. Calculus if yes: bubble in A, if no please leave blank
79. Statistics if yes: bubble in A, if no please leave blank
80. Other if yes: bubble in A, if no please leave blank

For the following questions, please bubble in the choice A if you have taken these courses in college. If you did not take the course in college, please leave the question blank.

81. Intermediate Algebra if yes: bubble in A, if no please leave blank
82. College Algebra if yes: bubble in A, if no please leave blank
83. Trigonometry if yes: bubble in A, if no please leave blank
84. Pre-Calculus if yes: bubble in A, if no please leave blank
85. Higher than Pre-Calculus if yes: bubble in A, if no please leave blank
86. Statistics if yes: bubble in A, if no please leave blank
87. Other if yes: bubble in A, if no please leave blank

Debriefing Sheet for "Achievement Motivation and Academic Performance"

Principal Investigator: Ashley Wilson arw0314@ecu.edu **Institution**: East Carolina University **Address**: Department of Psychology	**Faculty Advisor**: Dr. Marion Eppler epplerm@ecu.edu Department of Psychology, 312 Rawl Building East Carolina University (252) 328-6214

Stereotype threat: Researchers such as Aronson and Steele have examined how stereotype threat influences performance on a variety of tasks. Stereotype threat occurs when people are aware of stereotypes about their group, whether they believe the stereotype or not, and it can lead to impaired performance. For example, simply asking people to indicate their gender on an answer sheet can result in lower performance on a math task for women compared to men because of stereotypes about gender differences in math. People do worse in stereotype threat situations because they feel that their performance will confirm the negative stereotypes about their group. Previous research has also shown that reducing stereotype threat eliminates this underperformance. Stereotype threat can be reduced by making the stereotype irrelevant (not mentioning gender on a math task) or by countering the stereotype (telling people that on this particular math task, women tend to perform better than men).

Beliefs about intelligence: Another aspect of our research involves people's beliefs about the nature of their own intelligence. Academic success is influenced not only by past academic achievement, but also by motivational factors. Researchers such as Carol Dweck believe that students form ideas about their ability which then influences their performance. Some students come to believe that they have a certain amount of ability and that it does not change (fixed view). These students tend to do well as long as they are successful, but they are motivated by positive feedback about their ability. When things get challenging, however, these students often become discouraged and stop trying because they want to avoid negative evaluations of their ability. They sometimes engage in defensive strategies such as procrastination and withdrawing effort. However, to fully induce this concept would be unethical, so an alternate view of the fixed view is the multiple intelligence theory. This theory states that rather than viewing intelligence as one single entity, intelligence is comprised of several separate areas and abilities. Other students tend to think that ability is a changeable thing and that the more they learn the smarter they are (malleable view). They are motivated by a desire to learn and master new skills and are less threatened by academically challenging situations. These students interpret challenge as a need to work harder or try different strategies and are less likely to give up.

Hypotheses: For this study, there were two stereotype threat conditions: a stereotype threat condition and a gender-fair condition. The stereotype threat

group received information that the test they were about to take was diagnostic of their ability and would be compared to other students taking the test. They were also asked to write their name and gender on their answer sheet. These are subtle stereotype activation cues. The gender-fair group received information that there are no gender differences in math performance and on the test they were going to take men and women performed equally as well. This is an explicit stereotype removal strategy. These are the independent variables being tested. Everyone's scores on the test is the dependent variable. Our hypothesis is that women will do better on the math test that was described as gender-fair and women in the stereotype threat group will perform worse on the math test, whereas we expect to find no differences for men (they should do equally well on both math tests).

In the reading comprehension and writing task, you read one of two difference essays: (1) intelligence was described as being stable and comprised of multiple entities or (2) intelligence was described as malleable. This is a second independent variable. We predicted that students who read the malleable-view article should do better on the math tests than the other two groups. We are also testing to see if there is an interaction between stereotype threat and beliefs about intelligence. For example, does a malleable-view of intelligence protect women from stereotype threat, so that they perform equally well on both math tests? Note that performance on the math tests is the primary dependent variable in our study.

Implications: Think about how this research applies to your own life. We want to encourage you to see intelligence as a malleable trait. Studies have shown that people who believe that their own intelligence is something that can be increased with effort tend to handle challenges and failure more successfully and often perform better overall (e.g., higher GPA). When people believe that their abilities are fixed, they tend to experience learned helplessness whenever things become difficult which can result in poor performance. They also tend to avoid new challenges, give up when faced with failure, procrastinate more, and become less interested in the topic. Let us know if you are interested in this topic and would like to see additional readings.

Thanks for taking the time to help us answer these research questions. We hope that this information helps us to understand the complex interaction between different motivational factors and how they influence performance. This kind of information may gradually lead to developing interventions to help counter the negative effects of stereotype threat and fixed views of intelligence. We also hope that learning about stereotype threat and beliefs about intelligence may help you to be aware of situations where they might be influencing your performance. Perhaps this awareness will help you to be more successful in future testing situations.

Important Note: It is extremely important that you not discuss this study with others because it may affect their behavior in our study. If students come into the study already knowing what it is about and what our hypotheses are, then they may not behave naturally. They may try harder to do well or not try at all, and this would invalidate our results. We will send you an e-mail message when we have finished the study and when a summary of the results is available. We will post a summary on the Experimentrak bulletin board outside of Rawl 130 later in the semester, and we will send you a copy of that summary if you include your e-mail address on the consent form.

Thank you again for your time, effort, and cooperation!

Achievement Motivation and Academic Performance

_____ 88. Stereotype threat is:

d. when people have negative thoughts about other groups
e. when people are aware of stereotypes about their own group and this causes them to perform poorly on a task
f. when people are aware of stereotypes about other groups and this causes them to perform better than those other groups

_____ 89. Stereotype threat can be reduced by:

d. making the stereotype irrelevant to the task
e. making the stereotype important to the task
f. countering the stereotype (telling participants that the opposite of the stereotype is true)
g. both a and c

_____ 90. If you are taking a math test and the instructor asks you to indicate your gender at the top of the test, what is likely to happen (based on stereotype threat research)?

d. women will perform worse than men
e. men will perform worse than women
f. there will be no difference between the performance of women and men

_____ 91. In this study, when the verbal and math task were described either as being gender-fair or diagnostic of your ability, this is an example of:

a. an independent variable b. a dependent variable c. a control variable

_____ 92. Everyone's scores on the verbal and math task is an example of:

a. an independent variable b. a dependent variable c. a control variable

_____ 93. Different groups of people in this study read essays about intelligence as a stable quality comprised of several different areas or as a changeable quality. These groups represent:

a. an independent variable b. a dependent variable c. a control variable

_____ 94. Which view of intelligence group were you in (which essay did you read)?

a. malleable view b. fixed view

_____ 95. Which stereotype threat condition were you in?

a. Stereotype threat group b. Gender-fair group

_____ 96. If students are experiencing stereotype threat, having the _____ view of intelligence may help to protect them from the negative effects of stereotype threat.

a. fixed b. malleable

_____ 97. Why is it important for you **NOT** to discuss this study with other students until all of the testing sessions have been completed?

a. because it may affect their behavior in the study
b. because if they know the concepts and hypotheses, they may try harder or put forth less effort to complete the tasks
c. because it would invalidate the results of the study
d. because Ashley Wilson's thesis would be ruined
e. all of the above

Appendix C: IRB Approval

University and Medical Center Institutional Review Board
East Carolina University • Brody School of Medicine
600 Moye Boulevard • Old Health Sciences Library, Room 1L-09 • Greenville, NC 27834
Office **252-744-2914** • Fax **252-744-2284** • **www.ecu.edu/irb**
Chair and Director of Biomedical IRB: L. Wiley Nifong, MD
Chair and Director of Behavioral and Social Science IRB: Susan L. McCammon, PhD

TO: Ashley Wilson, Graduate Student

FROM: UMCIRB

DATE: September 23, 2009

RE: Expedited Category Research Study

TITLE: "Achievement Motivation and Academic Performance"

UMCIRB #09-0704

This research study has undergone review and approval using expedited review on September 22, 2009. This research study is eligible for review under an expedited category because it involves survey research to study characteristics of a group.. The Chairperson (or designee) deemed this **unfunded** study **no more than minimal risk** requiring a continuing review in **12 months**. Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.

The above referenced research study has been given approval for the period of **September 22, 2009** to **September 21, 2010**. The approval includes the following items:

- Internal Processing Form
- Informed Consent Document
- Reading Comprehension and Writing Quiz
- Math and Verbal T.est with Confidence Ratings
- Demographics Survey
- Debriefing form and Debriefing Quiz

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

The UMCIRB applies 45 CFR 46, Subparts A-D, to all research reviewed by the UMCIRB regardless of the funding source. 21 CFR 50 and 21 CFR 56 are applied to all research studies under the Food and Drug Administration regulation. The UMCIRB follows applicable International Conference on Harmonisation Good Clinical Practice guidelines.

pc: Marion Eppler, Ph.D., Faculty Advisor