ABSTRACT

STEREOTYPES, INTEREST, AND PERSISTENCE: AN EXAMINATION OF WHY WOMEN LEAVE THE SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH FIELDS

By

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May 2012

The present study aimed to explain the disproportionate representation of women in Science, Technology, Engineering, and Math fields by examining the motivational processes through which stereotypes associated with the fields influence women's persistence. Although some explanations suggest that effects of stereotype salience on achievement, individual, and social motivations sufficiently explain gender differences in persistence, the Self-Regulation of Motivation Model suggests that activity-related feelings are also important predictors of persistence, and can be influenced by stereotype salience. Stereotypicality was manipulated with contextual images of male scientists and professionals. Contrary to expectations, female participants in the stereotypical environment did not show lower rates of achievement, individual, or social motivation, as with interest and persistence, compared to participants in the control condition. Potential explanations and implications are discussed.

STEREOTYPES, INTEREST, AND PERSISTENCE: AN EXAMINATION OF WHY WOMEN LEAVE THE SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH FIELDS

A THESIS

Presented to the Department of Psychology

California State University, Long Beach

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts in Psychology

Option in Psychological Research

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ACKNOWLEDGEMENT

Foremost, I would like to express my sincere gratitude to my advisor Dr. Dustin Thoman for the support and guidance he has provided during my Master of Art's career. He has been a constant source of inspiration and motivation, and this thesis would not have been possible without him. His "trees and the forest" metaphor will stay with me for the rest of my academic and professional career.

I would also like to thank the rest of my thesis committee: Dr. William Pedersen, and Dr. David Whitney, for their encouragements and insightful comments. Their hard questions pushed me to think like a psychological researcher.

I would like to give special thanks to all the staff in the Psychology Department, especially Diane Roe who answered my endless questions with patience and expertise.

And lastly I would like to thank my family for supporting my decision to pursue a career in psychological research, and for believing in me.

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CHAPTER 1

STEREOTYPES, INTEREST, AND PERSISTENCE: AN EXAMINATION OF WHY WOMEN LEAVE THE SCIENCE, TECHNOLOGY, ENGINEERING AND MATH FIELDS

In 1950, women represented only 29.6% of the United States workforce. Fifty years later, women represented 46.6% of the United States workforce, with expectations that this figure will continue to increase (Tossi, 2002). Despite this overall integration of women into the U.S. workforce over the past several decades, women remain dramatically underrepresented in specific domains; women particularly remain underrepresented in the upper tiers of education and workforce in science, technology, engineering, and mathematics (STEM) fields. In 2006, women earned about 60% of all college degrees in the United States (U.S. Census, 2007), but only half of the Bachelor's degrees in science and engineering recipients were women, and women received only 38% of the science and engineering doctorates in that same year (National Science Foundation, 2006). Beyond educational statistics, women represent only 25% of the STEM workforce (IEEE-USA, 2009). Margolis and Fisher (2002) argue that this underrepresentation is an important social problem because missing out on female perspectives can have negative consequences for society, as evident by negative outcomes attributed to all-male design teams.

What is the source of the underrepresentation of women in STEM? Although many women may start out in the STEM fields, especially in high school and college, fewer women than men persist to earn advanced degrees and enter the workforce. Researchers answering this question have made different assumptions and posited different theoretical models for explaining this lack of persistence over the last 30 years. These models have ranged from focusing primarily on biological or innate differences in math ability to social models that focus on multiple paths through which socialization experiences (including gender stereotypes) can influence women's choices to persist.

Biological or innate explanations for gender differences in STEM suggest that women are less competent than men at math and science (Halpern et al., 2007) suggesting differences in innate ability. Because of the differences between men and women on some advanced mathematical achievement and ability tests, many concluded that women simply did not have the innate ability to survive in a discipline that requires advanced mathematical abilities. The disparate ratio of women to men in STEM fields was then believed by the researchers to be due to the "scarcity of females with exceptional mathematical talent" (Halpern et al., 2007, p. 2). Much current research, however, argues against this explanation, as studies now show that math performance does not vary as widely across gender as previously thought; average SAT scores, complex problem solving abilities, and the number of bachelor's degrees earned in mathematics show insignificant gender differences (Else-Quest, Hyde, & Linn, 2010) and females consistently outperform males on tasks involving computational abilities and in selective samples (Hyde, Fennema, & Lamon, 1990). The inconsistency in performance differences between men and women on advanced mathematical achievement and ability tests suggest that differences are not sufficiently explained by innate ability, as differences caused by innate ability should be stable across all mathematic related achievements and samples.

If ability differences do not account for gender discrepancies in STEM, why do large discrepancies remain in these fields? With women performing as well as men across various STEM fields, the discrepancy is not due to women's inability to compete in the field; rather women are *choosing* to not persist in STEM fields.

One psychological explanation for why women choose not to pursue STEM focuses on the influence of stereotypes associated with women and STEM fields, and how these stereotypes can influence both perceptions of these women and their experiences in the stereotyped environment. Women who violate the gender stereotype (i.e., self-promoting women or women in stereotypically masculine fields) are negatively perceived, oftentimes rated as unlikeable and incompetent, compared to their stereotypic counter parts (i.e., modest women or women in stereotypically feminine fields; Rudman & Fairchild, 2004). This phenomenon is known as backlash effect, where counterstereotypic or atypical behavior (i.e., self-promoting for women, self-effacing for men) intended to have a positive effect on others' perception (such as during a job interview, or partner selection for competence game) adversely leads to rejection (both socially and professionally), resulting in unfavorable perceptions (Rudman, 1998). Women also internally experience negative effects of stereotypes. Specifically, social psychological research has shown that knowledge of self-stereotypes (stereotypes about one's group) can influence performance, behavior, and academic and professional preferences of targets of those stereotypes (Cheryan, Plaut, Davies, & Steele, 2009;

Gadassi & Gati, 2009; Wheeler & Petty, 2001). For example, awareness of a negative self-stereotype can create a surge of anxiety, causing members of the stereotyped group to perform worse, consistent with the negative stereotype (Schmader, 2010; Steele, 1997). The negative psychological experience that result from the awareness of a negative self-stereotypes in a given situation is identified as stereotype threat, part of a broader phenomenon known as social identity threat (SIT; Major & O'Brien, 2005; Steele, Spencer, & Aronson, 2002).

Persisting in STEM

To understand how stereotypes impact women's choices for persistence in STEM, it is important to understand what factors influence typical educational and career choices, as well as choices for persistence. First, certain achievement and achievement motivations need to be met. Because people need to perform well to advance to higher levels of education, and also to demonstrate achievement and knowledge, it is important for individuals to attain a certain level of performance, or achievement. Specific achievement motivations (i.e., goals) also need to be adopted, as different goal adoptions lead to different performance outcomes, as well as motivation for persistence. Performance and goal adoption has been shown to be susceptible to stereotype salience (Brodish & Devine, 2009; Smith, 2006; Spencer, Steele, & Quinn, 1999; Steele & Aronson, 1995). Secondly, people need to meet, and expect to meet, certain individual motivations. People are generally motivated to hold positive self-perceptions about themselves (Kuppens, Realo, & Diener, 2008), including being motivated to see the self as competent or high in self-efficacy (Bandura, 1982; Hu, Motl, McAuley, & Konopack, 2007); therefore, a field that promotes positive self-perceptions is more desirable than those that do not. Third, social motivations also need to be considered. People are motivated to seek out fields in which they feel high social connectedness (i.e., sense of belonging; Walton & Cohen, 2007), which predicts favorable outcomes such as performance, initial choice, involvement in the field, and persistence (Davies, Spencer, Quinn, & Gerhardstein, 2002; Davies, Spencer, & Steele, 2005; Marx & Roman, 2002; Murphy, Steele, & Gross, 2007).

Together these variables emphasize the achievement-related motivations (i.e., performance and goals), individual motivation (i.e., positive self-perceptions), and social-motivation (i.e., belonging) that lie underneath the choice for persistence. For these reasons it is important to understand the influence that stereotypes have on achievement and achievement motivation, individual motivation, and social motivation. Social psychological research has focused on each of these processes to explain how stereotypes may decrease persistence. Figure 1 presents a diagram of these processes.

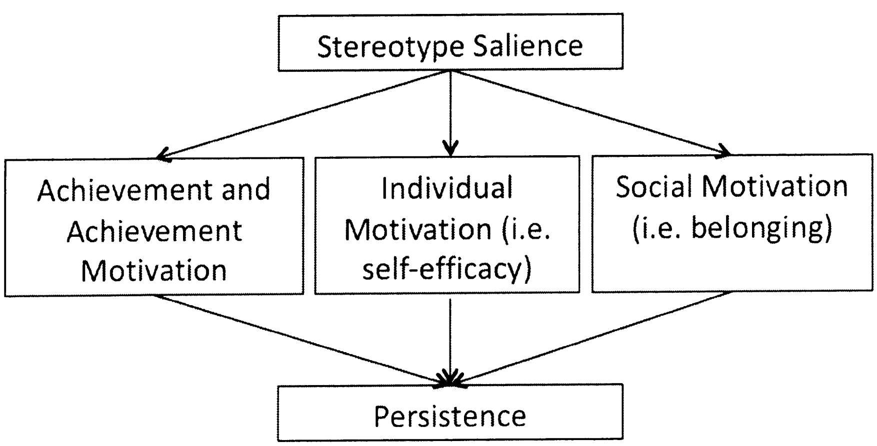


FIGURE 1. Effects of stereotype salience on persistence.

Achievement and Achievement Motivation

In settings where high competence is both emphasized and recognized, such as academic settings, certain achievement and achievement motivations need to be met. High achievement, or performance, is of utmost importance in these fields to demonstrate competency and advance to higher levels of education and employment. While performance is typically interpreted as a measure of innate ability, it can also reflect other factors, such as environmental and situational factors that reinforce stereotypes (i.e., being the only female in a mathematics class). When women take a test or participate in other measures of performance in a situation where the negative stereotype associated with women and math is made salient, they are often filled with anxiety at the possibility of fulfilling that stereotype, the motivation to prove that stereotype wrong, and a general negative feeling at having to take a test they are not expected to do well on (Schmader, Johns, & Forbes, 2008; Steele et al., 2002). The surge of emotion occupies the mind, and inevitably leads to a lowered test score. This negative psychological phenomenon is known as SIT. SIT refers to the feelings that arise when a stereotype is made salient or when one's identity is negatively primed in the situation.

Another important aspect of achievement motivation is goal adoption. Social psychologists have used different ways students approach achievement settings, achievement motivation, or goals, to explain how stereotypes negatively affect persistence. Within the achievement goal context, Elliott and Dweck (1988) identify two types of goals: mastery, which emphasizes individual improvement (i.e., learning), and performance, which emphasizes outcomes (e.g., grades; see also Darnon, Butera, Mugny, Quiamzade, & Hulleman, 2009; Dowson & McInerney, 2003; Karabenick & Collins-

Eaglin, 1997). The present study deals with performance goals, which research has shown to be susceptible to the effects of self-stereotype salience (Brodish & Devine, 2009; Smith, 2006). Furthermore, research shows differential performance outcomes depending on the type performance goal adoption. Adoption of performance-approach (PAP) goals, where individuals are motivated to outperform others, positively predicts performance outcomes, while adoption of performance-avoidance (PAV) goals, where individuals are motivated to avoid performing poorly compared to others, negatively predicts performance outcomes (Darnon et al., 2009).

One well-studied result of SIT is a drop in performance (Ben-Zeev, Fein, & Inzlicht, 2005; Purdie-Vaughns, Steele, Davies, & Ditlmann, 2008; Schmader, 2010; Spencer et al., 1999; Steele, 1997; Steele & Aronson, 1995; Stone, Lynch, Sjomeling, & Darley, 1999; Wheeler & Petty, 2001). Research conducted by Spencer and colleagues (1999) demonstrated how SIT can negatively affect women's math performance. When participants were told that the math test was sensitive to gender differences, women scored significantly worse than male participants, but these gender differences in test scores were only observed when the math and gender stereotype was made salient. Although the focus here is on gender, SIT affects other groups who face negative academic and non-academic stereotypes (e.g., Spencer et al., 1999; Steele & Aronson, 1995; Stone et al., 1999).

Stereotypes also contribute to shaping individual's goals, oftentimes with negative actual and expected performance outcomes. Smith (2006) showed the negative relationship between stereotype salience and performance through PAV goal adoption using the gender-math stereotype. When participants were explicitly reminded that men are superior to women in mathematics, women were more likely to adopt PAV goals, which negatively predicted performance expectations, compared to male participants. Brodish and Devine (2009) conducted a similar study, exposing participants (all female) to the gender-math stereotype and examining differences in adopted goals by condition, but also adding a math test as a measure of actual performance. Participants who were exposed to the gender-math stereotype more highly adopted PAV goals and obtained significantly lower test scores than participants who were in the control condition. Because goals are susceptible to the effects of stereotypes, it is an important variable to consider in explaining the relationship between stereotypes and motivation to persist.

A stereotype does not have to be blatantly stated, as in the study by Spencer et al., (1999). Rather, it can be emphasized through social interactions and situational cues. For example, Vescio, Gervais, Snyder, and Hoover (2005) found that when female employees were placed in devalued positions (positions that were considered inferior, or of requiring little skills and abilities) but received high praise from male employers (patronizing interaction), they showed a decrease in job performance, consistent with effects of SIT. Cheryan et al., (2009) also demonstrated that being a female student in a science lab full of stereotypically masculine items and images of men, even without the presence of any actual males, can trigger identity threat. In addition, members of negatively stereotyped groups can experience and be affected by identity threat in situations when their stereotyped identity is made salient, regardless of whether or not they personally believe that the stereotype is true. Huguet and Regner (2009) found that middle school girls who did not endorse gender differences in geometry performance (thus holding counterstereotypic beliefs) still showed the negative effects of SIT on tests labeled as "geometry" compared to tests labeled as "drawing," consistent with suggestions made by Steele (1997). With performance held at utmost importance in academics, continuously receiving low test-scores is enough to deter persistence.

Students are both motivated and encouraged to pursue areas in which they have high abilities and expect to perform well in; therefore, it is important to examine performance and performance goal adoptions in studying the effects of stereotype salience on women's persistence in STEM fields. Because performance can negatively impact persistence, underperformance resulting from SIT and PAV goal adoption from stereotype salience has been posited as one explanation for why women do not pursue STEM fields.

Individual Motivation

While performance is important in education and employment, it is not the only predictor of educational and career choices. As previously mentioned, people are individually motivated to hold positive self-views (i.e., self-esteem) and perceive themselves as competent (i.e., self-efficacy). Having high or positive self-perceptions leads to having various high or positive physiological and psychological outcomes, such as better stress coping, increase in intrinsic interest, career pursuits, enjoyment, as well as increase in performance, while having low or negative self-perceptions leads to negative physiological and psychological outcomes (Bandura, 1982; Hu et al., 2007). Hence, people are expected to choose to persist in fields in which their individual motivations can be met. For example, individuals are more likely to choose educational and occupational fields in which they have high expectations of success, confidence in abilities to succeed, or high personal efficacy, compared to fields in which they have low expectations of success, confidence in abilities, or low personal efficacy (Eccles, 1994).

Stereotype salience can also influence performance indirectly by influencing self-efficacy (Marx & Roman, 2002; Stangor, Carr, & Kiang, 1998). Marx and Roman (2002) illustrated how individual motivation can be influenced by stereotype salience by exposing female students to SIT situations. Female participants showed the lowest level of self-esteem as well as lower test scores on the math test when the experimenter was male (SIT condition), compared to when the experimenter was a competent female (nullified SIT condition), and compared to male participants. Stangor and colleagues (1998) found that the effects of stereotype salience undermined initial performance confidence. When participants were led to believe that they had high ability (efficacy) on a task, they had high performance expectations, compared to those who were led to believe low ability on a task. However, when female participants were told that the spatial ability task shows gender differences, they reported low ability and low performance expectations, compared to when the task was expected to show no gender differences, despite initial high efficacy beliefs.

Furthermore, research shows that self-efficacy mediates the effects of stereotype on persistence, as well as performance. Hansen and Wanke (2009) primed participants with either a "professor" (stereotypically high intellectual ability) or a "secretary" (stereotypically low intellectual ability), and found that participants who were primed with professor reported higher confidence in intellectual ability (efficacy), compared to those who were primed with secretary. Essentially greater confidence in intellectual ability predicted better performance. This is also seen with non-academic priming as well, where when athletes were primed with high athletic ability, they persisted longer in physical exercise, compared to those who were primed with low athletic ability. The authors conclude that stereotyped priming manipulated self-efficacy beliefs and the motivational consequences, rather than skill.

Individual motivation can directly influence persistence, as people seek out environments that encourage high individual motivation because it can lead to positive psychological outcomes, and furthermore, individual motivation can indirectly influence persistence by affecting performance. It is important to examine individual motivation in understanding how stereotype affects women's persistence in STEM, because individual motivation is susceptible to stereotype salience.

Social Motivation

The experience of a sense of social connectedness (i.e., belonging) is a basic human motivation (Baumeister & Leary, 1995), distinct from the aforementioned achievement motivation and individual motivation, but just as important (Deci & Ryan, 1985). People are fundamentally motivated to feel a sense of belonging with the people and the environment, and seek out environments that fulfill that motivation (Baumeister & Leary, 1995; Deci & Ryan, 1985). Without adequate social bonds, negative affect, such as anxiety and depression is likely to occur (Baumeister & Leary, 1995). Social motivations are important to consider in examining the lack of women in STEM fields, because not having the sense of belonging oftentimes deter people from that field and prevent them from joining the field in the first place (Cheryan & Plaut, 2010; Cheryan et al., 2009).

Stereotype salience has a negative effect on women's sense of belonging in traditionally masculine fields (i.e., STEM fields). Murphy and colleagues (2007) examined women's sense of belonging after being exposed to either a gender-balanced or gender unbalanced math, science, engineer (MSE) conference videos. Women who were exposed to the gender unbalanced video reported the lowest level of sense of belonging, compared to women who viewed the gender balanced video and compared to male participants. Cheryan and colleagues (2009) found that women who were introduced to a computer science setting with stereotypically computer science items (i.e., stereotypically masculine objects) reported the lowest level of sense of belonging, compared to a non-stereotypical room and compared to male participants. An important conclusion made by the authors is that even when participants were told that the room was used by all-female teams, female participants still reported low levels of sense of belonging. Furthermore, when individuals consider reasons for joining a new field, perceived similarity (i.e., belonging) to the items and people in the field are considered. For example, if perceived sense of belonging in the field is high individuals show high interest in joining the field, while if perceived sense of belonging is low individuals show low interest in joining the field (Cheryan & Plaut, 2010). Sense of belonging is also a stronger predictor of persistence than expectations of success and SIT effects (Cheryan & Plaut, 2010).

Social motivations are important to consider in examining the effects of stereotype salience on women's choices to persist in STEM fields because of their susceptibility to stereotypes, and because they are reliable predictors of initial choice and persistence.

The multiple processes by which stereotypes influence persistence create a complex process to explain the causes of the lack of persistence in female STEM students. Taken together, previous research distinguishes three paths through which stereotypes affect women's choices to persist. These three paths, illustrated in Figure 1, show the influence of stereotypes as mediated by achievement and achievement motivation, individual motivation, and social motivation. Essentially, the three processes span across achievement, views of the self, and the relationship with the environment and the people in it.

Interest as the Missing Motivator

Missing from this picture thus far, however, is perceptions about the activity, such as interest. The Self-Regulation of Motivation (SRM) Model (Sansone & Thoman, 2005) suggests another psychological route through which stereotypes may affect motivation to persist in the stereotyped activity or domain, focusing on activity perceptions. More specifically, this model suggests that feelings of an activity experience (i.e., interest) can be as important for maintaining motivation as achievement, individual, and social motivations. Interest is a strong predictor of persistence and future choices, especially in activities that lack external motivation to persist. SRM suggests that when individuals participate in an activity, they consider possible reasons (intrinsic or extrinsic motivation) to continue with the activity. The experience of interest provides sufficient intrinsic motivation for the individual to continue with the activity. However, if the activity is not interesting, then extrinsic motivations are examined, and without sufficient reasons the individual would stop participating in the activity (Sansone & Thoman, 2005). Interest for an activity also functions as a buffer against negative effects of feedback, predicts individual's persistence, as well as initial choice in activity (Lepper & Henderlong, 2000; Thoman, 2008) and is an important source of human motivation (Thoman, Sansone, & Pasupathi, 2007).

Another reason interest is of importance in examining female persistence in STEM fields is because interest is a strong predictor of college students' choice of academic major (Hidi & Renninger, 2006). Current research studying the effects of stereotypes on interest often fails to highlight the importance of interest in predicting persistence. Previous research shows that the experience of interest is a stable and reliable predictor of positive (or more desirable) outcomes, such as increase in task choice and persistence, and activity engagement, while a lack of interest leads to negative outcomes, such as decrease in intrinsic motivation, persistence, and increase in learning time (Sansone & Thoman, 2005).

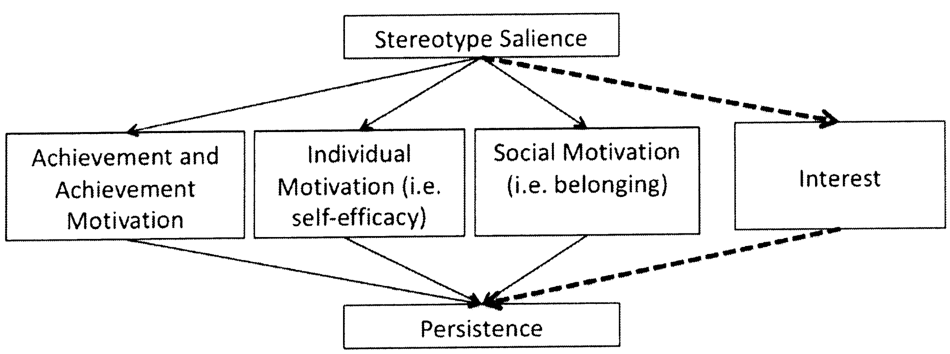


FIGURE 2. New model incorporating interest as a possible mediator.

A more complete picture in studying the effects of stereotypes on persistence should include the processes through which stereotypes influence persistence via interest in the stereotyped activity. That is to say, exposure to a stereotype about the domain will lead individuals to report a decrease in the experience of interest after having participated in the activity. The newly proposed model (Figure 2) includes the experience of interest.

Present Study

The purpose of the present study was to test whether task interest mediates the effects of stereotype salience on persistence, within a multiple mediator framework along with achievement and achievement motivation, individual motivation, and social motivations (see Figure 2). Stereotypicality, or gender exclusivity, was induced by exposing participants to a stereotypical engineering environment, created with posters containing images of male scientists or professionals only (Cheryan et al., 2009; see Appendix A). Two control settings were used: the first was a nature environment, consisting of posters showing images of nature (i.e., flowers, trees, etc), with no presence of people or technology of any sorts to induce gender neutrality; the second was a mixed-gender environment, consisting of posters with equal gender or high female representation to induce gender inclusivity. The reason for two gender inclusive environments was to be able to distinguish whether the group differences were simply due to presence or lack of people in the environment or, as the present study suggests, due to the stereotypicality of the environment. Because the gender exclusive condition is consistent with the STEM stereotype, only female (but not male) participants were expected to show group differences as a function of the posters' manipulation.

While previous research has not exclusively focused on the effects of gender exclusivity created by environmental stereotypes on task experience (i.e., interest), Rickford's (2001) study on cultural congruence and performance shows support for the current study's proposed model. When ethnic minority students were exposed to culturally congruent reading materials (i.e., ethnic folktales) where students could relate to the contexts and experiences, at-risk students showed increase in enjoyment, interest, motivation, and performance. This research provides support for the proposed model in that it shows the importance of environmental cues on interest, and its effect on performance. An important difference to take notice of is that environmental cues in Rickford's study were manipulated via learning materials, not through the context in which the learning activity took place.

Further support for the current study's proposed influence of stereotype on interest comes from Smith, Sansone, and White's (2007) examination of the relationship between different types of goals and its mediation on experience of interest in a stereotype threat context. Smith and colleagues illustrated goal adoptions as a key mediator between negative competence stereotypes and experience of interest, by conducting a 2 (stereotype threat vs. stereotype nullified) x 4 (PAV goal vs. PAP goal vs. mastery goal vs. no goal provided) between subjects study examining the experience of interest in a computer science task. Within the math-gender stereotype (i.e., men are superior to women in mathematics domain) salient condition, women assigned to the PAV goal group reported the least amount of interest in the computer science task, while women assigned to the PAP goal group reported the most amount of interest. The study not only highlights the importance of performance goals (PAV and PAP) in predicting interest, over and beyond mastery goals or no goals, it also provides support for an indirect effect of stereotype salience on the experience of interest. An important difference here is that the current study will examine direct influences of negative stereotype on the experience of task interest.

The present study differs from previous studies on interest in that it studied the experience of interest from a learning activity, rather than reported interest in pursuing a domain. Previous SIT studies examining the effects of gender exclusive/inclusive environments on interest have only investigated domain interest. That is, participants were asked to rate their interest in the stereotyped domain, but were not asked to participate in activities related to that domain. Furthermore, previous research has focused only on the stereotypicality of the domain, implying that changing the stereotypic environment associated with the domain will be enough to generate persistence in the stereotyped domain (Cheryan et al., 2009; Davies et al., 2002).

The present study to investigated how the stereotypicality of the environment influences interest in the task, which is also expected to influence interest in the domain. Although somewhat subtle, the theoretical (and practical) significance of predictions about task versus domain interest is important for models of interest development. Hidi and Renninger (2006) describe the formation of individual (or domain) interest as a four-phase process, where each phase is sequential and distinct, but dependent upon the formation of the previous phase. The four-phase model of interest identifies situational (or task) interest as the starting point for development of domain interest. Each step following the initial development of task interest emphasizes maintaining that task interest, with the ultimate goal of attaining stable domain interest. Environmental or textual features can trigger initial task interest, where it is maintained with focused attention and persistence over an extended period of time. Domain interest emerges with well-maintained task interest, where the individual seeks to reengage in that activity. The final stages are signified by well-developed domain interest, with relatively enduring predisposition to reengage with the activity. For example, a female student may develop task interest in an engineering activity she is exposed to in class, but that interest can only develop into interest in engineering (domain interest) when she repeatedly experiences interest in the same or similar activity over extended period of time, followed by seeking the activity outside of required classroom context. Without support, the individual can regress to the previous step, or interest can disappear altogether.

The present study planned to examine the relationship between stereotype salience on interest and persistence, taking into account the importance of initial situational interest on enduring individual interest. More specifically, the present study identified initial situational interest as related to interest in the lab activity or task only, and individual interest as related to interest in the domain as a whole (i.e., engineering). Both are assumed to be necessary in increasing female persistence in STEM. I suggest that for female engineering students to persist in STEM fields, not only should STEM environments become more gender inclusive, but women also need the chance to develop individual interest. For example, if there was a surge of female students and professors at the engineering department, that change in environment alone would not be enough to spark individual interest for the female student. Rather, for individual interest to occur the female student has to develop task interest in the engineering context first, and slowly cultivate that interest into more persisting individual interest.

Hypothesis 1

Female participants in the stereotypical environment will show lower rates of achievement (i.e., performance) and achievement motivation (i.e., goal adoption), individual motivation (i.e., self-efficacy), and social motivation (i.e., belonging), along with experience of interest and persistence, compared to participants in the other two conditions, and male participants.

Hypothesis 2

Stereotype salience will likely affect persistence indirectly via multiple paths, one of the significant indirect paths will be associated with task interest.

CHAPTER 2

METHOD

Participants

A total of 256 participants were recruited from an Introductory Psychology class. Of the 256 participants, three were excluded for missing manipulation check questionnaires, three were excluded because participant sex was missing, and seven were excluded because they rated the activity with "English" on a Science to English scale on the manipulation check questionnaire. Remaining data consisted of 157 females and 87 males, with a mean age of 19.33 (SD = 2.81). Of those participants, 31.6% were Asian, 27.5% Hispanic, 23.8% White, 9.84% Multi-racial, 2.9% African-American, 1.2% Middle Eastern, .4% Native American, and 7 participants did not answer the question.

Procedure

The research lab was prepared with the appropriate set of posters, randomly assigned per day. Three sets of five posters were used to create the intended stereotype environment. All of the posters had slogans and phrases (e.g., "Become a scientist-support the effort for solar technology") encouraging the use of solar power and becoming a scientist to invoke a science lab-like setting (see Appendix A). Each set of posters had different images to convey three different environments: (a) gender neutral, depicted with images of nature only (b) gender inclusive, depicted with images of male and female scientists and students, and (c) gender exclusive, depicted with images of scientists and professionals only. The use of the posters is modeled after Cheryan et al., (2009). To create a typical science lab-like setting, research assistants wore lab coats.

Participants were run individually. When participants arrived, the experimenter led them into the research lab and gave a brief introduction to the study. Participants were told the purpose of the study was to assess the value of using hands-on activities in science classes, and that this particular activity was randomly assigned to them from a number of different activities. To explain the various posters and the activity, participants were told that various science associations were funding the study. Participants were told that the purpose of the questionnaires was to assess for whom the activity is most beneficial. Before the activity, a pre-activity questionnaire was administered, which included measures of domain identification, performance and interest expectations, and achievement goal adoption. Upon completing the pre-activity questionnaire, participants read a lesson about solar energy from a solar power manual, and were instructed to try to learn as much as they can in five minutes, as a learning test would be administered at the end. After completing the reading, participants moved onto the activity portion of the experiment. The activity had participants complete a building activity by completing the partially built solar power elevator. This activity has been rated with high interest in previous studies (Thoman, 2008), ensuring that the baseline interest level would be high enough to prevent a statistical floor effect of interest in the data.

After completing the activity, a five-minute timed learning test was administered, followed by the post-activity questionnaire packet. The post-activity questionnaire packet included measures of performance, activity interest, efficacy, persistence, belonging, and previous experiences. Demographic information was also completed at this point.

After completing the activity evaluation, the experimenter led participants out of the room; the participant were told that the room needed to be prepped for the next participant. At this point, participants completed the manipulation check questionnaire. Participants were probed for suspicions first, and then debriefed. This was to ensure that the debriefing would not trigger participants' suspicions.

Measures

Preactivity Measures

Although random assignment to experimental condition was expected to rule out possible explanations for the results associated with pre-existing differences that participants bring to the lab, a pre-activity questionnaire was included to measure relevant differences in domain identification and expectations about the activity. Although there are no predictions made regarding these variables, they were included as potential covariates in tests of study hypotheses. All pre-activity items are included in Appendix B.

Domain identification measure. Smith and White's (2001) Domain identification measure (D.I.M) was used to measure how much participants associate him or herself with science. 7 of the items (e.g., "I have always done well in science") were rated on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree), and one was rated on a 5-point Likert scale. Because not all items were on the same scale, a z-score was calculated for all eight items, and then added together to create a composite score for D.I.M ($\alpha = .87$).

Expected activity interest. Three items measured expected activity interest (e.g., "I think this activity will be interesting"). Items were rated on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The composite score for the variable was calculated by adding the value of three items ($\alpha = .93$)

Self-perceptions. Two items measured self-perceptions of expected competence (or efficacy; i.e., "I think I will do well in this activity"). Items were rated on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). Composite score was created by adding the value of two items ($\alpha = .81$).

Goals. Goals consisted of six items measuring PAP (e.g. "It is important for me to do better than other students on this activity"; $\alpha = .92$), and six items for PAV (e.g. "I worry that I may not learn all that I possibly could in this activity"; $\alpha = .80$), adapted from Elliot and Church (1997). Each of the goals were calculated by adding the value of three corresponding items. Items were rated on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

Postactivity Measures

After completing the reading selection and activity, participants completed measures of performance, efficacy, activity interest, belonging, likelihood of persistence, demographic information, and lastly the manipulation check questionnaire. The manipulation check questionnaire was administered outside of the experimental room to ensure participants correctly remember the condition of the room. All items are included in Appendix C.

Performance. Performance in the activity was measured with a learning evaluation consisting of 10 multiple-choice questions (e.g., "How do you reverse the solar motor?"). Performance score was calculated by adding the number of correct responses for all ten items.

Efficacy. Two items on expectations of competence (or efficacy) were administered (e.g., "I think I performed just as well, if not better than others in this activity"). Items were rated on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The composite score was calculated by adding the value of two items, one of which was coded so that high values would reflect high perceived efficacy ($\alpha = .76$).

Activity interest. Activity interest was measured using eight items (e.g. "I enjoyed doing this task"), adapted from Sansone and Thoman (2005). Items were rated on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The composite score was calculated by adding the value of eight items, two of which were reverse coded so that high values would reflect high activity interest ($\alpha = .90$).

Belonging. Belonging was measured using five items (e.g., "how much do you feel you belong in an environment that uses this activity"), adapted from Murphy et al., (2007). Items were rated on a 7-point Likert scale, ranging from 1 (Not at all) to 7 (Very Much). The composite score was calculated by adding all five items together ($\alpha = .88$).

Likelihood of persisting. Likelihood of persisting was measured using seven-items an "order form" like questionnaire, where participants indicated whether or not they wanted more information about fictional solar-physics related groups (e.g., Solar energy society), careers, and majors. Composite score was created by adding up all the "yes" from the seven items ($\alpha = .73$).

Manipulation check. To ensure that participants were manipulated as intended by each condition, a manipulation check questionnaire was administered at the end of the study. Participants answered five questions pertaining to how they would describe the activity, engineering, science, and the experimental room (e.g., "How would you describe the activity you did today in the following categories?"; "Where would you place the research lab where you worked on the activity today on the following scale?") using three 7-point Likert scale ranging from "Science" to "English," "Not at all masculine" to "masculine," and "Feminine" to "Not at all feminine." They also answered two open-ended short-answer type questions which asked participants to recall what they remember about the room, as well as what they remember about the posters in the room. Because of the subtle nature of the manipulation, participant data was only be excluded from data analysis if they incorrectly rate the activity as "English."

See Table 1 for correlation matrix of all measured variables.

TABLE 1. Correlation Matrix for All Measured Variables

	1	2	3	4	5	6	7	8	9	10
1. D.I.M	1									
2. Expected activity interest	.29**	1								
3. Self perceptions	.35**	.53**	1							
4. Goals-PAP	.28**	.15*	.38**	1						
5. Goals-PAV	.04	.04*	-.03	.38**	1					
6. Performance	.12	.13*	.15*	.07	-.05	1				
7. Perceived efficacy	.26**	.20**	.33**	.16*	-.03	.11	1			
8. Activity interest	.28**	.43**	.30**	.20**	.21**	.14	.44**	1		
9. Belonging	.48**	.38**	.38**	.26**	.07	.09	.49**	.63**	1	
10. Likelihood of persisting	.17*	.27**	.13	.13	.11	-.12	.12	.38**	.43**	1

* $p < .05$; ** $p < .01$

CHAPTER 3

RESULTS

Analyses Overview

As stated earlier, the hypotheses for the current study were that female participants in the stereotypical environment will show lower rates of achievement and achievement motivation, individual motivation, social motivation, experience of interest and persistence, compared to participants in the other two conditions, and male participants. Initial analysis tested the main effects of participant sex, experimental condition, and the interaction between participant sex and condition on each of the outcome variables, using an analysis of variance (ANOVA) or analysis of covariance (ANCOVA). A 2 (participant sex: male vs. female) x 3 (experimental conditions: gender exclusive vs. gender inclusive vs. gender neutral) ANOVA was used to test the main and interaction effects on expected activity interest, achievement goals, perceived efficacy, performance, belonging, and likelihood of persistence. A 2 (participant sex) by 3 (experimental condition) ANCOVA was used to test the main and interaction effects on activity interest, using domain identification measure and expectations of interest measured during the pre-activity questionnaire as covariates.

Research Lab Manipulation

To ensure participants were correctly regarding the research lab as scientific, as the stereotype at play was related to science, it was important all participants described the study lab with "Science" rather than "English". As previously mentioned, seven participants' data was excluded from analyses for incorrectly rating the experimental room with a 5, 6, or a 7, indicating English on the scale, rather than Science. Participants otherwise rated the room with a mean of 1.84 (*SD* = 1.02), describing the room as "Science".

Sex x Condition ANOVAs

First, a 2 (participant sex) x 3 (experimental condition) between subjects ANOVA or ANCOVA was used to test for main and interaction effects on the outcome variables (see table 2 for descriptive statistics by condition and sex for each outcome variable). As seen in table 3, analyses showed non-significant main effects of sex, condition, and non-significant interaction effect on pre-activity measures, expected activity interest, performance approach goal, and performance avoidance goal. Main effects of sex, condition, and interaction effect on post-activity measures were also not significant, which included, performance, activity interest, and likelihood of persisting. Perceived efficacy showed a significant main effect of sex, where male participants reported a higher level of efficacy (*M* = 10.89, *SD* = 2.10) than female participants (*M* = 9.93, *SD* = 2.56), and condition, where participants in the gender exclusive condition reported higher (*M* = 10.92, *SD* = 2.11) efficacy rating than those in the gender inclusive condition (*M* = 9.76, *SD* = 2.54). Neither condition was significantly different from gender neutral condition (*M* = 10.11, *SD* = 4.31). Interaction effect was not significant. Belonging showed a significant main effect of sex, where male participants showed higher levels of belonging (*M* = 22.23, *SD* = 6.23) than female participants (*M* = 20.23, *SD* = 6.23), but showed non-significant results for main effect of condition and interaction effect. Results for activity interest were analyzed using ANCOVA with expectations of interest as the relevant covariate. Based on these results, hypothesis 1 was not supported.

Mediation Analyses

The study's second hypothesis was that stereotype salience would affect persistence indirectly via multiple paths, and task interest was expected to be a significant path. This specific hypothesis was based on an assumption that stereotype salience would significantly affect the mediator variables and persistence. However, analysis conducted did not show support for this assumption; mediator variables and likelihood of persistence showed non-significant main and interaction effects. Because the path from stereotype salience to the mediator variables or persistence was not significant, it is ineffectual to test the indirect paths. Based on these results, hypothesis 2 was not supported.

Supplemental Analyses

The purpose of the supplemental analysis was to explore three possible explanations for why the study hypotheses were unsupported. The first set of analyses tested whether experimenter sex became an unintentional manipulation, the second examined only the participants that were strongly manipulated, and the last analyses examined how participants' domain identification with science may have an effect.

Sex x Condition x Experimenter sex ANOVA. Even though random assignment of conditions should have eliminated any effects of experimenter sex, because the present study deals with subtle environmental manipulation it is possible that the experimenter sex played a greater role than anticipated. The purpose of these analyses was to examine whether there was an unexpected manipulation from the sex of the experimenter. In

TABLE 2. Means, Standard Deviations, and *N* by Participant Sex and Condition

	Condition					
	Gender exclusive		Gender neutral		Gender inclusive	
Outcome Variables (possible score range)	*M (SD)*	*N*	*M (SD)*	*N*	*M (SD)*	*N*
EXPECTATIONS OF ACTIVITY (7-21)						
Women	14.67 (3.33)	55	14.12 (3.47)	49	14.92 (3.57)	53
Men	14.97 (3.04)	32	15.33 (2.88)	24	15.42 (3.41)	31
GOALS- PAP (3-21)						
Women	11.75 (4.11)	55	10.82 (4.30)	49	11.42 (3.84)	53
Men	11.69 (4.54)	32	11.29 (5.17)	24	11.19 (4.41)	31
GOALS- PAV (3-21)						
Women	14.47 (3.14)	55	13.71 (4.32)	49	14.98 (4.36)	53
Men	14.13 (3.94)	32	13.33 (4.75)	24	14.06 (4.70)	31
PERFORMANCE (0-10)						
Women	9.01 (1.31)	55	8.84 (1.03)	49	9.04 (1.02)	53
Men	9.22 (.94)	32	9.13 (1.03)	24	9.19 (1.08)	31
PERCEIVED EFFICACY (2-14)						
Women	10.62 (2.05)	52	9.81 (2.76)	47	9.30 (2.71)	48
Men	11.42 (2.16)	31	10.74 (2.00)	23	10.48 (2.08)	31
ACTIVITY INTEREST (7-49)						
Women	41.62 (8.00)	52	40.40 (9.32)	48	41.85 (8.00)	48
Men	43.10 (7.33)	30	43.65 (7.94)	23	41.23 (9.34)	30
BELONGING (5-35)						
Women	20.47 (5.23)	53	19.55 (7.30)	49	20.63 (6.13)	52
Men	22.33 (5.71)	30	22.70 (7.30)	23	21.77 (6.79)	31
LIKELIHOOD OF PERSISTING (0-7)						
Women	1.71 (1.61)	52	1.48 (1.39)	46	2.00 (1.93)	51
Men	2.07 (1.53)	29	2.00 (2.04)	23	2.46 (2.19)	28

TABLE 3. 2 (Participant sex) x 3 (Experimental condition) ANOVA/ANCOVA by outcome variables

Outcome Variables	*df*	*F*	η^2	*p*
EXPECTATIONS OF ACTIVITY				
Participant Sex	1	2.20	.009	.14
Condition	2	4.07	.003	.70
Sex x Condition	2	.36	.003	.70
GOALS- PAP				
Participant Sex	1	.013	.001	.91
Condition	2	.45	.004	.64
Sex x Condition	2	.12	.001	.88
GOALS- PAV				
Participant Sex	1	.97	.004	.33
Condition	2	1.11	.009	.33
Sex x Condition	2	.11	.001	.89
PERFORMANCE				
Participant Sex	1	2.14	.009	.15
Condition	2	.36	.003	.70
Sex x Condition	2	.07	.001	.94
PERCEIVED EFFICACY				
Participant Sex	1	9.02	.04	.003
Condition	2	4.49	.04	.01
Sex x Condition	2	.13	.001	.88
ACTIVITY INTEREST				
Participant Sex	1	.29	.001	.59
Condition	2	.55	.005	.58
Sex x Condition	2	.64	.006	.53
BELONGING				
Participant Sex	1	5.57	.02	.02
Condition	2	.04	.001	.96
Sex x Condition	2	.44	.004	.65
LIKELIHOOD OF PERSISTING				
Participant Sex	1	3.33	.02	.07
Condition	2	1.40	.01	.25
Sex x Condition	2	.04	.001	.96

terms of the distribution of experimenters' sex across the conditions, 60.9% of the participants in the gender exclusive condition were run by a female experimenter; 49.3% of the participants in the gender neutral condition were run by a female experimenter; and 63.1% of the participants in the gender inclusive condition were run by a female experimenter. The following analyses used a 2 (participant sex) x 3 (experimental conditions) x 2 (experimenter sex) between subjects ANOVA or ANCOVA.

There were no significant main effects of experimenter sex, 2-way participant sex by experimental condition, participant sex by experimenter sex, or experimental condition by experimenter sex, or a 3-way participant sex by experimental condition by experimenter sex interaction effect on expected activity interest, achievement goals, performance, activity interest, or likelihood of persisting. Perceived efficacy showed a significant main effect of experimenter sex, where participants with a female experimenter reported higher perceived efficacy ($M = 10.57$, $SD = 2.43$) than participants who had a male experimenter ($M = 9.86$, $SD = 2.40$). Because experimenter sex should not have influenced any outcome variables, an ANCOVA was conducted using experimenter sex as a covariate in examining the effects of participant sex and experimenter condition on efficacy. The results were consistent with previous analyses, where both main effects of sex ($F(1, 225) = 8.84$, $p = .003$, $\eta^2 = .04$) and condition ($F(2, 225) = 4.62$, $p = .01$, $\eta^2 = .04$) were significant. These results and the uniform distribution of experimenter sex to each of the three conditions indicate that effects of the experimenter's sex did not unintentionally drive the observed main effects.

Filter by manipulation. Although only participants who correctly answered the manipulation check questions were included in the analyses, it is possible the gender exclusive manipulation was not strong enough to trigger a science-lab like experience. Participants in the gender exclusive condition should have rated the research lab with high masculinity. However, the mean rating of the gender exclusive room, with a possible range of 1 to 7, was a 4.19 (*SD* = 1.39), with a mode and median of 4 as well, indicating most participants rated the lab in the middle of "not at all masculine" and "masculine". To select only participants who perceived the gender exclusive room as masculine, only those who answered within the top 25% were selected, which were participants that rated the room with a 5 or higher. Only 27 participant data remained after the elimination, shifting the mean masculinity rating of the room from a 4.19 to 5.70 (*SD* = .87), and a new median and mode of 5. The purpose of these analyses is to ensure that only participants that were strongly manipulated by the gender exclusive condition are included in the analysis, which would test whether stronger manipulations would have yielded the expected results. Because the main focus of the present study lies in examining how gender exclusivity would interact with participant sex to negatively influence the outcome variables, the strength of the control condition manipulations are not examined.

A 2 (participant sex) x 3 (experimental condition) between subjects ANOVA or ANCOVA was conducted on the outcome variables using only participants that met the specifications listed above. No significant results were observed for expected activity interest, achievement goals, perceived efficacy, activity interest, or likelihood of persisting. Main effect of participant sex was significant for performance, where male participants scored higher (*M* = 9.21, *SD* = 1.00) than female participants (*M* = 8.91, *SD* = 1.17), but main effect of condition or interaction effect was not significant. Main effect of participant sex was also significant belonging, where male participants reported higher levels (*M* = 22.32, *SD* = 6.75) than female participants (*M* = 19.86, *SD* = 6.51), but main effect of condition or interaction effect was not significant. The general pattern of means did not show support for the study hypotheses, indicating that the lack of significant interactions is not due to the small sample size.

High science domain identification. Lastly, the current study recruited participants from the Introduction to Psychology course, which included students from a variety of different majors, not all of whom would be identified with the science domain. High identification with science is important in conducting a study using a science-related stereotype, because previous studies have shown that some level of identification with the domain is necessary for a stereotype to have an effect (Smith & Johnson, 2006). The purpose of the analyses here is to test whether only individuals who are highly identified with science are influenced by such subtle manipulations.

The following analyses only examined participants who scored in the top 25% of the domain identification measure. These included 45 participants, which were 20 (44.44%) females and 25 (55.56%) males, with a mean age of 19.98 (SD = 3.80). A 2 (participant sex) x 3 (experimental condition) between subjects ANOVA or ANCOVA was conducted for all the outcome variables. The results showed non-significant main effect of sex, condition, and interaction effect on expectations of activity, achievement goal, activity interest, belonging, and likelihood of persisting. A main effect of participant sex was significant for performance, where male participants scored higher (*M* = 9.44, *SD* = .71) than female participants (*M* = 9.00, *SD* = .92). The general pattern of means did not show support for the study hypotheses, indicating that the lack of significant interactions is not due to the small sample size.

CHAPTER 4

DISCUSSION

The present study hypothesized that female participants in the stereotypical environment would show lower rates of achievement and achievement motivation, individual and social motivation, as well as experience of interest and persistence, compared to participants in the other two conditions, and male participants. However, contrary to previous findings the hypotheses were not supported; stereotype salience did not negatively affect achievement and achievement motivation, individual motivation, social motivation, or experience of interest and persistence. Three possible causes for the unsupported hypotheses are discussed below: first, the hypotheses may have been incorrect; second, the participants were wrongly sampled; lastly, there may have been underlying methodological issues.

First it is important to consider that the hypotheses may have been unsupported, simply because they were wrong. On a broader scale, the implications of incorrect hypotheses are that environmental cues do not influence achievement and achievement motivation, individual motivation, social motivation, experience of interest, or persistence. However, as the proposed model is heavily supported by previous research, incorrect hypotheses are unlikely. Specifically, the present study heavily imitated the methods used by Cheryan et al., (2009), but failed to replicate the effects of environmental manipulation on belonging, suggesting the unsupported hypotheses are due to methodological errors, rather than incorrect hypothesizing.

The second possible cause of unsupported hypotheses is attributed to incorrect participant sampling. The main concern regarding the participant sample is that the low science identification from the recruited participants could have resulted in the non-significant results. Whereas previous SIT studies have demonstrated the detrimental effects of stereotype salience on individuals that were not highly identified with the field (Major & O'Brien, 2005; Schmader, 2010; Steele, Spencer, & Aronson, 2002), or believed in the stereotype (Huguet & Regner, 2009) they also used more blatant forms of stereotype salience, such as having the participant read articles supporting negative self-stereotypes. Because the manipulation used in the present study was much more subtle, higher science identification may have been necessary to see the intended effects. Murphy et al., (2007), who also used a subtle form of SIT manipulation, recruited upper-class (i.e., junior and senior) female STEM majors, with the sole purpose of recruiting highly science-identified participants. It is logical to consider the possibility that a more highly science-identified sample of participants may have led to support for the hypotheses.

To test the possibility of different results with a more highly science-identified sample, one of the supplemental analyses examined only the highly identified participants, based on their domain identification scores. The analysis of high science identification participants did not yield any support for the hypotheses, suggesting that a different participant sample may not have yielded supported for the hypotheses with the current study methods. This analysis is limited in that the domain identification level is relative to the sample, and high science identification from psychology students may still be lower than the lower end of science identification from science majors; therefore domain identification should not be ruled out completely as a cause of unsupported hypotheses. Because the unsupported hypotheses cannot be attributed to incorrect hypotheses or participant sample, methodological issues should be considered as a possible explanation.

There are two methodological issues to examine based on previous research that showed intended effects of environment SIT on the same outcome variables. The first is that the manipulation was either not strong enough or simply administered ineffectively; the second is the activity was too interesting. Based on supplemental analyses, experimenter sex can be ruled out as a possible unintended manipulation. To examine whether a stronger manipulation from the current methods may have made a difference, analysis was conducted examining only those who were strongly manipulated. Results of the analyses did not yield support for the hypothesis. These results indicate that stronger manipulation of the current methods will not yield intended results, indicating that the manipulations were most likely not administered correctly. Cheryan and colleagues (2009) had more stereotypically masculine items, such as Rubik's cube and video game boxes to induce gender stereotypes through environmental cues, and Murphy et al., (2007), had participants watch a video clip to trigger SIT, both of which required more interaction between the participants and the environment. The present study did not draw attention to the posters, aside from an offhand comment to justify the presence of the posters. Furthermore, while Cheryan and colleagues (2009) conducted the study in the computer science building, the present study was held in the Psychology building, therefore priming participants to a psychology mindset. The implications are that for environmental cues to trigger SIT, they need to be presented differently than what was used in the present study, and perhaps require more attention than simple off-hand comment, creating a psychologically stronger effect.

Another aspect to consider in methodological issues is with the activity used in the study. As previously mentioned, it was important for the activity to be interesting enough so that a statistical flooring effect could be prevented, but failed to take into account the possibility of an activity that was too interesting. Previous studies have shown that activity interest can function as a buffer against potential negative effects of gender stereotypes (Katz, Assor, Kanat-Maymon, & Bereby-Meyer, 2006; Thoman & Sansone, 2010). As seen in table 3, the means for activity interest is high, 40 or above, for both male and female participants in all three conditions, the upper limit of which was 49. It is also possible that completing the activity provided the participants with a counterstereotypic belief, nullifying the initial stereotype effect. For example, participants were provided with ample support and help from the experimenters during the solar-power activity, which ensured that all participants completed the activity within the allotted study time. This completion of the activity may have provided the participants with a positive "can-do" feeling, countering the previous negative effects of stereotype salience.

Furthermore, by spending too much time on an interesting activity, the activity may have acted as an interruption or a distraction for the participants. While the environmental cues (i.e., posters) were present during the entire length of the study, participants may have simply become too involved with the activity, nullifying the effects of the environmental cue. In previous studies examining the effects of environmental cues on interest, belonging, and persistence, questionnaires were administered immediately after the exposure to the manipulation. For example, Cheryan and colleagues (2009) had participants complete attitudinal questionnaire (i.e., interest, belonging, and persistence) in the experimental room containing stereotyped items, without interruptions from other activities or tasks. Murphy and colleagues (2007) also had participants complete the questionnaires immediately following the manipulation, uninterrupted by other activities or tasks.

Based on the discussed causes of non-significant intended effects, the future research section will discuss recommendations for future studies.

Future Research

Methodological issues could have led to null results, failing to correctly test the hypotheses. To correctly test the hypotheses, future research should administer the manipulation differently, and use an activity that does not create such a high interest rating.

As previously mentioned, other studies examining the effects of environmental cues on the same outcome variables required more interaction between the participant and the environment. For example, Cheryan and colleagues (2009) asked participants to imagine the type of people they thought would occupy the study room, requiring higher thought process than glancing at the posters on a wall. Murphy et al., (2007) also asked participants to examine the video clip as a possible conference for them to attend. This does not mean different objects or set-up of the experiment room is necessary, but rather that participants should psychologically experience being in a science lab by interacting with a science-lab like environment.

A different manipulation should lead to a clearer relationship between stereotypic environmental cues and the different motivational paths. Furthermore, to better test the same hypotheses, participants should be recruited from the science department with a declared major in a science field. Although using only the participants that were highly identified with science did not yield support for the current hypotheses, these participants were recruited from the Introduction to Psychology classes, who would not demonstrate the same level of identification with science as those who are actual science majors. For example, a high science-identification from an English major will not be the same as a high science-identification from an upperclass Science major. And lastly, as discussed above, the activity or task used for the study should be carefully selected so that it is interesting enough (to eliminate a statistical flooring effect on activity interest) but not too interesting (which may act as a buffer to negative self-stereotype salience).

If the future study, with improved methodologies, demonstrates the intended effects, follow-up studies should use different stereotypes and activities to ensure that the observed effects are due to real-world phenomenon, not the study methods. Study methods are important in correctly assessing the underlying phenomenon, and this was seen in the present study where due to the unforeseen methodological issues in the study the proposed hypotheses were unsupported. This could also occur in the opposite direction, where the study methods may provide support for the hypotheses, not due to actual real-world support, but rather due to the methodological choices made at the start of the study. To account for this, it is important for follow-up studies to test the same hypotheses using different methods, such as different means of administering the manipulation, and different study tasks.

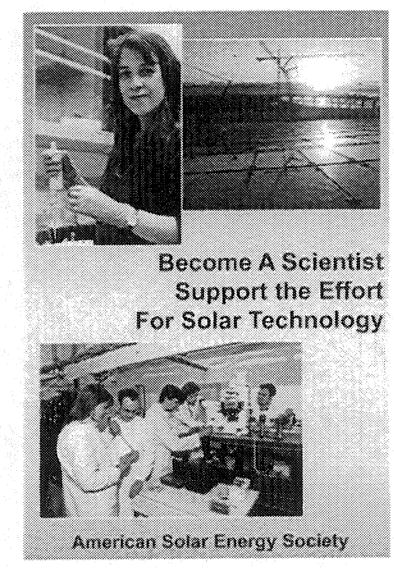
APPENDICES

APPENDIX A

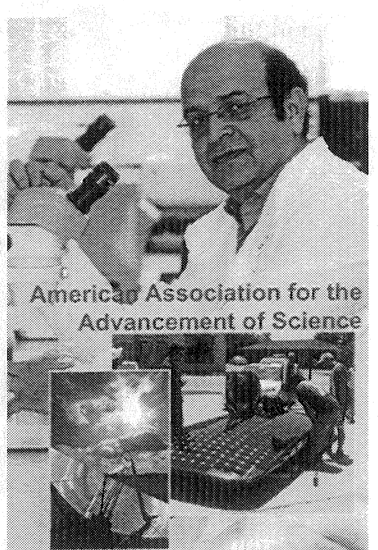
POSTER IMAGES

Gender neutral:

Gender inclusive:



Gender exclusive condition:



APPENDIX B

PREACTIVITY MEASURES

Domain identification measure

Using the following scale, please indicate the number that best describes how much you agree or disagree with each of the statements below.

1 Strongly Disagree	2	3	4 Neutral	5	6	7 Strongly Agree

1. I have always done well in Science
2. I get good grades in Science
3. I do badly on Science tests (R)

Please indicate the number that best describes you for each of the statements below using the following scale:

1 Not At All	2	3	4 Neutral	5	6	7 Very Much

1. How much do you enjoy Science?
2. How likely would you be to take a job in a Science related field?
3. How much is Science to the sense of who you are?
4. How important is it to you to be good at Science?

Compared to other students, how good are you at Science?	1 Very Poor	2 Poor	3 About the Same	4 Better than Average	5 Excellent

(R) Response reverse coded

Expected activity interest

Directions: For each of the following statements, please circle the number which best indicates how strongly you agree or disagree with the statement, using the following scale:

1 Strongly Disagree	2	3	4 Neutral	5	6	7 Strongly Agree

1. I think this activity will be interesting
2. I'm looking forward to the activity
3. I think I will enjoy this activity

Self-perceptions

Directions: For each of the following statements, please circle the number which best indicates how strongly you agree or disagree with the statement, using the following scale:

1 Strongly Disagree	2	3	4 Neutral	5	6	7 Strongly Agree

1. I think I will do well in this activity
2. I expect to perform just as well, if not better than others in this activity

3. Goals

Please indicate the extent to which you believe each item to be true of yourself, using the following scale:

1 Not at all True of me	2	3	4	5	6	7 Very True of me

1. It is important for me to do better than other students on this activity. (PAP)
2. It is important for me to do well compared to others on this activity. (PAP)
3. My goal in this activity is to perform better than most of the other students. (PAP)

4. I worry that I may not learn all that I possibly could in this activity. (MAV)

5. I'm afraid that I may not understand the content of this activity as thoroughly as I'd like. (MAV)
6. I am concerned that I may not learn all that there is to learn from this activity. (MAV)

7. I want to learn as much as possible from this activity. (MAP)
8. It is important for me to understand the content of this activity as thoroughly as possible. (MAP)
9. I desire to completely master the material presented in this activity. (MAP)

10. I just want to avoid doing poorly in this activity. (PAV)
11. My goal in this activity is to avoid performing poorly. (PAV)
12. My fear of performing poorly on this activity is what motivates me. (PAV)

PAP: Performance approach goal
MAP: Mastery approach goal
MAV: Mastery avoidance goal
PAV: Performance approach goal

APPENDIX C

POST-ACTIVITY MEASURES

Performance

The following questions will assess your understanding of solar power. Please answer each question to the best of your ability.

1. Electricity flows most easily through which of the following?
    a. Wood
    b. Cloth
    c. Metal
    d. Humans

2. The French physicist _______________ discovered that light can influence electrical processes in 1839.
    a. David Edmund Finch
    b. Alexandre-Edmond Becquerel
    c. Antoine de Saint-Exupery
    d. Laurence Guy Vallerier

3. The production of electricity from exposure to sunlight is known as
    a. Photosynthesis
    b. Photoelectric effect
    c. Electrons
    d. Semiconductor process

4. Semiconductors are electronic components of what?
    a. Circuit
    b. Conductor
    c. Solar cell
    d. Battery

5. How do you reverse the solar powered motor?
    a. Flip the solar panel
    b. Turn off the light, then back on
    c. Switch the cables
    d. It does not reverse

6. The process of adding impurities to silicone to make it a better conductor is called __________
    a. Tainting
    b. Doping
    c. Changing
    d. Impurifying

7. What happens to electrons when they are exposed to energy from light?
    a. They disappear into the light

b. They turn red
c. They burn and radiate heat
d. They get excited into motion

8. The two layers of treated silicone in the solar cell is called n-type and ______ doped silicone
a. a-type
b. m-type
c. backup layer
d. p-type

9. In 1958, what solar-powered object did the U.S send into space?
a. Space shuttle
b. Satellite
c. Docking station
d. Telephoto lens camera

10. The phenomenon of electricity is nothing more than the movement of electrons. What are electrons?
a. Negatively charged particles
b. Positively charged particles
c. Light energy particles
d. Electrical particles

Efficacy

Directions: For each of the following statements, please circle the number which best indicates how strongly you agree or disagree with the statement, using the following scale:

1 Strongly Disagree	2	3	4 Neutral	5	6	7 Strongly Agree

1. I think I performed just as well, if not better than others in this activity
2. I don't do this task very well. (R)

(R) Response reverse coded

Activity interest

Directions: For each of the following statements, please circle the number which best indicates how strongly you agree or disagree with the statement, using the following scale:

1 Strongly Disagree	2	3	4 Neutral	5	6	7 Strongly Agree

1. This task is uninteresting. (R)
2. I enjoyed doing this task.
3. I would describe this task as very interesting.
4. I thought this activity was very interesting.
5. I got caught up in the activity without trying to.
6. I would like to work on similar tasks, in the same subject
7. I liked this activity a lot.

(R) Response reverse coded

Belonging

Indicate to what extent you FEEL THIS WAY RIGHT NOW. Please circle your answer.

1 Not At All	**2**	**3**	**4 Neutral**	**5**	**6**	**7 Very Much**

1. How much do you feel you belong in an environment that uses this activity?
2. How similar do you feel to the people in an environment that uses this activity?
3. I would belong in a class that uses this activity
4. How comfortable would you feel in a classroom lab that uses activities like this?
5. How similar are you to science majors?

Likelihood of persisting

Please indicate which (if any) of the following groups or organizations you are interested in learning more about by placing a check next to each name

1. ___ Solar Energy Society (SP)

Please circle yes or no to indicate your answers below.

1. Are you interested in receiving information about majors and careers related to solar science? (SP)
2. Would you be willing to participate in similar individual science activity evaluations? (SP)
3. Would you be willing to join a focus group to discuss today's experiment? (SP)
4. Would you be willing to write a review of your experience today, promoting this study to other students? (SP)

Please circle yes or no to indicate your answers below.

1. We also have some information on careers in solar physics. Please circle one of the options below, indicating whether or not you would like this information. (SP)

2. Lastly, there is a solar physics club on campus at Cal State Long Beach focused on learning more about solar physics and providing information to interested members. Would you like to learn more about the solar physics club (including membership activities, benefits, & dues)? (SP)

(SP): Solar-physics related participation
(GS): General science
(WS): Women and science
(P): Purchasing science kit

Background Information

Please write your responses to the questions below.
Age:
Gender:
Ethnic background:
Academic Major:

How certain are you that you will graduate with this major?

1	2	3	4	5
Not at all Certain		Somewhat Certain		Very Certain

What is your current student status at CSULB?

Freshman Sophomore Junior Senior

What is your current GPA?

Manipulation check questionnaire

Please answer the following questions using the scale provided by circling the dot that best represents your answer.

1. How would you describe the activity you did today in the following categories?

Science						English
●	●	●	●	●	●	●
Not at all masculine						Masculine
●	●	●	●	●	●	●
Not at all feminine						Feminine
●	●	●	●	●	●	●

2. Where would you place engineering in the following scale?

Masculine						Not at all masculine
●	●	●	●	●	●	●
Feminine						Not at all feminine
●	●	●	●	●	●	●

4. Where would you place science in the following scale?

Not at all feminine						Feminine
●	●	●	●	●	●	●
Masculine						Not at all masculine
●	●	●	●	●	●	●

5. Where would you place the research lab (the physical room) where you worked on the activity today on the following scale?

Feminine						Not at all feminine

●	●	●	●	●	●	●
Not at all Masculine						Masculine
●	●	●	●	●	●	●

5. How similar was the research lab (the physical room) where you worked on the activity today to a room where you would expect to work on a lab for a real science class?

Not at all						Very much
●	●	●	●	●	●	●

What do you remember about the room?

What do you remember about the posters in the room?

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