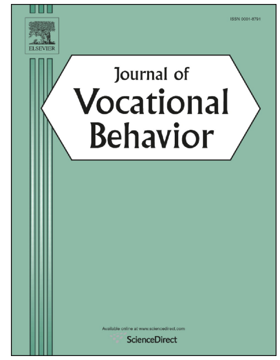
Accepted Manuscript



Stereotype threat as a barrier to women entering engineering careers

Michael C. Cadaret, Paul J. Hartung, Linda M. Subich, Ingrid K. Weigold

PII: S0001-8791(16)30101-4
DOI: doi: 10.1016/j.jvb.2016.12.002
Reference: YJVBE 3036

To appear in: *Journal of Vocational Behavior*

Received date: 9 March 2016
Revised date: 8 December 2016
Accepted date: 12 December 2016

Please cite this article as: Michael C. Cadaret, Paul J. Hartung, Linda M. Subich, Ingrid K. Weigold , Stereotype threat as a barrier to women entering engineering careers. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Yjvbe(2016), doi: 10.1016/j.jvb.2016.12.002

Stereotype Threat as a Barrier to Women Entering Engineering Careers

Michael C. Cadaret

Springfield College

Paul J. Hartung

Northeast Ohio Medical University

Linda M. Subich, and Ingrid K. Weigold

The University of Akron

This manuscript is based on the doctoral dissertation of the first author under the direction of Suzette Speight, Ph.D. Address all correspondence about this manuscript to Michael C. Cadaret, mcadaret@springfieldcollege.edu; Springfield College, 263 Alden Street, Springfield, Massachusetts 01109.

Stereotype Threat as a Barrier to Women Entering Engineering Careers

Abstract

Theory suggests that proximal contextual variables contribute to women's underrepresentation in STEM fields. We therefore examined relationships between stereotype threat as a proximal contextual variable and academic self-efficacy. We also examined the influence of self-efficacy for coping with educational barriers on those relationships. A total of 211 women undergraduate students majoring in engineering fields (73% White, mean age = 21 years) responded to measures of stigma consciousness and stereotype vulnerability as proxies for stereotype threat, along with measures of self-efficacy for coping with barriers (CWB) and academic self-efficacy. Stigma consciousness (in the form of awareness of sexism and negative attitudes about women), but not stereotype vulnerability, negatively related to women's confidence in their abilities to complete a college degree in a engineering major field. Results of a moderation model indicated a significant interaction of CWB and stigma consciousness on academic self-efficacy, with no such interaction effect for stereotype vulnerability. Our findings add to the proximal contextual barriers framework within Social Cognitive Career Theory by uncovering the existence of negative relationships between consciousness of discrimination due to group identity and academic self-efficacy. Promoting positive identity and constructive interaction with the environment may support women's career development in engineering fields.

Keywords: STEM, women in engineering, academic self-efficacy, coping efficacy, stereotype threat

Stereotype Threat as a Barrier to Women Entering Engineering Careers

Careers in Science, Technology, Engineering, and Mathematics (STEM) fields rank among the fastest-growing nationally (Bureau of Labor Statistics, 2014). Yet, the problem of inconsistent support and encouragement often poses a barrier for women to enter STEM careers and leaves them underrepresented in STEM fields, especially in computer sciences, mathematics, and engineering (National Science Board, 2012). Research about factors contributing to such underrepresentation is important given increased employment opportunities in STEM fields, increased need for professionals working in STEM fields, and issues of gender inequity.

Women graduate college at a higher percentage than men (57% vs 43% respectively), yet they represent only 18% of engineering and computer science graduates and 19% of physics graduates (National Science Foundation, 2013). A U.S. Department of Education report found that women were more likely than men to leave STEM majors by switching to non-STEM majors (Chen, 2013). This occurrence has led to increased research on factors that promote women’s interest, retention, and success in STEM-related career fields. Social Cognitive Career Theory (SCCT; Lent, Brown, & Hackett, 1994) has guided much research in this regard. Proponents of SCCT have been especially interested in examining the role of proximal contextual influences in the career development of individuals historically underrepresented in STEM fields (Byars-Winston & Fouad, 2008; Lent, Brown, & Hackett, 2000). Such influences in the form of barriers have been shown to directly predict self-efficacy and, indirectly through self-efficacy, predict choice goals and actions (Lent et al., 2003, 2014; Lent, Singley, Sheu, Schmidt, & Schmidt, 2007). Self-efficacy, in turn, has been a strong predictor of both persistence intentions (Brown et al., 2008; Robbins et al., 2004; Wright, Jenkins-Guarnieri, & Murdock, 2012) and actual persistence (Lee, Flores, Navarro, & Kanagui-Munoz, 2015).

Among STEM fields, research has supported the SCCT model among female engineering students (Flores et al., 2014; Inda, Rodriguez, & Pena, 2013; Lent et al, 2005; Lent, Miller, Smith, Watford, Lim, & Hui, 2016; Lent et al., 2014; Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010; Lee et al. , 2015) and identified barriers among women in engineering (Fouad et al., 2010; Miller et al., 2015). Although research has clearly demonstrated a link between barriers and self-efficacy, and self-efficacy and persistence, need remains to better understand contextual proximal barriers to choice behaviors that decrease self-efficacy among women in engineering (Lent et al, 2002). This leads to the question, if high self-efficacy beliefs determine persistence and interests, is there an opposing variable that predicts attrition and disinterest? In many ways, stereotype threat acts as the inverse of self-efficacy. When individuals are chronically exposed to stereotype threatening situations in the classroom, the result is theorized (Steele, 1997) and demonstrated (Aronson, Fried, & Good, 2002; Woodcock, Hernandez, Estrada, & Schultz, 2012) to be disidentification and attrition from the academic domain. Therefore, the present study examined the possible influence of the context- and gender-dependent variable of stereotype threat on women's self-efficacy for pursuing an engineering degree. Responding to calls for increased understanding of individual differences in barrier management (Lent et al., 2000, 2002), we also sought to determine how women's confidence in coping with barriers to education might mitigate the influence of stereotype threat on self-efficacy.

Women in Engineering Fields

The primary focus of SCCT-based research has been self-efficacy. Because self-efficacy concerns judgments about ability to perform particular tasks, the mediating effect of self-efficacy has been studied in beliefs about careers appropriate for one's identity. As an example, Betz and Hackett (1981) posited that women are less likely to pursue traditionally male-dominated fields, believing they do not have the capabilities. According to Betz and Hackett, women experience vicarious learning that results in sex-role stereotyping, a lack of exposure to performance accomplishments, and a lack of verbal persuasion or encouragement from others. Alternatively, men report higher math/science self-efficacy, more positive outcome expectancies related to pursuing a math or science career, and more parental involvement than do women. Women, in contrast, perceive greater barriers to pursuing a career in math or science than do men (Byars-Winston & Fouad, 2008). Similar results have been found among women in introductory STEM courses (Hardin & Longhurst, 2016), where women reported less self-efficacy toward their success in STEM classes and lower interest in obtaining a STEM degree. Likewise, Inda and colleagues (2013), found that second-year Spanish female engineering students reported significantly less self-efficacy than did their male classmates, resulting in less interest in academic and scientific activities.

Self-efficacy beliefs account for the majority of influence on interests and development of goals related to pursuing a career (Bandura, 1977, Lent et al., 2001, 2003), and predict engineering persistence intentions and career goals across numerous studies among engineering students (Inda et al., 2013; Lee, et al., 2015; Lent, Lopez, Lopez, & Sheu, 2008; Lent, Sheu, et al., 2008; Lent et al., 2003, 2014; Lent, Sheu, Gloster, & Wilkins, 2010). Therefore, identifying variables to help explain decreases in self-efficacy beliefs among women in engineering seems vital for reducing attrition.

Proximal Contextual Influences

Self-efficacy, along with outcome expectations and goals, are influenced directly by proximal contextual variables. Proximal contextual variables, denoted by barriers and supports, exert an influence during active phases of career decision making and choice through their influence on self-efficacy (Sheu et al., 2010). Research on proximal contextual influences support a path from contextual supports and barriers to self-efficacy, which mediates the effect of contextual influences on choice goals and actions (Lent et al., 2003). These relationships have been replicated in studies examining links between proximal supports in the form of parental support on math/science goals as mediated through self-efficacy with Mexican American high school students (Garriott, Raque-Bogdan, Zoma, Mackie-Hernandez, & Lavin, 2016), parental support and math/science goals explained by self-efficacy (Navarro, Flores, & Worthington, 2007) and parental involvement (distal contextual influence) and barriers among undergraduate students (Byars-Winston & Fouad, 2008).

There has been a call for expanding proximal contextual influences beyond those generally used, which Lent and Brown (2006) argued are "typically too broad to offer much precision in predicting domain-specific criteria" (p. 30). To predict vocational outcomes, researchers have extended proximal contextual influences to include variables such as in-group and out-group orientation (Byars-Winston et al. , 2010; Cabrera Nora, Terenzini, Pascarella, & Hagedorn, 1999), perceived campus climate (Byars-Winston et al., 2010), social class experiences and identity (Thompson, 2008), perceived social status (Thompson, 2013; Thompson & Dahling, 2012), critical consciousness (Olle & Fouad, 2015), and stereotype threat (Deemer, Thoman, Chase, & Smith, 2014).

Among women in engineering, Fouad et al. (2010) found college women in math and science identified barriers that included parents' lack of knowledge and support, low teacher support and inspiration, a lack of extracurricular opportunities, not knowing others who are successful in math and science careers, anxiety during test taking, past performance, and lack of interest in the subject. Similarly, Marra, Rodgers, Shen, and Bogue (2009) found across institutions in their study, women in engineering cited a perceived a lack of inclusion in their academic environments. The authors attribute this to negative social cues from peers and professors that act as a form of social persuasion and therefore impact self-efficacy (Zeldin & Pajares, 2000). Fouad, Singh, Cappaert, Chang, and Wan (2016) found that for women who persisted or left engineering jobs, it is the "enduring attitudes and cognitions about the engineering profession" (p. 90) that determined persistence. Fouad et al. found that barriers, such as micro-aggressions and work-role stress, may interact with other factors to create an accumulation of barriers that influence career decision making.

These findings suggest that an interaction of identity, environment, and social cognitive factors constitute the barrier framework for women in engineering. Thus, we posited that the intersection of identity and environment uniquely influences women engineering students' perceptions of their potential for success. Similarly, stereotype threat is enacted within environments where one may perceive judgements regarding negative social stereotypes about their identity. Stereotype threat influences individuals through physiological arousal, working memory depletion, off-task rumination, self-handicapping, and stereotype priming effects (see Spencer, Logel, & Davies, 2016 for a review), which results in decreased performance on academic tasks. Thus, we proposed that, for women in engineering, stereotype threat acts as a proximal contextual barrier to career development.

Stereotype Threat

Stereotype threat occurs "when one is in a situation or doing something for which a negative stereotype about one's group applies" (Steele, 1997, p. 614). A person exposed to stereotype threat feels threatened about being negatively stereotyped, judged, treated stereotypically, or having to conform to the stereotype. Research suggests that negative social identity stereotypes can diminish task performance due to pressure and anxiety that poor performance will confirm the culturally held stereotypes about one's group (Aronson & Inzlicht, 2004; Spencer, Steele, & Quinn, 1999; Steele & Aronson, 1995).

Research indicates that stereotype threat affects women who identify with the domain (e.g., engineering; Aronson et al., 1999; Spencer, Steele, & Quinn, 1999), are highly gender identified (Rydell, McConnell, & Bellock, 2009; Schmader, 2002), find the task challenging (Spencer, Steele, & Quinn, 1999), and perceive the environment to be threatening (Adams, Garcia, Purdie-Vaughns, & Steele, 2005; Logel, Walton, Spencer, Iserman, von Hippel, & Bell, 2009). Moreover, internalized beliefs about female identity and related stereotypes shape attitudes and behaviors toward math identification among women (Nosek, Banaji, & Greenwald, 2002). Stereotype threat functions on a cognitive level (e.g., reduced working memory, rumination, self-monitoring) as well as a physiological level (stress-response), but is activated by socially-ascribed stereotypes, such as the stereotype that women are less capable in mathematics. Therefore, the environment plays a key role in activating stereotype threat and the resulting decrease in performance on diagnostic tests of ability. Logel et al. (2009) found that for women in engineering, if they interacted with a male classmate or a confederate who behaved in a sexist manner, their performance was significantly worse on an engineering test than women who had experienced non-sexist male interactions. Logel et al. (2009) concluded that "environments can be a potent source of creating threat" (p. 1100).

To capture stereptypes' effect in real-world situations, researchers have used two proxies for stereotype threat: stereotype vulnerability and stigma consciousness. Stereotype vulnerability is defined as the "tendency to expect, perceive, and be influenced by negative stereotypes about one's social category" (Aronson & Inzlicht, 2004; pp. 829-30) and includes situational responses to conditions in which members of stigmatized groups can be vulnerable to devaluation based on intellectual performance (Spencer, 1993). Across five studies evaluating math performance among equally prepared male and female college students, stereotype vulnerability proved a useful indicator of performance (Spencer, 1993). In situations where performance on a math test was characterized as being gender relevant, women reported greater stereotype vulnerability and scored significantly lower on the test as compared to women in the condition that framed the test as gender neutral. Addtionally, when performance on a math test improved across conditions, women in the experiments subsequently scored lower on stereotype vulnerability.

Stigma consciousness (Pinel, 1999) refers to an expectation of judgment based on one's group membership. Whereas stereotype threat represents the fear that one may confirm a negative stereotype through acting in a stereotypical way, high levels of stigma consciousness represent the anticipation that others will stereotype a person regardless of that person's behavior. In a series of studies, individuals who scored higher on stigma consciousness were consistently found to perceive greater levels of discrimination and were able to provide with greater specificity examples of when they were treated in a prejudicial manner (Study 1; Pinel, 1999). Additionally, women who scored higher on stigma consciousness chose to compete on topics that were stereotype irrelevant rather than stereotypically male when in competition with men as opposed to women (Study 6; Pinel, 1999). Brown and Pinel (2003) combined the experimental manipulation typified within the study of stereotype threat with measurement of stigma consciousness, and provided evidence that stigma consciousness serves to moderate the relationship between stereotype threat and performance. We conceptualized these two proxies for stereotype threat (stereotype vulnerability & stigma consciousness) as constructs that represent the perceived experiences of women in their academic environments.

Coping with Barriers to Education

Bandura (1997) theorized that coping efficacy acts as an individual difference variable, such that those with high coping efficacy are likely to view new social realities as a challenge, whereas those with low coping efficacy may view the same event as a threat. In discussing contextual supports and barriers to career choice, Lent and colleagues (2000) suggested that one's perspective given an environmental demand "may be viewed alternatively as an insurmountable barrier, a minor obstacle, a character-building opportunity, or even a personal contest or challenge" (p. 47). Coping efficacy is viewed as one's confidence in managing perceived situational and environmental demands that have the potential to impede performance in a given domain. For example, situational and environmental demands have been identified as gender and racial discrimination (Swanson, Daniels, & Tokar, 1996) or financial and educational opportunities (Swanson & Woitke, 1997). Existing research suggests coping efficacy relates positively to content (academic) self-efficacy, outcome expectations, interests, and choice intentions, while it relates negatively to career barriers (Lent et al., 2001). Coping efficacy also appears to directly predict academic self-efficacy and interests as well as mediate the strength of association between career barriers and academic self-efficacy (Byars-Winston & Fouad, 2008; Perrone, Civilette, Webb, & Fitch, 2004; Thompson, 2013; Thompson & Dhaling, 2012). Lent et al. (2000) suggest several possible interrelations between coping efficacy and negative process expectations (proximal barriers). These include (a) a greater perception of barriers as a result of poor coping efficacy formation, (b) coping efficacy mediating barriers influence on perception of choice goals, (c) bidirectional influences of coping efficacy and barrier perceptions, and (d) coping efficacy as a moderator of barrier perceptions and choice goals. These studies offer support for coping efficacy as a mediator, yet minimal research has tested coping efficacy as a moderator (Novakovic & Gnilka, 2015; Thompson, 2008). To-date, no studies have explored the possibility of coping efficacy as a moderator of contextual barriers and self-efficacy among women in engineering. Given the theorized associations between coping efficacy and barriers outlined by Bandura (1997) and Lent et al. (2000), it follows that women in the present study who are vulnerable to stereotype threat may see barriers as threatening and withdraw or, alternatively, view barriers as a challenge to be overcome and persist. We posit more research on the relationships between barriers, coping, and self-efficacy is needed in SCCT research because the majority of research on barrier coping efficacy has been correlational in nature, making true mediation difficult to determine (MacKinnon, Krull, & Lockwood, 2000).Therefore, we proposed that the level of self-efficacy for coping with educational barriers (high vs. low) would moderate the relationship between stereotype threat and academic self-efficacy.

Purpose of the Study

Based on the relevant literature, we used self-efficacy for STEM completion to examine women's confidence in completing their degree in their chosen major. Self-efficacy appears to be a strong predictor of interests, goal formation, and persistence (Inda et al., 2013; Lee et al., 2015; Lent, Lopez, et al., 2008; Lent, Sheu, et al., 2008; Lent et al., 2003, 2014, 2010). Thus, variables negatively related to self-efficacy can be expected to reduce retention and impede career development. Following recommendations based on SCCT's performance model (Brown et al., 2008), we included GPA to control for academic ability in self-efficacy perceptions. Next, we included proxies for stereotype threat as proximal contextual barriers to examine how stereotype threat may influence women's career development in academic environments that contain an "ethos of diagnosticity" (Good, Aronson, & Harder, 2008, p. 25) and often contain a disproportionally small number of women. There is evidence that such factors can suppress women's academic performance in mathematics courses (Good et al., 2008). Finally, we included a measure of self-efficacy for coping with educational barriers. Measurement of coping efficacy has been completed using both a coping-with-barriers scale (Luzzo & McWhirter, 2001) and a task-specific scale for math and science (Lent et al., 2001; 2003). For the current study, we proposed coping with barriers as an individual difference that may explain how women interpret their environment generally and, in turn, form efficacy beliefs regarding their STEM performance. Furthermore, the barriers identified in Luzzo and McWhirter's scale include items concerned with gender discrimination and overlap with those identified in barrier research among women in engineering (Fouad et al., 2010; Miller et al., 2015). We proposed that differing levels of confidence for coping with barriers to education would moderate the relationship of stereotype threat and STEM self-efficacy. Specifically, we examined the following hypotheses: *(H1)* academic self-efficacy is negatively related to stereotype vulnerability and stigma consciousness; *(H2)* coping efficacy is positively related to academic self-efficacy and negatively related to stereotype vulnerability and stigma consciousness; *(H3a)* coping efficacy moderates the relationship between stereotype vulnerability and academic self-efficacy; and *(H3b)* coping efficacy moderates the relationship between stigma consciousness and academic self-efficacy.

Method

Participants

Participants were 211 women undergraduate college students enrolled in engineering-degree programs and recruited through STEM-program contacts of a state-wide scholarship program that works with 47 colleges and universities in a large Midwestern state. Students recruited were at least 18 years of age and had declared a major in a STEM field. Participant majors were in engineering, Chemical Engineering (18.0%; n = 38), Mechanical Engineering (17.5%; n = 37), Industrial Systems Engineering (14.2%; n = 30), and Computer Science Engineering (10.4%; n = 22) accounted for over half of the sample. Participants ranged in age from 18-32 years with a mean age of 20.72 (SD = 2.92) years. Most participants (27.5%) were second-year students with fewer third-year (24.6%), fourth-year (19.9%), first-year (18.5%), fifth-year (8.5%), and more than fifth-year (.9%) students. Racial and ethnic representation was 73% White, 13.7% Asian-American, 4.7% African-American/Black, 4.3% Bicultural, 2.8% Hispanic/Latino(a), 0.9% Pacific Islander, and 0.5% Mexican-American or Chicano. Most participants (53%) reported an intention to pursue a graduate/professional degree and all participants attended a public and primarily white institution.

With regard to extramural and supportive programing, 28% of participants indicated being in a scholarship program, 42.7% reported involvement in mentoring, 27.8% were receiving academic advising, and 29.9% were involved in academic tutoring. Additionally, 48.5% of participants indicated being involved with social opportunities with other students in their major, 24.5% reported being involved with study groups, 9.1% reported involvement with test preparation, and 55.2% of participants indicated they were not involved with any academic support beyond what is normally offered in their program.

Measures

Academic Self-Efficacy. Academic self-efficacy was assessed using a version of Lent, Brown, and Larkin's (1984, 1986) Self-Efficacy for Academic Milestones (AM-S) index. The index measures participants' confidence in their ability to accomplish specific academic tasks. AM-S items focus on participants' confidence in accomplishing specific tasks critical to success for science, agriculture, or engineering majors (e.g., "complete the mathematics requirements for most science, agriculture, or engineering majors"). Byars-Winston et al. (2010) additionally added an item to assess completing the "biological requirements for most science, agriculture, or engineering majors" as this task would be applicable to biological science as well as biomedical engineering majors. The modified scale consists of 11 items. Participants' confidence ratings are determined on a 10-point Likert-type scale, ranging from 0 (*no confidence)* to 9 (*complete confidence*), indicating the degree to which participants feel they can accomplish each academic milestone. Scores are summed across items and divided by the total number of items, yielding a measure of strength of self-efficacy for academic milestones. Initial reporting of the coefficient alpha for the AM-S was .89 (Lent et al., 1984; 1986). Lent et al. (1986) reported the AM-S was correlated with high school rank and previous academic performance, as well as related self-efficacy measures. Furthermore, the AM-S predicted academic performance and persistence above measures of academic ability and achievement. Byars-Winston et al. (2010) reported their modified version was related to interests as well as predictive of commitment to college major. Byars-Winston et al. reported a Cronbach's alpha coefficient of .92. For the current study the Cronbach's alpha coefficient was .89, consistent with previously reported reliability.

Coping efficacy. Coping efficacy was measured with the Coping With Barriers (CWB) scale (Luzzo & McWhirter, 2001). The CWB was used to measure college students' efficacy for coping with barriers related to their career and educational goals. The 28-item scale contains two subscales: Career-Related Barriers (7 items) and Education-Related Barriers (21). The present study used only the Education-Related Barriers subscale. In response to education-related barriers, respondents are asked to "Please rate your degree of confidence that you could overcome each of the potential educational barriers listed below." Using a Likert-type scale ranging from 1 (*not at all confident*) to 5 (*highly confident*), participants rate items such as

"Money problems," "Not being prepared enough," "Lack of support from friends," "Negative comments about my racial/ethnic background [insults, jokes]." Total scores were summed and divided by the number of items, with lower scores indicating less perceived ability to overcome barriers (i.e., less coping efficacy). Luzzo and McWhirter (2001) supported the validity of the CWB through parallel assessment of perception of barriers. Subsequent studies using the CWB scale have support convergent validity with positive relationships among related self-efficacy and support variables as well as discriminant validity with perception of barriers and social status (Lopez & Ann-Li, 2006; Tate et al., 2015; Thompson, 2013). The test-retest reliability for the scale was obtained over a two-month period and demonstrated moderate stability with a coefficient of .48. Luzzo and McWhirter (2001) reported an initial alpha reliability of .93 for the Educational-Related Barriers subscale. In the present study, the Cronbach's alpha was .91 for Education-Related Barriers subscale of the CWB.

Stereotype vulnerability. We used the eight-item Stereotype Vulnerability Scale (SVS; Spencer, 1993) to measure the experience of stereotype threat for women. Each item begins with the stem: "How often do you feel that because of your gender…" Sample items include "Some people believe that you have less ability" and "If you do poorly on a test, people will assume that it is because of your gender." The SVS asks participants to rate each item on a Likert-type scale ranging from (1) *never* to (5) *almost always.* Scores are summed and divided by eight providing an average score ranging from 1-5. Higher scores on the SVS indicate greater incidence of experiencing stereotype threat. Additionally, instructions included the following statement, "The following questions are concerned with your experiences at college. Where it applies, please respond concerning courses within your stated college major." Spencer (1993) administered the SVS after a manipulation of stereotype threat conditions (gender-differences-implied vs. control) and found that post-test, women in the gender-differences-implied condition reported higher levels of stereotype vulnerability, state anxiety, and lower levels of self-esteem. Spencer reported a coefficient alpha of .67 for the SVS. Woodcock, Hernandez, Estrada, and Schultz (2012) used a revised, 4-item version, of the scale with a large sample of ethnically/racially under-represented college students. They report a coefficient alpha of .85. A coefficient alpha of .91 was found in the present study.

Stigma consciousness. To measure individual differences in stigma consciousness, we used the Stigma Consciousness Questionnaire (SCQ; Pinel, 1999). The SCQ is a 10-item questionnaire that can be adapted to targeted populations who may experience negative stereotypes regarding their identity. Pinel (1999) stated the SCQ is meant to reflect an "expectation that one will be stereotyped, irrespective of one's actual behavior" (p. 115). The SCQ for women (Pinel 1999) consists of 10-items and includes statements such as "Stereotypes about women have not affected me personally." Respondents are asked to indicate their level of agreement with these statements on a Likert-type scale ranging from 0 (*strong disagree*) to 6 (*strongly agree*). Scores are summed and divided by 7 yielding a mean score ranging from 0 to 6 with higher scores reflecting greater stigma consciousness. Pinel reported the SCQ was related to Public Self-Consciousness, negatively related to the Modern Sexism Scale, and a measure of implicit sex-role demands, demonstrating convergent and discriminant validity. Subsequent analysis supported women scoring high on the SCQ were more susceptible to stereotype threat (Brown & Pinel, 2003), anticipate interactions with males to be sexist (Pinel, 2002), and are more likely to attribute performance feedback to discrimination (Pinel, 2004). Pinel found a test-retest reliability of .76 over a 1-month period as well as predicted correlations with related measures of sexism and sex-role demands (Pinel, 1999; study 2). Initial reliability analysis demonstrated a Cronbach's alpha of .72 (Pinel, 1999; study 1). The current study produced a Cronbach's alpha of .81.

Procedure

All data were collected via online survey. E-mail announcements were sent to department heads of universities that participated in the statewide STEM scholarship programs. The announcements described the study's aim to understand and promote the experiences of students in STEM fields and how they cope with various environmental barriers. Students wishing to participate were directed to a web site that provided informed consent and a description of the study. Participants who fully completed the study were given.the option to be entered into a drawing for the chance to win one of several prizes such as an Amazon Kindle Fire tablet and cash awards.

Results

Preliminary Analyses

Initial examination of 355 total cases collected revealed 71 cases without responses on any measures or with no responses on a key measure and were therefore removed from analysis. Another 17 cases were removed because their major did not directly match others within underrepresented STEM fields (e.g., nursing, dietetics, AYA education). Of the remaining cases, 92% represented engineering majors. Twenty-three cases were removed because they identified as men. In total, 111 cases were initially removed leaving a sample size of 244. The remaining 244 cases were inspected using missing values analysis (MVA) in SPSS v24. Results indicated that variables missing data ranged from 3.7% (SVS; 9 missing cases) to 0% (CWB). For the current sample, Little's MCAR test indicated a χ^2 (3021) = 2613.76, p = 1.00. Therefore, it was inferred that the pattern of missing data was completely at random. Tabachnick and Fidell (2009) suggested that less than 5% of data missing can be treated with any procedure for handling missing data with similar results. For the current data set, expectation maximization (EM) methods were used to replace missing data. This new data set was then explored for outliers using Mahalanobis distances, Cook's D, and casewise diagnostic criteria supplied by SPSS analysis. Criteria used to evaluate data included Cook's D values larger than 1.00 as problematic (Tabachnick & Fidell, 2009), with casewise diagnostics supplying information on standardized residual values whose value is above 3.0 or -3.0 (Pallant, 2010). Finally, the inspection of Mahalanobis distances is dependent on critical values determined by the number of independent variables in the analysis. For the current study, cases with values above 18.47 (four independent variables) were considered for removal. Results of these analyses resulted in the removal of 17 cases total. Final inspection revealed non-engineering majors such as Computer Science (n = 5), Biology (n = 5), Biochemistry (n = 4) and Chemistry (n = 4) represented too few cases for generalization and were therefore removed. The final data set consisted of 211 cases.

The final data set was then inspected for normality, linearity, and homoscedasticity. Inspection revealed a negatively skewed distribution within the academic self-efficacy scale (-1.07). Inspection of the histogram is recommended as skewness may not make "substantiative difference" in samples greater than 200 (Tabachnick & Fidell, 2009, p. 80). The histogram revealed a peak of scores on the right-tail of the distribution. Transformation of the data distribution yielded the best results from reflect and inverse transformation, but visual inspection showed a bimodal distribution, which was not an improvement from the untransformed distribution. As the sample was large and improvement was marginal at best, the untransformed academic self-efficacy distribution was retained.

We then examined group differences based on educational and supportive programming. Differences based on endorsement of involvement in a form of supportive programming yielded significant differences among students involved in a learning community on AM-S (M = 7.99, SD = 1.03) compared to those who were not (M = 7.67, SD = 1.26), t (196.26) = 2.11, p = .036. Students involved in a learning community reported significantly higher GPAs in high school (M = 3.92, SD = .14) than did those not so involved (M = 3.84, SD = .26) t (247.94) = 2.98, p = .003. High school GPA was used as a covariate in the proposed model. There were no group differences identified by involvement in a scholarship program.

Hypothesis Testing

Hypothesis 1 stated that academic self-efficacy would relate negatively to stereotype vulnerability and stigma consciousness. As seen in Table 1, this hypothesis was not supported in the case of stereotype vulnerability (r = -.11, p = .11) but was supported in the case of stigma consciousness (r =-.24, p < .001). Hypothesis 2 stated that coping efficacy would relate positively to academic self-efficacy and negatively to stereotype vulnerability and stigma consciousness. Results supported this hypothesis. As seen in Table 1, scores on the coping efficacy and academic self-efficacy measures were significantly positively correlated (r = .52, p < .001). Also, scores on the stereotype vulnerability and coping efficacy measures (r = -.20, p < .001) and on stigma consciousness and coping efficacy measures (r = -.39, p < .001) were negatively correlated.

Hypothesis 3a stated that coping efficacy (CWB) would moderate the relationship between stereotype vulnerability (SVS) and academic self-efficacy (AM-S). Hypothesis 3b stated that coping efficacy would moderate the relationship between stigma consciousness (SCQ) and academic self-efficacy.

Testing for Hypothesis 3a-b consisted of forming an interaction term in PROCESS (Hayes, 2016) from the transformed products of CWB and SVS; and CWB and SCQ. Consistent with the lack of a significant relationship between SVS and AM-S based on the zero-order correlations seen in Table 1, the interaction term for CWB and SVS was non-significant ($\beta = .25$; $p = .064$). Thus Hypothesis 3a concerning moderation of the relationship between SVS and AM-S by CWB was not supported. Results for Hypothesis 3b indicated a significant interaction ($\beta = .34$, $p < .01$). Probing for conditional effects of stigma consciousness on academic self-efficacy at levels of coping efficacy revealed a significant effect at -1 standard deviation of coping efficacy ($\beta = -.34$, $se = .111$; $t = -2.87$, $p < .01$) with a 95% confidence interval of lower bounds equal to -.535 and upper bounds equal to -.099. The effects at the mean-value and +1 standard deviation were not significant (($\beta = -.11$, $se = .068$; $t = -1.64$, $p = .103$ & $\beta = .09$, $se = .079$; $t = 1.19$, $p = .237$, respectively). The effects were plotted for a visual representation of the effect of coping with barriers on the relationship between stigma consciousness and academic self-efficacy as seen in Figure 1.

Structural Equation Modeling (SEM) was used to further explore the interaction effect proposed in hypothesis 3b. We used this additional statistical model to attenuate the influence of measurement error within our latent variables and to reduce multicollinearity. First, based on the recommendations of Little, Rhemtulla, Gibson, and Schoemann (2013), item parcels for structural models in SEM were employed as parcels have the advantage of improved psychometric characteristics, closer approximation of model estimation and fit characteristics, and reduction of sampling error (as opposed to using items as indicators for the constructs). The shared-uniqueness strategy outlined by Hall, Snell, and Foust (1999) was applied. This strategy recommends inspection of scale items, assuming a univariate construct, with the intent of identifying secondary factors such as negatively-worded versus positively-worded items. Next, an EFA is run on each parcel forcing items into three to five factors. Items that share loadings on a secondary factor are then grouped into the same parcel. Item loadings from the construction of item parcels for the current study are presented as part of the measurement and structural model estimates. Lastly, we used an orthogonalizing procedure for modeling interaction terms among latent variables (Little, Bovaird, & Widaman, 2006). This procedure consists of first creating orthogonalized indicators from the two latent constructs in the model, CWB and SCQ. For the current study, a total of fifteen interactions could be produced (three indicators for SCQ and five indicators for CWB). The resulting interaction terms are then regressed on the first-order effect indicators from the initial constructs.

This is repeated for each one of the fifteen interaction terms and the resulting residual for the regression is saved and used as an indicator for the interaction construct in the moderation model. The resulting construct is uncorrelated with the two latent variables and therefore reduces instances of multicollinearity within the model. Finally, each of the indicators that shares unique variance is correlated. The completed model appears in Figure 2. The interaction was run using maximum likelihood estimation in AMOS 22. Results indicated an excellent fit to the data, χ^2 (271) = 278.796, p =.359; CFI = .997; GFI = .917; RMSEA = .012 (90% CI = .00 - .03, $p_{\text{close-fit } Ho}$ = 1.00); AIC = 492.796. The path from the interaction to self-efficacy was significant and the total model demonstrated good fit, accounting for 49.2% of the variance in self-efficacy. Results indicated support for hypothesis 3b.

Discussion

Research has shown a consistent underrepresentation of women and minority students earning degrees in engineering fields (NSB, 2012). This disparity contributes to discrepancies in opportunity, income, and social mobility for women. To address this problem, the current study focused on the intersection of social identity and environment as a barrier for female college students in engineering majors and responded to calls for understanding the implications for individuals when contextual barriers become internalized (Byars & Hackett, 1998; Lent et al., 2000; Lent et al., 2001). Specifically, we used stigma consciousness and stereotype vulnerability to determine whether the perception and awareness stereotypes regarding one's gender relate to academic self-efficacy. Additionally, self-efficacy for coping with barriers to education was included as a variable that could lead to an understanding of how levels of confidence in responding to educational barriers might buffer the effect of negative stereotypes. Thus, we also responded to a call for advancing research on SCCT with implications for the potential development of interventions to assist individuals in coping with environmentally imposed barriers (Lent et al., 2000).

The present findings suggest that barriers, such as stigma related to gender, demonstrate an important consideration in SCCT. Our finding that stigma consciousness was negatively related to self-efficacy supports previous research on the proximal contextual influences in SCCT (Deemer et al., 2014; Lent et al., 2001; Lent et al., 2003: Sheu et al., 2010). As women high in stigma consciousness endorse more incidents of sexism with greater specificity than low stigma-conscious women (Pinel, 1999), participants in the current study may be more sensitive to environmental cues that do not encourage their success in engineering. This finding is consistent with Hardin & Longhurst (2016) who found that over the course of a semester, women perceived greater barriers, resulting in less self-efficacy and interest goals for STEM, whereas men noted increased support. Women high in stigma consciousness have been shown to self-select out of gender-stereotyped tasks (Pinel, 1999). As stigma consciousness was a negative predictor of self-efficacy, it may be inferred to carry the deleterious effects of low self-efficacy on persistence and goal behaviors (Brown et al., 2008; Lee et al., 2015; Robbins et al., 2004; Wright, Jenkins-Guarnieri, & Murdock, 2012). The inclusion of stigma consciousness as a proximal contextual barrier provides understanding of person and environment interactions that inhibit career development in the SCCT framework (Lent et al., 2003; Lent et al., 2002).

Next, the lack of relationship between academic self-efficacy and stereotype vulnerability suggests that stereotype vulnerability does not directly influence self-efficacy beliefs. Given that stereotype vulnerability was significantly related to both stigma consciousness and coping with barriers, it could be that the direct effects of stereotype vulnerability within the SCCT model were not captured. In Spencer's (1993) study, women in diagnostic testing situations scored higher on SVS after completing the assessment. It may be that women in STEM classrooms situationally experience stereotype vulnerability as a result of academic performance and SVS may serve as an indirect influence from performance to learning experiences (path 6, Lent et al., 1994). This would assert a cumulative effect of stereotype threatening situations serve to diminish self-efficacy and is reflected in a heightened stigma consciousness. Research exploring multiple variables in the SCCT model with use of stereotype and stigma measures specific to self-efficacy, performance, and persistence could assist in capturing the influence of stereotype threat across social cognitive career development.

Results for self-efficacy for coping with barriers demonstrated a significant relationship to academic self-efficacy for STEM. This supports previous research that has found a modest association between self-efficacy and coping efficacy (Byars-Winston & Fouad, 2008; Lent et al., 2001; Thompson, 2008) Additionally, this supports Lent et al.'s (2001) belief that coping and content self-efficacy are related, yet separate constructs. The level of confidence women reported in coping with a range of educational barriers moderated the negative relationship between stigma consciousness and academic self-efficacy. As seen in Figure 1, scoring one standard deviation above the mean for the sample on coping efficacy negated the negative influence of high stigma consciousness on academic self-efficacy. Although there is little previous research studying coping as a moderator of barriers and self-efficacy within SCCT (Novakovic & Gnilka, 2015; Thompson, 2008), the relationship is an important area of consideration. If coping efficacy serves as an individual difference between those who are successful in spite of having internalized messages from discouraging environments, an immediate tool for assisting women in engineering could be to facilitate greater coping efficacy along with instituting the slow process of changing the beliefs of those within engineering environments. This finding offers the first test of the relationship between barriers and self-efficacy for coping with barriers postulated by Lent et al. (2000). Our findings underscore that global confidence in one's ability to overcome educational barriers may protect against the ill effects of chronic and internalized discrimination consciousness due to identity as a woman in an engineering program.

Limitations, Future Directions, and Practical Implications

The present study results and their implications should be considered in light of the following limitations. First, participants comprised predominantly White women majoring in various engineering disciplines. Therefore, results may not generalize to other underrepresented populations across disciplines. Specifically, African-American/Black, Latino/a, Southeast Asian, and Native American represent a racial and ethnic disparity in STEM fields. Therefore, research expanding the present model to include exploration of how racial bias and stereotypes influence academic self-efficacy would serve to support the present findings. Additionally, exploring the combined effect of racial or ethnic minority identity and gender would assist understanding how multiple underrepresented identities are navigated within STEM fields and also point to coping beliefs and their role in buffering these potential negative effects.

Second, our research design relied on statistical relationships among variables based on correlational data gathered from self-report instruments. Consequently, future studies would do well to use longitudinal and experimental designs to examine with greater specificity relationships among the variables studied and, specifically, to understand how the experience of stereotype threat impacts self-efficacy in math-based fields. Additionally, experimental designs may study the influence of various interventions on coping with discrimination, stigma, and stereotypes regarding identity in math-based fields. Mixed methods or strictly qualitative investigations may gather greater information about the complexity of the relationships represented in the current study. For instance, qualitative studies could help to understand both the experience of stigma and stereotypes as well as the implementation and use of methods for coping with barriers to educational goals.

Results of the present study have implications for addressing the problem of persistence for women in engineering majors across three domains: preventive, remedial, and programmatic. In terms of preventing attrition in engineering majors, initial work should be completed prior to young women attending college. Education surrounding issues concerned with gender-role socialization and the impact of gender roles on career choice, self-efficacy, and academic performance could serve to raise young women’s awareness of how social environments may limit their self-confidence and constrain their interests. Career interventions should assist young women to strengthen their expectations for success in engineering fields, expand social support and professional affiliation, and improve their identity as scientists through effective mentoring and exposure to role models within science disciplines.

Often, women do excel in science and mathematics at the same level as men during primary and secondary education, yet when choosing college majors, less women state interest in engineering majors and even less graduate with a engineering degree (AAUW, 2010). University-based counselors and psychologists may see women in engineering within counseling centers presenting with career or other issues, including psychological distress or academic concerns. As an exploratory exercise, they might do well to determine how identity, role salience, and social support are impacting women's pursuit of an engineering degree (Hardin & Longhurst, 2016). Additionally, they can assist women to increase awareness of socio-political and other power dynamics that exist and their impact on career development. Following similar frameworks for critical consciousness raising (Diemer, 2009; Olle & Fouad, 2015) with the inclusion of self-efficacy for political action (Diemer & Rapa, 2016) could prepare women entering college to feel equipped to manage barriers and promote personal agency and persistence.

Additional remedial interventions could also draw from research that has shown decreases in the impact of stereotype threat in experimental conditions. Ambady, Shih, Kim, and Pittinsky (2001) demonstrated that the process of individuation (listing special interests and describing positive and negative qualities about oneself) reduced the impact of stereotype threat on student performance. Similarly, Martens, Johns, Greenberg, and Schimel (2006) encouraged self-affirmation through ranking 11 characteristics and values. Students then chose those most important values and wrote about them. Both interventions serve to distance stereotype vulnerable students from their relevant groups Professionals may also inquire about environmental supports and assist in linking students to role models, such supports are protective against negative stereotypes (Blanton, Crocker, & Miller, 2000).

Programmatic interventions should involve collaboration with administrators and educators within the engineering community who care about access and equality within the field. Broadly, psychologists and counselors concerned with the vocational development and success of women in engineering can pair with organizations (e.g., Society of Women Engineers) that aim to engage underrepresented persons in engineering fields. By bringing established career interventions to these organizations, professionals can be valued contributors to the development and success of women in engineering careers. Locating local chapters and faculty members within these organizations can serve to create a welcoming and encouraging community of support. Indeed, having others who encourage high standards for ability and assure students that educators believe in their abilities can mitigate the impact of negative stereotypes on performance (Cohen, Steele, & Ross, 1999).

Conclusion

Results of the present study offer the use of stigma consciousness as a personal and contextual barrier regarding sex discrimination within an SCCT model. Because high levels of stigma consciousness result in greater incidence of stereotype threat effects (Brown & Pinel, 2003), stigma consciousness may represent an important variable that identifies vulnerability to and influence of stereotype threat in real-world contexts for women in engineering. In the present study, self-efficacy for coping with educational barriers demonstrated an important individual differences variable for overcoming negative stereotypes that lower self-efficacy. Thus, future research should address individual factors (e.g., personality and psychological, behavioral, or performance attributes), coping strategies, and supports that undergird high coping efficacy. Finally, the present study underscores the importance of environment in retention and successful completion of STEM degrees for women.

References

AAUW. (2010). *Why So Few? Women in Science Technology Engineering and Mathematics,* by Corbett, Hill, Rose. Washington, DC. Retrieved from: https://www.aauw.org/files/2013/02/Why-So-Few-Women-in-Science-Technology-Engineering-and-Mathematics.pdf.

Adams, G., Garcia, D. M., Purdie-Vaughns, V., & Steele, C. M. (2006). The detrimental effects of a suggestion of sexism in an instruction situation. *Journal of Experimental Social Psychology, 42,* 602-615.

Ambady, N., Shih, M., Kim, A., & Pittinsky, T. L. (2001). Stereotype susceptibility in children: Effects of identity activation on quantitative performance. *Psychological Science, 12*, 385-390.

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology*, *38*, 113-125.

Aronson, J., & Inzlicht, M. (2004). The ups and downs of attributional ambiguity: Stereotype vulnerability and the academic self-knowledge of African-American students. *Psychological Science, 15*, 829-836.

Aronson, J., Lustina, M. J., Good, C., Keough, K., Steele, C. M., & Brown, J. (1999). When White Men Can't Do Math: Necessary and Sufficient Factors in Stereotype Threat. *Journal of Experimental Social Psychology, 35,* 29-46.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 91-215.

Bandura, A. (1997). Self-efficacy: The exercise of control. New York: Freeman

Betz, N. E., & Hackett, G. (1981). The relationship of career-related self-efficacy expectations to perceived career options in college women and men. *Journal of Counseling Psychology*, *28,* 399-410.

Blanton, H., Crocker, J., & Miller, D. T. (2000). The effects of in-group versus out-group social comparison on self-esteem in the context of a negative stereotype. *Journal of Experimental Social Psychology*, *36*, 519-530.

Brown, S. D., Tramayne, S., Hoxha, D., Telander, K., Fan, X., & Lent, R. W. (2008). Social cognitive predictors of college students' academic performance and persistence: A meta-analytic path analysis. *Journal of Vocational Behavior*, *72,* 298-308.

Brown, R. P., & Pinel, E. C. (2003). Stigma on my mind: Individual differences in the experience of stereotype threat. *Journal of Experimental Social Psychology*, *39*, 626-633.

Bureau of Labor Statistics. (Spring, 2014). STEM 101: Intro to tomorrow's jobs. *Occupational Outlook Quarterly;* online publication; Retrieved from http://www.bls.gov/careeroutlook/2014/spring/art01.pdf. on July 15, 2016.

Byars, A.M., & Hackett, G. (1998). Applications of social cognitive theory to the career development of women of color. *Applied and Preventive Psychology*, *7*, 255-267.

Byars-Winston, A., Estrada, Y., Howard, C., Davis, D., & Zalapa, J. (2010). Influence of Social Cognitive and Ethnic Variables on Academic Goals of Underrepresented Students in Science and Engineering. *Journal of Counseling Psychology*, *57*, 205-218. doi:10.1037/a0018608

Byars-Winston, A., & Fouad, N. (2008). Math/science social cognitive variables in college students: Contributions of contextual factors in predicting goals. *Journal of Career Assessment*, *16*, 425-440.

Cabrera, A. F., Nora, A., Terenzini, P. T., Pascarella, E., & Hagedorn, L. S. (1999). Campus racial climate and the adjustment of students to college: A comparison between White students and African-American students. *Journal of Higher Education, 70*, 134-160.

Chen, X. (2013). STEM Attrition: College Students' Paths Into and Out of STEM Fields (NCES 2014-001). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Cohen, G. L., Steele, C. M., & Ross, L. D. (1999). The mentor's dilemma: Providing critical feedback across the racial divide. *Personality and Social Psychology Bulletin*, *25*, 1302-1318.

Diemer, M. A. (2009). Pathways to occupational attainment among poor youth of color: The role of sociopolitical development. *The Counseling Psychologist, 37*, 6–35.

Diemer, M. A., & Rapa, L. J. (2016). Unraveling the Complexity of Critical Consciousness, Political Efficacy, and Political Action Among Marginalized Adolescents. *Child development*, *87*, 221-238.

Deemer, E. D., Thoman, D. B., Chase, J. P., & Smith, J. L. (2014). Feeling the threat: Stereotype threat as a contextual barrier to women's science career choice intentions. *Journal of Career Development*, *41*, 141-158.

Flores, L. Y., Navarro, R. L., Lee, H. S., Addae, D. A., Gonzalez, R., Luna, L. L., ... & Mitchell, M. (2014). Academic satisfaction among Latino/a and White men and women engineering students. *Journal of counseling psychology*, *61*, 81–92.

Fouad, N. A., Hackett, G., Smith, P. L., Kantamneni, N., Fitzpatrick, M., Haag, S., & Spencer, D. (2010). Barriers and supports for continuing in mathematics and science: Gender and educational level differences. *Journal of Vocational Behavior*, *77*, 361-373.

Fouad, N. A., Singh, R., Cappaert, K., Chang, W. H., & Wan, M. (2016). Comparison of women engineers who persist in or depart from engineering. *Journal of Vocational Behavior*, *92*, 79-93.

Garriott, P. O., Raque-Bogdan, T. L., Zoma, L., Mackie-Hernandez, D., & Lavin, K. (2016). Social Cognitive Predictors of Mexican American High School Students' Math/Science Career Goals. Journal of Career Development, 0894845316633860.

Good, C., Aronson, J., & Harder, J. A. (2008). Problems in the pipeline: Stereotype threat and women's achievement in high-level math courses. *Journal of Applied Developmental Psychology*, *29*, 17-28. doi:10.1016/j.appdev.2007.10.004

Hall, R. J., Snell, A. F., & Foust, M. S. (1999). Item parceling strategies in SEM: Investigating the subtle effects of unmodeled secondary constructs. *Organizational Research Methods*, *2*, 233-256.

Hardin, E. E., & Longhurst, M. O. (2016). Understanding the gender gap: Social cognitive changes during an introductory stem course. *Journal of Counseling Psychology*, *63*, 233-239.

Hayes, A. F. (2016). PROCESS for SPSS (Version 2.16) [Macros]. Available from: processmacro.org.

Inda, M., Rodríguez, C., & Peña, J. V. (2013). Gender differences in applying social cognitive career theory in engineering students. *Journal of Vocational Behavior, 83*, 346-355.

Lee, H. S., Flores, L. Y., Navarro, R. L., & Kanagui-Muñoz, M. (2015). A longitudinal test of social cognitive career theory's academic persistence model among Latino/a and White men and women engineering students. *Journal of Vocational Behavior*, *88*, 95-103.

Lent, R. W., & Brown, S. D. (2006). On conceptualizing and assessing social cognitive constructs in career research: A measurement guide. *Journal of Career Assessment, 14*, 12-35.

Lent, R. W., Brown, S. D., Brenner, B., Chopra, S. B., Davis, T., Talleyrand, R., & Suthakaran, V. (2001). The role of contextual supports and barriers in the choice of math/science educational options: A test of social cognitive hypotheses. *Journal of Counseling Psychology, 48*, 474-483.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, *45*, 79-122.

Lent, R. W., Brown, S. D., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology*, *47*, 36-49.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. *Journal of Counseling Psychology*, *31*, 356-362.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of Counseling Psychology*, *33*, 265-269.

Lent, R. W., Brown, S. D., Schmidt, J., Brenner, B., Lyons, H., & Treistman, D. (2003). Relation of contextual supports and barriers to choice behavior in engineering majors: Test of alternative social cognitive models. *Journal of Counseling Psychology, 50*, 458–465.

Lent, R. W., Brown, S. D., Sheu, H. B., Schmidt, J., Brenner, B. R., Gloster, C. S., ... & Treistman, D. (2005). Social Cognitive Predictors of Academic Interests and Goals in Engineering: Utility for Women and Students at Historically Black Universities. *Journal of Counseling Psychology*, *52*, 84-92.

Lent, R. W., Brown, S., Talleyrand, R., McPartland, E., Davis, T., Chopra, S., et al. (2002).

Career choice barriers, supports and coping strategies: College students' experiences. *Journal of Vocational Behavior, 60,* 61–72.

Lent, R. W., Lopez, A. M., Lopez, F. G., & Sheu, H. B. (2008). Social cognitive career theory and the prediction of interests and choice goals in the computing disciplines. *Journal of Vocational Behavior, 73*, 52-62.

Lent, R. W., Miller, M. J., Smith, P. E., Watford, B. A., Hui, K., & Lim, R. H. (2014). Social cognitive model of adjustment to engineering majors: Longitudinal test across gender and race/ethnicity. *Journal of Vocational Behavior,* 83, 22-30.

Lent, R. W., Miller, M. J., Smith, P. E., Watford, B. A., Lim, R. H., & Hui, K. (2016). Social cognitive predictors of academic persistence and performance in engineering: Applicability across gender and race/ethnicity. *Journal of Vocational Behavior*, *94*, 79-88.

Lent, R. W., Sheu, H., Gloster, C. S., & Wilkins, G. (2010). Longitudinal test of social cognitive model of choice in engineering students at historically black universities. *Journal of Vocational Behavior,* 76, 387–394.

Lent, R. W., Sheu, H. B., Singley, D., Schmidt, J. A., Schmidt, L. C., & Gloster, C. S. (2008). Longitudinal relations of self-efficacy to outcome expectations, interests, and major choice goals in engineering students. *Journal of Vocational Behavior, 73*, 328-335.

Lent, R.W., Singley, D., Sheu, H. B., Schmidt, J. A., & Schmidt, L. C. (2007). Relation of social-cognitive factors to academic satisfaction in engineering students. *Journal of Career Assessment, 15*, 87–97.

Little, T. D., Bovaird, J. A., & Widaman, K. F. (2006). On the merits of orthogonalizing powered and product terms: Implications for modeling interactions among latent variables. *Structural Equation Modeling, 13,* 497-519.

Little, T. D., Rhemtulla, M., Gibson, K., & Schoemann, A. M. (2013). Why the items versus parcels controversy needn't be one. *Psychological Methods*, *18*, 285-300. http://dx.doi.org/10.1037/a0033266

Logel, C., Walton, G. M., Spencer, S. J., Iserman, E. C., von Hippel, W., & Bell, A. E. (2009). Interacting with sexist men triggers social identity threat among female engineers. *Journal of personality and social psychology*, *96*, 1089.

Lopez, F. G., & Ann-Yi, S. (2006). Predictors of career indecision in three racial/ethnic groups of college women. *Journal of Career Development*, *33*, 29-46.

Luzzo, D. A., & McWhirter, E. H. (2001). Sex and ethnic differences in the perception of educational and career-related barriers and levels of coping efficacy. *Journal of Counseling and Development*, *79*, 61-67.

MacKinnon, D. P., Krull, J. L., & Lockwood, C. M. (2000). Equivalence of the mediation, confounding and suppression effect. *Prevention science*, *1*, 173-181.

Martens, A., Johns, M., Greenberg, J., & Schimel, J. (2006). Combating stereotype threat: The effect of self-affirmation on women's intellectual performance. *Journal of Experimental Social Psychology*, *42*, 236-243.

Marra, R. M., Rodgers, K. A., Shen, D., & Bogue, B. (2009). Women engineering students and self-efficacy: A multi-year, multi-institution study of women engineering student self-efficacy. *Journal of Engineering Education*, *98*, 27-38.

Miller, M. J., Lent, R. W., Lim, R. H., Hui, K., Martin, H. M., Jezzi, M. M., ... & Wilkins, G. (2015). Pursuing and Adjusting to Engineering Majors A Qualitative Analysis. *Journal of Career Assessment*, *23*, 48-63.

National Science Board. (2012). Science and Engineering Indicators 2012. Arlington VA:

National Science Foundation (NSB 12-01).

National Science Foundation, National Center for Science and Engineering Statistics. (2013). Women, Minorities, and Persons with Disabilities in Science and Engineering: 2013. Arlington, VA. Retrieved from: http://www.nsf.gov/statistics/wmpd/

Navarro, R. L., Flores, L. Y., & Worthington, R. L. (2007). Mexican American middle school students' goal intentions in mathematics and science: A test of social cognitive career theory. *Journal of Counseling Psychology, 54*, 320-335.

Novakovic, A., & Gnilka, P. B. (2015). Dispositional Affect and Career Barriers: The Moderating Roles of Gender and Coping. *The Career Development Quarterly*, *63*, 363-375.

Olle, C. D., & Fouad, N. A. (2015). Parental Support, Critical Consciousness, and Agency in Career Decision Making for Urban Students. *Journal of Career Assessment*, *23,* 533-544.

Pallant, J. (2010). SPSS survival manual, 4th. *England: McGraw-Hill Education*.

Perrone, K. M., Civiletto, C., Webb, M. K., & Fitch, J. C. (2004). Perceived barriers to attainment of family and career goals. *International Journal of Stress, 11*, 114-131.

Pinel, E. C. (1999). Stigma consciousness: the psychological legacy of social stereotypes. *Journal of Personality and Social Psychology*, *76*, 114-128.

Pinel, E. C. (2002). Stigma consciousness in intergroup contexts: The power of conviction. *Journal of Experimental Social Psychology, 38*, 178-185.

Pinel, E. C. (2004). You're just saying that because I'm a woman: Stigma consciousness and attributions to discrimination. *Self and Identity, 3*, 39-51.

Robbins, S. B., Lauver, K., Le, H., Davis, D., Langley, R., & Carlstrom, A. (2004). Do psychosocial and study skill factors predict college outcomes? A meta-analysis. *Psychological Bulletin, 130*, 261–288.

Rydell, R. J., McConnell, A. R., & Beilock, S. L. (2009). Multiple social identities and stereotype threat: imbalance, accessibility, and working memory. *Journal of personality and social psychology*, *96*, 949.

Schmader, T. (2002). Gender identification moderates stereotype threat effects on women's math performance. *Journal of Experimental Social Psychology*, *38*, 194-201.

Sheu, H., Lent, R. W., Brown, S., Miller, M., Hennessy, K., & Duffy, R. D. (2010). Testing the choice model of social cognitive career theory across Holland themes: A meta-analytic path analysis. *Journal of Vocational Behavior, 76*, 252–264.

Spencer, S. (1993). *The Effect of Stereotype Vulnerability on Women's Math Performance*. n.p.: ProQuest, UMI Dissertations Publishing.

Spencer, S. J., Logel, C., & Davies, P. G. (2016). Stereotype threat. *Annual review of psychology*, *67*, 415-437.

Spencer, S., Steele, C., & Quinn, D. (1999). Stereotype threat and women’s math performance. *Journal of Experimental Social Psychology*, *35*, 4-28.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual ability and performance. *American Psychologist*, *52*, 613-629.

Steele, C., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, *69*, 797-811.

Swanson, J. L., Daniels, K. K., & Tokar, D. M. (1996). Assessing perceptions of career-related barriers: The Career Barriers Inventory. *Journal of Career Assessment*, *4*, 219-244.

Swanson, J. L., & Woitke, M. B. (1997). Theory into practice in career assessment for women: Assessment and interventions regarding perceived career barriers. *Journal of Career Assessment*, *5*, 443-462.

Tabachnick, B. G., & Fidell, L. S. (2009). Using multivariate analysis. *California State University Northridge: Harper Collins College Publishers*.

Tate, K. A., Fouad, N. A., Marks, L. R., Young, G., Guzman, E., & Williams, E. G. (2015). Underrepresented First-Generation, Low-Income College Students' Pursuit of a Graduate Education Investigating the Influence of Self-Efficacy, Coping Efficacy, and Family Influence. *Journal of Career Assessment*, *23,* 427-441. doi:1069072714547498.

Thompson, M. N. (2008). *Relations of supports and barriers to social status and vocational behavior.* (Electronic Thesis or Dissertation). Retrieved from https://etd.ohiolink.edu

Thompson, M. N. (2013). Career barriers and coping efficacy among Native American students. *Journal of Career Assessment*, *21,* 311-325. doi: 1069072712471501.

Thompson, M. N., & Dahling, J. J. (2012). Perceived social status and learning experiences in social cognitive career theory. *Journal of Vocational Behavior*, *80*, 351-361.

Woodcock, A., Hernandez, P. R., Estrada, M., & Schultz, P. (2012). The consequences of chronic stereotype threat: Domain disidentification and abandonment. *Journal of personality and social psychology, 103*, 635-646.

Wright, S. L., Jenkins-Guarnieri, M. A., & Murdock, J. L. (2012). Career development among first-year college students: College self-efficacy, student persistence, and academic success. *Journal of Career Development*, *40*, 292-310. doi: 10.1177/0894845312455509.

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal*, *37*, 215-246.

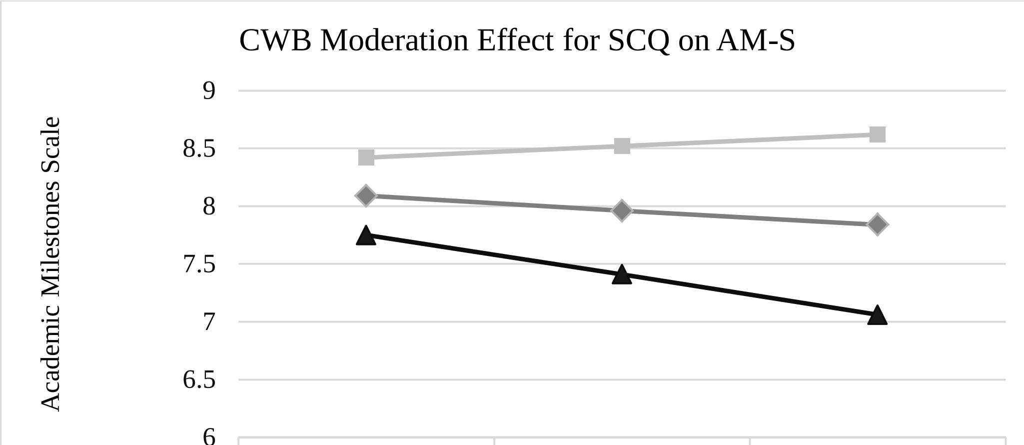
Table 1

Descriptive Statistics for Primary Variables

	GPA	SVS	SCQ	CWB	AM-S	*M*	*SD*
1. GPA	--					3.86	.338
2. SVS	.06	*.91*				2.25	.842
3. SCQ	-.05	.52**	*.78*			3.80	1.06
4. CWB	.05	-.20**	-.39**	*.91*		3.96	.652
5. AM-S	.18*	-.11	-.24**	.52**	*.89*	7.77	1.31

Note. . GPA = Grade Point Average, cumulative high school; SVS = Stereotype Vulnerability Scale; SCQ = Stigma Consciousness Questionnaire; CWB = Coping With Barriers; AM-S = Academic Milestones Scale. Alpha coefficients appear in italics on diagonal.

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



	Low SC	Med SC	High SC
CWB High	8.42	8.52	8.62
CWB Med	8.09	7.96	7.84
CWB Low	7.75	7.41	7.06

Figure 1. Conditional effect of Coping With Barriers on the relationship between Academic Milestones Scale and Stigma Consciousness Questionnaire. *Note.* CWB = Coping With Barriers; AM-S = Academic Milestones Scale; SCQ, SC = Stigma Consciousness Questionnaire.

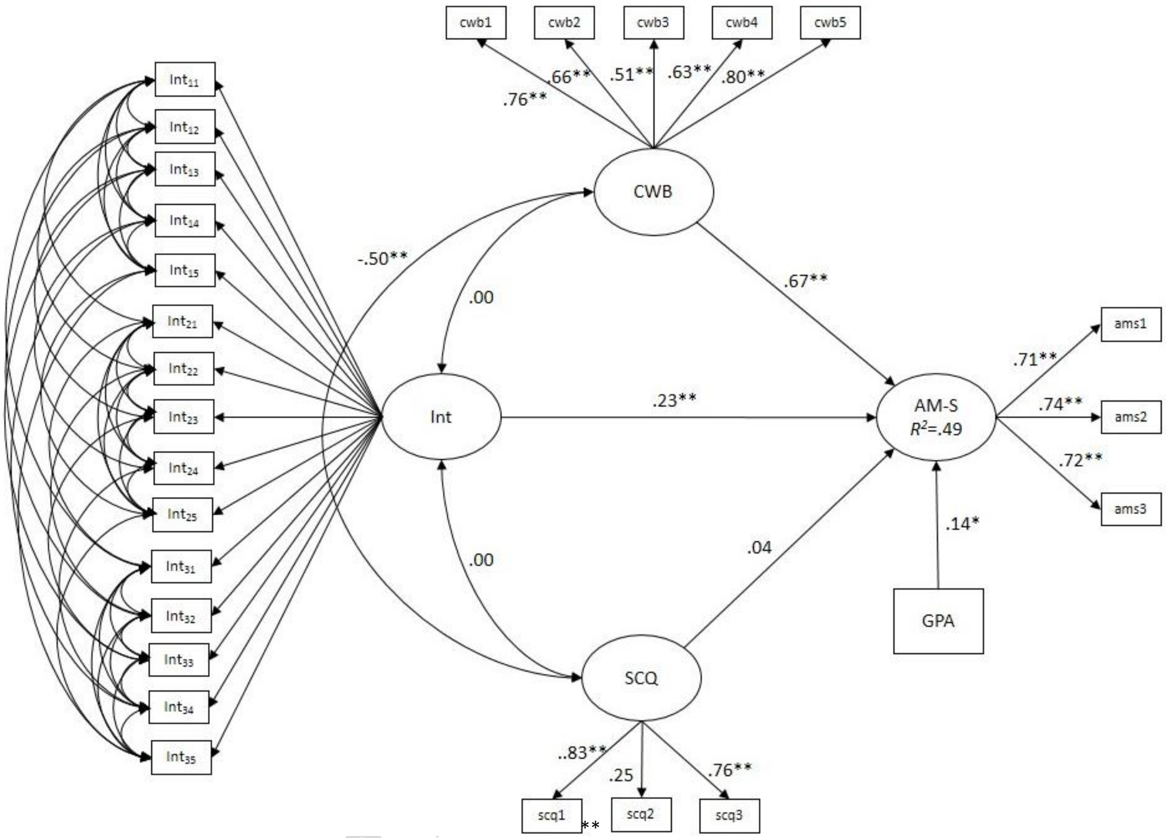


Figure 2. Moderation model. *Note.* CWB = Coping With Barriers; AM-S = Academic Milestones Scale; SCQ = Stigma Consciousness Questionnaire; Int = Interaction term (CWBxSCQ); GPA = Grade Point Average, cumulative high school. All values are standardized loadings. *p < .05; **p < .01

Highlights – Stereotype Threat as a Barrier to Women Entering Engineering Careers

- Stigma consciousness negatively related to women's academic self-efficacy in engineering.
- Coping efficacy moderated the relationship of stigma consciousness on self-efficacy.
- Results add to the barrier framework within Social Cognitive Career Theory.