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Stereotype Threat: An Intervention with a Focus on Attribution Theory and Group Composition

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STEREOTYPE THREAT:

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ATTRIBUTION THEORY AND GROUP COMPOSITION

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Abstract

When females are in a situation which is high in stereotype threat, they underperform on math tasks in comparison to males. Stereotype threat intervention research has found several methods for improving performance, such as allowing the female participants to attribute potential failure to an external source. This study aimed to replicate the results of a teaching intervention study which consisted of informing participants about stereotype threat, and asking that they attribute any stereotype threat-related anxiety to stereotype threat, and to deter it from interfering with their performance on a math task. Based on the research by Inzlicht and Ben-Zeev (2000), which found that females underperformed in comparison to men when completing a math test in a male majority group, the study examined the effectiveness of the teaching intervention when it was administered to female only and male majority groups. The study hypothesized that female participants in the female only group would perform better on a math test than females in the female minority group. The study additionally examined the attributions made for performance on the math test using the Causal Dimension Scale II. The results demonstrated that no significant differences were found between the math test performances of the participants who were taught about stereotype threat and those who were not. In addition, no significant differences were noted between the math test performances of the participants in the female only and the male majority group. Finally, the study did not find any significant differences between groups on the Causal Dimension Scale II, a scale which measures attributions made for success or failure on a task. Although this study did not find any significant differences between groups, these results do not

disprove the theory of stereotype threat. There are several factors that affected the results of this study, such as the fact that the math test used in the study was probably too difficult for the participants. Some participants did not understand how to complete the Causal Dimension Scale II. Therefore, the results of this study should be interpreted with consideration of these issues. Further limitations of this study as well as future research directions are explored.

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Introduction

Males and females sit together in the same mathematics classrooms and are taught the same mathematics material. Males and females have the same ability and propensity to learn mathematics (National Center for Education Statistics [NCES], 2004). So why are there fewer women in the field of mathematics (National Science Foundation [NSF], 2000)? Current data suggests fewer females than males are earning undergraduate and graduate degrees in mathematics (NCES, 2004). In 2001, only 23% of doctoral degrees in mathematics were earned by females (NSF, 2006) and only 8% of mathematics professors are women (NSF, 2000). This shortage of women in the field of mathematics might be understandable if women were less skilled than men at mathematics concepts and computations; however, there is virtually no difference in the math aptitude of high school males and females (NCES, 2004). Female high school students report that they like math less than male students (NCES, 2004), and college students studying math reported significantly more discrimination as well as a significantly higher proportion of students considering leaving the field than students in "female dominated" areas, such as education and social science departments (Steele, James, & Barnett, 2002). Across the educational pipeline, there is a progressively greater attenuation of females majoring in math or pursuing careers in mathematics.

Steele (1999) has attempted to understand this gender discrepancy through the study of stereotype threat, "the threat of being viewed through the lens of a negative stereotype, or the fear of doing something that would inadvertently confirm the stereotype" (p. 46). Steele conceived of stereotype threat after he realized that at every level of SAT math scores obtained amongst students at the University of Michigan,

females were underperforming in comparison to men in advanced math classes. He also found that African American students at the same university were underperforming in comparison to White students at every level of SAT scores obtained.

Stereotype threat can exist for any group for which negative stereotypes exist, yet it appears to harm the performance of those who care most about their performance within the domain (Steele, 1999). Perhaps the most pernicious ramification of stereotype threat is that students who care most about their educational performance may start to convince themselves that they don't care about their performance in a particular academic subject in order to eschew the anxiety and potential failure that pursuit of mastery in this subject might cause. At this point, females may remove the academic subject from their self-concept. This type of withdrawal is referred to as disidentification (Steele, 1997; Steele & Aronson, 1995).

Disidentification is most likely to take place among members of a stereotyped group who strive to do well in the domain for which a negative stereotype about that group exists (Steele, 1997; Steele & Aronson, 1995). After the individual repeatedly experiences performance-hindering anxiety due to the fear that they may confirm this negative stereotype, they may choose to convince themselves that their performance in this domain is not important to them, consequently withdrawing this domain from their self-concept. As the Taoist Chinese philosopher Lao-Tzu said "Abandon learning and there will be no sorrow" (Kaltenmark, 1969). Students in this plight may choose to avoid applying themselves in a particular domain in order to escape the anxiety that might accompany this experience. In order to examine the domains in which an individual may

potentially disidentify, stereotype threat research has uncovered its associated performance-hindering effects with a variety of different fields and populations.

Stereotypes regarding several racial and ethnic groups have been explored in stereotype threat research. These studies have consistently produced results that demonstrate how a group's performance can be affected by such a threat. For example, African American students underperformed in comparison to Caucasian students when a test was presented as being diagnostic of ability, yet performed as well as Caucasians when the test was presented as non-diagnostic of ability (Steele & Aronson, 1995). Similar results were found among Latinos (Aronson & Salinas, 1997) and with students from low SES backgrounds (Croizet & Claire, 1998). Shih, Pittansky, and Ambady (1999) found that math performance improved when the Asian identity of Asian American college students was made salient, yet performance was hindered when their female identity was made salient. These results were replicated in a younger sample of girls enrolled in kindergarten through eighth grade (Ambady, Shih, Kim, & Pittansky, 2001).

Research has also explored the effect of stereotype threat in other populations, such as the elderly and even a non-stigmatized group, such as European American men. When the stereotype regarding elderly people having poor memory skills was made salient, elderly participants performed significantly worse on memory tasks than when positive characteristics associated with the elderly were activated (Levy, 1996). Research has also found performance suffers among European Americans (in comparison to African Americans) when participants are told that performance on 10 holes of golf is indicative of "natural athletic ability." However, European Americans outperform

African Americans when they are told that the 10 holes of golf are representative of "strategic sport intelligence" (Stone, Lynch, Sjomeling, & Darley, 1999). Math performance suffered in European Americans when stereotypes regarding Asians having superior math skills were made salient (Aronson, Lustina, Good, & Keough, 1999).

An area of particular interest in stereotype threat research has been performance-hindering results with regard to gender. Specifically, a large body of research (Ambady et al., 2001; Ambady, Paik, Steele, Owen-Smith, & Mitchell, 2003; Inzlicht & Ben-Zeev, 2000; Johns, Schmader, & Martens, 2005; Martens, Johns, Greenberg, & Schimel, 2006; McIntyre, Paulson, & Lord, 2003; Shih et al., 1999; Spencer, Steele, & Quinn, 1999; Steele, 1999) has examined the effects of stereotype threat on female performance of math tasks. These studies produced robust findings showing that females' performance was negatively impacted when gender stereotypes were activated. Through gender research results, we may gain a better understanding of the contributing factors to the dearth of females working in the field of mathematics. In order to better understand why fewer females are entering and staying in the field of mathematics, these researchers have examined how and why the effects of stereotype threat take place, as well as methods for improving female math performance while experiencing the effects of stereotype threat (Ambady et al., 2001; Ambady et al., 2003; Inzlicht & Ben-Zeev, 2000; Johns et al., 2005; Martens et al., 2006; McIntyre et al., 2003; Shih et al., 1999).

Conditions Under Which Effects of Stereotype Threat Emerge

In order to examine the ways in which the effects of stereotype threat emerge, a number of studies have primarily employed either a direct (Johns et al., 2005; Martens et al., 2006; McIntyre et al., 2003) or indirect (Ambady et al., 2003; Inzlicht & Ben-Zeev,

2000) stereotype threat manipulation. An example of a direct manipulation would be when the researchers blatantly state to the participants that there is a stereotype which favors the ability of men over women on a particular task (Johns et al., 2005; Martens et al., 2006; McIntyre et al., 2003). Researchers have used a direct manipulation approach to ensure that participants are cognizant of the stereotype regarding female math performance. In particular, this method has been used in studies to test an intervention intended to buffer against the harmful effects of stereotype threat (Johns, et al., 2005; Martens et al., 2006). In order to measure the effectiveness of the intervention, the stereotype must be activated.

The majority of research studies which activate stereotype threat in a direct manner provide some sort of statement to the participants regarding a stereotype about female mathematical ability. Johns et al. (2005) told participants in their study that they would take a math test diagnostic of their true math ability and that performance-based gender comparisons would be made after they finish the test. Martens et al. (2006) told participants to complete a spatial rotation task for which a stereotype exists favoring the performance of men on the task. The researchers stated that the goal of the experiment was to compare the performance of men and women on the task to judge the veracity of this stereotype. McIntyre et al. (2003) employed a similar stereotype activation technique by telling participants that some previous research has shown men outperform women on math tests, but that these findings are inconclusive. These examples all involved a direct method of making the stereotype salient regarding female math performance.

Some researchers (e.g., Ambady et al., 2003; Inzlicht & Ben-Zeev, 2000) have preferred to activate the stereotype in an indirect manner to focus on how even the

slightest cues may affect the performance of females on a difficult math task. A form of indirect manipulation might be any type of activity that primes the female identity of the participant prior to the completion of a math task, such as asking participants to complete a questionnaire that focuses on issues of gender. The aim of these studies is to replicate real world settings in which females perform math tasks.

Inzlicht and Ben-Zeev (2000) may have primed the gender of the female participants in their study simply by having them complete a math task in a group in which they were outnumbered by males. This study activated stereotype threat in an indirect manner replicating a scenario that is often experienced by females in real-world settings. Compared to the math test performance of females who completed the math test in a group consisting solely of females, the females who were outnumbered by males performed worse on the math test. A limitation of this study lies in the fact that only small groups were used in this experiment. As each group only had three participants, it is important for future research to examine if similar results will be obtained when using larger groups of participants that approximate real world classroom conditions. As females may commonly be enrolled in math classes where they are outnumbered by males, it is possible that these students may experience the effects of stereotype threat. This may lead to diminished performance on math tests and eventual disidentification with the field of math.

Additional studies (Ambady et al., 2003; Inzlicht & Ben-Zeev, 2000) have activated stereotype threat in an indirect manner by making salient the gender of the participants. This appears to indirectly prime the stereotype as well. A study by Ambady et al. (2003) used an indirect stereotype activation technique by making the gender of the

female participants salient by having participants complete a computer task prior to taking a difficult math task. The participants were asked to indicate if they saw a flash appear on the left or right side of a computer monitor screen. The flash was actually one of 20 different words related to the female gender (such as aunt, doll, dress, and earring). A second group of participants also completed this computer task, but were exposed to gender neutral words that flash across the screen. When the math test performance of the participants in the gender-prime condition was compared to those in the gender-neutral condition, participants in the gender-prime condition performed worse on the math task (Ambady et al., 2003).

An alternative indirect method for making gender salient prior to completing a math task was utilized in a study by Shih and colleagues (1999) as well as a study by Ambady and colleagues (2001). Both of these studies included conditions which asked the participants to complete a questionnaire prior to the math test. Shih and colleagues (1999) asked the participants questions about their preferences for living conditions, such as their preference for female-only or coed dorms or dorm floors as well as whether or not they would choose to have a male roommate. The study by Ambady et al. (2001) included a questionnaire for the participants in grades three through eight that asked questions such as whether they preferred male or female friends, or if they thought that males were treated differently in school. This study provided an alternative method for priming gender in the younger participants in kindergarten through grade two. The participants colored a picture of a girl holding a doll in order to make gender salient. When gender was primed in both studies, the participants performed worse on the math task then when an alterative identity was made salient.

A variety of different methods have been explored in stereotype threat research in order to understand how stereotype threat and its effects emerge. Through this research, we may develop a better understanding of the likelihood that such performance-hindering effects may exist in the real world, for example, in the classroom. Females often participate in math classes where they are outnumbered by males or may experience moments where their gender is made salient in those classes. Based on the results of stereotype threat research it is probable that females suffer from the effects of stereotype threat. In order to better understand the process of stereotype threat, researchers have attempted to study why the effects of stereotype threat emerge. However, understanding how and why the effects of stereotype threat emerge lead us to solving a greater problem: How to improve the performance of females while in a stereotype threat situation.

Studies Examining Why Stereotype Threat Effects Exist

The effects of stereotype threat are seen in a wide variety of experimental conditions whether activated in a direct or indirect manner, and many researchers have tried to explore exactly the mechanism(s) that contribute to the experience of stereotype threat. In Steele and Aronson's (1995) first published stereotype threat study, they considered that there may be several potential mediators contributing to stereotype threat effects. They believed that when individuals are in a situation where stereotype threat is high, they might suffer from low self-efficacy (belief one has ability to accomplish task at hand), evaluation apprehension, anxiety, and low performance expectations. Several studies have sought to explore these as the potential mediators of stereotype threat.

Spencer et al. (1999) studied evaluation apprehension, anxiety, and self-efficacy, however, producing meager findings. Evaluation apprehension and self-efficacy were not

found to be mediators on the effects of stereotype threat, but anxiety provided a minimal contribution. Oswald and Harvey (2001) examined potential mediators, finding that state self-esteem, anxiety, and self-efficacy did not relate significantly to stereotype threat effects. When examining performance expectancy, results showed that this factor significantly contributed to stereotype threat effects in that the performance of participants correlated positively with their level of performance expectancy (Cadinu, Maass, Frigerio, Impagliazzo, & Latinotti, 2003). Although the specific mechanisms contributing to stereotype threat effects are not fully understood, the conditions in which stereotype threat exists as well as the conditions in which performance has been found to improve while individuals are in situations where stereotype threat is high have been identified.

The Improvement of Female Math Performance

One method for examining how female math performance might improve in a situation high in stereotype threat is to make salient an identity that has positive math-related stereotypes. Cultural stereotypes exist for Asians (e.g., they have superior math skills when compared to other ethnic groups) as well as for females (e.g., they have inferior math skills when compared to males). Shih and colleagues (1999) examined the effect of activating more than one social identity of Asian American women in order to study if the participants' performances on the math test would vary according to the identity that was activated prior to taking the test. Participants answered questions which focused on the designated stereotype of the group (female or Asian identity). Results of this study showed that the females who obtained the highest math scores on the test were the females whose Asian identity was made salient. The participants who performed least

well were those whose female identity was made salient. Similar results were found when Shih et al. (2001) replicated their earlier findings with a younger sample including children in kindergarten through eighth grade. Although it is promising to find conditions in which female math performance improves, not all women belong to groups for which multiple stereotypes exist regarding their mathematics abilities. It is important that future stereotype threat research focus on finding interventions that can be used on most populations.

In order to examine stereotype threat intervention studies that are not limited to specific cultural groups, several studies (Ambady et al., 2004; Gresky, Eyck, Lord, & McIntyre, n.d.) have focused on making salient the many roles and characteristics a woman possesses. Interventions created for these studies made participants focus on what makes them different from others in order to make them feel that they stand out from their in-group. For example, Martens and colleagues (2006) found participants performed significantly better on a math test after completing an act of self-affirmation. The self-affirmation exercise consisted of having participants rank order 11 characteristics or values in order of personal importance (i.e., sense of humor and physical attractiveness). Gresky and colleagues (no date) found female math performance improved when participants were asked to think about the many roles and identities they possess in life through the act of completing a self-concept map. The participants who were asked to complete a self-concept map which listed as many characteristics as possible performed better on the math test than the group who was asked to list only a few characteristics. In both of these studies, the participants were protected from experiencing the performance hindering effects of stereotype threat when they were asked to consider the characteristics

that make them unique. Although these results provide insight into understanding the ways in which we might improve female math performance in stereotype threat situations, it is important that we focus on finding a less time-consuming intervention to implement. To be applied in a school setting, interventions need to be as time limited as possible to ensure ready application.

Rather than focus on one's individual identity, McIntyre et al. (2003) conducted two experiments which highlighted the accomplishments of other females as a potential intervention against stereotype threat. In the first study, the female participants were told that they were participating in the experiment in order to help standardize new questions for the GRE quantitative section. These participants were informed that only females would be used for the standardization process because "women produce more reliable and valid data, comprehend the task requirements better, and produce better results in all types of psychological experiments" (McIntyre et al., 2003, p. 84). Results showed that the participants who read about the "advantage" of using female participants obtained more correct responses on the math test than those who did not read this. In the second experiment, the stereotype regarding female math skills is made salient when a male experimenter told participants that "research has shown men to perform better than females on math tasks," yet states that "empirical research is non-conclusive" (McIntyre et al., 2003, p.87). The participants then read four brief essays describing either a female's or a corporation's success in a variety of different fields. After reading the short essays, participants completed a math test. Results showed that when participants read essays about the success of females, they obtained a larger percentage of correct answers on the math problems than the females who were placed in the control group or the

females who read essays about successful corporations. Although female math performance improved when participants were made to consider the achievements of others, this research does not help to explain the specific mechanisms that contributed to this improved performance. It is through the application of attribution theory to stereotype threat research that we may develop a better understanding of how to improve female math performance.

Effect of Making Attributions for Potential Failure

Attribution theory has been applied to several research studies as a means to understand how performance might improve when participants are asked to attribute potential failure to an external source (Brown & Josephs, 1999; Good et al., 2003; Johns et al., 2005; Wilson & Linville, 1985). Weiner, one of the leading Attribution theorists who applied the theory to the domain of achievement, stated that "attribution theorists are concerned with perceptions of causality, or the perceived reasons for a particular event's occurrence" (Weiner, 1989, p.280). Weiner found there to be three major causal dimensions which contribute to the manner in which one attributes their success or failure on a task: locus of causality (internal of external), stability, and controllability (Wilson, Damiani, & Shelton, 2002). Locus of causality refers to whether or not an individual attributes failure to an external source (e.g., difficulty of task) or an internal source (e.g., lack of ability). The causal dimension of stability refers to whether or not the individual sees the causes of failure in achievement as stable and unchangeable or as something that is temporary and changeable in the future. The level of controllability describes if performance is attributed to something an individual has the ability to control (such as

skill or efficacy) with something one can't control such as mood or luck (Wilson et al, 2002).

These causal dimensions are relevant to the interpretation of the effects of stereotype threat due to the effect that stereotype threat has in causing a person to doubt their ability to successfully perform the task. If an individual doubts their ability to succeed on a task, they may attribute potential failure to an internal source such as lack of ability. Attributing potential failure to an internal source such as lack of ability may cause one to experience anxiety. This anxiety may increase the next time one takes a difficult math test, causing one to experience increasingly more anxiety and greater difficulty in completing such tasks in the future. Storms and McCaul (1976) have described this entire process as an exacerbation cycle. After experiencing the distress associated with performing tasks which produce increased amounts of anxiety, one may eventually disidentify with the domain in order to escape these negative sensations. However, when one attributes potential failure (or its associated anxiety) to an external source, it is possible that performance may improve. The following studies demonstrate how academic performance improves when individuals are invited to attribute difficulties to an external source. However, understanding how individuals attribute performance to the causal dimensions proposed by Weiner (locus of causality, stability, personal control, and external control) would provide even greater insight into how to improve performance in stereotype threat situations.

Wilson and Linville (1985) examined a method for improving the performance of freshmen college students experiencing academic difficulties. This method focused on helping the students to attribute academic difficulties to a temporary, external source.

Participants in this study were taught that the difficulties they experienced during the first semester were related to difficulties of transitioning into college. The researchers showed participants that these difficulties are commonly experienced by freshman by showing the students statistics of grade increases in the second year of school. The participants also watched videos of older students discussing the fact that they too experienced difficulties transitioning to college their freshman year and that their grades improved over time. Results showed that the participants' GPA improved in their second year of college as did the likelihood that they would stay in school. When students were presented with the "proof" that their plight is commonly experienced and overcome by many others, the students experienced greater motivation to persevere. Weiner found that when students believed that their poor performance was a result of a factor that is out of their control, they would be less likely to apply themselves in the future. However, as evidenced in the study, when students believed that their poor performance was something that they could overcome, it is more likely they would push themselves harder in the future (Weiner, 1985).

Another study which applied attribution theory to stereotype threat research was conducted by Brown and Josephs (1999). The study led participants to believe that they would be able to complete practice exercises on a computer prior to taking a math test. However, once the participants were led to the computer to engage in the practice exercises, the participants were told that the computer crashed and that they will have to take the test without completing the practice exercises. The study examined whether female performance on a math test would improve if participants were able to attribute potential failure to an external rather than an internal cause. Female participants

completing the study attributed their potential failure to an external cause (the computer "crashing") resulting in the females performing as well as the males. However, when the females were not able to attribute failure to an external source, they performed worse than the males on the math test. Allowing participants to attribute possible failure to an external controllable source is a method that has also been used in research which attempts to improve performance in a stereotype threat situation.

Good et al. (2003) conducted a study examining attribution as an intervention to buffer against the effects of stereotype threat on standardized tests. The study aimed to teach students to attribute any academic difficulties they experienced to difficulties in transitioning to a new school (junior high). Researchers examined if the standardized test scores of females, minority students, and students from lower SES backgrounds might improve after receiving this intervention. Each student involved in the study was assigned a college student mentor to meet in person and correspond with via e-mail. The college student taught the seventh grade student that many students start to believe that they are incapable of high academic achievement during times of difficult transition, yet they often overcome these difficulties and perform better in school during eighth grade. Results showed that males and females performed equally well on the math portion of standardized tests when placed in the attribution condition, whereas males outperformed females on the math test when placed in the control group. It is difficult to isolate the effects of applying attribution theory from the effects of providing students with mentors. Regardless, this combination helped to improve the performance of students in a real world setting.

Johns and colleagues (2005) conducted a study that also provided its participants an alternative attribution for any difficulties they might experience. This study included a condition which led participants to believe that they would be completing a standardized math test to study gender differences in math ability (math-test condition). The teaching-intervention condition also informed participants that they were taking part in a study to examine gender differences in mathematical ability. However, the participants in the teaching-intervention condition were also taught about the concept of stereotype threat. The researcher emphasized that they could attribute any anxiety that they experienced during the task to stereotype threat, and that they shouldn't allow this to interfere with their performance. When these participants were aware of the effects of stereotype threat, and cautioned to deter anxiety from interfering with their performance, women performed equal to the men in the same condition. The participants in the teaching-intervention condition also performed better than the participants in the math-test condition. This study used an innovative yet simple intervention approach by explaining the phenomenon of stereotype threat. When participants were asked to attribute anxiety to an external source (stereotype threat) they did not experience performance deficits.

Johns et al. aimed to "release stereotype-threatened individuals from assuming that the increased arousal that they are feeling indicates that they do not have the ability to do well" (Johns et al., 2005, p.176). In addressing stereotype threat and the performance-hindering anxiety which often accompanies it directly, the exacerbation cycle described by Storms and McCaul (1976) is halted. Instead of allowing the experience of anxiety to convince participants that they may fail on the task due to lack of ability, the participants are able to attribute the anxiety to an external source – stereotype

threat. Results of the study by Johns et al. (2005) show that individuals can be protected from experiencing performance deficits due to stereotype threat effects when they have an external source to which they can attribute physiological arousal. When the participants of the study were not provided with an external source to which they could attribute anxiety (math test condition), they performed significantly worse on the math task.

One consideration of the study conducted by Johns et al. (2005) lies in the fact that the majority of the participants were female (75 women, 42 men). Although the exact gender composition of the groups who received the intervention was unspecified, it is possible that the majority of the groups had a greater female to male ratio. Inzlicht and Ben-Zeev (2000) found that females performed as well as males on a math test when taking the test in a group composed solely of females. However, females performed worse than males on the math test when placed in a group in which they were outnumbered by males. Therefore, it is important to examine the effectiveness of the intervention that teaches females about stereotype threat when it is administered to females who are placed in groups in which they are outnumbered by males in order to examine the vigor of this intervention.

Statement of Purpose

The purpose of this study was to examine the impact of direct statements about stereotype threat on females' performance on math tests. A second purpose was to assess the impact of females' performance on math tests when there are varying numbers of males present in the testing environment. More specifically, female participants were exposed to one of two conditions. In the first condition, no males were present in the

testing environment. In condition two, the male to female ratio was 3:1. A third purpose of this experiment was to assess the effect of directing females to make external attributions for any anxiety they experience during testing.

Research Hypotheses

Hypothesis 1: Female participants taught about the concept and dangers of stereotype threat (teaching intervention condition) will outperform female participants who believe their performance will be compared with that of the males in Hypothesis 1a (no teaching intervention condition) (Inzlicht & Ben-Zeev, 2000; Johns et al., 2005). In the present study, participants heard a description of stereotype threat (see Appendix E). They also heard about how stereotype threat has negatively impacted the performance of females on math tasks and some minority groups on academic or cognitive assessments. It was predicted that when participants are aware of stereotype threat, they would perform better on a math test than the participants who have not received this instruction in both the intervention condition (Hypothesis 1b) and in the stereotype threat condition (Hypothesis 1c). This would provide a main effect of experimental condition.

Hypothesis 2: When females take a math test in an all-female group, they would perform better on a math test than the females in a male majority group (Hypothesis 2a). When females are taught about the concept and dangers of stereotype threat (those in the teaching intervention condition) they will perform better on a difficult math test when in a female-only group compared to females in a female minority group (Hypothesis 2b). When females are not taught about the concept and dangers of stereotype threat (the no teaching intervention condition) they will perform better on a math test in a female-only group compared to participants in a female minority group (Hypothesis 2c). It is

hypothesized that greater performance deficits will be experienced by the participants in the no teaching intervention condition than in the teaching intervention condition. Inzlicht and Ben-Zeev (2000) found that females performed worse on a math test when they completed the test in a group outnumbered by males than females who completed the test in a group consisting only of females. It is predicted that females will experience similar performance deficits in the current study when they take the math test in a group outnumbered by males. That is, there will be an interaction effect between the experimental condition and the group composition. This study does not intend to disprove the findings of Inzlicht and Ben-Zeev. Rather, this study is examining if group composition affects math test performance in the teaching intervention / no teaching intervention conditions.

Hypothesis 3: When female participants are taught about the concept and dangers of stereotype threat, they will obtain higher scores on the Causal Dimension Scale II, (see Appendix F) a measure of external and internal attributions, than female participants who are led to believe that their performance on the test will be compared to male performance on three factors: locus of causality, stability, and personal control. However, it is predicted that female participants who are taught about stereotype threat will obtain lower scores on the external control factor than the females who believe their performance on the test will be compared to that of the males.

Method

Participants

Participants in this study included 120 females. The total amount of participants necessary was calculated using power analysis. The study conducted by Johns et al. (2005) yielded an effect size of d = 0.82. In calculating this power analysis with the expectation of producing a medium effect size, 30 participants were necessary for each group. This required a total of 120 participants. A combination of male undergraduate psychology students and confederates participated in this study although their results were not analyzed as only female math performance was the focus of the study. There were 30 females in each condition of the 2 x 2 factorial design. These conditions consisted of 2 testing conditions (teaching intervention and no teaching intervention) and 2 group gender compositions (female only and female minority).

One hundred and six participants (89%) in this study self-identified as "White/European American", 8 (7 %) as "Black/African American", and 3 (3 %) as "Other Race/Ethnicity." Participants were asked to indicate the number of advanced math classes they had completed (algebra, geometry, advanced algebra, trigonometry, calculus, and advanced calculus). Six participants (5 %) completed all 6 classes, 19 participants (16 %) completed 5 classes, 44 participants (37 %) completed 4 classes, 36 participants (30 %) completed 3 classes, 15 participants (13 %) completed 2 classes, and no participants completed only one class. Participants were also asked to indicate the scores they received on the quantitative section of the SAT. These scores ranged from 290 to 690. Seventeen participants also provided the scores they obtained on the verbal and quantitative SAT combined. These scores ranged from 980 to 1760.

Measures/ Instrumentation

The participants completed four measures: The Math Inventory Questionnaire (used for a priori data collection), the math test, the Causal Dimension Scale II (CDS-II), and a demographic survey.

Math Inventory Questionnaire

The Math Identification Questionnaire (MIQ) (Brown & Josephs, 2000) consists of 13 statements rated on a 7 point Likert scale (1= strongly disagree and 7 = strongly agree). This questionnaire measures the degree to which an individual identifies with the domain of mathematics and includes statements such as "My math abilities are important to me" and "Math abilities will probably be important to me in my future career" (see Appendix A). The range of possible scores on the measure is 13 to 91. Low scores on this scale indicate that the individual does not strongly identify with the domain of mathematics and high scores suggest that math is an important part of the individual's self-concept. Previous research has suggested that stereotype threat effects are most commonly observed by individuals who score mid to high levels of math identification (Cadinu et al., 2003; Inzlicht, Aronson, Good, & McKay, 2005). On this scale, mid to high scores range from 45 to 91. This scale was found to have a coefficient alpha of .86 in previous research (Brown & Josephs, 2000). When factor analysis was performed on the scale, the 13 items were found to support a single-factor model (Brown & Josephs, 2000). No other psychometric data are available about this instrument at present.

Math Test

The math test consisted of 20 multiple choice questions taken from the Graduate Record Examination (GRE) test guide (see Appendix E). This test includes problems focusing on algebra, geometry, and computational skills. In a previous administration by Educational Testing Services, 36.6% of examinees answered all the questions correctly (Educational Testing Service, 1994). When this test was administered in past stereotype threat research, participants obtained scores ranging from M = .55 (SE = .05) to M = .70 (SE = .05) based upon the experimental condition they were placed in (Inzlicht & Ben-Zeev, 2000). Scores for this test were computed by dividing the total items correct by the total items attempted (Steele, 1995). No information regarding the psychometric properties of this test are available. Internal consistency reliability was calculated in the current study using Cronbach's coefficient alpha and was found to be .49. Cronbach's coefficient alpha is a reliability measure used to indicate the degree to which different items on a scale measure the same construct. When Cronbach's coefficient alpha is low, the data is likely measuring several factors rather than a single factor.

Causal Dimension Scale (CDS II)

The CDS II was developed by McAuley, Duncan, and Russell (1992) to measure the causal attributions one makes for performance. This scale is a type of semantic differential measure consisting of 12 items which assess four dimensions of causal attributions. The four include: locus of causality, stability, personal control, and external control (see Appendix F). Each of the 12 items is scored on a 9 point scale. Each subscale consists of 3 items. Each subscale score ranges from 3 points to 27 points. Higher scores represent attributions that are more internal, stable, personally controllable and externally

controllable. Previous research has found coefficient alpha values for the four subscales are as follows: locus of causality = .60 to .71, stability = .66 to .68, personal control = .72 to .90, and external control = .71 to .92 (McAuley et al., 1992). No further psychometric information exists for this scale. CDS II data were analyzed using Multivariate Analysis of Covariance (MANCOVA) contributing to four dependent variables: locus of causality, stability, personal control, and external control.

Demographic Survey

After participants completed the math test, they completed a brief questionnaire which asked them to indicate gender, racial/ethnic background (American Indian or Alaska Native, Asian American, Black or African American, Native Hawaiian or Other Pacific Islander, White, Hispanic or Latino, or Some Other Race), math courses completed (algebra, geometry, advanced algebra, trigonometry, calculus, and advanced calculus) and prior SAT Quantitative scores obtained (see Appendix G).

Procedures

Participants for this study were recruited from the Introductory Psychology class at the University of Rhode Island. A priori data collection involving administration of the MIQ took place in the recitation sections of the class. Participants who obtained a score on the MIQ which fell on at least the midpoint (45 points or above) of the Math Inventory Questionnaire (MIQ) were considered eligible for the study. Students from the class were provided with a list which showed the days and times they could participate in the study. Students who were eligible and chose to volunteer for the study did so by writing their

name on a sign-up sheet and indicating the times they were available to participate (see Appendix B). Participation in the study satisfied partial course credit.

Participants were assigned to a 2 (gender composition: female only or male majority) x 2 (experimental condition: teaching intervention or no teaching intervention) factorial design. Once participants signed up to participate in the study, they were randomly assigned to a condition to complete the experiment. Sessions were run in either a male-majority group or a female-only group by the experimenter. In the male-majority condition, there was 3:1 male to female ratio. In order to allow all participants to hear exactly the same message, the experimenter played an audio-recorded message which delivered the description of the experimental condition (see Appendices C and D) after the students completed the Informed Consent form. The participants in the no teaching intervention condition were told that they were completing a standardized math test in order to examine gender differences in math performance. Participants in the teaching intervention condition were provided the same instructions as the participants in the math test condition. They additionally had the concept of stereotype threat described to them and were reminded that "it's important to keep in mind that if you are feeling anxious while taking the test, this anxiety could be the result of negative stereotypes that are widely known in society and have nothing to do with your actual ability to do well on the test" (Johns et al., 2005, p. 176). Participants were provided with 30 minutes to complete the timed math test. They completed the CDS II and demographic survey, after which they were debriefed (see Appendices H and I). All participants were assured that their identities would be confidential.

The total amount of elapsed time between the administration of the informed consent form to completion of the experiment ranged from three to eight weeks. The first contact with participants was in their recitation sections of their introductory psychology class. Participants were then contacted by e-mail to participate in the study. Some participants completed the study three weeks later, while others did not complete the experiment until eight weeks later. All participants first completed the MIQ. When participants participated in the complete experiment, they first completed the math test, then the CDS II, and finally they completed the demographic survey.

Data Analysis

Results of this study were analyzed using Multivariate Analysis of Covariance (MANCOVA), followed by individual follow-up ANCOVAs. The two independent variables were the experimental condition (teaching intervention or no teaching intervention) and group composition (female only group or female minority group). The five dependent variables were the score on the math test, and the subtest scores on the CDS II (for the following four factors: locus of causality, stability, personal control, and external control). The math test score was calculated by taking the total amount of correct responses and dividing them by the total amount of problems attempted. The number of math classes successfully completed was used as a covariate in order to control for individual differences in mathematics skill level (Steele & Aronson, 1995). The data from this study was analyzed using the statistical program SPSS.

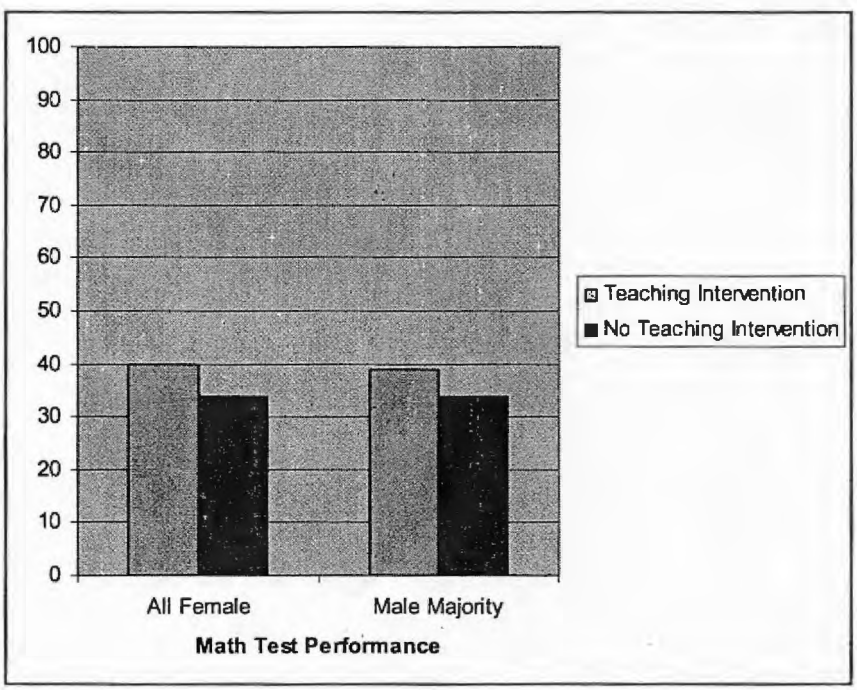
Results

Multivariate analysis of covariance (MANCOVA) was performed in order to investigate differences in the math test performance of females in a stereotype threat

intervention condition as well as a stereotype threat condition. This study also examined the attributions made by participants for their success (or failure) on the math test. The independent variables were test condition (stereotype threat intervention condition and stereotype threat condition) and group composition (groups consisting of females only and male majority groups). Five dependent variables were used: performance on the math test, external control, personal control, locus of causality, and stability. Preliminary assumption testing was conducted to check for normality, linearity, and homogeneity of variance with no serious violations noted.

Table 1

Plotting of Means: Group Composition (All Female and Male Majority) x Condition (Teaching Intervention and No Teaching Intervention)



Hypothesis 1: In Hypothesis 1a, female participants taught about the concept and dangers of stereotype threat (teaching intervention condition) will outperform female participants who believe their performance will be compared with that of the males (no teaching intervention condition) (Inzlicht & Ben-Zeev, 2000; Johns et al., 2005). In the

present study, participants heard a description of stereotype threat (see Appendix E). They also heard about how stereotype threat has negatively impacted the performance of females on math tasks and some minority groups on academic or cognitive assessments. It was predicted that when participants are aware of stereotype threat, they would perform better on a math test (see Appendix D) than the participants who had not received this instruction in both the intervention condition (Hypothesis 1b) and in the stereotype threat condition (Hypothesis 1 c). This would provide a main effect of experimental condition.

In Hypothesis 1a, the researcher states that it is expected that females will perform better on a math test when they take the test after having heard a description of stereotype threat. In order to examine this, the two intervention conditions (both female-only groups and male majority groups) were compared to the two no teaching intervention groups (female-only combined with male majority) (means plotted in Table 1). There were no significant differences found between the groups: F (5, 113) = 1.97, p = .09, partial eta squared = .08 and Wilks' Lambda = .92. This analysis demonstrates that differences did exist between the groups, however, they were not statistically significant. Providing the participants with a description of the concept of stereotype threat did not provide a buffer which allowed participants to perform significantly better than those who did not receive this description. The results of this study did not support Hypothesis 1a.

The researcher states in Hypothesis 1b that she expects the females in the intervention condition to perform better than the females in the no teaching intervention condition. When the two groups consisting solely of females were compared (the stereotype threat condition and the intervention condition) no significant differences were found: F (5, 53)

= 1.26, p = .295, partial eta squared = .11 and Wilks' Lambda = .89. In Hypothesis 1b, the researcher stated that she expected to see the female only intervention group perform better that the female only no teaching intervention condition. However, there were no significant differences found between groups. These results suggest that when females took a math test in a female-only group, they did not perform better on a math test when they were aware of the concept of stereotype threat.

In Hypothesis 1c, the researcher stated that she expected to find that females would perform better on a math test when they were provided with a description of stereotype threat. When examining the results of the participants who completed the math test in a male majority group, it was expected that the females in the intervention condition would perform better than the females in the no teaching intervention condition. The results of this study found there were no significant differences between the intervention condition and the stereotype threat condition in the male majority group: $F(5, 53) = .47$, $p = .79$, partial eta squared = .04, and Wilks' Lambda = .95. This study demonstrates that females did not perform any better on a math test in a male majority group when they completed the test after having heard about the concept and dangers of stereotype threat.

Hypothesis 2: When females take a math test in an all-female group, they will perform better on a math test than the females in a male majority group (Hypothesis 2a). When females are taught about the concept and dangers of stereotype threat (those in the teaching intervention condition) they will perform better on a difficult math test when in a female-only group compared to females in a female minority group (Hypothesis 2b). When females are not taught about the concept and dangers of stereotype threat (the no teaching intervention condition) they will perform better on a math test in a female-only

group compared to participants in a female minority group (Hypothesis 2c). It is hypothesized that greater performance deficits will be experienced by the participants in the no teaching intervention condition that in the teaching intervention condition. Inzlicht and Ben-Zeev (2000) found than females performed worse on a math test when they completed the test in a group outnumbered by males than females who completed the test in a group consisting only of females. It is predicted that females will experience similar performance deficits in the current study when they take the math test in a group outnumbered by males. That is, there will be an interaction effect between experimental condition and group composition. This study does not intend to disprove the findings of Inzlicht and Ben-Zeev. Rather, this study is examining if group composition affects math test performance in the teaching intervention / no teaching intervention conditions.

Several comparison analyses were made in order to examine if females performed better on a math test when they took the test in a group consisting solely of females rather than in a group consisting of a male majority. None of the comparison analyses demonstrated that females performed better when they completed the math test in a female only group than when they took the test in a male majority group (means plotted in Table 1).

In order to examine the effect of group composition on math test performance, the two female only groups were compared to the two male majority groups (Hypothesis 2a). There were no significant differences found between groups. When the two female only groups were combined (no teaching intervention condition and intervention condition) and compared to the two male majority groups (no teaching intervention condition and intervention condition) no significant differences were found: $F(5, 113) = .45$, $p = .81$,

partial eta squared = .02 and Wilks' Lambda = .98. Hypothesis 2 stated that the researcher expected to find that the females in the female only groups would perform better on the math test than the females in the male majority groups. The results of this study found that there were no significant differences between these groups.

Hypothesis 2b stated that the researcher expected to find that the female only group in the intervention condition would perform better than the females in the male majority intervention group. When the two intervention groups were compared (all female group and male majority group) no significant differences were found: F (5, 53) = .47, p = .79, partial eta squared = .04 and Wilks' Lambda = .95. These results indicate that the gender composition of the group in which female participants completed the math test in the intervention condition did not have any effect on math test performance.

In Hypothesis 2c, the researcher stated that it was expected that this study would find the female only group to perform better on the math test than the male majority group in the no teaching intervention condition. When the two no teaching intervention groups were compared (all female group and male majority group) no significant groups were found: *F* (5, 53) = .23, p = .95, partial eta squared = .02 and Wilks' Lambda = .97. These results suggest that the gender composition of the groups in the no teaching intervention condition did not have an effect on math test performance.

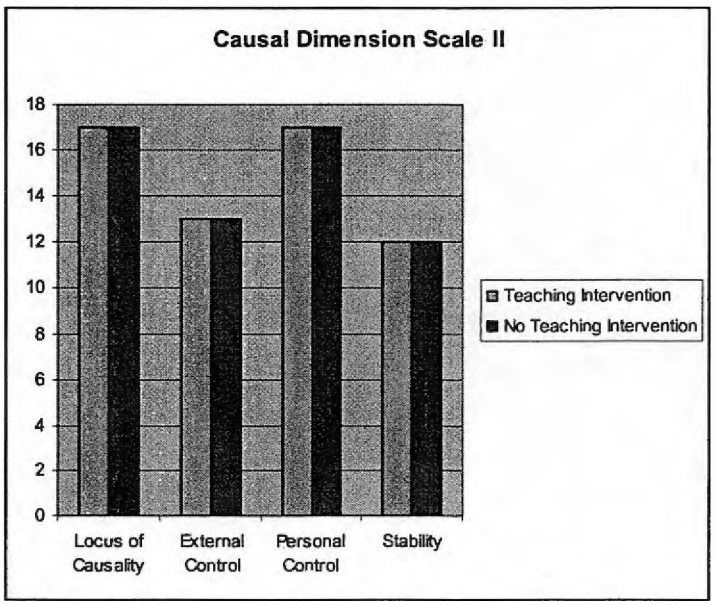
Hypothesis 3: When female participants were taught about the concept and dangers of stereotype threat, they would obtain higher scores on the Causal Dimension Scale II, a measure of external and internal attributions, than female participants led to believe that their performance on the test will be compared to male performance on three factors: locus of causality, stability, and personal control. However, it was predicted that

female participant taught about stereotype threat will obtain lower scores on the external control factor than the females who believe their performance on the test will be compared to that of the males.

In Hypothesis 3, the researcher stated that differences in scores on the CDS II were expected to be found between participants who had been taught about stereotype threat and those who had been in the stereotype threat group. It was hypothesized that participants in the intervention condition would obtain higher scores on three factors (locus of causality, stability, and personal control) and lower scores on the factor of external control. Results showed that there were no differences between groups: F (5, 113) = 1.97, p = .09, partial eta squared = .08 and Wilks' Lambda = .92 (means plotted in Table 2). The results of this study suggest that the participants in the group who learned about stereotype threat did not attribute their performance in a different fashion than the participants who did not learn about stereotype threat.

Table 2

Plotting of Means for the Causal Dimension Scale II Scores



Discussion

The present study sought to examine the effectiveness of an intervention that would protect females from the potentially harmful effects of stereotype threat. Participants were provided with a description of stereotype threat and warned to heed caution to the performance hindering effects associated with it. After being provided with this explanation, participants completed a math test. The math test results of these participants were compared to those of participants who had not been provided with information related to stereotype treat. Results of this study demonstrated that the participants who were provided with this information performed better on the math test than those who were not given the stereotype threat information. However, the differences between these groups were not statistically significant.

This study also examined females' performance on math tests when there were varying numbers of males present in the testing environment. Female participants were exposed to one of two conditions. In the first condition, no males were present in the testing environment, and in the second, the male to female ratio was 3:1. It was hypothesized that the math test performance of females would be negatively impacted when the females performed the test in the male majority group. This study examined if females would perform better on the math test if they completed the test in a group consisting solely of females. The results showed no statistically significant differences between the math test performances of each group. Females in the male majority group performed as well on the math test as females in the female only group.

A third purpose of this experiment was to assess the effect of directing females to make external attributions for any anxiety they experienced during testing. Participants

completed the CDS II, a scale which measures the attributions one makes for a success or failure on a task. It was hypothesized that when female participants were taught about the concept and dangers of stereotype threat, they would obtain higher scores on the CDS II than female participants who were led to believe that their performance would be compared to male performance on three factors: locus of causality, stability, and personal control. It was predicted that female participants who were taught about stereotype threat would obtain lower scores on the external control factor than the females who believed their performance would be compared to that of the males. This study did not demonstrate significant differences between groups on any of the four dimensions.

The design of this study was based in part on a study conducted by Johns et al. (2005). In the Johns study, participants in the teaching intervention condition were provided with a description of stereotype threat and warned to deter anxiety from interfering with their performance. The results showed that females performed better than those who were not provided with words of caution prior to taking the math test. When the participants of the current study were provided with a description of stereotype threat, the participants did not perform significantly better on the math test than those who were not provided with this explanation. When comparing the results of the current study to that of Johns et al. (2005) it is possible that the reason that different results were found is due to the fact that the math test administered in the current study was too difficult for the present sample of participants. In Johns et al. (2005) a different math test was used in which participants obtained an average mean score of .49, with some groups obtaining mean scores as high as .58. In the present study, the mean score of all female participants was .37, and the highest mean score was .40 (obtained by females in the all female group

who were taught about stereotype threat). As the participants obtained lower math test scores on the math test that was used in the present study, it is possible that the math test was too challenging for the participants. If the math test had been slightly less challenging, it is possible that greater group differences might have been found.

It is also possible that the current study produced different results than those found by Johns et al. (2005) due to confusion by participants about the stereotype threat concept. Participants were taught about the concept of stereotype threat by listening to a recording of a description of stereotype threat prepared by the experimenter. Although the participants provided with this information performed better on the math test than those not informed about stereotype threat, it is possible that some participants did not understand the description of the concept. After completing the math test, participants were asked how well (or poorly) they thought they performed on the test, and were additionally asked why they thought they performed as they did. Three participants in the intervention condition (those provided with the information about stereotype threat) wrote that they did not perform well because they knew that males performed better than females on math tasks. Responses such as these indicate that not all participants understood the stereotype threat description. It is quite possible that some participants understood a contrary message. If some participants did not understand the message provided, this likely affected the psychological state with which they completed the test and consequently how well they performed. It is possible that there were participants who did not understand the message that was intended to be conveyed to them. Had more participants understood the intended message, more participants might have obtained higher scores on the math test.

A second study which provided inspiration for the current study was conducted by Inzlicht and Ben-Zeev (2000). Inzlicht's study asked female participants to complete a math test in either a male majority group or a group consisting solely of females. Inzlicht's study demonstrated that females performed better on the math test when they were in a group consisting only of females than they did when they took the test in a male majority group. The current study examined whether or not females would perform better when taking a math test in a female-only group than in a male majority group. The results of the current study found that there were no differences in math test results between the females who took the math test in a group consisting of females or a male majority group.

While these results are unsatisfying in that they did not confirm the researcher's hypothesis, they are promising for their representation of what might take place in the classroom. Inzlicht's study placed participants in groups of no more than 3 people, whereas the present study placed participants in groups with as many as 20 people – a size closer to the likely composition of most classrooms. It is possible that females only experience performance deficits in math when outnumbered by males in small groups but not in larger groups. As most math classes are likely to have an enrollment of students closer to the number of participants in the current study, the results of the present study indicate that females may not experience performance deficits as a result of being outnumbered by males in the classroom.

Limitations

One limitation of the present study concerns the possibility that the math test was too difficult for this population. Stereotype threat research examining math performance of females has strived to administer math tests that are challenging for the participants,

yet not so challenging that the scores obtained on the test demonstrate a truncated range of scores. The effect of stereotype threat is thought to produce anxiety which interferes with performance during problem solving. If the problems are so difficult that the participant cannot solve them, then the effects of stereotype threat will not emerge. If the test administered in this study had been slightly easier, more participants may have excelled and the range of scores may have been greater. The range of scores also may have been affected by an additional limitation – the participants' misunderstanding of the description of stereotype threat.

As already mentioned, some of the participants did not understand the stereotype threat message conveyed to them. Three participants wrote that the reason they may not have performed well on the math test was because they thought males perform better than females on math tests; a message contrary to that which was meant to be heard by the participants. If three participants wrote comments suggesting they did not understand the stereotype threat message, there may have been additional participants who might have misunderstood the message. Had the intended message been more clearly conveyed, more participants might have completed the math test in the intended psychological state.

A third limitation involves the instructions for the CDS II. A lack of significantly different results amongst groups on the CDS II may be due to the fact that participants didn't understand the task asked of them on the CDS II. When participants completed the CDS II, several (approximately 7) participants raised their hand to ask how the CDS II was to be completed. As some participants did not understand the instructions, there may have been other participants who completed the task without asking for a clarification of

the instructions. If participants completed the CDS II without understanding the task's demands, the results may be interpreted as invalid and unreliable.

A final limitation may be the power of the study. If a greater number of participants were included, the power of the study would have been increased. Power refers to a study's sensitivity in detecting differences between treatment conditions when differences are present. It is possible to increase the sensitivity of a study by increasing the number of participants in each group (Keppel, 1991). It is important to include a sufficient amount of participants in order for a study to have suitable power to produce a sufficient effect size. Cohen calculated that a small effect size is equal to .01, a medium effect size equals .06, and a large effect size equals .15 (Cohen, 1992). As this study produced small to medium effect sizes, it is clear that inclusion of more participants will increase the likelihood of finding statistically significant results. It is also possible to increase the power of a study by using reliable measures. As some of the instructions were not clear to participants, this resulted in the measure providing less reliable results. Consequently, this resulted in the study having less power.

It was hypothesized that female participants would be buffered from the harmful effects of stereotype threat if they were taught to understand the concept of stereotype threat. Although statistically significant results were not found between groups (those informed about stereotype threat and those who were not) on the math test scores, group differences in math performance were observed ($p < .08$). When participants were taught about the concept and dangers of stereotype threat, they obtained a higher percentage of math items correct ($M = .40$) than those who were not provided this explanation ($M = .35$). If slightly larger groups had been used, it is possible that the differences observed

might have been statistically significant. Future studies would need a larger sample size to examine this issue.

Future Research Directions

First, in the future, piloting the math test is suggested. The math test used in these studies is the primary vehicle through which the effects of stereotype threat (and associated interventions) emerge. When a math test is administered that is too difficult (or too easy) for a population of participants, then the main hypotheses of the study cannot be tested. If the math test is piloted before being used in a research study, then it would be possible to examine the level of difficulty of the math test prior to conducting the study.

Second, after the stereotype threat message is delivered, it is recommended that participants have an opportunity to restate the definition in their own words. As the participants who heard the description of stereotype threat performed better on the math test than those who did not, it may be important for future research to compare several methods of informing participants about stereotype threat. Johns et al. (2005) found this practice to be an effective intervention and the present study demonstrated that participants performed better on the math test after receiving this information. It is possible that the most effective medium for conveying this message to participants has not yet been employed, therefore, it is recommended that future research studies examine a variety of methods.

In future research, it might be important to consider the effect of females having figures in their life who support the idea that they can excel in math. For instance, if female participants have a female role model in the math field, this figure of support could possibly act as buffer to the harmful effects of stereotype threat. If females have

this supportive figure in their lives that has excelled in math, they might think of the person when in a stereotype threat situation. Thinking of this person may provide the female participant with strength and consequently protect them from experiencing performance deficits. One might additionally consider the effect of having supportive parents or coming from a culture that is supportive of females excelling in math. A female may feel so supported by role models, family, or culture that their math performance will not suffer in stereotype threat situations.

An additional factor to consider in future research is the effect of having a female experimenter lead the experiment versus having a male. Does either a female or a male experimenter provide a stronger figure of authority? If one figure appears more authoritative than the other, does this enhance the effects of the intervention? It is also important to consider if different effects are produced when a male or female voice reads the description of stereotype threat on the tape. Future research studies might compare the effects of using a male or female experimenter and voice on the tape reading the stereotype threat explanation.

In the future, stereotype threat research would benefit from the implementation of modifications to the design of this study. Engaging in the piloting of the math test prior to test administration, as well as ensuring that the math test is the correct level of difficulty would greatly improve this study. Stereotype threat research has unearthed important findings that have led to a broader understanding of score depression on specific tasks amongst stigmatized groups. It is important that this research continues so that we might better understand how to improve performance in such conditions.

Appendix A

Name_____
Gender_____

The Mathematics Identification Questionnaire (MIQ)

For the statements below, indicate the extent to which you agree or disagree with each statement by writing a number that best represents your level of agreement:

1-------2-------3-------4-------5-------6-------7
Strongly Disagree — Strongly Agree

____ 1. My math abilities are very important to me.
____ 2. Math abilities are not important to my success in school.
____ 3. If I took an IQ test of my math abilities and I did poorly on this test, I would be very bothered.
____ 4. I don't care at all if other people believe that I am good at math.
____ 5. Math abilities will probably be very important to me in my future career.
____ 6. I feel good about myself when I do well on a math test.
____ 7. I don't care what math tests say about my abilities.
____ 8. Being good at math is not an important part of who I am.
____ 9. Doing well on math-related tasks is important to me.
____ 10. My score on a math test does not affect my opinion of how intelligent I am.
____ 11. I care a great deal about performing well on tests of my math abilities.
____ 12. It does not matter to me one way or the other how I do in math classes.
____ 13. How I do in math has a lot to do with who I feel I am.

Appendix B

URI Psychology Department
PIA Experiment

Name_____

Student ID number_____

E-mail address_____

Are you interested in taking part in this experiment? (circle)	yes	no
Are you available on Tuesdays at 11 am? (circle)	yes	no
Are you available on Tuesdays at 5 pm? (circle)	yes	no
Are you available on Thursdays at 10 am? (circle)	yes	no
Are you available on Thursdays at 1 pm? (circle)	yes	no

Appendix C

Transcription of Instructions
No Teaching Intervention Condition

AUDIO-RECORDED MESSAGE:
Thank-you for coming today to participate in this study. You have a piece of paper in front of you called an "informed consent" form. Please read through it thoroughly before we proceed.

(Pause while all participants read the informed consent form).

Has everyone finished? Do any of you have any questions? _____ (one of experiment assistants) is going to provide you with a packet of papers and a pencil. Please wait to open the packet until you are instructed to do so.

(Pause while packets and pencils are being handed out).

Today you will be completing a standardized math test. You will be completing this test in order for us to examine gender differences in mathematics ability. You will be provided with 30 minutes to complete the test. We will let you know when you should stop working on the test.

(Participants complete the math test).

Alright, everyone put your pencils down. In the last few pages of the packet, you will find a few short surveys. Please complete the surveys in their entirety. If you are uncertain of a response, please estimate a response. Please remain seated until you are instructed to leave.

(Provide participants with time to complete the surveys. When everyone has completed the surveys, the surveys will be collected).

Thank you all for your participation!

Debriefing instructions follow in Appendix H.

Appendix D

Transcription of Instructions
Teaching Intervention Condition

AUDIO-RECORDED MESSAGE:
Thank-you for coming today to participate in this study. You have a piece of paper in front of you called an "informed consent" form. Please read through it thoroughly before we proceed.

(Pause while all participants read the informed consent form).

Has everyone finished? Do any of you have any questions? _____ (one of experiment assistants) is going to provide you with a packet of papers and a pencil. Please wait to open the packet until you are instructed to do so.

(Pause while packets and pencils are being handed out).

Today you will be completing a standardized math test. You will be completing this test in order for us to examine gender differences in mathematics ability. You will be provided with 30 minutes to complete the test. We will let you know when you should stop working on the test.

Before beginning this test, we would like to inform you about a phenomenon that has been found to negatively impact female performance on math tasks. This phenomenon is called stereotype threat. Stereotype threat has been found to take place when there are negative stereotypes about a group's performance on a specific task. Research about stereotype threat shows that women and minorities may underperform on math and intellectual tests when stereotypes about math or intellectual abilities are highlighted. So, for example, when females are told that a math test that they are about to take has shown gender differences in the past, (i.e., males performing better than females) the females perform significantly worse than the males. However, when participants were told that there were no gender differences in the performance on the test, men and women performed equally well. Females in a stereotype threat situation sometimes experience anxiety that causes them to perform worse on a math task (pause). We would like you to attribute any anxiety you might experience during the math test to stereotype threat (pause). Do not attribute this anxiety to a lack of ability to perform well on the test (pause). Please start the math test.

(Participants complete the math test).

Alright, everyone put your pencils down. In the last few pages of the packet, you will find a few short surveys. Please complete the surveys in their entirety. If you are

uncertain of a response, please estimate a response. Please remain seated until you are instructed to leave.
Provide participants with time to complete the surveys. When everyone has completed the surveys, the surveys will be collected).

Thank you all for your participation!

Debriefing instructions follow in Appendix I.

Appendix E

FORM MMAB 96-17

MMAB®

010

Diagnostic Math Exam

Fill in the following information. Print clearly.

Date: ☐☐ Month ☐☐ Day ☐☐ Year

Name: ☐ First Initial ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ Last Name

Gender: ☐ MALE ☐ FEMALE

DO NOT OPEN THE TEST BOOKLET UNTIL INSTRUCTED TO DO SO.

THIS EXAM BOOKLET MUST NOT BE TAKEN FROM THE ROOM.

Please circle the letter that corresponds with the answer you choose for each problem. Choose only one answer for each problem. When you finish problem 20, please wait for further instructions.

TL

1) Which of the following equals the reciprocal of $x-\frac{1}{y}$□, where $x-\frac{1}{y}\neq 0$?

a	b	c	d	e

(A) $\frac{1}{x}-y$

(B) $-\frac{y}{x}$

(C) $\frac{y}{x-1}$

(D) $\frac{x}{xy-1}$

(E) $\frac{y}{xy-1}$

2) If $\frac{d-3n}{7n-d}=1$, then which of the following must be true about the relationship between d and n?

a	b	c	d	e

(A) n is 4 more than d

(B) d is 4 more than n

(C) is $\frac{7}{3}$ of d

(D) d is 5 times n

(E) d is 2 times n

3) If the circumference of a circle is less than 10π, then which of the following could be the area of the circle?

a	b	c	d	e

(A) 20π

(B) 25π

(C) 36π

(D) 81π

(E) 100π

TL

$$A = \frac{\pi d^2}{x}$$

a	b	c	d	e

4) If the formula above gives the area A of a circular region in terms of its diameter d, then $x =$

(A) $\frac{1}{4}$

(B) $\frac{1}{2}$

(C) 1

(D) 2

(E) 4

5) If t pills cost c cents, then at this rate how many cents will 5 pills cost?

a	b	c	d	e

(A) $5ct$

(B) $\frac{5c}{t}$

(C) $\frac{c}{5t}$

(D) $\frac{5t}{c}$

(E) $\frac{t}{5c}$

6) A rectangular floor 18 feet by 10 feet is to be completely covered with carpeting that costs x dollars per square yard. In terms of x, how many dollars will the carpeting cost? (1 yard = 3 feet)

a	b	c	d	e

(A) $20x$

(B) $28x$

(C) $60x$

(D) $180x$

(E) $540x$

TL 7) If $(2x - 1)^2 = 0$, then $x =$

a	b	c	d	e

(A) $-\frac{1}{4}$

(B) $-\frac{1}{2}$

(C) 0

(D) $\frac{1}{2}$

(E) $\frac{1}{4}$

8) In the sequence of numbers x_1, x_2, x_3, x_4, x_5, each number after the first is twice the preceding number. If $x_5 - x_1$ is 20, then which is the value x_1?

a	b	c	d	e

(A) $\frac{4}{3}$

(B) $\frac{5}{4}$

(C) 2

(D) $\frac{5}{2}$

(E) 4

9) The number 10^{30} is divisible by all of the following EXCEPT

a	b	c	d	e

(A) 250

(B) 125

(C) 32

(D) 16

(E) 6

TL 10) If $3x + 1$ represents an odd integer, then which of the following represents the next larger odd integer?

a	b	c	d	e

(A) $3(x + 1)$

(B) $3(x + 2)$

(C) $3(x + 3)$

(D) $3x + 2$

(E) $3(x + 2) + 1$

11) If a and b are both positive even integers, then which of the following must be even?

a	b	c	d	e

I. a^b

II. $(a + 1)^b$

III. $a^{(b+1)}$

(A) I only

(B) II only

(C) I and II only

(D) I and III only

(E) I, II, and III

12) Seven is equal to how many thirds of seven?

a	b	c	d	e

(A) $\frac{1}{3}$

(B) 1

(C) 3

(D) 7

(E) 21

TL

13) If $x \neq 0$, then $\frac{x(x^2)^3}{x^2} =$

a	b	c	d	e

(A) x^2

(B) x^3

(C) x^4

(D) x^5

(E) x^6

14) If membership in the drama club increases from 120 to 150, then what is the percent increase?

a	b	c	d	e

(A) 15%

(B) 25%

(C) 30%

(D) 40%

(E) 80%

15) If B is the midpoint of line segment AD, and C is the midpoint of line segment BD, then what is the value $\frac{AB}{AC}$?

a	b	c	d	e

(A) $\frac{3}{4}$

(B) $\frac{2}{3}$

(C) $\frac{1}{2}$

(D) $\frac{1}{3}$

(E) $\frac{1}{4}$

TL

16) If a rectangular block that is 4 inches by 4 inches by 10 inches is placed inside a right circular cylinder of radius 3 inches and height 10 inches, the volume of the unoccupied portion of the cylinder is how many cubic inches?

a	b	c	d	e

(A) $6\pi - 16$

(B) $9\pi - 16$

(C) $160 - 30\pi$

(D) $60\pi - 160$

(E) $90\pi - 160$

17) If x can only have the values –3, 0, and 2, and y can only have the values, -4, 2 and 3, then what is the greatest possible value for $2x + y^2$?

a	b	c	d	e

(A) 13

(B) 15

(C) 16

(D) 20

(E) 22

18) If $y = 3x$ and $z = 2y$, then in terms of x, $x + y + z =$

a	b	c	d	e

(A) 10x

(B) 9x

(C) 8x

(D) 6x

(E) 5x

TL

19) The value of $\left(1-\frac{5}{7}\right)\left(1+\frac{3}{4}\right)$ is

a	b	c	d	e

(A) $\frac{1}{28}$

(B) $\frac{3}{14}$

(C) $\frac{9}{28}$

(D) $\frac{13}{28}$

(E) $\frac{1}{2}$

20) In the system of equations below, if $z \neq 0$, then the ration of x to z is

a	b	c	d	e

$$x - y + z = 0$$

$$2x + y + 3z = 0$$

(B) $-\frac{4}{3}$

(C) $-\frac{1}{2}$

(D) $\frac{3}{4}$

(E) $\frac{4}{3}$

Appendix F

How well do you think you performed on the math test?

_____
_____
_____
_____
_____

What caused you to perform well (or poorly)?

_____
_____
_____
_____
_____

Think about your responses above. The items below concern your opinions about the causes of your performance. Circle one number for each of the following questions.

Is this cause(s) something:

1. That reflects an aspect of the situation	1 2 3 4 5 6 7 8 9	That reflects an aspect of yourself
2. Not manageable by you	1 2 3 4 5 6 7 8 9	Manageable by you
3. Temporary	1 2 3 4 5 6 7 8 9	Permanent
4. You cannot regulate	1 2 3 4 5 6 7 8 9	You can regulate
5. Over which others have no control	1 2 3 4 5 6 7 8 9	Over which others have control
6. Outside of you	1 2 3 4 5 6 7 8 9	Inside of you
7. Variable over time	1 2 3 4 5 6 7 8 9	Stable over time
8. Not under the power of other people	1 2 3 4 5 6 7 8 9	Under the power of other people
9. Something about others	1 2 3 4 5 6 7 8 9	Something about you
10. Over which you have no power	1 2 3 4 5 6 7 8 9	Over which you have power
11. Changeable	1 2 3 4 5 6 7 8 9	Unchangeable
12. Other people cannot regulate	1 2 3 4 5 6 7 8 9	Other people can regulate

Appendix G

Personal Background Questions

Instructions:
Please provide the following information:

1) Student identification number_____

2) Sex (circle one) Male Female

3) SAT Quantitative score_____ (if you do not remember your exact score, please estimate. **It is extremely important that you do not exaggerate your SAT score. This will greatly affect the results of this study**).

4) Which of the following math classes have you successfully completed? (place a check next to those you have completed)
_____Algebra
_____Geometry
_____Advanced Algebra
_____ Trigonometry
_____Calculus
_____ Advanced Calculus

5) With which racial/ ethnic group do you self-identify? (check one)

_____American Indian or Alaska Native
_____Asian American
_____Black/ African American
_____Native Hawaiian/ Other Pacific Islander
_____White/ European American
_____Hispanic/ Latino(a)
_____ Other Race/ Ethnicity

Appendix H

Debriefing Statement
No Teaching Intervention Condition

Thank you for participating in this study. This study is examining an intervention to protect females from the performance-hindering effects of stereotype threat. Stereotype threat is a phenomenon that takes place when there are negative stereotypes about a group's performance on a specific task. Research about stereotype threat shows that women and minorities may underperform on math and intellectual tests when stereotypes about math or intellectual abilities are highlighted. For example, when females are told that a math test that they are about to take has shown gender differences in the past, (i.e., males performing better than females) the females perform significantly worse than the males. However, when participants were told that there were no gender differences in the performance on the test, men and women performed equally well. This study is examining a method for improving female performance while in a stereotype threat situation. Do you have any questions? Again, thank you very much for your participation.

Appendix I

Debriefing Statement
Teaching Intervention Condition

Thank you for participating in this study. This study is examining an intervention to protect females from the performance-hindering effects of stereotype threat. Stereotype threat is a phenomenon that takes place when there are negative stereotypes about a group's performance on a specific task. Research about stereotype threat shows that women and minorities may underperform on math and intellectual tests when stereotypes about math or intellectual abilities are highlighted. For example, when females are told that a math test that they are about to take has shown gender differences in the past, (i.e., males performing better than females) the females perform significantly worse than the males. However, when participants were told that there were no gender differences in the performance on the test, men and women performed equally well. This study is examining a method for improving female performance while in a stereotype threat situation. Do you have any questions? Again, thank you very much for participating in this study.

Appendix J

Informed Consent

University of Rhode Island
Department of Psychology
Chafee Building
Kingston, RI 02881
Telephone 401.874.2193

You are being asked to take part in a research project in which you will complete a brief survey. If you are eligible to participate in Part 2 of this study, you will complete a math test and answer some questions about college student math performance. You don't have to like or be good at math to take part. This project will be explained to you in detail by the researcher. If you have any questions, please feel free to ask them. If you have any questions that you would like after you complete this experiment, Megan Frost, the principal researcher of this study, (617.838.8474) will be available to discuss them with you later. You must be at least 18 years old to participate in this research study.

Description of the project:
We would like you to participate in a research study titled "Math Performance Among Students in a Psychology Class." The purpose of this study is to gain a better understanding of student math performance.

What will be done:
This may potentially be a two part study. If you decide to take part in Part 1 of this study, here is what will happen: you will complete a questionnaire. This will take approximately 3 minutes. If you are determined eligible for this study, you may be asked to return for Part 2. If you participate in Part 2, you will take a math test, and then you will complete a few questionnaires. Part 2 of the study will take no more than 45 minutes total.

Risks or discomfort:
If you choose to participate in this study, you may experience some mild psychological discomfort.

Benefits of this study:
In participating in this study, you will have an opportunity to learn more about the math performance of students in a psychology class.

Confidentiality:
Your participation in this study is confidential. All information will be number coded and strictly confidential. Your identity will not be revealed without your written consent.

Decision to quit at any time:
Your participation is voluntary and you may choose to terminate participation and leave at any time without penalty. Your Psychology 113 grade will not be affected in any way if you decide to stop. If you wish to quit, you simply inform Megan Frost (phone) of your decision.

Rights and Complaints:
If you are not satisfied with the way in which this study was conducted, please address your complaints with Megan Frost (617.838.8474) or with Margaret Rogers (401.874.7999). In addition, you may contact the office of the Vice Provost for Graduate Studies, Research and Outreach, 70 Lower College Road, Suite 2, University of Rhode Island, Kingston, Rhode Island, telephone: (401) 874-4328.

You have read the Consent Form. Your signature on this form means that you understand the information and you agree to participate in this study.

_____	_____
Signature of Participant	Signature of Researcher
_____	_____
Typed/printed name	Typed/printed name
_____	_____
Date	Date

Please sign both consent forms, keeping one for yourself and return the other form to the researcher.

APPROVED - URI
Institutional Review Board
On 10/19/06

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