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A Model of Responses to Race-Based and Gender-Based Stereotype Threat in Computer Science

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STEREOTYPE THREAT IN COMPUTER SCIENCE

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ABSTRACT

A MODEL OF RESPONSES TO RACE-BASED AND GENDER-BASED STEREOTYPE THREAT IN COMPUTER SCIENCE

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The perception of stereotype threat among computer science students was examined at two universities. A model of stereotype threat was developed and tested among students enrolled in three undergraduate computer science courses at two universities. The goal of this model was to provide an understanding of the underlying mechanisms through which stereotype threat works.

The study tested relationships among the following variables: race-based stereotype threat, gender-based stereotype threat, goal orientation, CS self-efficacy, active coping, behavioral disengagement, effort, and performance. Structural equation modeling was used to test the measurement model and a series of nested structural models. Findings supported the proposed model of stereotype threat and most of the hypothesized relationships. Future directions and contributions of this research are discussed.

This dissertation is dedicated to my husband, Kevin Tedrow, and my children, Katherine and Nathanial Tedrow, who sacrificed so much and loved me unconditionally throughout this entire process.

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CHAPTER I

Introduction

The continued loss of women and minorities from the field of computer science has become alarming in recent years (Goode, Estrella, & Margolis, 2008). There is a significant smaller proportion of Blacks, Hispanics, and women found in computer science than in the total student-age population. (Bombardieri, 2005; Rosenbloom, Ash, Dupont, & Coder, 2008; Taulbee Report Survey, 2008; Varma, 2006). Computer science is the only science, technology, engineering, and mathematics (STEM) field whose gender gap has widened during the last twenty years (Yashura, 2005). Researchers are attempting to understand this phenomenon and develop ways to stop the loss. One environmental explanation proposes that women and minorities are deterred from engaging in technology-related fields because pervasive negative cultural stereotypes hinder their performance and self-confidence. For example, it is commonly assumed that women and minorities are admitted into CS programs to increase diversity and not because they are competent (Hammond, 2001). Research aimed at understanding how stereotypes interact with performance provides an important step in understanding why women and minorities are leaving the field of computer science. Claude Steele (1992) reasoned that the burden of negative social stereotypes creates an added stressor for minorities in academic settings. Much research has been done on 'stereotype threat' in an attempt to understand further the mechanisms behind this situational factor (Ryan & Ryan, 2005; Smith, 2004).

This dissertation adheres to the format of the *Journal of Applied Psychology*.

This research examined the influence of stereotype threat in a population of undergraduate computer science students. A stereotype threat measure based on work by Steele and Aronson (1995) and Ployhart, Ziegert, and McFarland (2003) was used to examine the differential influence of stereotype threat among Black and female students. A model of stereotype threat and its influence on motivation, self-efficacy, coping strategies, effort, and performance was tested.

Stereotype Threat

Stereotype threat is a concept initially introduced by Steele and Aronson (1995). Stereotype threat occurs when a negative stereotype about an individual's group (e.g., women are poor at computer science) is made salient in a performance situation. It provides a contextual explanation as to why stigmatized groups have performance deficits in various domains. The stereotype can be threatening to the individual's performance because of concerns placed upon the performer about reinforcing the accuracy of the stereotype. If an individual is concerned with performing well at the task, the threat posed by this stereotype cognitively disrupts his or her performance (Spencer, Steele, & Quinn, 1999). For example, a woman in computer science may be so distracted by worries about confirming the 'women are poor at computer science' stereotype that her performance suffers.

Stereotype Threat and Performance.

In their classic experiment, Steele and Aronson (1995) examined performance on the most difficult verbal items in the GRE among Black and White college students. Their study compared test performance among high-achieving majority and minority students under two conditions: one in which stereotype threat was induced and one in which it was not. They induced threat by means of instructional set. In the threat condition, students were told they would take a test that measured intelligence. In the non-threat condition, students were told they would be given a set of problem-solving tasks that researchers had developed. In reality, all students were completing the same test. When introducing the exam as "a test of intellectual ability," Steele and Aronson found Black participants scored significantly worse than Whites who were given the same instruction. After controlling for prior math SAT performance, both groups performed equally well when given the non-diagnostic instructions. Differences in achievement test scores were found even when test takers were matched on background variables such as socioeconomic status. Since then, the impact of stereotype threat on performance has been investigated in a variety of situations.

Evidence for stereotype threat. Most studies focus on stereotype effects in performance in academic environments, and similar to Steele and Aronson's (1995) results, the majority of this research shows stereotype threat can reduce performance. Nguyen and Ryan (2008) investigated the extent to which stereotype threat is detrimental to test taker's performance on cognitive ability tests. They found in a meta-analysis that stereotype threat does result in performance decrements. They also found differential effects for race and gender. Women experience smaller decrements in performance than did minorities when tests were difficult. Women experience more stereotype threat effects if the threat-activating cues are subtle; whereas, minorities experience more stereotype threat effects if the threat-activating cues are moderately explicit. The following sections describe some of the specific research on stereotype threat effects and the conditions that cause it.

O'Brien and Crandall (2003) examined stereotype effects for gender. Participants were told either the test they were about to take had shown gender differences or had not shown gender differences. Participants then completed two math tests, one easy and one difficult. Compared to women in the 'no differences' condition, women in the 'gender differences' condition scored better in the easy test condition and scored worse in the difficult math test condition. Men in the 'gender differences' condition did not perform significantly different from men in the 'no difference' condition. Davis, Aronson, and Salinas (2006) found performance decrements for Black students attending predominantly White universities. Participants completed 38 verbal items from a GRE practice test under one of three threat conditions. In the low threat condition, participants were told the researchers were studying student responses to challenging problem solving exercises. In the medium and high threat condition, participants were informed the test was a measure of verbal intelligence. In the high threat condition, participants also completed an ethnic identity measure, a technique designed to prime racial identity and racial identity attitudes. After controlling for prior SAT scores, Black students in both the medium and the high threat condition performed significantly worse on the GRE practice items than Black students in the low threat condition. Similar stereotype threat effects have been shown by Spencer et al. (1999), Steele, Reisz, Williams, and Kawakami (2007), and Walsh, Hickey, and Duffy (1999).

For some groups, competing stereotypes may exist. For example, Ambady, Shih, Kim, and Pittinsky (2001) studied stereotype threat in Asian-American females (including those of Chinese, Korean, and Japanese origin) ranging from kindergarten to eighth grade. One stereotype is that Asians are good at math. A competing stereotype is that women are not good at math. The children completed tasks designed to highlight either their ethnicity or their gender. Then they completed a grade-appropriate standardized math test. The Asian American girls at the lower-elementary and middle school grades performed worse when gender was made salient but performed better when their Asian ethnicity was made salient. Similar results were reported at the high school level (Shih, Pittinsky, & Ambady, 1999).

Brown and Day (2006) found stereotype effects on Raven's Advanced Progressive Matrices (APM), a non-verbal measure of cognitive ability that is purported to be culturally fair. Prior to completing the test, participants were given one of three sets of instructions: standard ("measure of observation and clear thinking"), high threat (measures individuals' intelligence and ability), or low threat ("a series of puzzles"). Results showed that Whites outperformed Blacks in the standard and high threat conditions. Blacks and Whites performed similarly in the low threat condition. Mayer and Hanges (2003) also investigated stereotype threat effects on performance with Raven's APM. Students were told either the test measures intellectual ability (stereotype threat condition) or perceptual ability (non-stereotype threat condition). Blacks experienced significantly more stereotype threat when they believed the test measured cognitive ability than when they believed it measured perceptual ability. There was also a significant negative relationship between the amount of stereotype threat experienced and test scores.

Majority group members such as Whites can also experience stereotype threat's impact on performance. Aronson et al (1999) selected white males with high scores on the mathematics section of the SAT test. In the experimental condition, the researchers explicitly confronted participants with the stereotype that Asian students outperform White students in mathematical tasks. Participants also were told that the study was designed to identify the nature and scope of these differences. In a control condition no mention of the stereotype was made. High math-identified white male students performed significantly worse when the pro-Asian stereotype was mentioned than when it was not.

Much of the stereotype research has been conducted in laboratory settings, resulting in criticisms of the generalizability of stereotype threat. However stereotype effects also are found in field settings. Neuville and Croizet (2007) examined stereotype effects in the classroom. Third grade students colored pictures of a boy or a girl with a ball (to highlight gender) or a landscape (control condition). Students then completed a set of three easy and four difficult math problems. After coloring a picture that emphasized gender, girls performed worse on the difficult items (but not the easy items). The authors offer these results as evidence that stereotype threat effects occur in a realistic setting, but only for difficult or challenging items. Similarly, Keller (2007) had male and female secondary school students complete a difficult math test. Girls who were highly identified with math performed worse on the test when told the test showed gender differences (stereotype threat condition) than girls who were told the test showed no gender differences (control).

Field studies have also been conducted at the university level. Cole, Matheson, and Anisman (2007) followed White and ethnic minority students over the course of their freshmen year at a predominantly White Canadian university. Ethnic minority students showed stronger ethnic identity, higher levels of avoidance goals, and lower levels of perceived institutional academic support than their White counterparts. As the year progressed, ethnic minority students showed increased depression and anxiety and had lower grades at the end of the year. Anxiety, depression, and ethnic identity predicted grades for minority but not White students. The authors believe these results suggest that minority students experienced stereotype threat and it reduced their academic performance. In another field experiment, Good, Aronson, and Harder (2008) attempted to eliminate the negative effects of stereotype threat in an upper-level college math class. Male and female students were given a practice test with items similar to the GRE. To induce stereotype threat, all students were told the test measured mathematical abilities. However, to negate this stereotype, half of the students were also told the test did not show gender difference in performance or math ability. Women scored higher than men in the threat negation condition. Women's performance did not differ from men's performance on the test in the stereotype threat condition or in final grades. However, women in the threat negation condition performed better on the practice test than would have been predicted from their final grades, demonstrating that the negative effects of stereotype threat may be mitigated.

In addition to impacting test performance, research shows the impact of stereotype threat when negative stereotypes are activated in a variety of tasks and domains. White males' athletic performance suffers when stereotypes about African Americans' natural athletic ability are activated (Stone, Lynch, Sjomeling, & Darley, 1999). Stereotype threat effects have also been shown to affect the performance of Whites when they feared appearing racist (Frantz, Cuddy, Burnett, Ray, & Hart, 2004). Stereotype threat even influences the attributions for failure. Koch, Müller, and

Sieverding (2008) found women in a stereotype threat condition were more likely than men to attribute failure at a computer task to internal factors. Croizet and Claire (1998) demonstrated stereotype effects based on expectations tied to social class. Prior to completing a test of 21 difficult, verbal, GRE-like items, participants either were told the study was designed to assess intellectual ability (experimental) or the study was designed to test the role of attention in lexical memory (control). Participants in the salient SES (socioeconomic status) condition were asked questions about their parents' occupations and education level. Researchers found participants from poorer families performed worse than high SES participants when the study was presented as measuring intellectual ability.

Research also suggests that stereotypes do not have to be explicitly presented to induce threat effects. Situations where one is a numerical minority can create a heightened group identity and can induce stereotype threat if negative stereotypes are associated with that identity. Inzlicht and Ben-Zeev (2003) induced stereotype threat in women in a mathematics task by simply manipulating the group composition. Women were assigned to take a math test in the presence of either all men, all women, or mixed gender groups. Women performed significantly worse on the math task when tested in the presence of men. As the proportion of men increased, women's performance got worse. Ambady, Paik, Steele, Owen-Smith, and Mitchell (2004) found that subliminal priming of gender can induce stereotype effects for women in a mathematical task. In the primed condition, participants were shown subliminally a series of feminine words, including girl, lipstick, pink, and she. Women in the unprimed condition were presented with neutral words, including carpet, banana, and oxygen. Participants then completed a math test. The researchers found unprimed females performed significantly better on the math test than gender-primed females.

The findings from this diverse body of literature show that stereotype threat can depress performance. This decrement can occur for any individual members of a group about whom a negative stereotype exists and can occur across a variety of tasks and situations.

Evidence against stereotype threat. A number of applied studies and laboratory simulations of employee selection have failed to find an effect for stereotype threat-related factors on performance (McFarland, Lev-Arey, & Ziegert, 2003; Ployhart et al., 2003; Stricker, 1998; Stricker & Ward, 2004). McFarland et al. (2003) examined the impact of incentives on stereotype threat. They thought stereotype threat may be less likely in situations where performance is rewarded. Students were told high performers would receive monetary reward. Their analyses showed Blacks performed worse than Whites on a test of cognitive ability but there were no effects from threat manipulation. That is, Blacks in the stereotype threat conditions did not perform significantly worse than those in the non-stereotype threat condition. The relationship between threat and performance was influenced by domain identification and racial identity. Domain identification reflects a person's experiences with and perceived self-relevance in a particular area (Smith, Morgan, & White, 2005). For example, someone who is high in math identification bases part of their self-esteem on their ability to do well in math. Racial identity reflects a person's attachment to their race. McFarland et al. found Whites who were highly identified with academics performed better on the cognitive ability test than those who did not. No relationship was found between domain identification and performance for Blacks. They also found that a strong racial identity aids performance. Again, stereotype threat was found not to influence performance.

Ployhart et al. (2003) studied the impact of applicant reactions and stereotype threat on test performance in a selection context. The test was presented as a possible selection device for applicants for a retail management position. There were three threat conditions: test presented as diagnostic of cognitive ability (diagnostic condition), test presented as a difficult test (control condition), and test presented as diagnostic of retail manager skills rather than of cognitive ability (non-diagnostic condition). The researchers also altered the face validity of the test. The test was either presented as face valid, in which the test name and questions were couched in a retail context, or as generic, in which the test name and questions are not retail-specific. Results show that across conditions Whites scored higher than Blacks. Stereotype threat predicts that Blacks would perform worse than whites in the diagnostic condition. Contrary to stereotype threat predictions, there were smaller differences between the groups in the diagnostic condition. Scores for both groups were higher in the control condition than in the diagnostic condition. However, additional analyses showed that stereotype threat interacts with face validity and race but only for individuals who are highly identified with their race. Under generic conditions, highly race-identified Blacks scored highest in the control condition. Under face valid conditions, highly race-identified Blacks scored highest under the non-diagnostic condition, in which the test was presented as measuring managerial skills. With the face valid test, Black scores for the control condition were similar to those for the diagnostic condition. The authors suggest that "lacking a description of what the test measures, Blacks assume the face valid measure taps cognitive ability (p. 248)." The results of the Ployhart et al. study indicate that in real-world settings stereotype threat effects may be weaker than effects obtained in laboratory research.

Stricker (1998) examined the effect of ethnicity and gender inquiries on performance on an Advanced Placement (AP) calculus exam. This test setting should invoke stereotype threat for both Blacks, because it is an obvious measure of intellectual ability, and women, because it is a mathematical test. Stricker (1998) varied the timing of the collection of demographic information for the AP calculus exam. Based on stereotype threat, inquiring about race and gender would make that group membership salient for those minorities and should result in performance decrements. In the experimental group, students were asked to fill out the background information, including race and gender, after completing the AP exam. In the control group, the exam was administered as usual, with the background information being completed just prior to taking the exam. Contrary to Steele and Aronson's (1995) findings, Stricker (1998) found no effects for inquiring about gender and race on performance when this information was collected before administration of the test. Stricker reasons that the motivation for taking the AP exam (to earn college credit) may outweigh any stereotype threat effects. Similarly, Stricker and Ward (2004) examined the influence of soliciting race/gender information prior to high-stakes testing. Individuals reported race or gender either prior to or after completing the AP Calculus examination and the Computerized Placement test at a community college. They found no significant differences based on the timing of the social identity information questions. The authors suggest that these high-stakes testing situations result in higher levels of motivation that negate any stereotype threat effects. The theoretical model to be tested in this research examines the mediating influence of different motivational states between stereotype threat and academic performance.

Danaher and Crandall (2008) dispute the findings of Stricker and Ward (2004). They argue that Stricker and Ward's "conservative criterion for evidence led them to overlook significant stereotype threat effects with real practical implications (p. 1639)." Stricker and Ward (2004) reported an effect if it showed $p < .05$ for the overall ANOVA, $p < .05$ for the planned comparisons (familywise, corrected by the Bonferroni method), and showed $\eta \geq .10$ or $d \leq .20$ (small effect size). Danaher and Crandall reanalyzed the Stricker and Ward data with less stringent criteria ($p < .05$ for the overall ANOVA and $\eta \geq .05$ for effect sizes) and found some important results. Women's performance on the AP Calculus grades (an AP grade of 3.0 or above results in college credit) and formula scores (basic performance on the exam) improved when they were asked about gender after completing the exam. Danaher and Crandall assert that soliciting identity information after the testing session minimized gender differences in performance by 33%. Reanalyzing the data for the computerized placement test in Stricker and Ward's study, Danaher and Crandall reported similar surprising results: women's performance improved substantially when identity information was solicited after taking the test. Danaher and Crandall argue that even a small effect could yield noteworthy practical significance. They estimate that "nearly 9000 test takers would likely be affected by a timing change (p. 1652)" if demographic information was provided after completion of the test rather than before.

Concerns about Stereotype Threat

Some concerns about stereotype threat have been raised (Sackett, Hardison, & Cullen, 2004). The primary concern of Sackett et al. is that the results of Steele and Aronson's work on stereotype threat are misinterpreted in an attempt to explain away the continued gap between Blacks and Whites on achievement tests. Sackett et al. (2004) argue that many people interpret Steele and Aronson's (1995) findings in such a way to suggest that the reason the average SAT score for Blacks is lower than the average SAT score for Whites is because of stereotype threat. The implication is that if we eliminate stereotype threat, we will equalize SAT scores between Blacks and Whites. However, Steele and Aronson do not proffer this interpretation of their results. As Sackett et al. point out, the misinterpretation lies with the general public. In reality, differences exist between Blacks and Whites *even without* stereotype threat. Eliminating stereotype threat does not eliminate the gap in scores between the two groups. But, in the presence of stereotype threat, the difference is larger than would be expected. Sackett et al. discuss how both scholars and popular publications have promoted the inaccurate conclusion that stereotype threat is solely responsible for Black-White achievement differences. They found evidence for this misinterpretation in popular media sources, scientific journals, and psychology textbooks. Merely changing the wording on test instructions will not completely eliminate the score differences between Blacks and Whites. It may reduce stereotype threat and its possible affect on performance. Sackett et al. suggest continued work is needed to determine the extent to which stereotype threat generalizes to the real world.

Obviously more research is needed to clarify the types of situations in which stereotype threat effects are found. Much of the stereotype threat research involves explicitly manipulating stereotype threat. Smith (2006) stresses the need to examine the relationships among stereotype threat and performance in a less "explicit" stereotype threat condition. Are stereotype threat performance decrements only found when the conditions are explicitly manipulated? Or may a natural level of stereotype threat occur in certain situations? The first part of this study hopes to ascertain the degree to which women and African Americans experience stereotype threat in university computer science classes. Is simply being a minority member enough to prime the stereotype? Sackett and colleagues would argue that the motivation to succeed offsets any stereotype threat effects students may experience being a minority in the classroom. Steele and colleagues would suggest that the experience of being a minority in the classroom creates threat effects that are reflected in decreased performance. An advantage of the proposed research is that it draws from two distinct university populations: one is an urban university with a predominantly white but culturally diverse student body and one is a historically Black university. This unique sample allows for exploration of the boundary conditions on stereotype threat. As previously mentioned, research suggests being a numerical minority is sufficient to prime stereotype threat, thus it is hypothesized that gender and race will impact perceptions of stereotype differentially depending on the setting. It is not expected that White students at a traditional Black university will experience stereotype threat because there is not a negative stereotype about White students and academic performance.

Hypothesis 1a: Female participants will report significantly greater levels of stereotype threat than will male participants.

Hypothesis 1b: Blacks will report significantly greater levels of stereotype threat than will White participants.

Hypothesis 1c: Blacks will report less stereotype threat in a predominantly black setting than Blacks in a predominantly white setting.

Testing a Model of Stereotype Threat

In an attempt to help explain the loss of women and minorities from computer science, the current research seeks to understand stereotype threat in a computer science setting. A review of the research on stereotype threat reveals a complex chain of mechanisms is involved. The purpose of the proposed research is to develop an integrative model to aid in understanding the consequences of stereotype threat. A second purpose is to test this model in an academic setting. It is accepted that stereotype threat exists but research examining the mechanisms that link stereotype threat to performance have yielded inconclusive results. The proposed model examines how stereotype threat is related to goal orientation, self-efficacy, coping strategies, effort, and performance. The constructs and their expected relationships are discussed below.

Research supports the possibility that situational factors that arouse negative stereotypes can have a profound impact on performance. However, the causal mechanism underlying stereotype threat is unclear. A number of variables have been examined, including diverted attention (Schmader, Johns, & Forbes, 2008; Steele & Aronson, 1995), anxiety (Bosson, Haymovitz, & Pinel, 2004; Harrison, Stevens, Monty, & Coakley, 2006; Osborne, 2001), and effort withdrawal (Stone, 2002), but the literature does not consistently support any of the proposed mechanisms. However, two recent literature reviews suggest that stereotype threat situations influence individuals' performance by inducing different achievement goals. Smith (2004) and Ryan and Ryan (2005) argue that stereotype threat conditions may encourage the adoption of performance-avoidance goals, causing diminished performance. Individuals under stereotype threat conditions are motivated to avoid being judged as having low ability (that is, they adopt a performance-avoidance orientation) in order to disprove the stereotype. The following sections describe the concept of goal orientation and its relationship to stereotype threat.

Goal Orientation

Goal orientation refers to a person's set of beliefs that reflect the reasons why they approach and engage in academic and learning tasks (Dweck & Leggett, 1988). It has become a major area of research due to its usefulness in explaining why individuals in learning contexts display particular behaviors. In its original form, goal orientation was a dichotomy: mastery and performance goals (Dweck & Leggett, 1988). Individuals with a mastery goal orientation are motivated primarily to 'master' the skill or concept. These individuals are willing to put forth effort, face difficulty and frustration, take risks, and try new things in an attempt to learn. In contrast, individuals motivated by performance goals seek to appear competent or avoid negative judgments of their competence. These individuals are less willing to take risks for fear of failure and want to do better than those around them. Many studies on achievement goals produced inconsistent findings, particularly with performance goals, so a trichotomous theory of goal orientation was proposed: mastery, performance approach (or prove competence) orientation and performance avoidance (avoid failure) orientation (Elliot, 1999). Individuals with a performance approach orientation are driven to appear competent and gain favorable judgments. These individuals want to be the best and to appear the most competent. They may work hard and put in a lot of effort – not because they want to learn but so as to surpass their peers. Individuals with a performance avoidance orientation try to avoid negative judgments and appearing incompetent relative to others. They are reluctant to show their work unless it's perfect, or take on unchallenging tasks, and are likely to hold back and avoid risks.

Stereotype threat and goal orientation. In an attempt to understand how stereotype threat results in reduced performance, recent literature reviews (Ryan & Ryan, 2005; Smith, 2004) suggest that the similarities between stereotype-threatened individuals and individuals with a performance-avoidance goal orientation may be the result of stereotype threat situations creating a performance-avoidance goal orientation. Smith (2004) proposes that negative stereotype information in a situation can lead to the adoption of performance avoidance goals while performing a stereotype-relevant activity. Stereotype threat triggers a performance-avoidance goal orientation because individuals feel a need to avoid validating the competence-based stereotype. When an individual feels pressure to demonstrate that he or she has high ability, achievement goal research predicts that he or she will become concerned with performance relative to other people, feel less interested in the task, and ultimately perform poorly on difficult tasks (Nicholls, 1984). Research from both stereotype threat and goal orientation shows that the two fields of study share similar and overlapping elements. The environmental factors that can induce performance avoidance motivation are composed of the same elements that can induce stereotype threat effect. Individuals with a performance goal orientation, specifically a performance-avoidance goal, behave similarly to individuals who are in a stereotype threat situation (Smith, 2004).

There are a limited number of studies testing the assumption that the form of goal-based motivation differs for stereotype threatened individuals. However, the research that does exist supports the idea that stereotype threat triggers the adoption of performance-avoidance goals. Seibt and Förster (2004) found that introduction of negative self-relevant stereotypes fosters a prevention focus. Individuals with a prevention focus are sensitive to the absence or presence of negative outcomes and concerned with avoiding these negative outcomes (Higgins, 1997). Beauchamp and Peyton (2006) found that achievement goal orientation did not mediate stereotype threat effect on performance of women in math, but they also suggest the need for more studies in this field to ensure accurate results and generalizability. They suggest a number of reasons for the lack of results, including inadequate manipulation of the conditions (manipulation statements worded too weakly, need to verbally repeat instructions multiple times for some participants) and inappropriate population selection (selection of only students with a high math identification may have yielded a stronger effect). Smith (2006) showed that women reminded of the 'women are poor at math' stereotype were more likely to endorse performance-avoidance goals in a math situation. Bakker (2007) also found women in math reported greater levels of performance-avoidance orientation under stereotype threat. Smith, Sansone, and White (2007) found individuals subjected to stereotype threat had more performance-avoidance thoughts than those in a control condition. They also found stereotypes were activated in math-related situations even without explicitly mentioning gender. This research provides evidence that stereotype threat can induce the adoption of performance-avoidance goals.

Women and Blacks still are underrepresented in computer science classrooms, the field of study on which the current study is focusing. A National Science Board (NSB, 2008) report found the percentage of women in computer science (25%) is unchanged since 1985 and their percentage in engineering (22%) remains low. The report also shows the proportion of students planning to major in a science-related field was higher for men in every racial/ethnic group. The proportion of underrepresented minority students in science and engineering fields was only 6 to 7 % (NSB, 2008). One survey found the portion of female students to be less than 10% in many Bachelor's computer science programs, and over 66% of the student population in these programs are White (Zweben, 2008). Data from the current INSITE project shows similar trends. At University A (a historically Black university) women represent 31% of the computer science majors and 26% of the engineering majors. At University B (a large urban university), the percentage of women in computer science and engineering are 22% and 16%, respectively. At University A, Blacks represent 93% of the computer science majors and 84% of the engineering majors. At University B the percentage of Black students majoring in computer science and engineering is 19% for each major. Minority status and gender are two characteristics that easily activate one's identification of group membership. Thus, one would expect in computer science classrooms women would begin to focus on their identity as a female and subsequent stereotypes about females would be elicited. Similarly, for Blacks, racial identity will become salient and these individuals may become more aware of stereotypes surrounding race. The combination of salience of group membership *and* activated stereotypes may cause females and minorities to adopt performance-oriented goals in these settings. Based on this research, the following relationships are expected. These and all other relationships in the model are depicted in Figure 1.

Hypothesis 2a: Stereotype threat will be negatively related to mastery goal orientation.

Hypothesis 2b: Stereotype threat will be negatively related to performance-approach orientation.

Hypothesis 2c: Stereotype threat will be positively related to performance-avoidance orientation.

Coping Strategies

Coping strategies are behavioral and psychological steps people employ to reduce or minimize stressful events, such as stereotype threat (Carver, Scheier, & Weintraub, 1989). One distinction made in the coping literature is between active and avoidant coping strategies. Active coping strategies are responses designed to change the nature of the stressor itself or how one thinks about it. Avoidant coping strategies involve activities and mental states designed to keep the individual from directly addressing the stressor. The next section looks at research on coping responses and stereotype threat.

Behavioral disengagement as a coping strategy. It is important to consider how individuals may cope effectively with stereotype threat. Unfortunately, there has been relatively little research on the influence of coping strategies in response to the experience of stereotype threat (Shapiro & Neuberg, 2007; von Hippel et al., 2005).

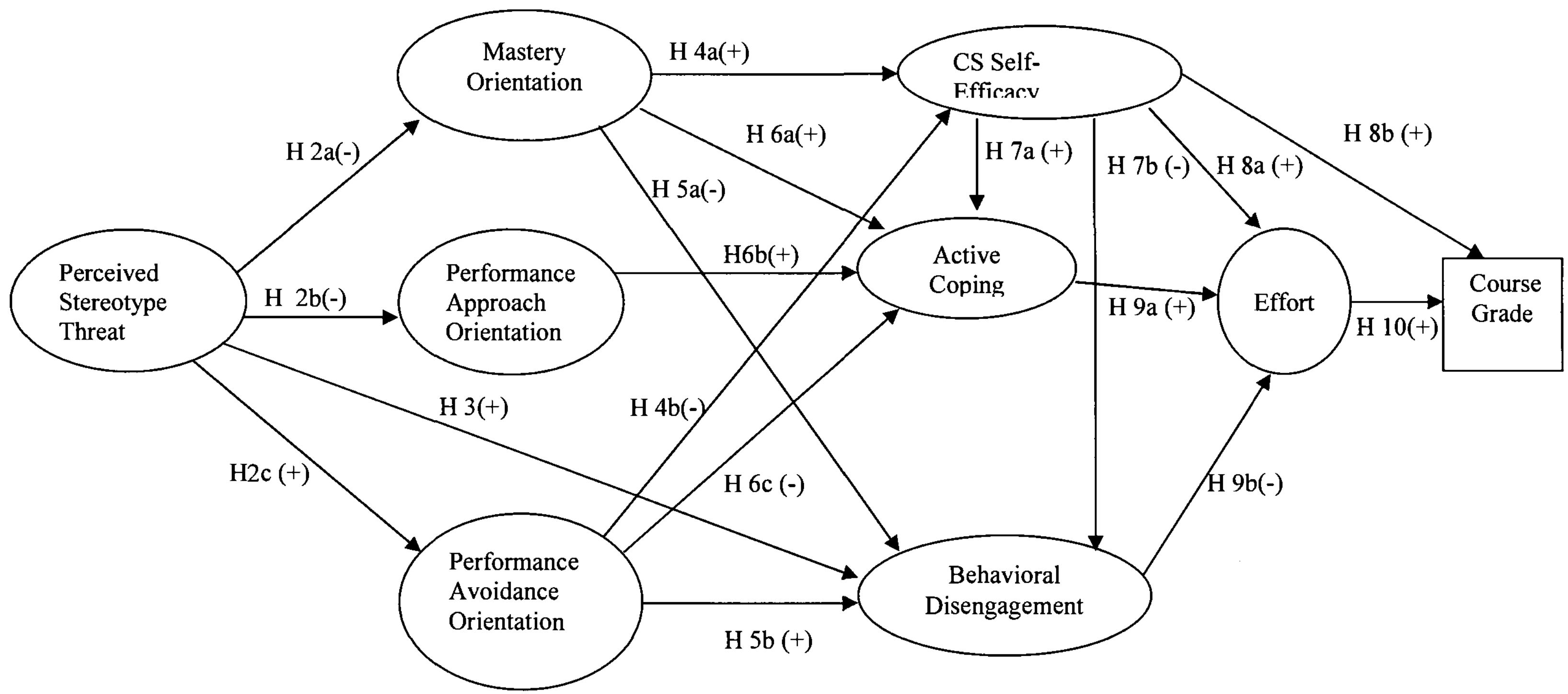

Figure 1. Model of responses to stereotype threat.

However, the research that has been done reveals one common coping strategy individuals use when experiencing stereotype threat: disengagement.

Individuals who experience stereotype threat often use disengagement as a coping strategy (Major, Spencer, Schmader, Wolfe, & Crocker, 1998). Disengagement involves distancing oneself, physically or psychologically, from the threatened domain. When an individual distances himself from a domain, self-worth becomes unrelated to that domain and, thus, poor performance in the domain no longer impacts self-esteem. For example, von Hippel et al. (2005) found that when presented with the stereotype of Asians' superior intelligence, White students claimed intelligence was relatively unimportant to them. Research in the area of stigma also provides some insight into the use of coping strategies and stereotype threat. Stigma involves prejudice and discrimination an individual experiences simply because they have personal characteristics deemed socially undesirable, such as skin color, ethnicity, weight, and disabilities (Heatherton, Kleck, Hebl, & Hull, 2003). Because the experience of stigma presents psychological challenges and threats to self-esteem similar to stereotype threat, people who are stigmatized use the same coping strategies as those used by individuals under stereotype threat (von Hippel et al., 2005). Matheson and Cole (2004) report that individuals who were particularly distressed under identity threat conditions were most motivated to deny the self-relevance of the group.

Disidentification, a form of chronic disengagement, involves detaching one's identity from the stereotyped domain (Crocker, Major, & Steele, 1998). This response is beneficial because it protects self-esteem but becomes maladaptive if an individual copes with long-term threats by avoiding the domain or de-identifying from the domain (Steele, James, & Barnett, 2002). For example, women who were highly identified with math would reduce their gender identity under stereotype threat (Pronin, Steele, and Ross, 2004). Alternately, some female math students cease to view themselves as a "math person" in response to the stereotype threat. Indeed, women majoring in male-dominated disciplines experienced more stereotype threat and as a result were more likely to disidentify with the field by changing their major (Steele et al., 2002). Osborne and Walker (2006) found that Black students who were most identified with academics were more likely to withdraw from school than those Black students whose self-esteem and identity did not depend on academics. Disidentified individuals maintain their self-esteem in the face of immediate failure, but they also tend not to value performance in the domain or incorporate the domain as part of their identity.

Hypothesis 3: Stereotype threat will be positively related to behavioral disengagement.

Mechanisms Linking Goal orientation and Performance

With the dichotomous theory of goal orientation, mastery orientation has a positive impact on performance, but research on performance orientation has resulted in mixed and contradictory findings (Button, Mathieu, & Zajonc, 1996; Ford, Smith, Weissbein, Gully, & Salas, 1998; Phillips & Gully, 1997). Concerning the trichotomous model, the approach and avoidance components have different outcomes, with the avoidance dimension appearing more dysfunctional (Elliot & Church, 1997; Elliot & Harackiewicz, 1996; VandeWalle, 1997). Although the splitting up of performance goals into performance-approach and performance-avoidance goals has done much to clarify the results associated with performance goals, it has not yet settled the debate regarding the effects of performance-approach goals as more papers have generated results regarding both beneficial and harmful effects of pursuing performance-approach goals (Urdan, 2004). Payne, Youngcourt, and Beaubien (2007) attempted to elucidate the nature of the relationship between the different goal orientations and various types of performance. They found in a meta-analysis of research that mastery goal orientation had a small positive correlation with all types of performance: learning, academic, task performance, and job performance. Avoidance performance goal orientation was found to be negatively related to learning, task performance, and job performance. Approach or prove performance goal orientation had no relationship to learning or academic performance, but was positively related to task and job performance (Payne et al., 2007). However, when focusing on grades as a measure of performance, research has shown that performance-approach goals are positively related, whereas performance-avoid goals are negatively related, to undergraduates' exam grades (Elliot, McGregor, & Gable, 1999), final course grades, and GPAs (Harackiewicz, Barron, Tauer, & Elliot, 2002). Thus, research indicates that different achievement goals lead to different outcomes regarding affect, behavior, cognition, and performance (Elliot et al., 1999; McGregor & Elliot, 2002; Wolters, 2004), but the exact nature of the relationship of goal orientation to performance is far from settled. The model in this research examined whether computer science self-efficacy, coping strategies, and effort mediated the relationship between goal orientation and performance.

Goal orientation and self-efficacy. Self-efficacy refers to one's self-assessment of capability to perform a task and has been found to predict one's accomplishment of tasks (Bandura, 1986). Self-efficacy can be general or specific. General self-efficacy is a relatively enduring belief in one's ability to perform in a variety of tasks and situations (Chen, Gully, & Eden, 2001). However, specific self-efficacy is a belief in one's ability to perform well on a specific task (Bandura, 1982). Self-efficacy also can be specific to a particular domain. Computer self-efficacy, the variable of interest in this study, refers to perceptions of one's capability in computer use (Compeau & Higgins, 1995).

An individual's goal orientation is expected to influence his or her self-efficacy (Kavussanu & Roberts, 1996), but the exact nature of the relationship is unclear. General self-efficacy influences both learning and performance-avoidance orientations (Payne et al., 2007). However, specific self-efficacy is thought to be an outcome of goal orientation. This study focuses on a specific task (performance in a computer science class), so it is assumed that goal orientation will influence self-efficacy in this study.

There is a positive relationship between mastery orientation and self-efficacy (Patrick, Ryan, & Pintrich, 1999; Philips & Gully, 1997; Wolters, Yu, & Pintrich, 1996). Payne et al. (2007) found in their meta-analysis that individuals with high levels of mastery orientation tended to have high levels of self-efficacy. A mastery orientation buffers individuals from the negative effects of failure, thereby helping to increase or maintain self-efficacy (Button et al., 1996; Ford et al., 1998). Individuals with a mastery goal orientation have higher self-efficacy because they tend to view intelligence as malleable (Kanfer, 1990). These individuals are more likely to interpret failures or non-perfect performances as opportunities to learn (Phillips & Gully, 1997). So, negative performance does not reduce their self-efficacy.

Research on performance orientation has resulted in mixed and contradictory findings. Phillips and Gully (1997) and Ford et al. (1998) found that performance orientation has a negative effect on individuals' self-efficacy, but Bell and Kozlowski (2002) and Button et al. (1996) found it to be unrelated. A meta-analysis showed high levels of self-efficacy associated with weak levels of performance-avoidance goals (Payne et al., 2007). A negative relationship has been found between performance orientation and self-efficacy (Patrick et al., 1999; Wolters et al., 1996). Cumming and Hall (2004) found mastery orientation, but not performance orientation, influenced self-efficacy. The performance-approach orientation is largely unrelated to outcomes such as self-efficacy and self-regulation (Elliot & Moller, 2003; Payne et al., 2007). A performance-avoidance goal has been linked to decreased self-efficacy (Middleton & Midgley, 1997; Skaalvik, 1997). When students are oriented towards performance-avoidance goals and they experience difficulty or challenge, they are likely to be concerned that their difficulty indicates low ability, confirming the negative stereotype, and undermining their self-efficacy (Schunk & Pajares, 2001). Individuals with a performance goal orientation tend to view intelligence as a fixed, non-changing entity which causes them to interpret any mistake or imperfect performance as indicating failure and lower intelligence (Dweck, 1989). This interpretation lowers the individual's self-efficacy level (Phillips & Gully, 1997). Based on past research, it is expected that performance-avoidance and mastery orientations, but not performance-approach orientations, would be related to self-efficacy.

Hypothesis 4a: Mastery orientation will be positively related to self-efficacy.

Hypothesis 4b: Performance-avoidance orientation will be negatively related to self-efficacy.

Goal orientation and coping style. The relationship between goal orientation and coping with stress has just recently received some attention in education-related research (Boekaerts, 2002; Grant & Dweck, 2003; Rijavec & Brdar, 2002). This attention should not be surprising given that motivational variables are considered important in coping research. In his model of stress and coping, Lazarus (1991) suggested that motivational processes influence coping choices. A mastery orientation should result in the most adaptive responses, such as increased effort to solve a problem or more perseverance when confronted with a difficult situation (Roedel, Schraw, & Plake, 1994). Conversely, a performance goal orientation is likely to reflect maladaptive responses, and is characterized by a focus on outcome and a desire to avoid negative feedback. This orientation often leads to increased anxiety and an inability to persist when faced with obstacles (Eppler & Harju, 1997).

Research supports the idea that goal orientation impacts coping strategies. Dykman (1998) found growth seeking factor (similar to a learning or mastery goal orientation) had negative correlations with cognitive activities that waste attentional resources such as self blame and emotional venting, but had positive correlations with useful strategies such as active coping, planning, task persistence, and positive reinterpretation. Tanaka, Murakami, Okuno, and Yamauchi (2002) found that mastery and performance-approach goals are positively related to help seeking while performance-avoidance goals were related to perceived threats and avoidance of help seeking. Pensgaard and Roberts (2003) examined the relationship between task and ego orientations and the use of stress-coping strategies among athletes participating in the 1994 Winter Olympic Games. They found that high task/low ego orientation (similar to a mastery goal orientation) predicted the use of active coping and social/emotional support, while low task/high ego orientation (similar to a performance goal orientation) predicted the use of positive redefinition and growth strategies. They also found that high ego (performance) orientation was associated with less use of active coping and planning strategies among female athletes. This pattern was not found among male athletes. Cetin and Akin (2009) found learning goals positively correlated to active planning (part of the active coping scale). Performance goals were negatively correlated with active planning and positively correlated with acceptance (part of the passive coping scale). Dweck and Leggett (1988) found performance avoidance goals to be correlated with the avoidance of learning opportunities and deterioration of academic performance. Individuals pursuing performance-avoidance goals engage in a number of withdrawal behaviors such as self-handicapping, task disengagement, and off-task cognitions (DeShon & Gillespie, 2005). Conversely, mastery orientation was negatively related to behavioral disengagement as a means of coping (Ntoumanis, Biddle, & Haddock, 1999). Roeser, Strobel, and Quinhuis (2002) found a mastery approach was negatively correlated with withdrawal behaviors, whereas ego-avoidance orientations were positively associated with withdrawal. Young adolescents who oriented toward avoidance goals in the classroom were more likely to avoid participating in classroom activities (Roeser et al., 2002). Wrosh, Scheier, Carver, and Schulz (2003) suggest that having a performance goal orientation may influence the ease of disengagement. Cury, Elliot, Sarrazin, DaFonesca, and Rufo, (2002) found that performance-avoidance goals reduced competence valuation, the importance one places on obtaining proficiency. They suggest the possibility that failure prompts a self-protective response of divesting oneself from competence to minimize the sting of failure. This strategy is effective in protecting self-esteem but also may diminish interest, motivation, and achievement (Steele & Aronson, 1995). Thus, it is expected that an individual's goal orientation would be related to the coping strategies he or she would use.

Hypothesis 5a: Mastery orientation will be negatively related to behavioral disengagement.

Hypothesis 5b: Performance-avoidance will be positively related to behavioral disengagement.

Hypothesis 6a: Mastery orientation will be positively related to active coping.

Hypothesis 6b: Performance-approach orientation will be positively related to active coping.

Hypothesis 6c: Performance-avoidance orientation will be negatively related to active coping.

Self-efficacy and coping skills. Self-efficacy impacts the choice of coping strategy. Individuals who believe in their ability to perform likely will use coping methods that will allow them to persevere. Individuals who do not believe in their ability to perform likely will cope with the inability by disengaging from the activity. Research supports these suppositions. Rijavec and Brdar (1997) found that children with high self-esteem use more positive coping strategies and less negative strategies, including disengagement. Devonport, Lane, Milton, and Williams (2003) also found a significant relationship between higher self-efficacy and the use of active coping. Self-efficacy was negatively related to disengagement coping (Haney & Long, 1995). Loncaric (2008) found self-efficacy influences performance through coping strategies. High self-efficacy leads to increased use of active coping and decreased use of disengagement strategies. Lower efficacy increases the use of withdrawal strategies.

Hypothesis 7a: Self-efficacy will be positively related to active coping.

Hypothesis 7b: Self-efficacy will be negatively related to behavioral disengagement.

Self-efficacy, effort and performance. Self-efficacy beliefs influence task choice, effort, persistence, resilience, and achievement (Schunk, 1995). Compared with other students who doubt their learning capabilities, Schunk and Pajares (2001) find that those who feel efficacious for learning or performing a task participate more readily, work harder, persist longer when they encounter difficulties, and achieve at a higher level.

Robbins et al. (2004) found general self-efficacy to be highly correlated with college GPA and retention. This relationship is strong for domain specific self-efficacy as well. For example, mathematics self-efficacy predicts mathematics problem solving to a greater degree than other self-beliefs such as mathematics anxiety or self-concept, previous mathematics experience or self-efficacy for self-regulatory practices (Pajares & Miller, 1994; Zimmerman, Bandura, & Martinez-Pons, 1992). Computer self-efficacy is positively correlated with interest in using computers, expectations of success, persistence, and computer performance (Brosnan, 1998; Christoph, Schoenfeld, & Tansky, 1998; Gist, Schwoerer, & Rosen, 1989; Hill, Smith, & Mann, 1987; Karsten & Roth, 1998; Murphy, Coover, & Owen, 1989).

Hypothesis 8a: Computer science self-efficacy will be positively related to effort.

Hypothesis 8: Computer science self-efficacy will be positively related to course grade.

Coping skills, effort, and performance. Coping skills impact both effort and performance. Active coping increases effort and performance; while disengagement decreases effort and performance. Disengagement, as a coping strategy, involves giving up, or withdrawing effort from, the attempt to attain a goal. So, logically, higher levels of disengagement should result in reduced effort. As a response to stereotype threat, domain disengagement alleviates threats to one's social identity, but it also contributes to poor performance (Osborne, 1997; Verkuvten & Thijs, 2004). Research indicates that lower levels of engagement in school are linked with poor performance in school. Student engagement has been found to be one of the most robust predictors of student achievement and behavior in school. (Connell, Spencer, & Aber, 1994; Finn & Rock, 1997; Mounts & Steinberg, 1995). Students with low levels of engagement are at risk for negative outcomes, including increased absenteeism and dropping out of school (Finn, 1989; Lee, Smith, & Croninger, 1997, Steinberg, Brown, & Dornbush, 1996).

Positive coping skills are linked to more effort and better performance outcomes (Tero & Connel, 1984). Carver et al. (1989) suggest increasing one's effort is a manifestation of active coping. Indeed, subjects who use active coping reported higher levels of effort (Gerin, Pieper, Marchese, & Pickering, 1992). Leong, Bonz, and Zachar (1997) found active coping predicts academic success. Mantzicopoulos (1990) found that children who employ positive, action-oriented strategies are more likely to have higher academic achievement. This model proposes that effort is the mechanism through which coping skills influence performance.

Hypothesis 9a: Active coping will be positively related to effort.

Hypothesis 9b: Behavioral disengagement will be negatively related to effort.

According to the model by Porter and Lawler (1968) effort leads to increased performance. In the academic field, effort is positively related to test performance (Fisher & Ford, 1998; VandeWalle, Cron & Slocum, 2001). Thus, higher levels of effort should increase performance.

Hypothesis 10: Effort will be positively related to course grade.

Connecting all the research on stereotype threat, goal orientation, and coping strategies, one can see a chain reaction. Stereotype-threat induces a performance-avoidance goal, which in turn induces behavioral disengagement as a coping skill, which leads to reduced effort and poor performance (Smith, 2004).

Mediated Relationships

Self-efficacy and stereotype threat. Research on the impact of stereotype threat on self-efficacy yields mixed results. Stereotype threat has been found to reduce the expected probability of success. That is, performance expectancies decrease under threat (Cadinu, Maass, Frigerio, Impagliazzo, & Latinotti, 2003; Sekaquaptewa & Thompson, 2003; Stangor, Carr, & Kiang, 1998). For example, activating the ‘women are poor in math’ stereotype decreased female students’ confidence in their mathematics ability (Skaalvik, 2004). Stereotype threat also causes self-doubt immediately prior to taking an exam (Spencer et al., 1999). More specifically, Black students taking a standardized test display significantly more self-doubt than White participants or Black participants in a non-diagnostic condition (Steele & Aronson, 1995). These results suggest that stereotype threat impacts self-efficacy and that lowered self-efficacy then impacts performance.

Others propose that stereotype threat does not directly lower expectancies for test success or work through self-fulfilling prophecies (Aronson, Quinn, & Spencer, 1998;

Shih et al., 1999; Steele & Aronson, 1995). Instead, the situations introduce negative stereotypical thoughts that individuals must contend with during performance. Thus, stereotype threat may not instantly influence self-efficacy but rather set up the structure for self-evaluation, so that when difficulty is experienced, self-efficacy falters, and performance is depressed (Steele, 1997). However, research has not supported self-efficacy as a significant mediator of the effects of stereotype threat on performance (Spencer et al., 1999). Smith (2006) suggests that stereotype threat impacts self-efficacy and performance through goal orientation. She found that stereotype threat triggered a performance-avoidance goal that then led to lower performance expectancies. Again, the research suggests a chain of events that connects stereotype threat to poor performance. Thus, in this study, stereotype threat is not hypothesized to influence self-efficacy directly. As represented by hypotheses 2, 4, and 8, it is hypothesized that goal orientation mediates the relationship between stereotype threat and self-efficacy.

Goal orientation and effort. Goal orientation influences the amount of effort someone applies in a learning situation. A mastery goal orientation is more likely to be associated with high levels of effort because of the student's focus, the enjoyment of the learning process, and the belief that effort will lead to success. VandeWalle (1997) found that a mastery goal orientation had a strong relationship with the desire to work hard. VandeWalle et al. (2001) studied the impact of goal orientation on effort (as measured by the averaging of self-assessments of amount of time, work intensity and overall effort put into preparing for an exam). After providing performance feedback, mastery and performance-approach orientations were positively related to effort. Performance-avoid orientation had a negative but non-significant relationship with effort. However, this result could be a function of this particular study. The study participants were enrolled in a core course with full enrollment and a waiting list. The authors point out that "although students might have wished that they could have avoided, transferred from, or dropped the course, the curriculum requirements and course queues severely limited such choices (p. 638)." These results suggest goal orientation impacts effort. However, further research suggests that goal orientation is linked indirectly to effort and achievement through coping strategies. Grant and Dweck (2003) explored how goal orientations influence performance and proposed coping as one potential mechanism. They found that mastery goals predicted active coping and were negatively related to denial and disengagement. They also found performance goals positively related to the coping strategies of behavioral disengagement and denial. Brdar, Rijavec, and Loncaric (2006) also found goal orientation influenced coping strategies. Students with performance and work-avoidance orientations use emotion-focused coping; students with learning orientations used problem-focused coping. Brdar et al. also found the relationship between goal orientation and school achievement was fully mediated by coping strategies. In their study, the significant relationship between goal orientation and school achievement disappeared when coping strategies were added to the model. Thus, in this study, goal orientation is not hypothesized to influence effort directly. As represented by hypotheses 5, 6, and 9, it is hypothesized that coping skills mediate the relationship between goal orientation and effort.

CHAPTER II

METHOD

This study tested a model using existing data collected as part of a National Science Foundation (NSF) funded project called Increasing Success in Information Technology Education (INSITE; Davis et al., 2006). The study was a four-year, research-based intervention with the computer science (CS) departments at two universities in the Southeast. University A is one of the largest predominantly black, public learning institutions in the nation with an enrollment of over 6000 students. University B is a medium-sized public university with over 20,000 enrolled students. The computer science departments of each university have approximately 20 faculty and staff members. The goal of the project was to increase the retention of women and minority CS majors by enhancing their inclusiveness through interventions aimed at faculty and students.

Participants

This study is a secondary analysis of data collected from the INSITE pool of participants. The full INSITE dataset contains 1038 participants. 133 participants (12.9%) indicated a race other than Black or White. These races included American Indian/Native Alaskan (6), Asian Indian (9), Asian/Pacific Islander (77), Hispanic (31), and Middle Eastern (10). Because this study focused on Black-White differences in stereotype threat these participants were not included in the analyses. This exclusion left 905 participants in the database. After conducting a missing values analysis, the final sample with which these analyses were completed contains 718 participants. Refer to the missing data section below for a complete discussion of the missing values analysis. All participants were enrolled in either Programming I (N=649) or Programming II (N = 69) at their university. Demographic information for this smaller sample is presented in Table 1. The students are predominantly White (58.8%) and male (76%). Just under a quarter of the sample (24%) is a CS major. Most participants attended University B (73.3%). The average age is 20.6 (SD = 4.27). The average grade is 6.28 (SD = 3.44), which is equivalent to a C+.

Because the sample was drawn from two different courses, analyses were conducted to determine if there were course differences on stereotype threat. There were significant group differences such that students in the Programming 2 course (M = 27.09, SD = 10.64 for race; M = 26. 17, SD = 10.74 for gender) endorsed higher levels of stereotype threat for both race and gender than students in the Programming 1 course (M = 23.63, SD = 9.73 for race; M = 23.53, SD = 10.14 for gender), t (716) = 2.89, $p < .05$ for race and t (716) = 2.18, $p < .05$ for gender. However, course accounted for only 1% of the variance in stereotype threat for race ($R^2 = .01$) and for gender ($R^2 = .01$). Tabachnick and Fidell (1996) cautions that with large sample sizes, most multiple correlations will "depart significantly from zero, even one that predicts negligible variance (p.133)." Therefore, data were combined across courses for all analyses.

Because the sample was drawn from two different universities, prior to model testing, analyses were conducted to determine if there were differences between the universities on the performance variable of course grade. There were significant differences such that students at University A (M = 5.20, SD = 3.45) received significantly lower grades than University B students (M = 6.60, SD = 3.37), t (716) =

-2.99, $p < .05$. However, university accounted for none of the variance in course grade ($R^2 = .00$). Therefore, data were combined across universities for the model testing and analyzed as a single sample.

Table 1

Demographic Characteristics of the Sample

	Univ A		Univ B		Total	
Characteristic	N	%	N	%	N	%
Race						
Black	186	96.9	110	20.9	296	41.2
White	6	3.1	416	79.1	422	58.8
Gender						
Male	121	63.0	425	80.8	546	76.0
Female	71	37.0	101	19.2	172	24.0
Major						
CS major	92	47.9	73	13.9	165	23
Non CS major	100	52.1	453	86.1	553	77
Sample Total	192	26.7	526	73.3	718	100

Measures

Stereotype threat. Items for this scale were adapted from Steele and Aronson (1995) and Ployhart, Ziegert, and McFarland (2003). The nine item scale (see Appendix A) measures the extent to which participants perceive that there is a negative stereotype for their demographic group's performance in a particular domain. Items were adapted to make them relevant to computer science in the classroom. Additionally, each item was duplicated: one for race/ethnicity and one for gender. Responses to the questions are rated on a seven-point agreement-type scale anchored by 1 (strongly disagree) to 7 (strongly agree). The coefficient alpha for this scale was .95 (race) and .96 (gender).

Goal orientation. Goal orientation was measured using a scale developed by Elliot and Church (1997). The goal orientation scale (see Appendix A) is composed of subscales measuring each of the three goal orientations: mastery, performance-approach, and performance-avoid. Students responded to six items for each subscale on a seven-point agreement scale anchored by 1 (not at all true of me) to 7 (very true of me). The coefficient alphas for each subscale were .89 (mastery), .90 (performance-approach), and .77 (performance-avoid).

Active Coping. Active coping was measured using the 'active coping' subscale of the COPE scale (Carver et al., 1989). This subscale (see Appendix A) measures how likely the respondent is to take action or exert efforts to remove or circumvent the stressor. The active coping subscale consists of four items with responses rated on a 4-point agreement scale ranging from 1 (*I usually don't do this at* all) to 4 (*I usually do this a* lot). The coefficient alpha for this scale was .76.

Behavioral disengagement. Behavioral disengagement was measured using the 'behavioral disengagement' subscale of the COPE scale (Carver et al., 1989). This subscale (see Appendix A) measures how likely the respondent is to give up if they have a problem. The behavioral disengagement subscale consists of four items with responses rated on a 4-point agreement scale ranging from 1 (*I usually don't do this at* all) to 4 (*I usually do this a* lot). The coefficient alpha for this scale was .81.

Computer science self-efficacy. This scale, which measures the extent to which respondents feel secure in their ability to program and perform well in CS, is an abbreviated version of the 'confidence in learning' subscale of the Computer Science Attitude Survey (Williams, Wiebe, Yang, Ferzli, & Miller, 2002). This shortened version does not contain the negatively worded items used in the original scale. These items were deleted because they were, for the most part, simply the opposite of the positively worded items. A pilot study showed that removal of the items did not affect reliability estimates (Davis, Major, Sanchez-Hucles, & DeLoatch, 2006). Students respond to six items (see Appendix A) on a five-point agreement scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The coefficient alpha for this scale was .93.

Effort. This measure was assessed with three items (e.g., I exert a great deal of effort on assignments for this class) created by Selgrade (2007) for the INSITE study. The items (See Appendix A) are rated on a five-point agreement scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The coefficient alpha for this scale was .91.

Performance. Performance was measured by course grade, which was obtained from each university's Office of Institutional Research. The Office of Institutional Research provides letter grades for final course grades. These letter grades were recoded into the following numeric values: F = 0, D- = 1, D = 2, D+ = 3, C- = 4, C = 5, C+ = 6, B- = 7, B = 8, B+ = 9, A- = 10, and A = 11.

Procedure

As part of the INSITE project, participating instructors provided the INSITE research team with student email addresses. An email invitation was sent to every student asking them to participate in an online survey. This invitation contained a link to the survey. The first page of the survey described the project and instructions for completing the survey (see Appendix B). The survey remained active for approximately three weeks. The researchers sent weekly reminder emails to all potential participants (see Appendix B). Participants received extra credit for completing the survey.

Data Analysis Overview

Perceptions of Stereotype Threat. The first set of hypotheses examined the influence of race and gender on perceptions of stereotype threat. Levene's test of equality of error variances revealed a significant difference in the variance between groups for race, $F(7,710) = 4.03$, $p = .00$) and for gender, $F(7,710) = 9.21$, $p = .00$, indicating that the assumption of homogeneity of variance was violated. Because this assumption was violated it was not appropriate to conduct an ANOVA as planned. Therefore, group differences were analyzed as a structural equation model in EQS 6.1 (structural equation modeling software; Bentler, 2006; Bentler & Wu, 2002). Structural equation modeling (SEM) has the capability to estimate analysis of variance models through the use of dummy codes (Rovine & Molenaar, 2003). This method uses the Satorra-Bentler scaled statistic and robust standard errors to account for heterogeneity of variance. The variables of race, gender, and university were dummy-coded and entered as simultaneous predictors in a path analysis. Stereotype-threat was entered as the dependent variable. Because the three-way (gender by race by university) interactions were not relevant to the hypotheses, they were not analyzed.

Hypothesized Model. Structural equation modeling (SEM) was used to test the remaining hypothesized relationships and the overall fit of the hypothesized model. Measurement models, structural models, and fit indices were used to examine the hypothesized model and relationships. Each of these aspects of the data analysis is described next. Each set of procedures was run twice: once with race-based stereotype threat in the model and once with gender-based stereotype threat in the model. Results for each type of stereotype threat are reported separately.

Parceling. This data analytic strategy required the use of a parceling procedure to create indicators for the variables in the model. Parceling is an increasingly common practice in SEM in which item scores from two or more items are summed or averaged. Then, these composite scores are used as indicators in the SEM analysis instead of the directly observed item scores (Bandalos, 2002). Research suggests that parceling has several benefits when used for items from unidimensional scales. The use of parcels, compared to the use of individual items, results in fewer model rejections and better fit indices (Bandalos, 2002).

Model modification refers to the practice of modifying an initial model, generally by empirical criteria, until it fits the data (MacCallum & Austin, 2000). SEM models that initially display a poor fit can be easily modified to improve fit by parceling individual items into groups that are then used as manifest variables. Parcels have been shown to significantly improve fit of the CFA model in many circumstances (Bandalos & Finney, 2001). Post hoc item parceling (i.e. parceling items after the model with each item measured individually does not demonstrate a good fit) can be warranted, especially when one is interested in the relationships among latent constructs (Little, Cunningham, Shahar, & Widaman, 2002). Furthermore, although measurement models for the latent factors may be included in the overall model, interest in such studies is typically centered on the structural rather than the measurement parameters. In situations such as these, Bandalos and Finney (2001) suggest that the use of item parcels is a defensible strategy. Thus, in order to facilitate convergence of the measurement model, items were parceled within the following constructs: master orientation, performance approach orientation, performance avoid orientation, and computer science self-efficacy. These factors were parceled because confirmatory factor analyses showed that these items did not fit the latent traits.

Each goal orientation scale and the self-efficacy scale contained six items, so two parcels of three items were created for each of these latent variables. The item-to-construct approach was used to create the parcels (Little et al., 2002). First, a confirmatory factor analysis for each construct was run. Using the loadings as a guide, the two items with the highest loading were used to anchor the two parcels. Then the next two items with the highest item-to-construct loadings were added to the anchors in an inverted order. This way the highest loaded item from the anchor items was matched with the lowest loaded item from the second selections. This process continued until all items were used. Once the parcels were created, the overall fit of the measurement model was assessed.

Measurement Model. EQS 6.1 (Bentler, 2006) was used to test the hypothesized measurement model. The measurement model represents the regression of each indicator on its corresponding latent variable. Anderson and Gerbing (1988) recommend that the measurement model be tested prior to simultaneously testing the measurement model and structural model. A maximum likelihood (ML) estimation method was used to test goodness of fit of the models (Joreskog & Sorbom, 1996).

Structural model. Structural equation modeling (SEM) using EQS 6.1 (Bentler, 2006) was used to test the hypothesized relationships and the overall fit of the hypothesized model. EQS structural models involve manifest variables, latent variables, and error variances. It allows for the estimation of relationships among the latent variables while accounting for measurement error of those variables. EQS provides parameter estimates as well as estimates of the goodness of fit of the structural model. The significant level of each parameter estimate is determined with a *t*-test. When a parameter estimate has a *t*-value greater than 2.00, the relationship is considered significant at $p < .05$. A maximum likelihood (ML) estimation method was used to test goodness of fit of the models (Joreskog & Sorbom, 1996). In comparing maximum likelihood (ML) and generalized least squares (GLS), it has been found that the GLS estimates are likely to be negatively biased (Joreskog & Goldberger, 1972). Moreover, ML estimates have been found to be robust to the violation of normality (Chou & Bentler, 1995). To further assess model fit, several goodness of fit indices were used.

Fit indices. The chi-square (χ^2) test is the standard overall fit test. It assesses the level of discrepancy between the sample and fitted covariance matrix (Hu & Bentler, 1995). Because the χ^2 test is a "badness of fit" test, a good fitting model is indicated by smaller χ^2 values and a non-significant χ^2 test (Hoyle, 1995). Additionally, the χ^2 test can be evaluated by examining its value relative to the available degrees of freedom for the test (Hoyle, 1995). Carmines and McIver (1981) suggested that a χ^2 /df ratio of no more than three serves as an adequate indicator of good fit.

In addition to the χ^2 statistic, model fit was evaluated with two additional fit indices recommended by Hu and Bentler (1999): the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). CFI (Bentler, 1990) values of .90 or greater suggest a good model fit. RMSEA values less than or equal to .05 indicate a close-fitting model; RMSEA values less than or equal to .08 indicate a reasonably well-fitting model (Browne & Cudeck, 1993).

Nested models. One of the greatest strengths of structural equation modeling is the ability to test competing theories. Comparing models statistically provides a strong theoretical test of the model (Bollen & Long, 1993). Nested models are models that are subsets of one another. That is, these models contain "the same parameters but the set of free parameters in one model is a subset of the free parameters in the other (Hoyle, 1995, p. 8). Hypotheses 2 to 10 predict that goal orientation, self-efficacy, coping skills, and effort mediate the relationship between stereotype threat and performance (course grade). This was tested using four nested structural models for each type of stereotype threat to lend support to the final model. Model fit was assessed and compared after the testing of each model. First, a baseline model was tested which assessed the direct effects of stereotype threat on performance. Subsequent models were built by adding the hypothesized paths. The second model test was a simple model (Nested model 1) that added a path from stereotype threat to effort and from effort to performance (Hypothesis

10). This model assessed whether effort mediated the impact of stereotype threat on performance. A third model added paths to represent hypotheses 7 through 9 (Nested model 2). This model assessed the impact of self-efficacy and coping strategies. Finally, with the addition of the goal orientation paths (Hypotheses 2 to 6), the full model was examined. This model contained all hypothesized paths. Ideally, as the model gets closer to the full hypothesized model, the model fits better as evidenced by improvements in the χ^2 test and other fit indices. Differences between models are examined with χ^2 - difference tests (Hoyle & Panter, 1995). The difference between the resulting χ^2 and the degrees of freedom for each nested model determines whether the change in χ^2 ($\Delta \chi^2$) is significant given the change in degrees of freedom (Δdf).

CHAPTER III

RESULTS

Outlier Analysis

Prior to data analysis, outlier analysis (using box plots) found no outliers and/or participants who responded randomly.

Missing Data

A missing values analysis was conducted to determine extent of missing data. Seventeen individuals (1.6%) did not report race or gender data, and 162 (15.6%) did not report a course grade; these participants were excluded from data analysis. Responses of participants who did not report course grade were compared to responses of participants who reported course grade on the following variables: race-based stereotype threat, gender-based stereotype threat, CS self-efficacy, active coping, behavioral disengagement, all three goal orientations, and effort. There were no significant differences between the two groups suggesting that the pattern of missing data was unrelated to other variables in the models being tested. Finally, any participants with more than 33% missing data on any one construct were deleted, resulting in a loss of 8 more participants. These deletions left 631 cases with no missing data at all and 87 cases with at least one missing data point for a total sample of 718 cases. The Expectation - Maximization (EM) algorithm was used for estimating model parameters.

Perceptions of Stereotype Threat

The first set of hypotheses examined the influence of race and gender on perceptions of stereotype threat. Table 2 shows the means and standard deviations for perceptions of gender-based stereotype threat. Table 3 contains the unstandardized estimates, standard error, t-values, and standardized estimates for perceptions of gender-based stereotype threat. There was a significant main effect for gender on the perception of stereotype threat. As hypothesized, females endorsed significantly higher levels of gender-based stereotype threat than males ($\beta = .25$, $p < .05$).

Table 4 contains the means and standard deviations for the perceptions of race-based stereotype threat. Table 5 contains the means and standard deviations for race-based stereotype threat broken down by university and race. Table 6 contains the unstandardized estimates, standard error, *t*-values, and standardized estimates for perceptions of race-based stereotype threat. There was a significant main effect for race on the perception of stereotype threat. As hypothesized, Blacks endorsed significantly more race-based stereotype threat than Whites ($\beta = .30$, $p < .05$). There was also a significant

Table 2

Means and Standard Deviations for Perceptions of Gender-Based Stereotype Threat

Gender	Race	M	SD	N
Male	Black	24.66	9.51	191
	White	21.13	9.03	355
	Total	22.36	9.35	546
Female	Black	27.90	10.10	105
	White	28.87	13.50	67
	Total	28.28	11.51	172

Table 3

Parameter Estimates for Perceptions of Gender-Based Stereotype Threat

Variable	Parameter Estimate	SE	*t*-value	β
Intercept	20.98	1.03	20.35*	.00
Gender (G)	7.61	2.85	2.67*	.25
Race (R)	3.35	2.24	1.50	.14
University (U)	13.06	3.89	3.39*	.45
G x R	-1.93	3.36	-.57	-.05
G x U	-3.74	2.44	-1.53	-.08
R x U	-12.52	3.80	-3.29	-.42

Note. $N = 718$. Gender was coded as Male (0) and Female (1); Race was coded as White (0) and Black (1); University was coded as Univ B (0) and Univ A (1).
* $p<.05$

Table 4

Means and Standard Deviations for Perceptions of Race-Based Stereotype Threat

Race	Gender	M	SD	N
Black	Male	27.47	10.01	191
	Female	27.38	9.63	105
	Total	27.42	9.86	296
White	Male	21.83	9.19	355
	Female	19.96	8.66	67
	Total	21.53	9.13	422

Table 5

Means and Standard Deviations for Perceptions of Race-Based Stereotype Threat by University

University	Race	Gender	M	SD	N
A	Black	Male	26.96	10.23	117
		Female	26.42	8.91	69
		Total	26.76	9.74	186
	White	Male	35.88	13.19	4
		Female	37.50	2.12	2
		Total	36.42	10.30	6
Total			27.06	9.88	192
B	Black	Male	28.22	9.67	74
		Female	29.21	10.75	36
		Total	38.54	9.99	110
	White	Male	21.67	9.04	351
		Female	19.42	8.20	65
		Total	21.32	8.94	416
Total			22.83	9.62	526

interaction between race and university. The effect of race on stereotype threat varies depending on the university (β = -.62, $p < .05$). As hypothesized, Black participants at University A (the predominantly Black university) endorsed lower levels of race-based stereotype threat than Black participants at the University B. Contrary to expectations, Whites at University A experienced higher levels of race-based stereotype threat than Whites at University B. However, the small number of White participants at the predominantly-Black university (n = 6) makes this result unreliable.

Table 6

Parameter Estimates for Perceptions of Race-Based Stereotype Threat

Variable	Parameter Estimate	Standard Error	*t*-value	β
Intercept	21.65	1.20	18.04*	.00
Gender (G)	-2.13	2.74	-.78	-.07
Race (R)	6.65	2.48	2.68*	.30
University (U)	15.84	4.28	3.70*	.58
G x R	2.85	3.26	.88	.08
G x U	-1.11	2.40	-.46	-.02
R x U	-17.25	4.19	-4.12*	-.62

Note. *N* = 718. Gender was coded as Male (0) and Female (1); Race was coded as White (0) and Black (1); University was coded as Univ B (0) and Univ A (1).
*p<.05

Tests of Hypothesized Model

Descriptive Statistics. Means, standard deviations, and intercorrelations among latent variables for race- and gender-based stereotype threats are presented in Tables 7 and 8, respectively. These intercorrelations are the factor correlations from the measurement model. Means, standard deviations, and covariances among manifest variables are provided in Appendix B. Covariances are provided because all analyses were conducted using the covariance matrix.

Test of Fit of Measurement Models. The measurement model for race-based stereotype threat included the nine indicators (items) for stereotype threat for race. The measurement model for gender-based stereotype threat included the nine indicators (items) for stereotype threat for gender. Each model also contained the following indicators: three indicators (parcels) for each goal orientation variable (mastery, performance-approach, and performance-avoid), four indicators (items) for active coping, four indicators (items) for behavioral disengagement, three indicators (parcels) for self-efficacy, three indicators (items) for effort, and one indicator (item) for grade

EQS provides a normalized estimate of Mardia's kappa coefficient, which measures the distribution of data such that large values indicate data that are not normally distributed. Mardia's normalized estimate was 68.33 for the race-based stereotype threat measurement model and 91.02 for the gender-based stereotype threat measurement model, indicating that multivariate normality was violated for both models. Therefore, the Satorra-Bentler χ^2 (S-B χ^2), robust CFI and robust RMSEA indices, which

Table 7

Means, Standard Deviations, and Intercorrelations among the Latent Variables for Race

Variable	M	SD	1	2	3	4	5	6	7	8
1. Stereotype Threat for Race	2.26	1.34	----							
2. Mastery Orientation	4.89	1.23	.02	----						
3. Performance-Approach Orientatioı	4.42	1.25	.11*	.66*	----					
4. Performance-Avoid Orientation	3.91	1.12	.16*	-.13*	.12*	----				
5. Self-Efficacy	3.49	0.89	-.07	.58*	.32*	-.56*	----			
6. Active Coping	3.29	0.51	-.06	.28*	.25*	.02	.18*	----		
7. Behavioral Disengagement	1.69	0.64	.32*	-.19*	.00	.24*	-.19*	-.13*	----	
8. Effort	3.81	0.76	.00	.44*	.42*	.10*	.11*	.27*	-.11*	----

Note. N=718. Intercorrelations and standard deviations provided by the measurement model.
*p < .05

Table 8

Means, Standard Deviations, and Intercorrelations among the Latent Variables for Gender

Variable	M	SD	1	2	3	4	5	6	7	8
1. Stereotype Threat for Gender	2.27	1.45	----							
2. Mastery Orientation	4.89	1.23	-.05	----						
3. Performance-Approach Orientation	4.42	1.25	.02	.66*	----					
4. Performance-Avoid Orientation	3.91	1.12	.15*	-.13*	.12*	----				
5. Self-Efficacy	3.49	0.89	-.14*	.58*	.32*	-.56*	----			
6. Active Coping	3.29	0.51	-.07	.28*	.25*	.02	.18*	----		
7. Behavioral Disengagement	1.69	0.64	.27*	-.19*	.00	.24*	-.19*	-.13*	----	
8. Effort	3.81	0.76	-.02	.44*	.42*	.10*	.11*	.27*	-.11*	----

Note. N=718. Intercorrelations and standard deviations provided by the measurement model.
*p < .05

correct for non-normality, were used to assess model fit (Satorra & Bentler, 1988; Tabachnik & Fidell, 1996). The measurement model fit adequately. The S-B χ^2 was significant for both measurement models, S-B χ^2 (488) = 1353.15, $p < .01$ for race model and S-B χ^2 (488) = 1486.11, $p < .01$ for gender model. However, researchers have suggested that this overall fit index should be viewed with caution due to its sensitivity to sample size (Anderson & Gerbing, 1988; Bagozzi & Yi, 1988). The χ^2/df ratio of 3.02 for the race model and 3.31 for the gender model indicate adequate fit. The other fit indices also indicate that both measurement models are a good fit: robust CFI = .93 and robust RMSEA = .06 for race-based model, robust CFI = .94 and robust RMSEA = .05 for gender-based model.

Table 9 presents the unstandardized factor loadings with their associated standard errors and t-tests. The standardized factor loadings and reliabilities for each indicator as well as scale reliabilities (coefficient alpha) also are displayed in Table 9. By convention, the indicators should have loadings of .7 or higher on the latent variable (e.g., Schumacker & Lomax, 2004). Most of the factor loadings are high (greater than .7). In addition, each loading has a t-value greater than 2.00, demonstrating that each indicator loads significantly on its corresponding latent variable. The squared multiple correlations (R^2) in the measurement model indicate parcel or item reliability. The R^2 values range from .31 (Race-based Stereotype Threat item 8 and Active Coping item 3) to .93 (Effort item 3). The indicator reliabilities for the active coping and behavioral disengagement scales are low, but most of the indicators for the other scales are above .70.

Structural Models with Race-based Stereotype Threat. This section presents results for the structural model testing of the series of nested models with race-based

Table 9

Factor Loadings, t-values, Standardized Estimates, and Reliability Coefficients in the Measurement Model

Variables	Factor Loadings[a]	*SE*	*t*-values	Standardized Loading	Indicator Reliability	Scale Reliability
Race-Based Stereotype Threat						.95
ST_R 1	1.00	0.00	0	.83	0.69	
ST_R 2	.83*	0.04	20.47	.73*	0.54	
ST_R 3	.88*	0.04	23.22	.86*	0.73	
ST_R 4	1.02*	0.04	28.85	.90*	0.81	
ST_R 5	1.11*	0.03	33.84	.95*	0.90	
ST_R 6	1.10*	0.04	29.88	.89*	0.79	
ST_R 7	.97*	0.04	25.93	.89*	0.79	
ST_R 8	.78*	0.04	18.73	.56*	0.31	
ST_R 9	1.04*	0.03	32.90	.88*	0.77	
Gender-Based Stereotype Threat						.96
ST_G 1	1.00	0.00	0	.90	0.81	
ST_G 2	.68*	0.04	15.93	.63*	0.40	
ST_G 3	.81*	0.04	19.63	.84*	0.70	
ST_G 4	.99*	0.03	32.42	.91*	0.82	
ST_G 5	1.04*	0.02	50.64	.96*	0.92	
ST_G 6	1.01*	0.03	40.50	.91*	0.83	
ST_G 7	.91*	0.03	27.77	.90*	0.81	
ST_G 8	.80*	0.04	20.76	.62*	0.38	
ST_G 9	.99*	0.02	41.91	.93*	0.87	
Mastery Orientation						.89
PMO 1	1.00	0.00	0	.86	0.74	
PMO 2	.99*	0.04	22.70	.88*	0.78	
PMO 3	.93*	0.04	23.50	.82*	0.67	
Performance-Approach						.90
PPAP 1	1.00	0.00	0	.85	0.72	
PPAP 2	1.07*	0.04	26.85	.93*	0.87	
PPAP 3	.96*	0.04	23.92	.79*	0.62	

(table continues)

Table 9 *(continued)*

Variables	Factor Loadings[a]	*SE*	*t*-values	Standardized Loading	Indicator Reliability	Scale Reliability
Performance-Avoid						.77
PPAV 1	1.00	0.00	0	.76	0.58	
PPAV 2	.98*	0.05	18.58	.77*	0.60	
PPAV 3	1.07*	0.06	19.16	.79*	0.62	
CS Self-Efficacy						.93
PCSSE 1	1.00	0.00	0	.90	0.80	
PCSSE 2	1.06*	0.03	39.88	.93*	0.87	
PCSSE 3	1.09*	0.03	36.28	.88*	0.78	
Active Coping						.76
AC 1	1.00	0.00	0	.72	0.52	
AC 2	1.10*	0.07	15.31	.71*	0.51	
AC 3	.92*	0.08	10.98	.56*	0.31	
AC 4	.99*	0.08	13.16	.68*	0.46	
Behavioral Disengagement						.81
BD 1	1.00	0.00	0	.76	0.58	
BD 2	1.00*	0.07	15.47	.74*	0.55	
BD 3	1.02*	0.06	16.95	.72*	0.53	
BD 4	.92*	0.06	15.87	.65*	0.42	
Effort						.91
EFF 1	1.00	0.00	0	.79	0.62	
EFF 2	1.10*	0.05	23.87	.88*	0.77	
EFF 3	1.20*	0.05	23.57	.96*	0.93	

Note. N = 718. ST_R =Race-Based Stereotype Threat, ST_G = Gender-Based Stereotype Threat, PMO = Mastery Goal Orientation Parcel, PPAP = Performance-Approach Goal Orientation Parcel, PPAV = Performance-Avoid Goal Orientation Parcel, PCSSE = CS Self-Efficacy Parcel, AC = Active Coping, BD = Behavioral Disengagement, EFF = Effort.

[a]Unstandardized estimates.

*$p < .05$

stereotype threat. The first model tested is the baseline structural model, which estimates a direct relationship between race-based stereotype threat and performance. It excludes the effects of goal orientation, coping strategies, self-efficacy, and effort. The fit of this model was poor, S-B χ^2 (495) = 2237.41, $p < .001$, S-B $\chi^2/df = 4.52$, robust CFI = .88, robust RMSEA = .07. The baseline model and its standardized parameter estimates are displayed in Figure 2. The second nested model examines whether effort mediates the relationship between stereotype threat and performance. A χ^2-difference test shows that this model is a better fitting model than the baseline model (see Table 10), but the fit of this model overall was also poor, S-B χ^2 (494) = 2228.45, $p < .001$, S-B $\chi^2/df = 4.51$, robust CFI = .88, robust RMSEA = .07. The model and its standardized parameter estimates are displayed in Figure 3. The third nested model adds the hypothesized mediating effects of CS self-efficacy and coping strategies but omits the mediating effects of the goal orientation variables. Again, a χ^2-difference test shows that this model is a better fitting model than the second nested model (see Table 10), but overall this model fits the data poorly, S-B χ^2 (486) = 1997.42, $p < .001$, S-B $\chi^2/df = 4.11$, robust CFI = .90, robust RMSEA = .07. The model and its standardized parameter estimates are displayed in Figure 4.

The final nested model is the full hypothesized model for race-based stereotype threat. All hypothesized relationships are tested in this model. This model fit moderately well, S-B χ^2 (478) = 1548.21, $p < .001$, S-B $\chi^2/df = 3.23$, robust CFI = .93, robust RMSEA = .05. The model and its standardized parameter estimates are displayed in Figure 5. A χ^2-difference test shows that the hypothesized model is a better fitting model than previous models. The fit statistics and χ^2-difference tests for the nested models are summarized in Table 10. Given the model comparisons, the hypothesized model is judged to be the best fitting model.

To summarize results from the race-based stereotype threat model, the relationship between race-based stereotype threat and mastery goal orientation (hypothesis 2a) was not significant. Contrary to the hypothesis, race-based stereotype threat showed a significant, positive relationship with performance-approach (hypothesis 2b). Race-based stereotype threat was positively related to performance-avoidance orientation (hypothesis 2c) and to behavioral disengagement (hypothesis 3).

Table 10

Model Goodness of Fit Statistics and Comparisons for Race Model

Model	*S-B* χ^2	*df*	Robust CFI	Robust RMSEA	Robust $\Delta\chi^2$	Robust Δdf
Baseline Model	2237.41	495	.88	.07	---	---
Nested Model 2	2228.45	494	.88	.07	8.96*	1
Nested Model 3	1997.42	486	.90	.07	231.03*	8
Hypothesized Model	1548.21	478	.93	.05	449.21*	8

Note. N = 718.
*p < .001

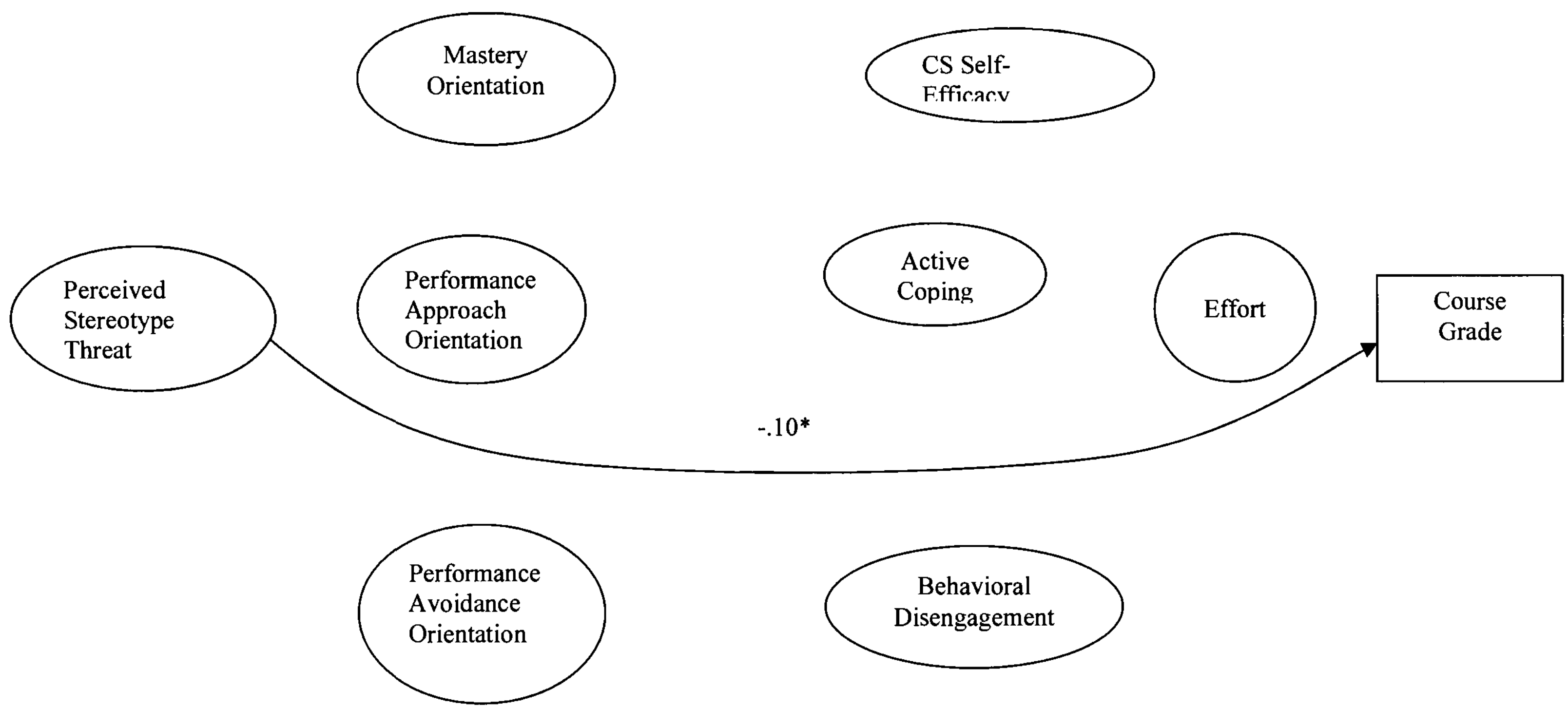

Figure 2. Baseline model for race. S-B χ^2 (495) = 2237.41, p < .001, S-B χ^2/df = 4.52, robust CFI = .88, robust RMSEA = .07.

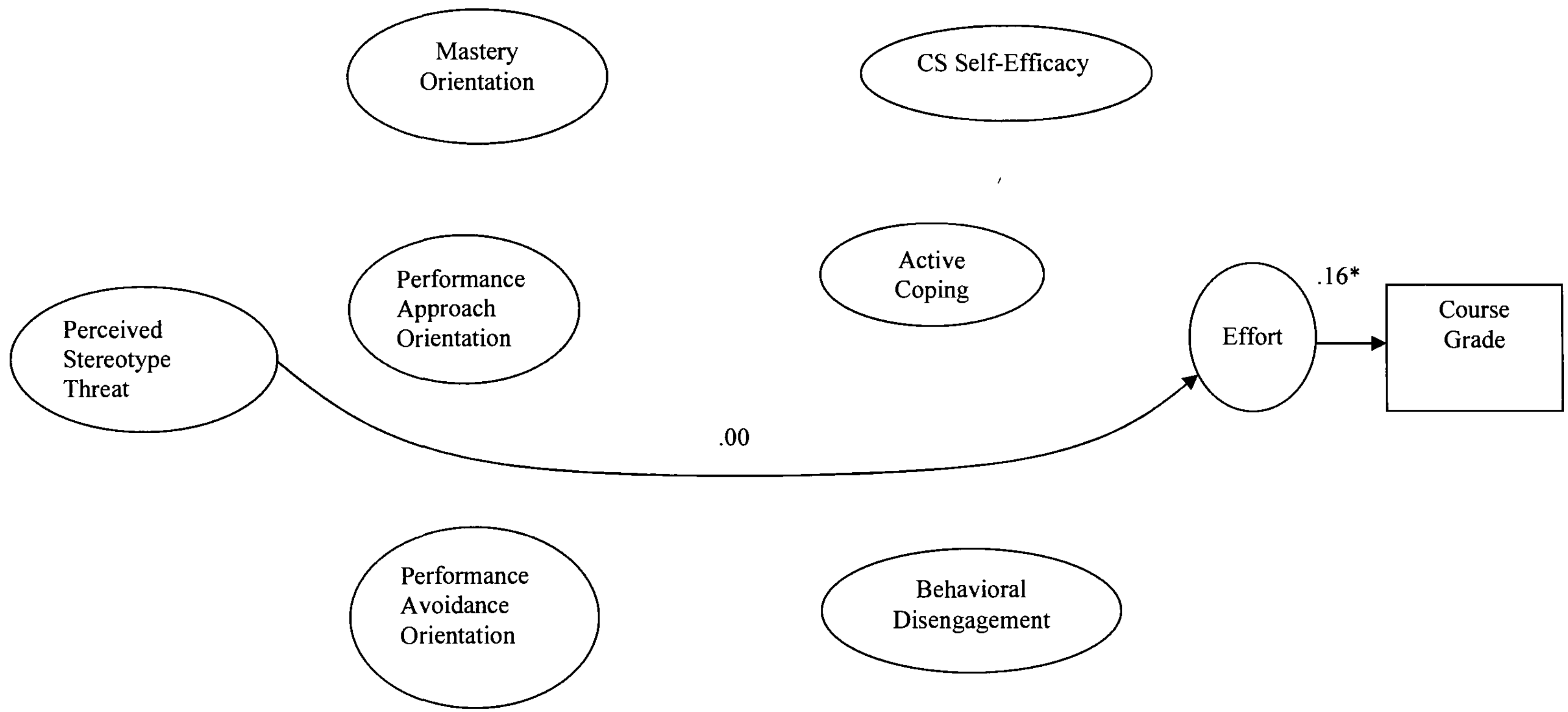

Figure 3. Nested model 2 for race. S-B χ^2 (494) = 2228.45, p < .001, S-B χ^2/df = 4.51, robust CFI = .88, robust RMSEA = .07.

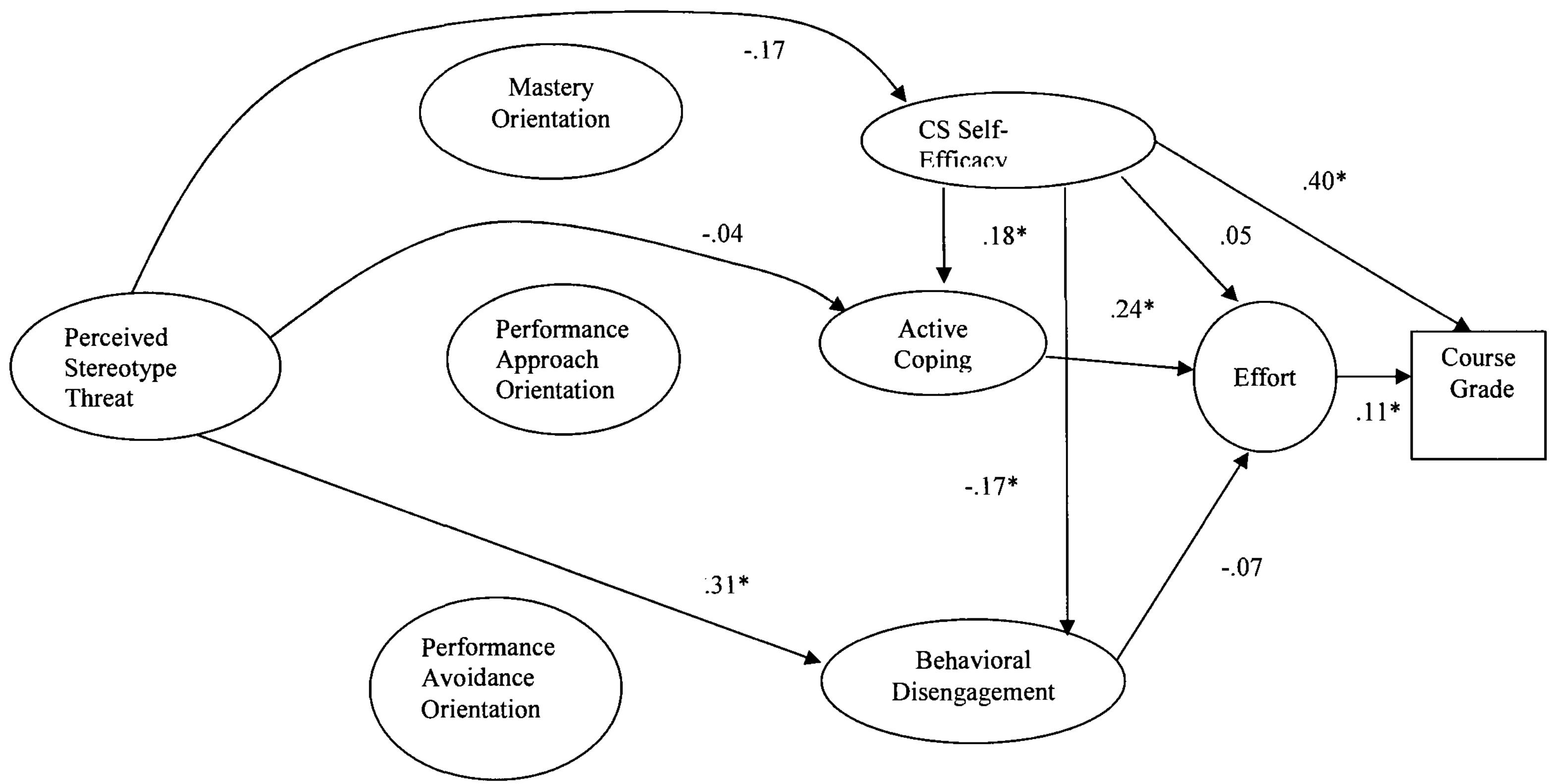

Figure 4. Nested model 3 for race. S-B χ^2 (486) = 1997.42, $p < .001$, S-B $\chi^2/df = 4.11$, robust CFI = .90, robust RMSEA = .07.

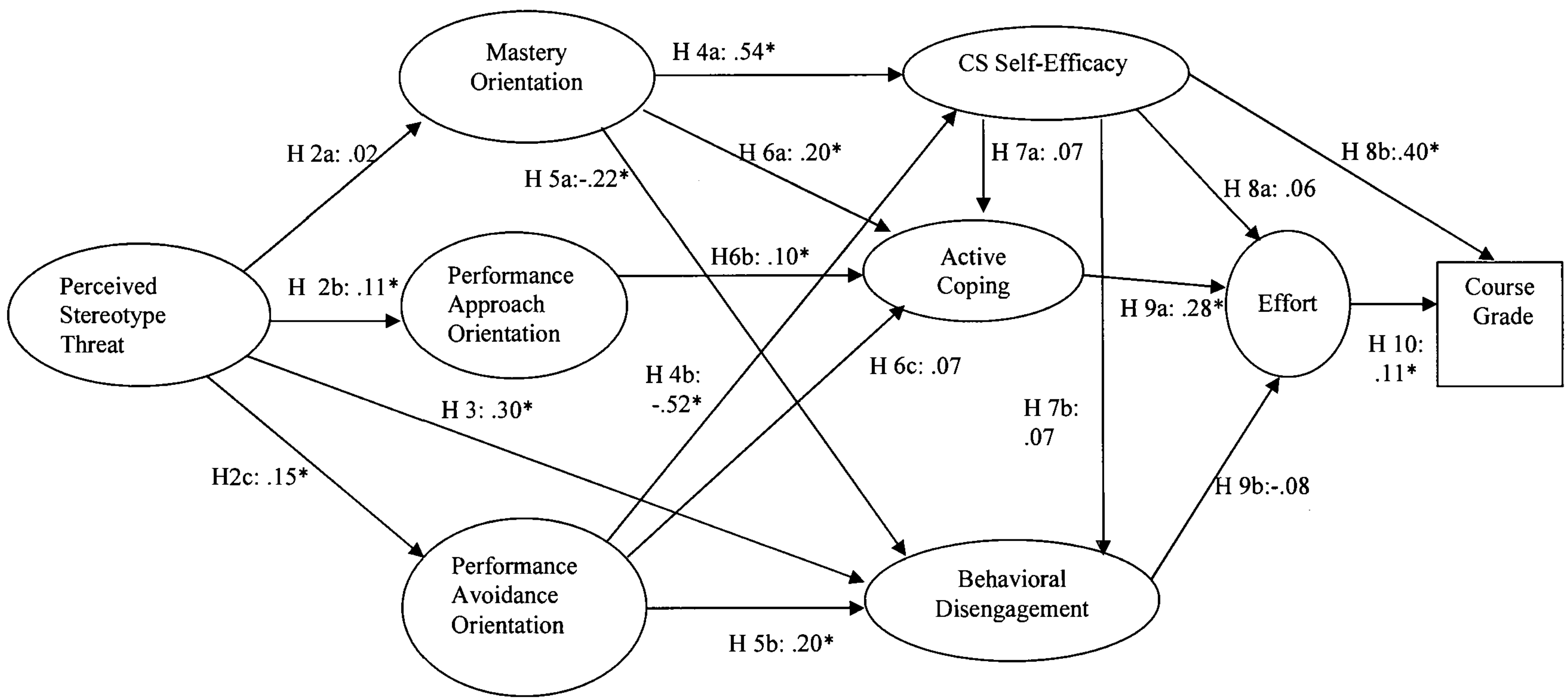

Figure 5. Hypothesized model for race. S-B χ^2 (478) = 1548.21, p < .001, S-B χ^2/df = 3.23, robust CFI = .93, robust RMSEA = .05.

As hypothesized, mastery orientation was positively related to CS self-efficacy (hypothesis 4a) and performance-avoidance orientation was negatively related to CS self-efficacy (hypothesis 4b). There was a significant negative relationship between mastery orientation and behavioral disengagement (hypothesis 5a) and a significant positive relationship between performance-avoidance orientation and behavioral disengagement (hypothesis 5b). Consistent with hypotheses 6a and 6b, both mastery orientation and performance-approach orientation were positively related to active coping. However, performance-avoidance orientation was not significantly related to active coping (hypothesis 6c). Contrary to the hypotheses, CS self-efficacy was not related to active coping (7a) or behavioral disengagement (7b). Additionally, CS self-efficacy was not related to effort (hypothesis 8a) but was related significantly to course grade (hypothesis 8b). Active coping was related significantly to effort (hypothesis 9a) but behavioral disengagement was not related to effort (hypothesis 9b). Finally, effort was related significantly to course grade (hypothesis 10).

Indirect effects suggested by the model were examined. Hypotheses 2, 4, and 8 suggest that goal orientation mediates the relationship between stereotype threat and self-efficacy. The results indicate that the relationship between race-based stereotype threat and CS self-efficacy was mediated by performance-avoidance orientation as expected, but not by mastery orientation. Hypotheses 5, 6, and 9 suggest that coping skills mediate the relationship between goal orientation and effort. Results indicated that behavioral disengagement did not mediate the relationship either between mastery orientation and effort or between performance-avoidance orientation and effort. However, active coping mediated the relationship between mastery and performance-approach orientations and effort, but did not mediate the relationship between performance-avoidance orientation and effort.

The amount of variance in each variable that was explained by the model is represented by the squared multiple correlations (R^2) for the structural equations. These values are listed in Table 11. Race-based stereotype threat accounted for only 1% of the performance-approach orientation variance and only 2% of the performance-avoidance orientation variance. Given the lack of significant relationship, it is not surprising that none of the variance in mastery orientation is explained by race-based stereotype threat. The model explains 56% of the variance in CS self-efficacy, 17% of the variance in behavioral disengagement, and 7% of the active coping variance. In turn, CS self-efficacy and coping skills explain 10% of the variance in effort. Finally, 18% of the variance in course grade was accounted for by the model.

Table 11

Squared Multiple Correlations (R^2) for Structural Equations in the Race Model

MO	PAP	PAV	CSSE	AC	BD	Effort	Course Grade
.00	.01	.02	.56	.07	.17	.10	.18

Note. N = 718. The squared multiple correlation (R^2) indicates the percent of variance in a variable that is being explained by the set of its predictors. MO = Mastery Orientation, PAP = Performance-Approach Orientation, PAV = Performance-Avoidance Orientation, CSSE = CS Self-Efficacy, AC = Active Coping, BD = Behavioral Disengagement

Structural models with gender-based stereotype threat. This section presents results for the structural model testing of the series of nested models with gender-based stereotype threat. The procedures used above to test the race-based model were used to test the gender-based model of stereotype threat. The first model tested is the baseline structural model, which estimates a direct relationship between gender-based stereotype threat and performance. It excludes the effects of goal orientation, coping strategies, self-efficacy, and effort. The fit of this model was poor, S-B χ^2 (495) = 2058.65, p < .001, S-B χ^2/df = 4.16, robust CFI = .90, robust RMSEA = .07. The baseline model and its standardized parameter estimates are displayed in Figure 6. The second nested model examines whether effort mediates the relationship between stereotype threat and performance. A χ^2-difference test shows that this model is a better fitting model than the baseline model (see Table 12), but the overall fit of this model was also poor, S-B χ^2 (494) = 2047.63, p < .001, S-B χ^2/df = 4.14, robust CFI = .90, robust RMSEA = .07. The model and its standardized parameter estimates are displayed in Figure 7. The third nested model adds the hypothesized mediating effects of CS self-efficacy and coping strategies but omits the mediating effects of the goal orientation variables. A χ^2-difference test shows that this model is a better fitting model than the previous nested model (see Table 12), but again, the model still fits the data poorly, S-B χ^2 (477) = 1837.23, p < .001, S-B χ^2/df = 3.78, robust CFI = .91, robust RMSEA = .06. The model and its standardized parameter estimates are displayed in Figure 8.

The final nested model is the full hypothesized model for gender-based stereotype threat. All hypothesized relationships are tested in this model. This model fit reasonably well, S-B χ^2 (469) = 1413.46, p < .001, S-B χ^2/df = 2.95, robust CFI = .94, robust

RMSEA = .05. The model and its standardized parameter estimates are displayed in Figure 9. A χ^2-difference test shows that the hypothesized model is a better fitting model than previous models. The fit statistics and χ^2-difference tests for the nested models are summarized in Table 12. Given the model comparisons, this hypothesized model is the accepted model.

To summarize results from the gender-based stereotype threat model, gender-based stereotype threat did not significantly impact mastery goal orientation (hypothesis 2a) or performance-approach goal orientation (hypothesis 2b). Gender-based stereotype threat was positively related to performance-avoidance orientation (hypothesis 2c) and to behavioral disengagement (hypothesis 3). As

Table 12

Model Goodness of Fit Statistics and Comparisons for Gender Model

Model	*S-B* χ^2	*df*	Robust CFI	Robust RMSEA	Robust $\Delta\chi^2$	Robust Δdf
Baseline Model	2058.65	495	.90	.07	---	---
Nested Model 1	2047.63	494	.90	.07	11.02*	1
Nested Model 2	1837.23	486	.91	.06	210.40*	8
Hypothesized model	1413.46	478	.94	.05	423.76*	8

Note. N = 718.
*p < .001

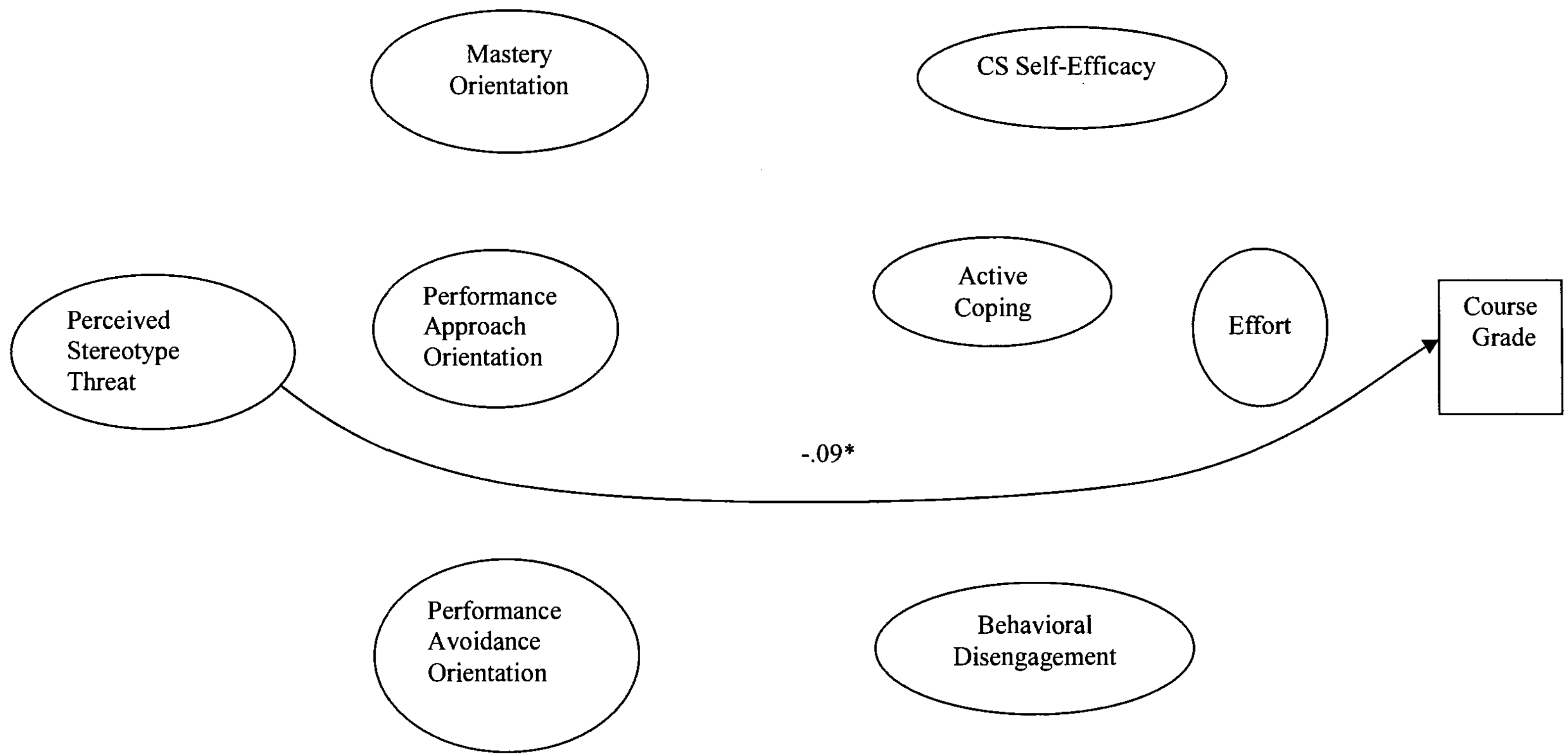

Figure 6. Baseline model for gender. S-B χ^2 (495) = 2058.65, $p < .001$, S-B $\chi^2/df = 4.16$, robust CFI = .90, robust RMSEA = .07.

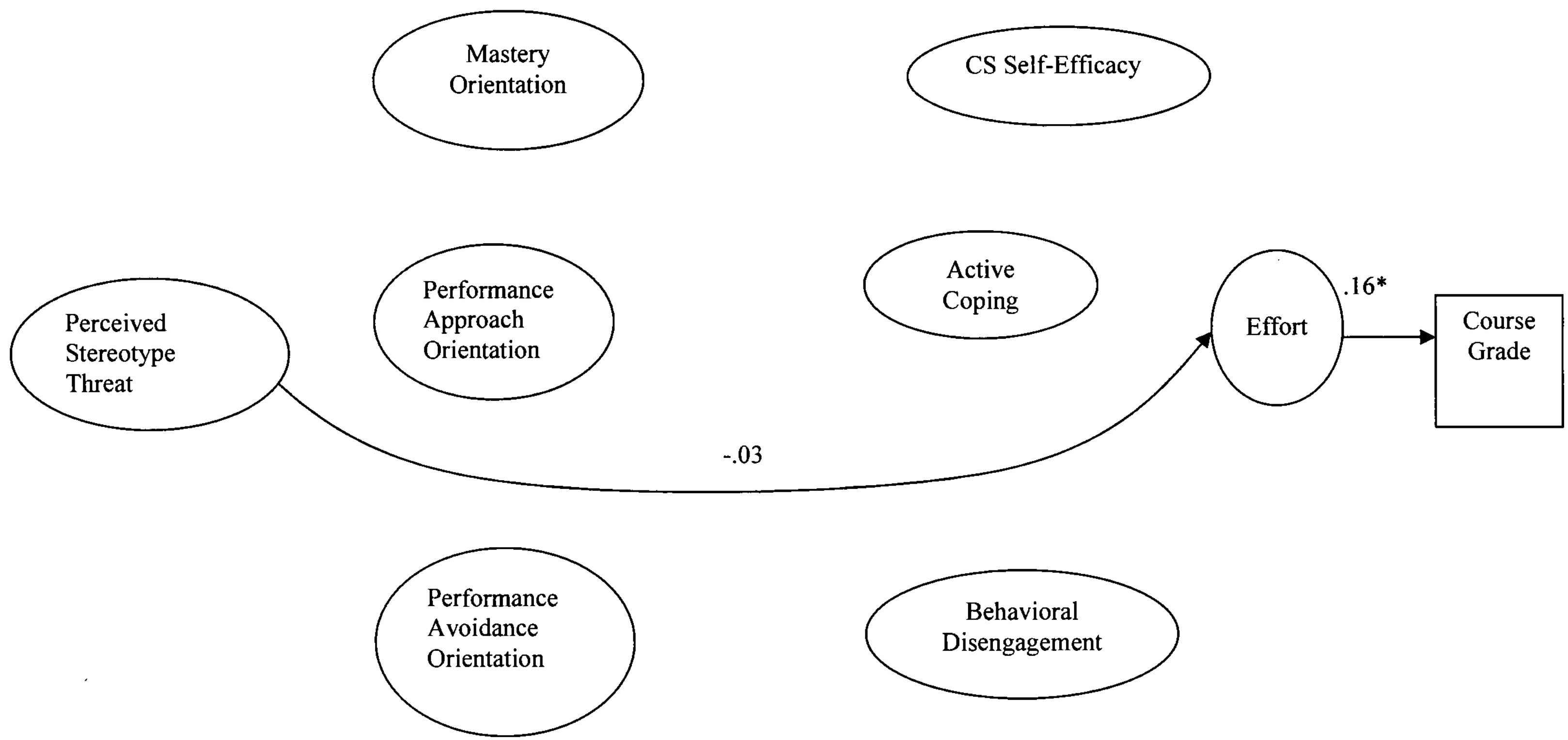

Figure 7. Nested model 2 for gender. S-B χ^2 (494) = 2047.63, p < .001, S-B χ^2/df = 4.14, robust CFI = .90, robust RMSEA = .07.

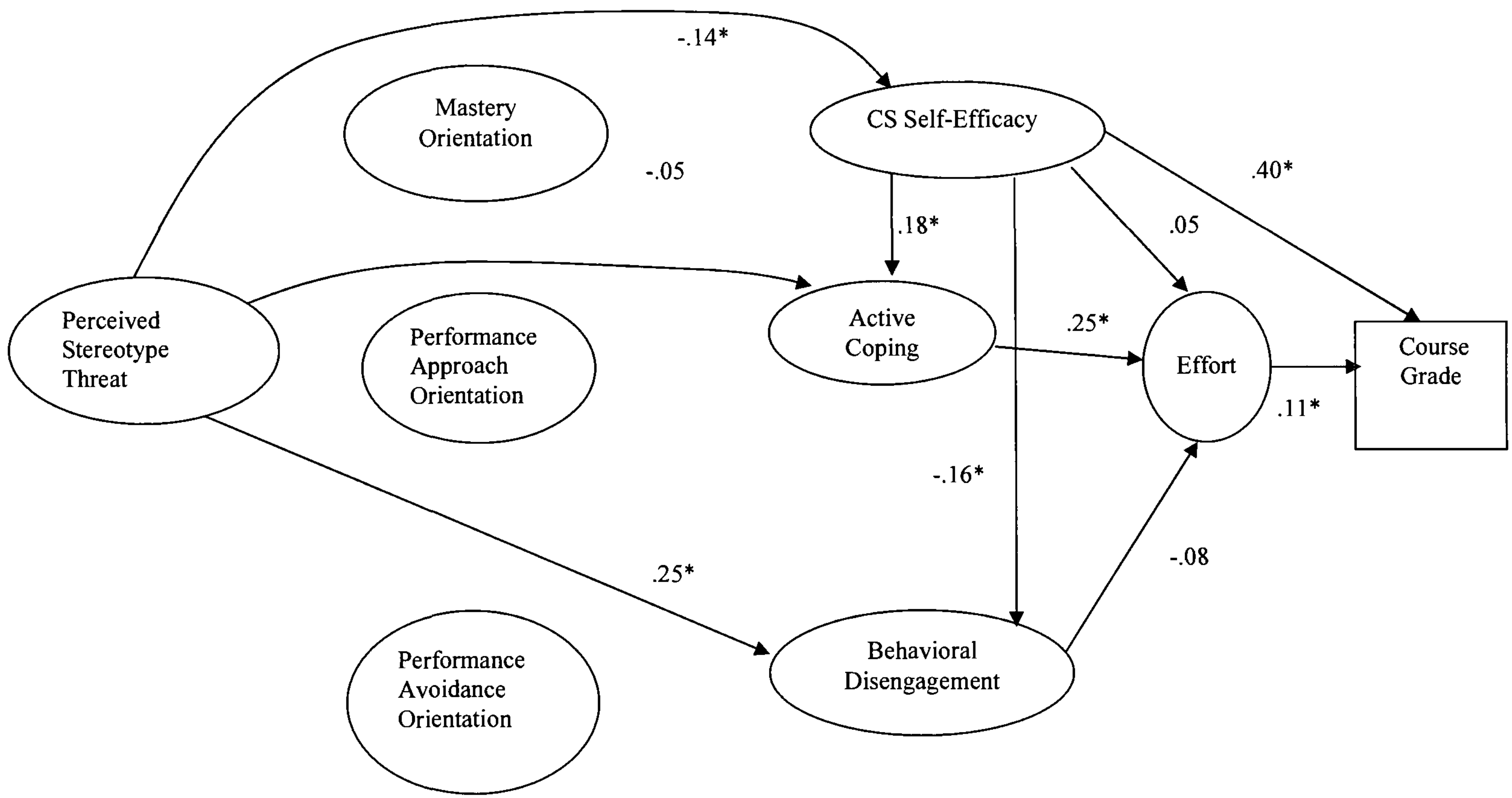

Figure 8. Nested model 3 for gender. S-B χ^2 (477) = 1837.23, p < .001, S-B χ^2/df = 3.78, robust CFI = .91, robust RMSEA = .06.

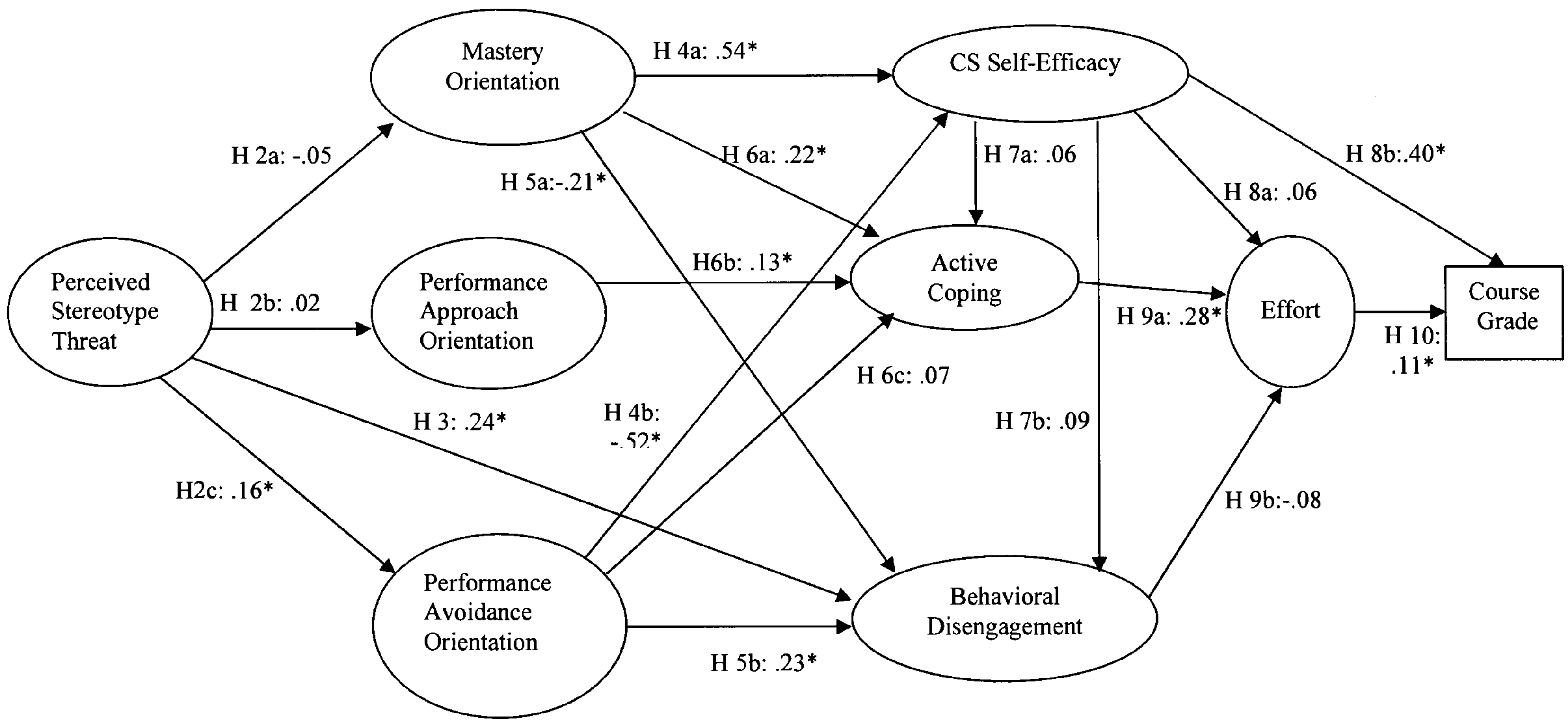

Figure 9. Hypothesized model for gender. S-B χ^2 (469) = 1413.46, p < .001, S-B χ^2/df = 2.95, robust CFI = .94, robust RMSEA = .05.

hypothesized, mastery orientation was positively related to CS self-efficacy (hypothesis 4a) and performance-avoidance orientation was negatively related to CS self-efficacy (hypothesis 4b). There was a significant negative relationship between mastery orientation and behavioral disengagement (hypothesis 5a) and a significant positive relationship between performance-approach orientation and behavioral disengagement (hypothesis 5b). Consistent with hypothesis 6a and 6b, both mastery orientation and performance-approach orientation were positively related to active coping. However, performance-avoidance orientation was not significantly related to active coping (hypothesis 6c). Contrary to the hypotheses, CS self-efficacy was not related to active coping (7a) or behavioral disengagement (7b). Additionally, CS self-efficacy was not related to effort (hypothesis 8a) but was related significantly to course grade (hypothesis 8b). Active coping was related significantly to effort (hypothesis 9a) but behavioral disengagement was not related to effort (hypothesis 9b). Finally, effort was related significantly to course grade (hypothesis 10).

Indirect effects suggested by the model were examined. Hypotheses 2, 4, and 8 suggest that goal orientation mediates the relationship between stereotype threat and self-efficacy. The results indicate that the relationship between gender-based stereotype threat and CS self-efficacy was mediated by performance-avoidance orientation, but not by mastery orientation. Hypotheses 5, 6, and 9 suggest that coping skills mediate the relationship between goal orientation and effort. Results indicated that behavioral disengagement did not mediate the relationship either between mastery orientation and effort or between performance-avoidance orientation and effort. However, active coping mediated the relationship between mastery and performance-approach orientations and effort. Active coping did not mediate the relationship between performance-avoidance orientation and effort.

The amount of variance in each variable that was explained by the model is represented by the squared multiple correlations (R^2) for the structural equations. These values are listed in Table 14. Gender-based stereotype threat did not account for the performance-approach orientation or mastery orientation variance. Additionally, it only accounted for 3% of the performance-avoidance orientation variance. The structural model explains 57% of the variance in CS self-efficacy, 14% of the variance in behavioral disengagement, and 9% of the active coping variance. In turn, CS self-efficacy and coping skills explain 9% of the variance in effort. Finally, 18% of the variance in course grade was accounted for by the model.

Table 13

Squared Multiple Correlations (R^2) for Structural Equations in the Gender Model

MO	PAP	PAV	CSSE	AC	BD	Effort	Course Grade
.00	.00	.03	.57	.09	.14	.09	.18

Note. N = 718. The squared multiple correlation (R^2) indicates the percent of variance in a variable that is being explained by the set of its predictors. MO = Mastery Orientation, PAP = Performance-Approach Orientation, PAV = Performance-Avoidance Orientation, CSSE = CS Self-Efficacy, AC = Active Coping, BD = Behavioral Disengagement.

Summary of Results.

Perceptions of Stereotype Threat. Results showed that females endorsed significantly more gender-based stereotype threat than males. Results also showed that Blacks endorsed significantly more race-based stereotype threat than Whites. There was also an interaction between race and university. At University B, Black students endorsed significantly more race-based stereotype threat than White students.

Hypothesized Model. Results for the fit for both the race-based and gender-based stereotype threat models indicated a good fit for the full hypothesized race-based stereotype threat model; 12 of the 18 hypothesized paths were supported. Similar results were found for the gender-based model, where 11 of the 18 hypothesized paths were significant. The results were similar for both types of stereotype threat. Stereotype threat was not related to mastery goal orientation for either model. Race-based stereotype threat showed an unexpectedly small but significant positive relationship with performance-approach orientation, but gender-based stereotype threat was not significantly related to it. Both types of stereotype threat led to an increase in performance-avoidance orientation, as expected. Additionally, participants who experienced either kind of stereotype threat were more likely to be behaviorally disengaged. As expected, for both models mastery orientation was related positively to CS self-efficacy and performance-avoidance was related negatively to CS self-efficacy. In both models, mastery orientation led to decreased behavioral disengagement, whereas performance-avoidance orientation led to an increase in behavioral disengagement. Students who endorsed mastery and performance-approach orientations were more likely to use active coping. Unexpectedly, performance-avoidance orientation was unrelated to active coping. CS self-efficacy did not show the hypothesized relationships to actively coping, behavioral disengagement, or effort, but it was positively related to grade. Participants who endorsed active coping reported higher levels of effort, but behavioral disengagement was not significantly related to effort. Finally, effort was significantly related to course grade. Overall, both the race-based model and the gender-based model accounted for 18% of the variance in course grade.

CHAPTER IV

DISCUSSION

In an attempt to explain the loss of women and minorities from computer science and other STEM disciplines, the current research sought to understand stereotype threat. The perception of stereotype threat among computer science students was examined at two universities. Additionally, an integrative model of stereotype threat and its influence on motivation, self-efficacy, coping strategies, effort, and performance was developed and tested to help understand the consequences of stereotype threat and then tested in a computer science classroom setting. The goal of this model was to provide an understanding of the underlying mechanisms through which stereotype threat works.

Perceptions of Stereotype Threat

The first part of this study aimed to explore the boundary conditions on stereotype threat by ascertaining the degree to which Blacks and women experience stereotype threat in university computer science classes. Based on previous research, it was hypothesized that females would experience greater levels of stereotype threat than males. This hypothesis was supported. Female students in the computer science courses at both universities reported feeling more stereotype threat than male students. It was also expected that Blacks would report higher levels of stereotype threat than Whites. This hypothesis was also supported. Finally, it was expected that Blacks would experience less stereotype threat in a predominantly Black setting than Blacks in a mixed setting. This hypothesis also was supported, but the small number of White students from in the sample from this university limits this result.

These results support the notion that negative stereotypes still exist for women and minorities in academics. It is commonly assumed that women and minorities are admitted into CS programs for diversity reasons, not because they are competent (Hammond, 2001). Additionally, Blacks must contend with negative stereotypes concerning their overall intellectual ability (Plous & Williams, 1995; Snyderman & Rothman, 1987). One explanation for the lack of women and minorities in the field of computer science suggests that women and minorities are deterred from engaging in technology-related fields because pervasive negative cultural stereotypes hinder their performance and self-confidence. These negative stereotypes may also influence retention by reducing performance of women and minority students who chose to major in CS and other STEP disciplines. In this study, participants reported feeling their classroom performance was being judged based on gender and race. It is possible that this perception of stereotype threat may drive them from the computer science classroom.

This study also answers the call by Smith (2006) to examine stereotype threat in a less "explicit" stereotype threat condition. Much stereotype threat research involves explicitly manipulating stereotype threat in contrived laboratory settings. In fact, a number of field studies have failed to find an effect for stereotype threat-related factors on performance (McFarland et al., 2003; Ployhart et al., 2003; Stricker, 1998; Stricker & Ward, 2004). However, these results suggest that stereotypes do not have to be explicitly presented to induce threat effects. In this research, participants reported race and gender information at the end of the questionnaire to prevent priming of stereotypes. These results suggest that priming is not necessary to elicit stereotype threat. Consistent with the findings of Inzlicht and Ben-Zeev (2003), this research shows when one is a numerical minority it is enough to heighten group identity and induce stereotype threat if negative stereotypes are associated with that identity. Black participants at the predominantly Black university were not in a minority and as a result, they did not experience as much stereotype threat as their counterparts at the other university.

White students at Black universities. One interesting finding is the fact that Whites at the historically Black university experienced the highest levels of stereotype threat. However, the extremely small sample size (N = 6) urges caution in interpreting these results. Prior research suggests being a numerical minority is sufficient to prime stereotype threat (Inzlicht & Ben-Zeev, 2003), but it was not expected that White students at a Black university will experience stereotype threat because Whites do not typically experience a negative stereotype about their academic performance. However, there may be assumptions about the intelligence of a White student who chooses to attend a predominantly Black school. Hall and Closson (2005) found that despite overall feelings of comfort and support, White students at Black colleges and universities did struggle with a sense of exclusion. Closson and Henry (2008) found Black students held diverse perceptions about their White peers at these institutions. Some Blacks expressed suspicions about the motivation of a White student for enrolling at the institution and questioned the level of intelligence of these students. So it is possible in this study that White students at the predominantly Black university were faced with negative stereotypes about their academic performance. This stereotype may have combined with their minority status to evoke feelings of stereotype threat in this small subset of students. Further research should investigate the ways in which members of majority groups may also experience stereotype threat.

Hypothesized Model

Overall, the results provide support for the hypothesized model. A test of four nested models supported the value of the integrative model. This model suggests that stereotype threat cannot be explained through direct relationships alone, and the data provide empirical support that achievement goal orientations, coping strategies, and self-efficacy serve as mediators of the processes underlying stereotype threat. The importance of including such mediating effects was supported by the data; the mediation model fit the data significantly better than did the baseline models, which did not include the mediating relationships. In addition to the overall test of the theoretical model, a majority of the proposed relationships were supported. These results are discussed next.

Stereotype threat and goal orientation. The positive relationship between stereotype threat and performance-avoid goal orientation was consistent with prior research. Students who reported feeling perceptions of stereotype threat were more likely to adopt performance-avoidance goals. Smith (2004) proposed that stereotype threat triggers a performance-avoidance goal orientation because individuals feel a need to avoid validating the competence-based stereotype. Students experiencing stereotype threat fear that their behavior will confirm the existing stereotype for their group so they seek to avoid appearing incompetent (a performance-avoidance goal), especially in the presence of other classmates.

Contrary to the hypothesis, stereotype threat had a non-significant relationship with mastery orientation for both the race and gender models. Students experiencing stereotype threat were not less likely to endorse mastery goals. It appears that stereotype threat pushes people towards avoidance goals but does not necessarily push them away from mastery goals. In many studies there has been no correlation between mastery and performance goals (Midgley et al., 1998; Nicholls, Cheung, Lauer, & Patashnick, 1989). This suggests that students may hold mastery and performance goals simultaneously and to varying degrees (Meece & Holt, 1993). This has been supported by qualitative studies in which students expressed multiple purposes or goals for engaging in schoolwork (e.g., Dowson & McInerney, 2001; Lee & Anderson, 1993; Levy, Kaplan, & Patrick, 2004). The results of this study support this notion that the goal orientations can operate independently and be influenced differentially.

It was hypothesized that stereotype threat would be negatively related to performance-approach orientation. Similar to the mastery orientation results, gender-based stereotype threat showed no relationship to performance-approach orientation. Unexpectedly, race-based stereotype threat was positively related to performance-approach orientation. Smith, Sansone, and White (2007) found that the effects of stereotype threat combine with and influence achievement goal adoption depending on achievement motivation. There is some suggestion that there are various manifestations of Black achievement motivation (Spencer, 2006). Perhaps there are differences in the achievement motivation of Blacks and Whites that are impacting the stereotype threat-achievement goal relationship. Stereotype threat may cause both a desire to not look bad (performance-avoid orientation) and a desire to prove their competence (performance-approach orientation) in Blacks. However, the limited research on racial differences in goal orientation does not support this idea. The research shows that Blacks seem to endorse mastery orientations more than Whites at the middle and high school level, but this difference seems to disappear at the college level (Britner & Pajares, 2001; Freeman, Gutman, & Midgley, 2002; Kaplan & Maehr, 1999). Midgley, Arunkumar, and Urdan (1996) found no significant difference in goal endorsement by race. Pajares, Britner, and Valiante (2000) found Black students reported stronger task goals and stronger performance-avoid goals than did White students but there were no race differences in performance-approach. Of the few studies done with college students, results show no differences between the races (Brandt, 2003; Campbell, Barry, Joe, & Finney, 2008). More research should explore racial differences in the experience of goal orientation.

Stereotype threat and behavioral disengagement. As expected, stereotype threat was positively related to behavioral disengagement for both race-based threat and gender-based threat. This result is consistent with prior research that shows individuals experiencing stereotype threat use disengagement as a coping strategy (Major, Spencer, Schmader, Wolfe, & Crocker, 1998; Nussbaum & Steele, 2007). Stereotype threat induces a norm-based evaluation of one's competence in a particular domain, and disengagement involves distancing oneself from this threatened domain as a protective measure. When presented with the negative stereotypes surrounding their gender and race in computer science, students give up or withdraw, physically or psychologically, as a means of dealing with the stress of confirming the stereotype threat.

Goal orientation and CS self-efficacy. As hypothesized, mastery orientation was positively related to CS self-efficacy, and performance-avoidance orientation was negatively related to CS self-efficacy. These relationships held true for both the race-based and gender-based stereotype threat models. Similar to previous research findings (Patrick et al., 1999; Payne et al., 2007; Philips & Gully, 1997), students who endorsed mastery-oriented goals had higher levels of CS self-efficacy. Individuals with a mastery goal orientation are interested in developing their skill and ability, believe that such development is possible, and approach situations with a sense of high self-efficacy. A mastery goal orientation can help individuals maintain their self-efficacy in the face of setbacks. By believing that ability can be developed, these individuals are receptive to finding ways to develop the skills needed to overcome the setback. Also consistent with prior research (Middleton & Midgley, 1997; Payne et al., 2007; Wolters et al., 1996), the current research shows that students who adopted performance-avoidance goals had lower levels of CS self-efficacy. Individuals with a performance goal orientation tend to believe intelligence is fixed and stable, which causes them to interpret any mistake or imperfect performance as indicating failure and lower intelligence (Dweck, 1989). This interpretation lowers the individual's self-efficacy level (Phillips & Gully, 1997). When these students experience difficulty or challenge, they assume that their difficulty indicates low ability, which undermines their self-efficacy (Schunk & Pajares, 2001).

Goal orientation and coping strategies. Consistent with prior research (Dykman, 1998; Pensgaard & Roberts 2003; Tanaka et al., 2002), mastery orientation was negatively related to behavioral disengagement and performance-avoidance orientation was positively related to it. That is, students who endorsed mastery goals were less likely to use disengagement as a coping strategy; whereas students who endorsed performance-avoidance goals were more likely to cope through disengagement. Additionally, as hypothesized, mastery and performance-approach orientations were positively related to active coping, confirming previous findings by Tanaka et al. (2002) and Pensgaard and Roberts (2003). However, contrary to prior research (DeShon & Gillespie, 2005; Roeser et al., 2002), performance-avoidance orientation showed no relation with active coping. Again, the attributions individuals with differing goal orientations make can explain these relationships. Mastery-oriented individuals believe intelligence is malleable and are more likely to attribute success and failure to internal controllable causes. Thus, a mastery orientation results, not in behavioral disengagement, but in adaptive responses, such as increased effort and more perseverance (characteristics of active coping) when confronted with a difficult situation (Roedel et al., 1994). Performance-approach oriented individuals strive to appear competent and gain favorable judgments. These individuals want to be the best and to appear the most competent. They use active coping strategies because these strategies will help them achieve their goal of surpassing their peers. Conversely, a performance-avoidance goal orientation is characterized by a focus on outcome, a desire to avoid negative feedback, and an entity view of intelligence. When faced with difficult or challenging situations, these individuals view failure as a negative reflection on the self and withdraw or disengage to protect the self. Additionally, VandeWalle et al. (2001) suggest that pessimism, anxiety, and disinterest in hard work are related to a performance-avoidance orientation. To avoid these feelings, individuals who adopt performance-avoidance goals engage in a number of withdrawal behaviors such as self-handicapping, task disengagement, and off-task cognitions (DeShon & Gillespie, 2005). It was expected that individuals with performance-avoidance orientations would be less likely to use active coping strategies but the results indicated no relationship between these two variables. Individuals with performance-avoidance goals are focused on avoiding looking less competent and are concerned with protecting their self-esteem at all costs. This emphasis clearly pushes them towards dysfunctional coping strategies but may not necessarily push them away from active coping strategies. Alternatively, active coping involves taking action or exerting effort to remove or circumvent the stressor. Perhaps for some performance-avoidant individuals psychologically or physically withdrawing when faced with challenges is their way of removing the stressor. They may be misinterpreting 'active coping.'

CS self-efficacy and coping strategies. Contrary to the hypotheses, CS self-efficacy was not related to coping strategies. Based on prior research (Devonport et al, 2003; Haney & Long, 1995; Rijavec & Brdar, 1997) it was expected that students with higher levels of CS self-efficacy would be more likely to use active coping and less likely to use behavioral disengagement. One potential explanation for the lack of expected results concerns the timing of the measurement of self-efficacy and coping skills. These variables were measured at the end of the semester and reflect a summary of behavior and perceptions over that period of time. However, self-efficacy and coping skills are dynamic constructs that can change over short intervals so this end-of-semester measurement approach may not be the most sensitive method for capturing the relationship between these two variables.

Other research has shown the relationship between self-efficacy and coping strategies to be the opposite of the hypothesized direction. That is, instead of self-efficacy influencing coping strategies, the coping strategies one uses can either increase or decrease one's self-efficacy. Devonport and Lane (2006) suggest that individuals evaluate if they have the means to cope with demands and if that evaluation is favorable, then self-efficacy for task completion is increased. Alternatively, a reduction in self-efficacy follows an unfavorable appraisal. Some research supports their theory. Sandler, Tein, Mehta, Wolchik, and Ayers (2000) found active coping lead to higher efficacy beliefs. Devonport et al. (2003) found that active-coping efforts were associated with higher self-efficacy scores and better grades. Further, Haney and Long (1995) found the relationship between self-efficacy and coping changes over time with performance feedback. Finally, the measure of self-efficacy was specific to computer science. It was not specific to the use of coping skills, which may explain in part the failure to find support for the hypothesis. Bandura (1997) describes coping efficacy as a specific instance of the broader construct of self-efficacy. The relationship between task-specific self-efficacy and coping skills may not be as strong as the relationship between coping skills and coping efficacy.

Self-efficacy, effort and performance. It was expected that CS self-efficacy would be positively related to effort and performance grade. The results provide partial support for the expected relationships. CS self-efficacy was positively related to performance. Students who believe they are capable of success in the computer science courses got better grades. This result is consistent with prior research that shows a direct link between self-efficacy and performance (Breland & Donovan, 2005; Phillips & Gully, 1997; VandeWalle et al. 2001). Unexpectedly, CS self-efficacy was not related to effort. However, this result could be a function of the research setting. These two classes are challenging programming courses in the CS curriculum and require a great deal of work outside of class. Research shows the relationship between self-efficacy and effort is lower at higher levels of task complexity. In highly complex tasks, individuals have a harder time accurately judging whether their abilities are up to the demands of the task (Stajkovic & Luthans, 1998). Thus, complex tasks lead to faulty evaluation of both the task requirements and outcomes, such as effort and performance. On average, students reported an effort of 3.83 on a five point scale. This mean suggests that students may have been reporting elevated effort levels due to task difficulty or that they may have been exaggerating how much effort they expend. Additionally, self-efficacy is a dynamic construct (Bandura, 1986). The efficacy judgment changes over time as new information and experience are acquired. Yeo and Neal (2006) found that self-efficacy varied across time. Increases in self-efficacy within one individual often coincided with subsequent decrements in performance. This finding partly reflects limited practice in response to elevated levels of self-efficacy. That is, students who came in the class with high self-efficacy may have put forth limited effort but once performance feedback became available adjustments in self-efficacy and effort were made. However, Yeo and Neal (2006) found individuals who, in general, reported higher levels of self-efficacy tended to perform more effectively.

Coping skills, effort, and performance. Active coping was related to effort in the hypothesized direction but behavioral disengagement was not. Consistent with prior research (Carver et al., 1989; Gerin et al., 1992; Leong et al., 1997; Mantzicopoulos, 1990), students who used active coping reported higher levels of effort. These students dealt with stress by putting forth more effort to overcome the obstacles. Disengagement, as a coping strategy, involves giving up, or withdrawing effort from, the attempt to attain a goal. So, the lack of significant negative relationship between these variables is perplexing. The correlation was in the hypothesized direction but not significant. The data shows a negative correlation between behavioral disengagement and grade suggesting disengagement does result in lower effort and grades, even if not at a significant level. Again, the fact that all these measures were completed at the end of the semester may be confounding some of the results. Perhaps students who have disengaged feel they did expend a lot of misplaced effort at one point in the semester. Finally, as expected, effort was positively related to performance. Students who put forth more effort earned higher grades.

Summary. The proposed model examined the impact of stereotype threat on goal orientation, self-efficacy, coping strategies, effort, and performance to help determine the causal mechanisms underlying stereotype. The model was tested with race-based and gender-based stereotype threat. Both kinds of threat yielded almost identical results. Out of the nine sets of hypotheses for the model, there was only one difference in the results. Race-based stereotype threat showed an unexpectedly significant positive relationship to performance-approach orientation but gender-based stereotype threat showed no relationship with it. These results provide evidence that the processes by which stereotype threat works are similar for Blacks and females.

However, the model results also suggest that stereotype threat does not have a large impact on performance in the classroom. The model accounted for 18% of the variance in course grade. Similar to the results of Ployhart et al. (2003), these results indicate that stereotype threat effects in field settings are weaker than effects obtained in laboratory research.

The overall model results suggest that stereotype threat works primarily by inducing a performance-avoidance goal orientation and increasing the use of behavioral disengagement. That is, individuals experiencing stereotype threat conditions are motivated to avoid being judged negatively in order to disprove the stereotype and begin to disengage from the domain as a method for coping with the stress of the threat. Additionally, students with a performance-avoidance orientation had lower CS self-efficacy and were less likely to use a good coping strategy like active coping. Blacks and females in computer science classes did report experiencing feelings of stereotype threat, which can lead these students to focus on outcomes to try to avoid negative feedback (and not mastery of the material), and to view failure as a negative reflection on the self and withdraw or disengage to protect the self.

While stereotype threat was not related to mastery or performance-approach orientations, the results of the model suggest these orientations provide a boost to students' grades. Students endorsing these orientations had stronger beliefs in their ability to handle computer science (CS self-efficacy) which resulted in higher grades. They also were more likely to use an active coping strategy resulting in an increase in the amount of effort they put into the class which resulted in higher grades. If students experiencing stereotype threat could adopt mastery and performance-approach goal orientations, then perhaps the negative impact of stereotype threat on performance could be offset.

Limitations and Future Research

This study has a few limitations that warrant attention. First, the timing of the measures may have influenced the results. All measures were taken at the end of the semester. This was practical and valuable, in that asking some of the questions prior to the end of the semester may have primed any negative stereotypes. Also, it may have been difficult to respond to some measures, such as effort, if administered early in the semester. However, it is possible that participants responded to these questionnaires in a manner that reflected their perceived classroom performance (Chan, Schmitt, Sacco, & DeShon, 1998). For example, a student may think "I think I performed poorly, so maybe I didn't put as much effort as I thought I did or maybe I'm not as good as I thought I was." Their answers would reflect their retrospective attributions and not how they really felt during the course of the semester. Additionally, relationships among the model variables may change over time, especially as feedback becomes available in the classroom. Future studies should examine stereotype threat and its processes over time.

Second, the generalizability of the results is limited. Although the goal of this study was to examine stereotype threat in a specific population (students in computer science), the influence of stereotype threat is felt in a variety of situations and by a variety of people. Steele et al. (2002) suggested mediators vary across people, situations, and the nature of the stereotype itself. Ployhart et al. (2003) expressed concern over the focus of between-condition threat manipulations and suggest within-condition variance reflects individual differences in perceptions of threat. This study only found one difference in the experience of race-based and gender-based stereotype threat (between threat and performance-approach orientation) but even one difference suggests stereotype threat may influence groups differentially. The model should be tested for invariance across different groups (i.e., White males). Additionally, this study did not measure race, gender, or domain identity, which are all variables known to influence stereotype threat. Future research is required to support the validity of the model for different domain groups in various settings. So, researchers should continue to explore the boundaries of stereotype threat. For example, measuring frustration levels and perceptions of task difficulty may help identify which students are likely to experience stereotype threat.

A third limitation is inevitable for any research based on structural equation modeling. For each accepted model, there may be several models that fit the data as well. These equivalent models have the same variables and are equally parsimonious to the tested model so they cannot be rejected as acceptable alternatives (Hoyle & Panter, 1995). There may be important variables that were not included in the model. Additionally, SEM cannot test directionality in relationships and thus causation cannot be inferred from the results of the study.

The final limitation is the measurement of effort. This study measured effort using self-report items, which can be problematic because perceptions of effort are relative to the individual. That is, what constitutes 'considerable effort' may change from person to person. However, using a measurement method that does not rely on self-report would require directly observing participants' effort over the course of the semester. One alternative may be to ask participants to record how many hours they spend per week studying or working on course material.

Contributions

In spite of these limitations, this study makes several contributions to the research literature as well as to practice. Again, much of the controversy surrounding stereotype threat has centered on determining the existence and impact of stereotype threat outside laboratory settings. This study adds to the small body of research examining stereotype threat in the real world. No attempts were made to manipulate stereotype threat or make race or gender salient to participants in the study. In fact, steps such as asking students to complete the study questionnaires at the end of the semester should have minimized stereotype threat. Despite the lack of deliberate manipulation, a significant effect for stereotype threat was found. Black and female students are feeling the burden of negative social stereotypes in university computer science classes where they are in a minority. Understanding the burden these students are carrying can help educators design interventions to make these students feel more comfortable in the classroom.

From the beginning of research in this area, several different factors have been suggested as being responsible for the negative impact of stereotype threat on performance. However, the majority of the research has examined single factors as mediators of the stereotype threat-performance relationship. This study offers a much needed model that shows how multiple processes arise under stereotype threat. Providing empirical support for this integrative model of stereotype threat's causal mechanisms also offers an important advance within the stereotype threat literature. Specifically, by presenting evidence that goal orientation, coping skills, and self-efficacy serve as mediators of the processes underlying stereotype threat, researchers can develop interventions that target these key variables. For example, teachers can help students adopt mastery orientations by stressing that intelligence is malleable and that taking risks and failure is part of learning. Adopting a mastery orientation will boost self-efficacy and decrease behavioral disengagement. Teaching students active coping strategies can increase effort. Teachers can also boost the self-efficacy of students by ensuring students experience some success in the classroom, by providing good role models, by providing quality feedback, and by creating a positive atmosphere in the classroom. Teachers can help eliminate stereotypes associated with threatened groups by recognizing that all students are in the course because of ability, not because of diversity initiatives. Classrooms that diminish the salience of stereotyped group memberships may reduce stereotype threat. For example, to overcome gender-based stereotypes, teachers can highlight female students' memberships in other non-stereotyped groups, such as being a college student. These interventions may help stop the loss of women and minorities from the stereotype-laden field of computer science.

CHAPTER V

CONCLUSION

Stereotype threat, introduced by Steele and Aronson in 1995, occurs when a negative stereotype about an individual's group is made salient in a performance situation and interferes with the performance of individuals in the stereotyped group. Much speculation has surrounded the presence and impact of stereotype threat. Despite much research, the specific mechanisms by which stereotype threat harms performance have not been entirely clear. This ambiguity likely reflects that fact that stereotype threat works through multiple variables, each of which can contribute to decreased performance (Steele, Spencer, & Aronson, 2002). Therefore, the purpose of this research was twofold: to examine the existence of stereotype threat in a real-world computer science classroom and to develop and test a model of variables mediating stereotype threat's influence on performance.

As the field of computer science continues to lose minorities and women, research aimed at understanding how stereotypes interact with performance provides an important step in understanding and stopping the loss. This study's findings support the proposed model and highlight several key points. First, Blacks and women are struggling with perceptions of stereotype threat inside the computer science classroom, but it only has limited impact on performance. Second, this model shows a chain reaction effect: stereotype threat induces disengagement and a performance-avoidance orientation, which leads to a loss of computer science self-efficacy, which leads to reduced effort and performance. Researchers may do well to remember these points when considering the loss of women and minorities in computer science.

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APPENDIX A

QUESTIONNAIRE SCALES AND ITEMS

Race-based Stereotype Threat

1. Some people feel I have less programming ability because of my race/ethnicity.
2. This class may have been easier for people of my race/ethnicity.
3. My professor expected me to do poorly in this class because of my race/ethnicity.
4. In Computer Science classes, people of my race/ethnicity often face biased evaluations.
5. My race/ethnicity negatively affects people's perceptions of my programming ability.
6. I worry that people will draw negative conclusions about my intelligence based on my race/ethnicity
7. Students who are the same race/ethnicity as me have been discriminated against in this class because of their performance.
8. Throughout this semester, I wanted to show that people of my race/ethnicity could perform well in this class.
9. A negative opinion exists about how people from my race/ethnicity perform in this type of class.

Gender-based Stereotype Threat

1. Some people feel I have less programming ability because of my gender
2. This class may have been easier for people of my gender.
3. My professor expected me to do poorly in this class because of my gender.

4. In Computer Science classes, people of my gender often face biased evaluations.
5. My gender negatively affects people's perceptions of my programming ability.
6. I worry that people will draw negative conclusions about my intelligence based on my gender.
7. Students who are the same gender as me have been discriminated against in this class because of their performance.
8. Throughout this semester, I wanted to show that people of my gender could perform well in this class.
9. A negative opinion exists about how people from my gender perform in this type of class.

Mastery Goal Orientation

1. I want to learn as much as possible from this class.
2. It is important for me to understand the content of this course as thoroughly as possible.
3. I hope to have gained a broader and deeper knowledge of computer science when I am done with this class.
4. I desire to completely master the material presented in this class.
5. In a class like this, I prefer course material that arouses my curiosity even if it is difficult to learn.
6. In a class like this, I prefer course material that really challenges me so I can learn new things.

Performance Approach Goal Orientation

1. It is important to me to do better than other students.
2. My goal in this class is to get a better grade than most of the students.
3. I am striving to demonstrate my ability relative to others in this class.
4. I am motivated by the thought of outperforming my peers in this class.
5. It is important to me to do well compared to others in this class.
6. I want to do well in this class to show my ability to my family, friends, advisors, or others.

Performance Avoidance Goal Orientation

1. I often think to myself, "What if I do badly in this class?"
2. I worry about the possibility of getting a bad grade in this class.
3. My fear of performing poorly in this class is often what motivates me.
4. I just want to avoid doing poorly in this class.
5. I am afraid that if I ask my TA or instructor a "dumb" question they might not think I'm very smart.
6. I wish this class was not graded.

Behavioral Disengagement

1. I admit to myself that I can't deal with it, and quit trying.
2. I just give up trying to reach my goal.
3. I give up the attempt to get what I want.
4. I reduce the amount of effort I'm putting into solving the problem.

Active Coping

1. I concentrate my efforts on doing something about it.
2. I take additional action to try to get rid of the problem.
3. I take direct action to get around the problem.
4. I do what has to be done, one step at a time.

Computer Science Self-Efficacy

1. Generally, I have felt secure about attempting computer programming problems.
2. I am sure I could do advanced work in computer science.
3. I am sure that I can learn programming.
4. I think I could handle more difficult programming problems.
5. I can get good grades in computer science.
6. I have a lot of self-confidence when it comes to programming.

Effort

1. I try as hard as I can to succeed in this class.
2. I exert a great deal of effort on assignments for this class.
3. I put forth a great deal of effort to achieve my goals in this class.

APPENDIX B

EMAIL INVITATIONS AND SURVEY INSTRUCTIONS

First email invitation

Dear Computer Science (CS) Student:

You are receiving this email because you are enrolled in at least one of the following classes at Old Dominion University (CS 110, CS 150, or CS 250) or Norfolk State University (CSC 101, CSC 170, or CSC 260). This email invites you to take advantage of the extra credit opportunity described by your professor.

The computer science (CS) departments at ODU and NSU are participating in an exciting research initiative funded by the National Science Foundation. The project is investigating the effects of new teaching techniques on retention of students enrolled in introductory CS classes. The goal of the project is to understand the factors that help retain CS students and ensure that all CS students have equal access to opportunities and feel included in the department. We hope that you will choose to share your opinions because they are important to us.

In order to receive credit for completing the survey, you will be asked to PRINT a confirmation page at the end of the survey and turn this in to your CS instructor. Please be sure to complete the survey using a computer where you have the ability to PRINT.

COMPLETE THIS SURVEY ONLY ONCE, even if you are required to complete the survey for more than one of your classes. If you are enrolled in more than one of the classes listed above, print the confirmation page for each one. Bring a copy of the confirmation page to each of your professors giving you extra credit for completion of the survey. You will receive your extra credit when you give the printed confirmation page to your professor.

The survey will be available only during the period (DATES). You must complete the survey before (CLOSING DATE) in order to receive extra credit.

This survey will take you about 30-40 minutes to complete. Be sure to allow that amount of time before starting the survey because once you begin the survey you will not be able to exit and return where you left off.

Please click on the link below and you will be taken to the survey.

[LINK]

PLEASE DO NOT REPLY TO THIS EMAIL.

If you have any questions, you my contact:

Dr. Donald D. Davis
dddavis@odu.edu
Thank you for your participation
INSITE Research Team

Follow up email reminder sent weekly to everyone

Dear Computer Science Student:

We are writing to remind everyone enrolled in the following classes at Old Dominion University (CS 110, CS 150, or CS 250) or Norfolk State University (CSC 101, CSC 170, or CSC 260) to participate in our computer science department survey for extra credit.

We must send an email to everyone because we do not know who has already completed the survey. If you have already completed the survey, we thank you for your participation and apologize for sending you this message again.

The survey will take you about 30 to 40 minutes to complete. Be sure to allow that amount of time before starting the survey because once you begin the survey you will not be able to exit and return where you left off.

Please click on the link below and you will be taken to the survey:

[LINK}

PLEASE DO NOT REPLY TO THIS EMAIL.

If you have any questions, you my contact:

Dr. Donald D. Davis
dddavis@odu.edu
Thank you for your participation
INSITE Research Team

Computer Science Department Survey Introduction

This questionnaire asks you to describe your experience as a Computer Science (CS) major at Old Dominion University. It is part of a research project sponsored by the National Science Foundation.

You have been selected to participate in this study because you are enrolled in CS110, CS150, or CS250. If you choose to participate in this study, all of your responses will be stored in a secure database. Although reports that summarize the overall results of the study will be published, only the researchers will see your responses. Your individual responses will not be revealed to your CS professors. Your participation in the study is entirely voluntary. You may withdraw from the study at any time or simply omit any questions that make you feel uncomfortable.

By participating in this survey, you have the chance to tell the computer science at Old Dominion University what you feel needs to be done to improve the department and what steps should be taken to develop a more inclusive environment for all CS majors. By giving us permission to ask for your participation, your department is demonstrating how important it believes this research is. Please take the time to make your voice heard. You will be benefiting CS majors at Old Dominion University and potentially many others across the country as well. We thank you in advance for your time.

If you agree to participate in our research, click "CONTINUE" and you will be taken to the first screen of the questionnaire. If you do choose to complete the survey, it should take about 30 minutes of your time.

Important: Once you begin the survey, you will not be able to exit the survey and return to where you left off. If you leave the survey before hitting the final submit button, you will have to start again when you return.

If you have any questions or if you just want additional information, please contact Dr. Donald Davis via email at dddavis@odu.edu or by calling him at (757) 683-4461.

[LINK]

APPENDIX C

MEANS, STANDARD DEVIATIONS, AND COVARIANCES FOR RACE-BASED STEREOTYPE THREAT MODEL

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. ST_R1	2.28	1.62	2.63										
2. ST_R2	2.40	1.52	1.56	2.32									
3. ST_R3	1.93	1.39	1.59	1.41	1.93								
4. ST_R4	2.19	1.51	1.83	1.59	1.73	2.3							
5. ST_R5	2.23	1.57	1.99	1.62	1.75	2.05	2.48						
6. ST_R6	2.28	1.67	2.04	1.60	1.63	1.91	2.29	2.78					
7. ST_R7	2.06	1.46	1.71	1.49	1.68	1.83	1.89	1.88	2.14				
8. ST_R8	3.07	1.89	1.47	1.25	1.03	1.3	1.54	1.76	1.26	3.56			
9. ST_R9	2.32	1.59	1.91	1.46	1.57	1.85	2.11	2.15	1.83	1.73	2.54		
10. PMO1	4.88	1.43	-0.04	0.01	-0.18	-0.07	0.04	0.15	-0.04	0.45	0.10	2.04	
11. PMO2	4.85	1.37	0.03	0.05	-0.13	0.00	0.14	0.22	0.00	0.42	0.15	1.50	1.88
12. PMO3	5.39	1.39	-0.08	0.01	-0.18	-0.09	0.01	0.09	-0.1	0.42	0.04	1.38	1.39
13. PPAP1	4.41	1.47	0.24	0.17	0.01	0.14	0.23	0.37	0.12	0.78	0.24	1.17	1.13
14. PPAP2	4.56	1.43	0.19	0.18	0.06	0.13	0.23	0.36	0.14	0.76	0.22	1.10	1.03
15. PPAP3	4.68	1.52	0.11	0.09	0.00	0.05	0.12	0.17	0.00	0.49	0.09	0.77	0.85
16. PPAV1	3.89	1.47	0.53	0.29	0.30	0.35	0.38	0.49	0.31	0.47	0.45	-0.10	-0.08
17. PPAV2	5.16	1.43	0.14	-0.04	-0.05	0.01	0.02	0.14	-0.01	0.35	0.07	-0.04	-0.06
18. PPAV3	4.38	1.53	0.43	0.13	0.27	0.29	0.30	0.40	0.25	0.53	0.35	-0.41	-0.44
19. PCSSE1	3.51	1.00	-0.15	-0.05	-0.15	-0.10	-0.08	-0.09	-0.13	-0.08	-0.1	0.67	0.61
20. PCSSE2	3.40	1.02	-0.14	-0.07	-0.18	-0.10	-0.06	-0.08	-0.12	-0.07	-0.09	0.70	0.64
21. PCSSE3	3.21	1.11	-0.12	0.02	-0.08	-0.05	-0.01	-0.06	-0.05	-0.03	-0.04	0.73	0.69

(table continues)

(table continued)

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
22. AC1	3.29	0.72	-0.05	-0.06	-0.08	-0.07	-0.03	-0.02	-0.06	0.06	-0.04	0.17	0.20
23. AC2	3.00	0.80	0.00	0.05	-0.06	-0.02	0.03	0.03	-0.05	0.15	0.03	0.21	0.20
24. AC3	2.91	0.86	-0.03	0.00	-0.03	-0.02	0.00	-0.04	-0.04	0.08	-0.05	0.11	0.12
25. AC4	3.17	0.76	-0.10	-0.08	-0.14	-0.13	-0.07	-0.09	-0.15	0.06	-0.09	0.17	0.17
26. BD1	1.68	0.86	0.28	0.21	0.27	0.27	0.23	0.21	0.26	0.07	0.23	-0.11	-0.12
27. BD2	1.55	0.88	0.38	0.32	0.36	0.34	0.38	0.34	0.32	0.22	0.30	-0.15	-0.12
28. BD3	1.74	0.91	0.33	0.32	0.34	0.33	0.29	0.31	0.32	0.20	0.29	-0.17	-0.17
29. BD4	1.97	0.93	0.23	0.18	0.24	0.25	0.24	0.20	0.24	0.13	0.16	-0.17	-0.18
30. EFF1	3.83	0.97	-0.07	-0.04	-0.06	-0.08	-0.02	0.01	-0.06	0.25	0.01	0.52	0.45
31. EFF2	3.87	0.96	0.02	-0.02	-0.04	-0.02	0.09	0.13	0.00	0.32	0.10	0.42	0.42
32. EFF3	3.81	0.95	-0.06	-0.03	-0.07	-0.07	0.01	0.06	-0.05	0.28	0.04	0.48	0.47
33. GRD	6.22	3.44	-0.53	-0.35	-0.44	-0.57	-0.50	-0.45	-0.32	-0.84	-0.54	0.83	0.80

(table continues)

(table continued)

Variable	12	13	14	15	16	17	18	19	20	21	22
1. ST_R1											
2. ST_R2											
3. ST_R3											
4. ST_R4											
5. ST_R5											
6. ST_R6											
7. ST_R7											
8. ST_R8											
9. ST_R9											
10. PMO1											
11. PMO2											
12. PMO3	1.95										
13. PPAP1	1.00	2.17									
14. PPAP2	0.99	1.66	2.05								
15. PPAP3	0.77	1.49	1.60	2.30							
16. PPAV1	0.00	0.23	0.20	0.11	2.18						
17. PPAV2	0.10	0.32	0.26	0.22	1.27	2.03					
18. PPAV3	-0.36	0.09	0.13	0.01	1.28	1.35	2.33				
19. PCSSE1	0.62	0.37	0.35	0.30	-0.52	-0.44	-0.72	1.00			
20. PCSSE2	0.63	0.40	0.40	0.37	-0.55	-0.45	-0.73	0.86	1.03		
21. PCSSE3	0.63	0.41	0.41	0.37	-0.62	-0.59	-0.85	0.87	0.93	1.23	

(table continues)

(table continued)

Variable	12	13	14	15	16	17	18	19	20	21	22
22. AC1	0.22	0.16	0.19	0.18	-0.02	0.04	-0.02	0.09	0.10	0.09	0.52
23. AC2	0.19	0.18	0.19	0.18	0.04	0.05	-0.01	0.09	0.12	0.12	0.30
24. AC3	0.13	0.14	0.15	0.16	0.04	0.12	-0.05	0.06	0.08	0.09	0.24
25. AC4	0.16	0.16	0.13	0.16	-0.08	0.00	-0.02	0.05	0.10	0.09	0.28
26. BD1	-0.13	0.17	0.04	-0.03	0.30	0.10	0.17	-0.15	-0.14	-0.11	-0.09
27. BD2	-0.14	0.17	0.02	-0.03	0.26	0.06	0.17	-0.11	-0.11	-0.07	-0.06
28. BD3	-0.17	0.14	0.02	-0.01	0.28	0.06	0.14	-0.14	-0.10	-0.07	-0.09
29. BD4	-0.14	0.19	0.06	0.03	0.28	0.15	0.19	-0.13	-0.11	-0.10	-0.09
30. EFF1	0.49	0.49	0.48	0.40	0.01	0.14	0.07	0.09	0.14	0.17	0.14
31. EFF2	0.43	0.44	0.46	0.38	0.09	0.21	0.18	-0.01	0.03	0.04	0.13
32. EFF3	0.48	0.48	0.52	0.41	0.03	0.16	0.07	0.07	0.12	0.13	0.14
33. GRD	0.60	0.35	0.43	0.68	-1.83	-1.42	-1.87	1.21	1.32	1.49	-0.03

(table continues)

(table continued)

Variable	23	24	25	26	27	28	29	30	31	32	33
22. AC1											
23. AC2	0.64										
24. AC3	0.28	0.74									
25. AC4	0.30	0.26	0.58								
26. BD1	-0.04	0.00	-0.09	0.73							
27. BD2	0.01	0.03	-0.06	0.44	0.78						
28. BD3	-0.02	0.08	-0.05	0.42	0.43	0.83					
29. BD4	-0.04	0.05	-0.06	0.39	0.36	0.43	0.86				
30. EFF1	0.16	0.15	0.11	-0.06	-0.08	-0.10	-0.04	0.94			
31. EFF2	0.12	0.10	0.09	-0.04	-0.06	-0.08	-0.04	0.64	0.92		
32. EFF3	0.13	0.13	0.11	-0.06	-0.07	-0.09	-0.05	0.70	0.77	0.91	
33. GRD	0.02	-0.10	-0.02	-0.38	-0.23	-0.39	-0.25	0.57	0.39	0.50	11.85

Note. N = 718. ST_R = Race-Based Stereotype Threat, PMO = Mastery Goal Orientation Parcel, PPAP = Performance-Approach Goal Orientation Parcel, PPAV = Performance-Avoid Goal Orientation Parcel, PCSSE = CS Self-Efficacy Parcel, AC = Active Coping, BD = Behavioral Disengagement, EFF = Effort, GRD = Course Grade.

MEANS, STANDARD DEVIATIONS, AND COVARIANCES FOR GENDER-BASED STEREOTYPE THREAT MODEL

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. ST_G1	2.26	1.61	2.58										
2. ST_G2	2.45	1.56	1.45	2.43									
3. ST_G3	2.00	1.40	1.61	1.41	1.95								
4. ST_G4	2.23	1.58	2.04	1.53	1.76	2.50							
5. ST_G5	2.23	1.57	2.12	1.42	1.71	2.15	2.45						
6. ST_G6	2.26	1.61	2.15	1.36	1.62	2.06	2.25	2.59					
7. ST_G7	2.10	1.46	1.85	1.39	1.69	1.91	1.94	1.90	2.12				
8. ST_G8	2.91	1.87	1.71	1.31	1.26	1.66	1.70	1.73	1.45	3.50			
9. ST_G9	2.24	1.55	2.10	1.33	1.66	2.05	2.19	2.12	1.91	1.73	2.42		
10. PMO1	4.88	1.43	-0.09	0.02	-0.19	-0.06	-0.05	-0.12	-0.11	0.31	-0.07	2.04	
11. PMO2	4.85	1.37	-0.07	0.06	-0.06	-0.07	-0.05	-0.11	-0.09	0.29	-0.06	1.50	1.88
12. PMO3	5.39	1.39	-0.11	-0.05	-0.18	-0.12	-0.11	-0.18	-0.14	0.29	-0.12	1.38	1.39
13. PPAP1	4.41	1.47	0.03	0.09	-0.02	0.07	0.08	-0.03	0.02	0.57	0.04	1.17	1.13
14. PPAP2	4.56	1.43	-0.03	0.15	0.02	0.06	0.06	0.04	-0.02	0.48	0.01	1.10	1.03
15. PPAP3	4.68	1.52	-0.05	0.00	-0.02	0.00	0.05	-0.01	-0.06	0.39	0.02	0.77	0.85
16. PPAV1	3.89	1.47	0.32	0.17	0.27	0.36	0.37	0.48	0.35	0.34	0.36	-0.10	-0.08
17. PPAV2	5.16	1.43	0.03	-0.17	-0.04	0.05	0.03	0.09	-0.01	0.23	0.04	-0.04	-0.06
18. PPAV3	4.38	1.53	0.34	0.13	0.30	0.34	0.36	0.43	0.32	0.46	0.37	-0.41	-0.44
19. PCSSE1	3.51	1.00	-0.19	-0.05	-0.18	-0.17	-0.19	-0.23	-0.22	-0.10	-0.17	0.67	0.61
20. PCSSE2	3.40	1.02	-0.20	-0.06	-0.19	-0.18	-0.19	-0.24	-0.22	-0.10	-0.19	0.70	0.64
21. PCSSE3	3.21	1.11	-0.18	-0.01	-0.11	-0.15	-0.17	-0.21	-0.15	-0.09	-0.15	0.73	0.69

(table continues)

(table continued)

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
22. AC1	0.22	0.16	-0.05	-0.08	-0.06	-0.03	-0.02	-0.02	-0.06	0.10	-0.02	0.17	0.20
23. AC2	0.19	0.18	-0.05	-0.08	-0.08	-0.03	-0.01	-0.01	-0.05	0.09	-0.02	0.21	0.20
24. AC3	0.13	0.14	-0.11	-0.16	-0.10	-0.09	-0.06	-0.10	-0.07	0.01	-0.05	0.11	0.12
25. AC4	0.16	0.16	-0.09	-0.16	-0.15	-0.11	-0.07	-0.10	-0.14	0.04	-0.08	0.17	0.17
26. BD1	-0.13	0.17	0.17	0.14	0.25	0.24	0.23	0.21	0.22	0.08	0.21	-0.11	-0.12
27. BD2	-0.14	0.17	0.30	0.25	0.37	0.32	0.33	0.29	0.34	0.22	0.31	-0.15	-0.12
28. BD3	-0.17	0.14	0.21	0.24	0.28	0.26	0.26	0.27	0.28	0.18	0.23	-0.17	-0.17
29. BD4	-0.14	0.19	0.16	0.12	0.21	0.16	0.21	0.19	0.20	0.05	0.16	-0.17	-0.18
30. EFF1	49.00	0.49	-0.05	-0.06	-0.08	-0.07	-0.04	-0.06	-0.06	0.19	-0.04	0.52	0.45
31. EFF2	0.43	0.44	-0.02	-0.01	-0.06	-0.02	-0.01	-0.02	0.00	0.23	0.04	0.42	0.42
32. EFF3	0.48	0.48	-0.05	-0.06	-0.10	-0.08	-0.03	-0.03	-0.07	0.22	-0.02	0.48	0.47
33. GRD	0.60	0.35	-0.39	-0.13	-0.57	-0.56	-0.43	-0.41	-0.43	-0.52	-0.29	0.83	0.80

(table continues)

(table continued)

Variable	12	13	14	15	16	17	18	19	20	21	22
1. ST_G1											
2. ST_G2											
3. ST_G3											
4. ST_G4											
5. ST_G5											
6. ST_G6											
7. ST_G7											
8. ST_G8											
9. ST_G9											
10. PMO1											
11. PMO2											
12. PMO3	1.95										
13. PPAP1	1.00	2.17									
14. PPAP2	0.99	1.66	2.05								
15. PPAP3	0.77	1.49	1.60	2.30							
16. PPAV1	0.00	0.23	0.20	0.11	2.18						
17. PPAV2	0.10	0.32	0.26	0.22	1.27	2.03					
18. PPAV3	-0.36	0.09	0.13	0.01	1.28	1.35	2.33				
19. PCSSE1	0.62	0.37	0.35	0.30	-0.52	-0.44	-0.72	1.00			
20. PCSSE2	0.63	0.40	0.40	0.37	-0.55	-0.45	-0.73	0.86	1.03		
21. PCSSE3	0.63	0.41	0.41	0.37	-0.62	-0.59	-0.85	0.87	0.93	1.23	

(table continues)

(table continued)

Variable	12	13	14	15	16	17	18	19	20	21	22
22. AC1	0.22	0.16	0.19	0.18	-0.02	0.04	-0.02	0.09	0.10	0.09	0.52
23. AC2	0.19	0.18	0.19	0.18	0.04	0.05	-0.01	0.09	0.12	0.12	0.30
24. AC3	0.13	0.14	0.15	0.16	0.04	0.12	-0.05	0.06	0.08	0.09	0.24
25. AC4	0.16	0.16	0.13	0.16	-0.08	0.00	-0.02	0.05	0.10	0.09	0.28
26. BD1	-0.13	0.17	0.04	-0.03	0.30	0.10	0.17	-0.15	-0.14	-0.11	-0.09
27. BD2	-0.14	0.17	0.02	-0.03	0.26	0.06	0.17	-0.11	-0.11	-0.07	-0.06
28. BD3	-0.17	0.14	0.02	-0.01	0.28	0.06	0.14	-0.14	-0.10	-0.07	-0.09
29. BD4	-0.14	0.19	0.06	0.03	0.28	0.15	0.19	-0.13	-0.11	-0.10	-0.09
30. EFF1	49.00	0.49	0.48	0.40	0.01	0.14	0.07	0.09	0.14	0.17	0.14
31. EFF2	0.43	0.44	0.46	0.38	0.09	0.21	0.18	-0.01	0.03	0.04	0.13
32. EFF3	0.48	0.48	0.52	0.41	0.03	0.16	0.07	0.07	0.12	0.13	0.14
33. GRD	0.60	0.35	0.43	0.68	-1.83	-1.42	-1.87	1.21	1.32	1.49	-0.03

(table continues)

(table continued)

Variable	23	24	25	26	27	28	29	30	31	32	33
22. AC1											
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26. BD1	-0.04	0.00	-0.09	0.73							
27. BD2	0.01	0.03	-0.06	0.44	0.78						
28. BD3	-0.02	0.08	-0.05	0.42	0.43	0.83					
29. BD4	-0.04	0.05	-0.06	0.39	0.36	0.43	0.86				
30. EFF1	0.16	0.15	0.11	-0.06	-0.08	-0.10	-0.04	0.94			
31. EFF2	0.12	0.10	0.09	-0.04	-0.06	-0.08	-0.04	0.64	0.92		
32. EFF3	0.13	0.13	0.11	-0.06	-0.07	-0.09	-0.05	0.70	0.77	0.91	
33. GRD	0.02	-0.10	-0.02	-0.38	-0.23	-0.39	-0.25	0.57	0.39	0.50	11.85

Note. $N = 718$. ST_G = Gender-Based Stereotype Threat, PMO = Mastery Goal Orientation Parcel, PPAP = Performance-Approach Goal Orientation Parcel, PPAV = Performance-Avoid Goal Orientation Parcel, PCSSE = CS Self-Efficacy Parcel, AC = Active Coping, BD = Behavioral Disengagement, EFF = Effort, GRD = Course Grade.

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EDUCATION

- **Master of Science**, Psychology (Major: Psychology) Old Dominion University, May 2001
- **Master of Science**, Education (Major: Special Education) Old Dominion University, December 1993
- **Bachelor of Science,** (Major: Psychology) Old Dominion University, May 1992

EXPERIENCE

- **Assistant Professor of Psychology,** Department of Business, Social Science, and Public Service: Tidewater Community College, Norfolk, VA (2006 to Present)
- **Lecturer,** Department of Psychology, Old Dominion University, Norfolk, VA (2004 to 2006)
- **Adjunct Instructor,** Department of Psychology, Christopher Newport University, Newport News, VA (2003 to 2004)
- **Research Assistant,** Organizational Research Lab, Old Dominion University, Norfolk, VA (2000 to 2002)

SELECT PUBLICATIONS AND PRESENTATIONS

- Davis, D. D., Bryant, J., Tedrow, L., Liu Y., Say, R., & Mihalecz, M. (2003). Leadership in global virtual teams. In N. DeLay (Chair), E-work Best Practices. Symposium presented at the 18th Annual Meeting of the Society for Industrial and Organizational Psychology, Orlando, FL, April, 2003.
- Davis, D. D., Janet J., Liu, Y., Tedrow, L., & Say, R. (2003). *National culture, team behavior, and error management in US and Chinese simulated flightcrews.* Proceedings of the 12th Annual Meeting of the International Symposium on Aviation Psychology, Dayton, OH.
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