Predictors of Engineering-Related Self-Efficacy and Outcome Expectations across Gender and Racial/Ethnic Groups

Abstract

To better understand the underrepresentation of women and Latino/as in engineering, the current study examined longitudinal effects between engineering-related learning experiences and self-efficacy and outcome expectations among a sample of 575 engineering students attending a Hispanic Serving Institution. Specifically, using Social Cognitive Career Theory (Lent, Brown, & Hackett, 1994; 2000) as the theoretical base, this study tests two models—one in the Realistic domain and one in the Investigative domain—to determine whether the domain-specific learning experience variables of performance accomplishments, vicarious learning, verbal persuasion and physiological arousal significantly predict domain-specific self-efficacy and outcome expectations over time. After controlling for the effects of Time 1 variables on the respective Time 2 variables, the findings indicated that Time 1 low emotional arousal was a significant predictor of Time 2 Realistic self-efficacy, and Time 2 Realistic outcome expectations were predicted by all four Time 1 learning experiences for all groups. Further, Time 1 vicarious learning, verbal persuasion and emotional arousal had significant effects on Time 2 Investigative self-efficacy, but Time 1 performance accomplishment was not a significant predictor across racial/ethnic groups. Neither gender nor race/ethnicity moderated the cross-lagged paths in either model. Implications of the findings are discussed in regard to educational interventions for promoting the persistence of women and Latino/as in engineering programs.

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Both Latino/as and women are underrepresented in science, technology, engineering, and math (STEM) occupations, fields that are widely recognized as high prestige and high paying. In particular, Latino/as and women received only 7% and 18%, respectively, of engineering degrees awarded in 2010 (Aud et al., 2011). More information is needed to understand factors influencing the selection and retention of engineering careers among Latino/as and women.

Social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994; 2000) is a highly utilized vocational theory that explains the development of career interests, career choices, and performance attainment within a career domain. Numerous studies have tested SCCT propositions to better understand the development of interests and goals within the STEM domains of engineering, computing, and biology with college student samples (e.g., Byars-Winston, Estrada, Howard, Davis & Zalapa, 2010; Lent et al., 2003; 2005; Lent, Lopez, Lopez, Sheu, 2008; Lent, Lopez, Sheu, Lopez, 2011; Lent, Sheu et al., 2008; Lent, Sheu, Gloster, & Wilkins, 2010; Lent, Singley, Sheu, Schmidt, & Schmidt, 2007). In addition to contextual and person-level variables, social cognitive variables play a central role in SCCT. Embedded within SCCT is Bandura's self-efficacy theory (1977, 1986), which hypothesizes that self-efficacy beliefs (e.g., confidence in one's ability to successfully perform career-related tasks) and outcome expectations (e.g., anticipated outcomes of a particular behavior) develop from four sources, or learning experiences (i.e., prior performance accomplishments, vicarious learning, verbal persuasion, and low levels of emotional arousal). Differential exposure to or access to these four sources may be influenced by personal demographics and life circumstances, leading to discrepancies in levels of self-efficacy and outcome expectations between groups, and ultimately, differences in career interests, goals, and performance (Lent et al., 1994). Levels of self-efficacy and outcome expectations may, in part, explain the racial/ethnic and gender disparities present in engineering between Latino/as and Whites and men and women. Given the underrepresentation of Latino/as and women in engineering, the current study investigates if engineering-related learning experiences differentially impact engineering-related self-efficacy and outcome expectations across racial/ethnic and gender groups.

The majority of SCCT research has examined the relations among the core variables in the model (i.e., self-efficacy, outcome expectations, interests, and choice goals) and has largely provided support for the relations among these variables. Prior research in the domain of engineering regarding the effects of outcome expectations on interests and goals has been inconsistent, with some reporting positive effects on interests and/or goals (Byars et al., 2010; Lent et al., 2005) and others reporting nonsignificant relations between these variables (Lent et al., 2003; 2007; 2010; Lent, Sheu et al., 2008). On the other hand, SCCT engineering research supports the relations between self-efficacy and interests (Byars et al.; Lent et al., 2003; 2005; 2010; Lent Sheu et al., 2008) and goals (e.g., Lent et al., 2003; 2005; 2007; 2010; Lent, Sheu et al. 2008). Given the associations between self-efficacy and outcome expectations to interests and goals, understanding ways to modify or increase engineering-related self-efficacy beliefs and positive expectations for outcomes related to engineering pursuits may be fruitful avenues for increasing the representation of Latino/as and women in engineering fields.

While a number of SCCT engineering-related studies have examined the effects of self-efficacy and outcome expectations on career interests and goals, few have explored the precursors to self-efficacy or have tested the relations of SCCT variables across time. With some exceptions (e.g., Alliman-Brissett & Turner, 2010; Gainor & Lent, 1998; Nauta, Epperson, &

Kahn, 1998), several have examined only one learning experience, prior performance accomplishments (Ferry, Fouad, & Smith, 2000; Navarro, Flores, & Worthington, 2007; Nauta & Epperson, 2003; Schaefers, Epperson, & Nauta, 1997). Also, with the exception of Schaefers et al., none of these prior studies focused solely on engineering students. In an effort to understand how to attract and retain Latino/as and women to engineering, the current study uses longitudinal data to test a model based on the portion of SCCT related to Bandura's theory. Specifically, the current study explores the role of engineering-related learning experiences in the development of engineering-related self-efficacy and engineering-related outcome expectations among a sample of engineering students. Findings from this study will contribute knowledge regarding the effects of learning experiences on self-efficacy beliefs and outcome expectations, and can lead to the development of educational interventions with Latino/as and girls/women to increase their self-efficacy in engineering tasks and expectations for positive outcomes in engineering.

Most engineering-related SCCT research has focused on engineering specific or math/science domains. Another route for examining engineering interests and career choices is to utilize Holland's (1997) RIASEC theory by focusing on Realistic and Investigative domains. Because both Realistic and Investigative activities are prominent in engineering careers and highly related to engineering environments, these domains can be used to assess relations among SCCT variables with engineering samples. A meta-analysis indicated that in both the Realistic and Investigative domains, self-efficacy and outcome expectations had positive effects on interests and goals, respectively, supporting SCCT propositions (Sheu et al., 2010).

Recent studies have extended the SCCT literature by testing precursors of RIASEC learning experiences (Schaub & Tokar, 2005; Thompson & Dahling, 2012; Tokar, Thompson, Plaufcan, & Williams, 2007) and the effects of RIASEC learning experiences on corresponding self-efficacy and outcome expectations (Schaub & Tokar; Thompson & Dahling; Williams & Subich, 2006). This literature supports the association between RIASEC learning experiences and self-efficacy and outcome expectations. Realistic and Investigative learning experiences were positively related to Realistic and Investigative self-efficacy, respectively, (Schaub & Tokar, 2005; Thompson & Dahling, 2012; Williams & Subich, 2006) and Realistic (Schaub & Tokar; Thompson & Dahling) and Investigative outcome expectations, respectively (Thompson & Dahling). Williams and Subich found that women indicated lower levels of Realistic and Investigative performance accomplishments and higher levels of Realistic and Investigative physiological arousal than males. Women also indicated lower levels of Realistic verbal persuasion and Investigative vicarious learning than men (Williams & Subich). The SCCT literature in the RIASEC domain is limited, however, in that the studies have been cross-sectional and have used general college student samples. Moreover, none of the studies have included diverse samples to test for racial/ethnic differences. Thus, whether the relations from Realistic/Investigative learning experiences to both Realistic/Investigative self-efficacy and outcome expectations can be generalized to engineering students remains unknown.

To summarize, the current study tests two SCCT-based models. Specifically, we investigate whether Realistic (and Investigative) performance accomplishments, vicarious learning, verbal persuasion and physiological arousal significantly predict Realistic (and Investigative) self-efficacy and outcome expectations over time. Further, we examine whether race and gender moderate the relations between the four Realistic/Investigative learning experiences and corresponding self-efficacy beliefs and outcome expectations.

Method

Participants

A total of 575 [397 male (69%), 177 female (30.8%), 1 missing data] engineering students attending a public university in the Southwest region of the United States participated in the study. Most indicated their race/ethnicity as Latino/a (n =307; 53.4%), with 228 (39.7%) White and 40 (7%) as bi- or multiracial (including Latino/a and/or White). The sample consisted of the following engineering majors: 67 (11.7%) Chemical, 87 (15.1%) Civil, 105 (18.3%) Electrical and Computer, 7 (1.2%) Engineering Physics, 45 (7.8%) Engineering Technology, 14 (2.4%) Industrial, 112 (19.5%) Mechanical, 105 (18.3%) Aerospace, 5 (0.9%) Surveying, and 12 (2.1%) “other” engineering [16 (2.8%) had missing data]. Their ages ranged from 18-34 years (M = 21.58; SD = 3.13). The sample consisted of 94 first year (16.3%), 117 second year (20.3%), 153 third year (26.6%), and 153 fourth year (26.6%) students. Twelve (2.1%) students reported “other” (e.g., students beyond their 4^{th} year of study, students seeking a second degree), and 46 had missing data (8%). White and Latino/a participants, respectively, self-identified their social class as follows: 165 (72.4%) and 180 (58.6%) were middle class, 26 (11.4%) and 95 (30.9%) were working class, 14 (6.1%) and 10 (3.3%) were upper class, and 23 (10.1%) and 22 (7.2%) had missing data. Of the Latino/as, their generation status was: 78 (25.4%) first-generation, 88 (28.7%) second-generation, 18 (5.9%) third-generation, 37 (12.1%) fourth-generation, 65 (21.2%) fifth-generation. The remaining 21 (6.8%) did not report generation.

Measures

Realistic and Investigative learning experiences. The Learning Experience Questionnaire (LEQ; Schaub 2003; Schaub & Tokar, 2005) assesses the four sources of learning experiences (i.e., performance accomplishments, vicarious learning, verbal persuasion, and physiological/emotional arousal) across the 6 subscales representing each Holland theme. Sample items include “I have made repairs around the house” (Realistic performance accomplishments) and “While growing up, I recall seeing people I respected reading scientific articles” (Investigative vicarious learning). There are five items per learning experience within each Holland theme, or 20 items for each Holland theme. Only the 40 items of the Realistic and Investigative subscales were used as these two themes are most closely associated with engineering activities. The Realistic and Investigative subscales were administered at Time 1. Participants were asked to refer to all of their prior educational experiences and to indicate their agreement with each item using a 6-point Likert-type scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Scores for each type of Realistic and Investigative learning experience are averaged, and high scores indicate high levels of the specific type of learning experiences for the respective theme. LEQ items were assessed by three expert psychologists in vocational research for content and construct validity. Schaub and Tokar (2005) reported internal consistency estimates of .84 and .86 for the Realistic learning experiences scores for men and women, respectively. Alphas of .74 were reported for the Investigative learning experience scale score for both men and women samples. In addition, coefficients reported in other studies using university student samples ranged from .76 to .90 (Thompson & Dahling, 2012; Williams & Subich, 2006). LEQ scores have been reported to have positive relations to corresponding RIASEC themes on measures of self-efficacy and outcome expectations (Williams & Subich).

Realistic and Investigative self-efficacy. The career self-efficacy measure designed by Lenox and Subich (1994) was administered at Time 2 and assesses self-efficacy across the six Holland themes (5 items per Holland theme). For this study, only the 10 items from the Realistic and Investigative themes were used as these are more closely associated with engineering activities. Participants were asked to indicate their belief in their abilities to complete activities such as using logarithmic tables and programming a computer to study a scientific problem using a scale ranging from 1 (*completely unsure*) to 10 (*completely sure*). Scores are averaged for each subscale; high scores indicate high levels of self-efficacy for the respective theme.

Coefficient alphas of .88 and .79 were reported for Realistic and Investigative scale scores (Lenox & Subich, 1994). In addition, validity was supported as both the Realistic and Investigative scales were positively associated with each other (Lenox & Subich). Among diverse college students, internal consistencies between .89 and .91 have been reported for the Realistic subscale and .70 and .82 for Investigative subscale (Betz & Gwilliam, 2002; Flores, Robitschek, Celebi, Andersen, & Hoang, 2010; Williams & Subich, 2006). Flores et al. reported that Realistic and Investigative self-efficacy were positively correlated to corresponding interest and goal scores among Mexican American college students.

Realistic and Investigative outcome expectations. The subscales assessing Realistic and Investigative outcome expectations were derived from the Occupational Self-Efficacy Beliefs scale (Gore & Leuwerke, 2000). This measure consists of 84 occupational titles with 14 occupations representing each of Holland's six work-personality types. In the current study, a total of 28 occupations were provided, with 14 occupations representing the Realistic and Investigative subscales of Holland's typologies. The instructions included a brief explanation of outcome expectations, and participants were then asked to rate the degree to which they would get what they wanted in a given occupation (e.g. airplane mechanic, physicist) on a 9-point scale ranging from 1 (*not very much)* to 9 (very *much).* Scale scores are the averaged responses of the 14 items corresponding with each subscale; high scores reflect the expectation of positive outcomes for careers within a Holland theme. Gore and Leuwerke reported adequate internal consistency reliability coefficients of .91 (Realisitc) and .94 (Investigative) for a sample of college students. In addition, occupational outcome expectations were positively correlated with occupational self-efficacy and occupational considerations (Gore & Leuwerke).

Demographic survey. A demographic survey was included to obtain participants' age, gender, race/ethnicity, major, year in college, and generation status.

Procedures

All engineering students enrolled in a university located in the Southwest were invited to participate in an online survey administered in Spring 2011 (Time 1). Brief presentations were made in key engineering courses across all levels and emails were sent to students inviting them to participate. Additional recruitment efforts were implemented for female students only by sending postcards and text messages and placing phone calls. In Summer 2012 (Time 2), emails were sent to all participants in the Time 1 survey to complete an online survey. Again, postcards were sent and phone calls were made to female students to increase their participation at Time 2. The retention rate of participants from Time 1 to Time 2 was 69.3%.

Results

Preliminary Data Analyses

Data screening. The initial data set of 604 participants was screened for the presence of univariate, multivariate, and age outliers. Participants with z-scores greater than 3.3 on any of the main variables at either Time 1 or Time 2 or age were considered outliers. These analyses resulted in the deletion of 3 univariate and 11 age outliers. Based on a review of Mahalanobis Distance scores, 11 participants were identified as multivariate outliers and deleted, resulting in a data set of 585 participants. Next, we examined the main variables for skewness or kurtosis. The statistics associated with skewness suggested that there were 4 variables that were highly skewed (greater than 1 or less than -1) and 8 variables that were moderately skewed (between 0.5 and 1 or between -1 and -0.5). However, there was no evidence of univariate kurtosis based on associated statistics (< -2 or > 2). In the presence of univariate skewness and the possibility of multivariate skewness or kurtosis, the maximum likelihood estimation with robust standard errors (MLR) was used in all model testing as it is robust to non-normal data.

Missing data. Using the multiple imputation feature in SPSS 20.0, we screened the data for missing values finding 3188 missing values out of 10,852 in 259 out of 585 cases across the 24 variables of interest in the study. The percentage missing ranged from 6.5% and 39.3%. One of the major reasons for this missingness was attrition from Time 1 to Time 2. Ten participants did not complete data associated with this particular study at either Time 1 or Time 2 and were dropped from the present study. There were 214 participants who only participated in Time 1, 23 participants who only participated in Time 2, and 338 participants who participated in both Time 1 and Time 2. Responses from 575 participants were retained for further analyses.

We conducted further analyses to determine if the data were missing completely at random (MCAR) or missing at random (MAR) by comparing those with no data at Time 2 (missing) to those with data at Time 2 (nonmissing). First, a multivariate analyses of variance was performed finding no significant differences across the five continuous variables at Time 1 by missingness [$\lambda = .967$ $F(12, 526) = 1.34$, $p > .05$]. Second, a t-test was conducted finding that GPA at the time of data collection differed [$t(356.5) = -2.06$, $p < .05$]; those who participated in both Time 1 and Time 2 ($M = 3.14$, $SD = .76$) had significantly higher GPAs than those who only participated in Time 1 ($M = 2.98$, $SD = .90$). The pattern of missingness at Time 2 was not related to the variables modeled in the present study; however, because the larger study focused on persistence in engineering, GPA appears to be an unmodeled variable that is relevant to participants' attrition from Time 1 to Time 2 suggesting that the data are MAR. Enders (2010) recommended that full information maximum likelihood (FIML) be used in statistical analyses to address this pattern of missingness. Taking into account both the non-normal data and the pattern of missingness, we used maximum likelihood estimation with robust standard errors (MLR) in the MPlus 6.11 program because it uses FIML in the presence of missing values to calculate parameter estimates with standard errors.

Gender and racial/ethnic group information. We examined the data by gender and racial/ethnic group to determine the sample size for subsequent multiple group analyses. One person identified their gender as "other." Therefore, a total of 574 participants (177 women, 397 men) were included in gender analyses. In terms of race/ethnicity, 40 participants identified as multiracial and were excluded from further racial/ethnic analyses by due to their small numbers, leaving a total of 535 participants (307 Latino/a, 228 White) for analyses by race/ethnicity.

We then conducted a series of one-way multivariate analyses of variance to determine if there were gender and racial/ethnic differences across variables of interest at Time 1 and Time 2, respectively. At Time 1, results revealed no racial/ethnic differences in Realistic-related and Investigative-related variables [$\lambda = .97$, $F(12, 488) = 1.25$, $p > .05$, $\eta^2 = .03$, where η^2 is the multivariate effect size]. Gender differences did emerge across these same variables [$\lambda = .85$, $F(12, 525) = 7.90$, $p < .001$, $\eta^2 = .15$]. Follow-up univariate analyses demonstrated that males reported more past performance accomplishments, verbal persuasion, and greater physiological arousal in both Realistic and Investigative domains as well as greater Realistic self-efficacy and outcome expectations than their female peers. On the other hand, females reported greater Investigative outcome expectations than their male peers See Table 1 for the means and standard deviations for the measured variables by gender and race/ethnicity. See Tables 2 and 3 for the correlations among the variables by gender and race/ethnicity for the Realistic and Investigative domains, respectively. Correlations for the full sample can be obtained from the first author.

Primary Analyses

Two models were tested across gender and racial/ethnic groups. The first model consisted of relations among the four sources of learning experiences, self-efficacy, and outcome expectations in the Realistic domain (hereafter called the Realistic model), and the second model consisted of the same relations within the Investigative domain (hereafter called the Investigative model). Each model included covariances (bidirectional paths between different variables at the same time period), autoregressive paths (paths between the same variables across Time 1 and Time 2), and cross-lagged paths (paths between different Time 1 and Time 2 variables; see Figure 1). We conducted a series of multiple group analyses using path analytic techniques to determine if the paths within each model were moderated by gender and then by race/ethnicity. The data for each model was analyzed using the MLR and FIML estimation methods via MPlus 6.1. Each model was fit using separate covariance matrices for each gender or racial-ethnic group and tested using increasingly restrictive parameter sets [i.e., no path constraints (unconstrained) to constraints on select paths (partially constrained) to full constraints across the specific groups (fully constrained)]. Regardless of the type of model constraints, the covariances within in the model were allowed to covary as to not be overly restrictive. Chi-square difference tests were used to compare and determine which model (i.e., unconstrained, partially unconstrained, or fully constrained) to retain (Kline, 2005) for the Realistic and Investigative models across gender and racial-ethnic groups, respectively. Given the use of FIML and MLR estimation procedures, the chi-square difference tests were calculated using an equation based on the loglikelihood values, scaling correction factors, number of free parameters, and degrees of freedom of each nested (i.e., more restrictive) and comparison (i.e., less restrictive) model (Satorra, 2000).

Model fit also was assessed using a series of fit indices to ensure more reliable and accurate decisions when choosing models and interpreting findings (Martens, 2005). One fit index is the chi-square test of significance (χ^2), which is expected to produce a small nonsignificant χ^2 if there is an adequate fit to the data. However, given the sensitivity of χ^2 to sample size and lack of standardization, it is difficult to interpret (Kline, 2005). Therefore, we calculated a normed χ^2 (i.e., χ^2/df) to reduce the sensitivity to sample size where a ratio of less than 3.0 is indicative of a good model fit (Kline, 2005). A second fit index is the Comparative Fit Index (CFI), which ranges from 0 to 1; values $\geq$ .90 represent an adequate fit to the data and $\geq$ .95 represents good fit (Loehlin, 1998). Finally, the standardized residual root-mean residual (SRMR) and Steiger's root-mean-square error of approximation (RMSEA) also ranged from 0 to 1, but with lower numbers indicating better fit to the data. SRMR and RMSEA values of $\leq$ .10 and $\leq$ .06 are indicative of a good model fit, and values of $\leq$ .08 and $\leq$ .05 suggest an excellent or close fit (Loehlin, 1998; Steiger, 1998). We determined model fit based on a preponderance of the evidence. See Table 4 for the summary of fit indices for each model tested.

Gender as a moderator in the hypothesized models.

Realistic model. Using FIML and MLR, we tested the unconstrained Realistic model (all paths were allowed to vary by gender), which was determined to have an adequate fit to the data [$\chi^2(42) = 113.36$, $p < .001$; $\chi^2/df = 2.70$; RMSEA = .08 (.060, .094); CFI = .95; SRMR = .10]. Next, we constrained one parameter (e.g., autoregressive or cross-lagged path) at a time to determine if there were gender differences in these relations within the model. Using an alternative chi-square test of difference (Satorra, 2000), we compared the unconstrained model to each model in which one path was constrained across both genders. Only the autoregressive path from Time 1 to Time 2 Realistic past performance accomplishments varied by gender. That is, the relation between Realistic past performance accomplishments over time was significant for both genders, but was stronger for women (.80) than for men (.69). Based on this finding, we tested a partially constrained Realistic model allowing this autoregressive path to vary by gender and constraining the other paths. Again, the partially constrained model was an adequate fit to the data [$\chi^2(56) = 136.64$, $p < .001$; $\chi^2/df = 2.44$; RMSEA = .07 (.056, .086); CFI = .94; SRMR = .10]. We then tested a model where the paths were constrained to be equal across groups, again finding an adequate fit to the data [$\chi^2(57) = 144.75$, $p < .001$; $\chi^2/df = 2.54$; RMSEA = .07 (.059, .088); CFI = .93; SRMR = .10].

To determine which model fit the data better, we first compared the unconstrained model to the partially constrained model, again using the alternative chi-square test of difference. This comparison resulted in a non-significant change in the chi-square [χ^2_{Trd} (14) = 23.49, $p > .05$] suggesting no detectable differences between these two models. Next, we compared the unconstrained model to the fully constrained model, which resulted in a significant change in chi-square [χ^2_{Trd} (15) = 31.70, $p < .05$]. This suggested that gender may moderate relations within the Realistic model. To determine if gender did moderate the relations in the model, the partially constrained model was compared to the fully constrained model resulting in a significant change in chi-square [χ^2_{Trd} (1) = 16.12, $p < .05$], suggesting a detectable difference between models. We concluded that gender moderated the autoregressive path of past performance accomplishments.

Although each Realistic model was an adequate fit to the data, we retained the partially constrained model based on slightly better fit indices and the ability to provide more rich information about gender differences in the relation of past performance accomplishments over time. Relations within the partially constrained Realistic model explained 9.2% and 5.3% of the variance in self-efficacy and 33.2% and 35.2% of the variance in outcome expectations for women and men, respectively, in this sample. See Table 5 for standardized path coefficient by gender for the partially constrained model.

Investigative model. We then tested the unconstrained Investigative model, which had an adequate fit to the data [$\chi^2(42) = 102.77$, $p < .001$; $\chi^2/df = 2.45$; RMSEA = .07 (.054, .089); CFI = .94; SRMR = .08]. Next, we constrained one parameter at a time to determine if there were gender differences in the relations in the Investigative model. We then compared the unconstrained model to each model in which one path was constrained across both genders using the alternative chi-square test of difference and found no significant differences in chi-square. The lack of significant chi-square differences suggests that gender did not moderate any of the relations in the Investigate model. This findings was supported when we compared the unconstrained model to the fully constrained model [$\chi^2(57) = 115.68$, $p < .001$; $\chi^2/df = 2.03$; RMSEA = .06 (.044, .076); CFI = .94; SRMR = .08] finding a non-significant chi-square change [$\chi^2_{Trd}(15) = 13.49$, $p < .05$]. Thus, we retained the fully constrained model given there were no detectable differences in relations by gender. Relations in the fully constrained Investigative model explained 10.0% and 5.0% of the variance in self-efficacy and 38.2% and 35.3% of the variance in outcome expectations for women and men, respectively, in this sample. See Table 5 for standardized path coefficient by gender for the fully constrained Investigative model.

Race/Ethnicity as a moderator in the hypothesized model.

Realistic model. We tested whether race/ethnicity moderated the relations in the Realistic model. First, after examining the goodness-of-fit indices, we found that the unconstrained model fit the data well [$\chi^2(42) = 80.12$, $p < .001$, $\chi^2/df = 1.91$; RMSEA = .06 (.038, .077); CFI = .97; SRMR = .07]. Next, we constrained one parameter at a time to see if there were racial-ethnic differences in the relations within the model. Using the alternative chi-square test of difference, two significant path differences emerged—the verbal persuasion autoregression and the direct path from Time 1 verbal persuasion to Time 2 self-efficacy. The relation between Realistic verbal persuasion over time was significant for both racial-ethnic groups, but was stronger for Whites (.71) than for Latino/as (.58). Also, verbal persuasion positively predicted self-efficacy for Latino/as (.13) and negatively predicted self-efficacy for Whites (-.13), but these relations were nonsignificant for both groups. Based on this finding, we tested a partially constrained model allowing the verbal persuasion autoregressive path and the path from Time 1 verbal persuasion to Time 2 self-efficacy to vary by race/ethnicity and constraining the other paths. Again, the partially constrained model was an excellent fit to the data [$\chi^2(55) = 89.13$, $p < .01$; $\chi^2/df = 1.62$; RMSEA = .05 (.029, .066); CFI = .97; SRMR = .08]. We then tested a model where the paths were constrained to be equal across groups again finding an excellent fit to the data [$\chi^2(57) = 97.48$, $p < .001$; $\chi^2/df = 1.71$; RMSEA = .05 (.033, .069); CFI = .97; SRMR = .08].

To determine which model fit the data better, we first compared the unconstrained model to the partially constrained model, resulting in a non-significant chi-square change [χ^2_{Trd} (13) = 10.97, $p > .05$] and suggesting no detectable differences between the two models. Next, we compared the unconstrained model to the fully constrained model, which resulted in a non-significant chi-square change [χ^2_{Trd} (15) = 18.42, $p > .05$]. Finally, we compared the partially constrained model to the fully constrained model resulting in a significant change in chi-square [χ^2_{Trd} (1) = 16.12, $p < .05$], suggesting a detectable difference between models. Therefore, we concluded that race/ethnicity did moderate the autoregressive path of verbal persuasion and the direct path from Time 1 verbal persuasion to Time 2 self-efficacy in the Realistic model.

Although each Realistic model was an adequate fit to the data, we retained the partially constrained model based on slightly better fit indices and the ability to provide richer information about racial-ethnic differences. Relations within the partially constrained Realistic model explained 12.2% and 7.8% of the variance in self-efficacy and 33.8% and 44.1% of the variance in outcome expectations for Latino/as and Whites, respectively, in this sample. See Table 5 for standardized path coefficient by racial/ethnic group for the partially constrained model.

Investigative model. Finally, we tested whether race/ethnicity moderated the relations within the Investigative model. First, we tested the unconstrained Investigative model, which had an adequate fit to the data [$\chi^2(42) = 95.02$, $p < .001$; $\chi^2/df = 2.26$; RMSEA = .07 (.050, .087); CFI = .94; SRMR = .08]. Next, we constrained one parameter at a time to determine if there were racial/ethnic differences in the relations within the Investigative model. We compared the unconstrained model to each model in which one path was constrained across both groups using the alternative chi-square difference test finding one significant difference in the autoregressive path of self-efficacy. Specifically, the relation between Investigative self-efficacy over time was significant for both racial-ethnic groups, but was stronger for Whites (.43) than for Latino/as (.16). We found that a partially constrained model allowing the self-efficacy autoregressive path to vary by race/ethnicity and constraining the other paths was an excellent fit to the data [$\chi^2(56) = 105.11$, $p < .01$; $\chi^2/df = 1.88$; RMSEA = .06 (.040, .074); CFI = .95; SRMR = .08]. The model where the paths were constrained to be equal across groups also was an adequate fit to the data [$\chi^2(57) = 112.18$, $p < .001$; $\chi^2/df = 1.97$; RMSEA = .06 (.044, .077); CFI = .94; SRMR = .09].

To determine which model fit the data better, we compared the unconstrained model to the partially constrained model, again using the alternative chi-square difference test. This comparison resulted in a non-significant change in the chi-square [χ^2_{Trd} (14) = 10.75, $p > .05$] suggesting no detectable differences between these two models. Next, we compared the unconstrained model to the fully constrained model, which resulted in a non-significant change in chi-square [χ^2_{Trd} (15) = 17.66, p > .05]. Finally, we compared the partially constrained model to the fully constrained model resulting in a significant change in chi-square [χ^2_{Trd} (1) = 7.34, p < .05], suggesting a detectable difference between models. Therefore, we concluded that race/ethnicity did moderate the autoregressive path of self-efficacy.

Although each Investigative model was an adequate fit to the data, we retained the partially constrained model based on slightly better fit indices and the ability to provide richer information about racial/ethnic differences. Relations in the partially constrained Investigative model explained 5.9% and 20.6% of the variance in self-efficacy and 37.0% and 39.0% of the variance in outcome expectations for Latino/as and Whites, respectively. See Table 5 for standardized path coefficient by race/ethnicity for the partially constrained Investigative model.

Discussion

To better understand the underrepresentation of women and Latino/as in engineering, the current study examined longitudinal effects between engineering-related learning experiences and self-efficacy and outcome expectations among a sample of engineering students at a HSI and explored whether gender and race/ethnicity moderated the relations among these variables. This study adds to the literature by (a) examining the effects of learning experiences on self-efficacy and outcome expectations over time, (b) focusing on a portion of the SCCT model that has rarely been tested, and (c) exploring differences in the model across gender and racial/ethnic groups.

After controlling for the effects of Time 1 variables on the respective Time 2 variables, the findings indicated that Time 1 low emotional arousal was a significant predictor of Time 2 Realistic self-efficacy, and Time 2 Realistic outcome expectations were predicted by all four Time 1 learning experiences. Contrary to hypotheses, Time 1 performance accomplishments, vicarious learning, and verbal persuasion were not significantly related to Time 2 Realistic self-efficacy, and Time 1 Realistic self-efficacy had no significant effects on Time 2 Realistic outcome expectations. Neither gender nor race/ethnicity moderated the cross-lagged paths in the model, however, the relation between Realistic performance accomplishments across time was significant for both genders, but stronger for women than men. Historically, women have not been afforded the same opportunity as men to engage in engineering-related tasks. Perhaps, once women have successfully performed engineering-related tasks, they seek out more of these opportunities and maintain their active involvement in such tasks over time at a greater rate than men. Additionally, Realistic verbal persuasion across time was significant for both racial groups, but stronger for Whites than Latino/as. Although family, friends, and professors appear to be verbally encouraging engineering students' progress in the field regardless of race, such reinforcement and encouragement appears to be more prominent for Whites. The high representation of Whites in engineering may serve as a strong reinforcement over time for White students when compared to their Latino/a peers.

For the Investigative model, Time 1 vicarious learning, verbal persuasion and emotional arousal had significant effects on Time 2 Investigative self-efficacy, but Time 1 performance accomplishment was not a significant predictor across White and Latino/a students. Contrary to hypotheses, none of the Time 1 learning experience variables nor Time 1 Investigative self-efficacy were predictive of Time 2 Investigative outcome expectations for Latino/as or women in our sample. Again, although the cross-lagged paths in the Investigative model did not vary by gender or race/ethnicity, the relation between Investigative self-efficacy across time was significant for both racial groups, but was stronger for Whites than Latino/as. These findings suggests that gains in self-efficacy are not maintained across time for Latino/as at the same rate as Whites and may be related to engagement in a nontraditional field of study in which Latino/as have less exposure and a less clear sense of their ability to succeed than their White peers. Engineering educators may need to provide positive affirmation to Latino/a students to maintain their self-efficacy over time.

Consistent with Bandura's theory and previous research, vicarious learning (Nauta et al., 1998; Williams & Subich, 2006), verbal persuasion (Ferry et al., 2000; Gainor & Lent, 1998; Williams & Subich) and physiological arousal (Gainor & Lent; Williams & Subich) were related to perceived Realistic outcome expectations and Investigative self-efficacy for Latino/a and women engineering students in our sample. All of these relations were in the hypothesized direction, with the exception of the negative relation between vicarious learning and Realistic outcome expectations. Given that most of this previous research was done with general college samples, it is possible that the present study's findings highlight the characteristics of our sample and the unique aspects of an engineering learning environment at HSI. That is, the learning environment at a HSI that includes significant numbers of Latino/a students and both Latino/a and women faculty may provide engineering students opportunities to (a) observe both fellow students and faculty from similar backgrounds model engineering tasks, (b) receive encouragement and support for engaging in engineering-related activities, and (c) learn strategies for coping with stress. These three learning sources appear to be critical to the development of engineering students' Realistic outcome expectations and Investigative self-efficacy. With regard to the negative relation between vicarious learning and Realistic outcome expectations, the larger environmental context may explain this unexpected finding. That is, living in an economically depressed state might expose these students to engineers who have struggled or who have encountered negative career barriers.

These findings have important implications for the development of educational interventions that are based on SCCT (Lent et al., 1994; 2000) and self-efficacy theory (Bandura, 1977; 1986) to promote the retention of women and Latino/as in engineering. Specifically, such interventions should target both self-efficacy and outcome expectations. Indeed, a prior study indicated that an intervention that incorporated all four learning experiences was effective in increasing Realistic self-efficacy beliefs among women college students (Betz & Schifano, 2000), albeit they did not focus on outcome expectations—a key to persistence in SCCT. Because women and Latino/as are underrepresented in engineering fields, they have fewer opportunities to observe others who are like them succeeding in engineering roles and tasks. Our data suggests that other women and Latino/as that they do encounter who are engaged in engineering related activities may serve as very powerful role models. A HSI may naturally provide these types of role models for women and Latino/as through their student and faculty composition. Other educational institutions should make efforts to exposure these students to other women and Latino/as in engineering early in their education. Programs that pair young girls and Latino/a youth with women and Latino/a engineering students or engineers in the workplace and allow them to shadow them in their day-to-day activities can serve as a powerful learning opportunity for students from underrepresented groups in engineering.

Educators can also work to identify women and Latino/a students with talents in math and science and encourage them to consider careers in engineering. Often because of the lack of role models in the field, these students may disregard engineering as a viable career; the active encouragement of family and teachers to pursue engineering may make a difference in entering the field. For those who have already selected engineering as a major of study, educational programs need to ensure that women and Latino/a students are receiving appropriate support and encouragement for their participation in engineering-related activities from instructors and other significant adults. Finally, programs can solicit outside experts with mental health training to teach engineering students, particularly women and Latino/as, stress management skills to appropriately manage anxiety that they might experience during the course of their educational and practical training. This latter skill is especially important as it was the only learning experience that produced a significant path to Realistic self-efficacy for all groups.

Our findings also replicated those from prior studies (Ferry et al., 2000; Williams & Subich, 2006) that indicated that previous performance accomplishments effected Realistic outcome expectations. Interestingly, although Bandura hypothesizes that performance accomplishments has the strongest effect of the four sources on self-efficacy and outcome expectation development, this learning experience was not significantly related to Realistic or Investigative self-efficacy or to Investigative outcome expectations with this sample. Thus, while opportunities to practice engineering-related tasks may be important in engineering students' development of positive expectations related to pursuing Realistic activities, its effects on Investigative self-efficacy and outcome expectations does not appear to be as strong as other learning experiences among engineering students at a HSI.

Consistent with expectations and prior research (Williams & Subich, 2006), low levels of physiological arousal produced a significant path to Realistic self-efficacy for all groups. Unexpectedly, however, emotional arousal was the only significant predictor of Realistic self-efficacy. It has been well documented that women and minorities face a "chilly climate" in traditionally White male-dominated fields, such as engineering, where they face bias and discrimination (e.g., Fouad, Singh, Fitzpatrick, & Lou, 2012; Camacho & Lord, 2011). Such bias and discrimination may lead to increased emotional arousal, which can distract from selfconfidence. Hence, effectively managing reactions to bias and discrimination may result in greater engineering-related self-efficacy. For Latina/o engineering majors in our study, their enrollment in a HSI may help to alleviate some concerns related to bias and discrimination given that HSIs historically have better rates of hiring faculty from underrepresented groups and graduating Latino/a students than other types of institutions (Camacho & Lord). Thus, they may be less emotionally aroused on a daily basis, which positively predicts their self-efficacy.

Our findings suggest that both Realistic outcome expectations and Investigative self-efficacy receive more input from the learning experiences than Realistic self-efficacy and Investigative outcome expectations in the learning and social context from which the participants were drawn. These findings suggest that the four sources of self-efficacy and outcome expectations have differential effects on these outcomes among our sample of engineering students attending a HSI. These findings should be replicated with other samples of engineering students to determine if these are domain-driven findings or if these results are sample-specific.

The study's findings should be understood in the context of its limitations. First, participants were drawn from a single HSI in the Southwest region of the U.S. and thus, the findings may be restricted to engineering majors attending similar universities in terms of size, admissions criteria, and student demographic characteristics. Future research is needed to examine if these findings can be generalized to engineering students at other HSI institutions. Second, the tested model focused on two domains related to engineering, Realistic and Investigative activities. Although the Realistic and Investigative measures tapped into activities related to engineering, some of the items may be associated with other Realistic and Investigative careers. Future studies might explore these research questions with engineering-specific measures. Third, the current sample included students across all levels of education.

Future research can examine whether cohort effects the relations within the model, as students who are further in their studies are likely to have had a high amount of learning opportunities through their undergraduate training. Finally, participants included only college students who had declared engineering as a major. Future studies should use younger samples (i.e., middle and high school students) at earlier stages of the career development to determine if the relations among these variables are consistent at stages prior to declaring a college major.

To summarize, the current study adds to the SCCT literature in the engineering domain by testing the temporal relations among the variables across a significant period of time with a sample of engineering students attending a HSI. The findings of our study suggested that the hypothesized models explaining the cross-lagged effects on engineering-related self-efficacy and outcome expectations were similar across White and Latino/a engineering students and across men and women engineering students in the current sample. These findings provide strong support for the utility of the SCCT model in developing empirically based educational interventions to promote the recruitment and retention of women and Latino/as into engineering.

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Table 1

Means and standard deviations of variables across gender and racial/ethnic groups

	Men		**Women**		**Latino/as**		**Whites**	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
T1_RPPA	5.14	.82	4.58	.94	4.95	.83	5.00	.99
T1_RVL	4.98	.85	4.92	.87	4.89	.86	5.03	.85
T1_RVP	4.53	.97	4.20	1.04	4.36	1.01	4.53	1.00
T1_REA	4.27	1.08	4.03	.96	4.15	1.03	4.24	1.08
T1_RSE	7.94	1.97	6.65	2.31	7.43	2.10	7.64	2.30
T1_ROE	3.90	1.39	3.27	1.49	3.73	1.52	3.68	1.37
T2_RPPA	5.19	.80	4.63	.99	4.93	.89	5.11	.91
T2_RVL	5.09	.81	5.04	.87	4.95	.88	5.20	.76
T2_RVP	4.54	1.02	4.20	1.12	4.30	1.05	4.58	1.06
T2_REA	4.24	1.10	4.28	1.01	4.29	1.03	4.21	1.08
T2_RSE	8.19	1.32	7.89	1.77	8.09	1.49	8.09	1.50
T2_ROE	4.09	1.53	3.37	1.45	3.97	1.65	3.72	1.35
T1_IPPA	4.69	.68	4.73	.65	4.67	.70	4.75	.63
T1_IVL	4.09	1.03	4.25	.97	4.12	1.10	4.19	.88
T1_IVP	4.24	.91	4.33	.94	4.22	1.00	4.32	.83
T1_IEA	4.14	.96	4.14	.96	4.05	.96	4.23	.97
T1_ISE	7.90	1.44	7.76	1.52	7.85	1.49	7.86	1.47
T1_IOE	3.82	1.67	4.10	1.74	3.99	1.83	3.82	1.59
T2_IPPA	4.77	.66	4.80	.65	4.73	.69	4.85	.61
T2_IVL	4.16	1.04	4.16	.99	4.09	1.06	4.25	.93
T2_IVP	4.34	.93	4.35	.93	4.26	.99	4.45	.85
T2_IEA	3.91	.75	3.97	.74	3.91	.72	3.96	.77
T2_ISE	8.20	1.74	6.89	2.50	7.72	2.03	7.75	2.29
T2_IOE	4.12	1.72	4.12	1.90	4.22	1.88	4.10	1.62

T1 = Time 1; T2 = Time 2; RPPA = Realistic Past Performance Accomplishments; RVL = Realistic Vicarious Learning; RVP = Realistic Verbal Persuasion; REA = Realistic Emotional Arousal; RSE = Realistic Self-Efficacy; ROE = Realistic Outcome Expectations, IPPA = Investigative Past Performance Accomplishments; IVL = Investigative Vicarious Learning; VP = Investigative Verbal Persuasion; IEA = Investigative Emotional Arousal; ISE = Investigative Self-Efficacy; IOE = Investigative Outcome Expectations. The percentage missing ranged from 6.5% and 39.3%.

Table 2

Correlations among four sources of learning experiences, self-efficacy, and outcome expectations within the Realistic domain across time by gender and race/ethnicity.

	Gender												***Race/Ethnicity***											
Variable	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1. T1_PPA	---	.52	.61	.47	.71	.37	.82	.47	.55	.45	.30	.24	---	.68	.69	.39	.75	.36	.90	.67	.66	.41	.18	.35
2. T1_VL	.64	---	.59	.17	.30	**.13**	.55	.73	.56	.17	.26	**.00**	.51	---	.68	.17	.47	.23	.67	.76	.63	.21	**.08**	.26
3. T1_VP	.57	.67	---	.22	.40	.28	.51	.47	.64	.26	.25	**.10**	.49	.62	---	.19	.53	.37	.60	.57	.73	.18	**.01**	.37
4. T1_EA	.31	.16	**.08**	---	.38	.35	.43	.22	.25	.72	.34	.17	.34	.14	**.05**	---	.37	.20	.40	.23	.32	.70	.32	.08
5. T1_SE	.29	.30	.29	**.12**	---	.46	.65	.23	.31	.37	.24	.26	.72	.31	.33	.29	---	.43	.68	.43	.42	.35	.28	.35
6. T1_OE	.18	.15	.27	**.03**	.30	---	.35	**.10**	.27	.45	.14	.53	.21	**.08**	.22	**.09**	.34	---	.33	.27	.32	.26	.22	.61
7. T2_PPA	.74	.53	.48	.26	.56	**.09**	---	.54	.59	.47	.33	.37	.70	.39	.40	.30	.58	.17	---	.71	.67	.41	**.28**	.34
8. T2_VL	.53	.67	.48	.17	.34	**.13**	.75	---	.63	.20	.22	**.00**	.34	.63	.38	.17	.18	**.03**	.58	---	.67	.29	**.16**	.25
9. T2_VP	.53	.52	.66	**.13**	.36	.19	.67	.67	---	.22	.18	.26	.42	.44	.58	**.06**	.27	.17	.59	.61	---	.31	**.14**	.36
10. T2_EA	.28	**.09**	**.04**	.58	.27	**.01**	.24	.14	.08	---	.31	.18	.28	**.06**	**.06**	.60	.25	**.11**	.27	**.10**	**.00**	---	.26	**.06**
11. T2_SE	**.12**	**.13**	**.13**	.22	.18	**.09**	.28	.24	.20	.19	---	.21	.22	.22	.24	.20	.14	**.05**	.35	.26	.20	.22	---	.22
12. T2_OE	.20	.14	.28	-.14	.19	.51	**.10**	**.09**	.24	-.25	**.08**	---	.19	**.00**	.14	-.12	.22	.51	.17	-.05	.19	-.23	.12	---

Note. Values for Women are above the diagonal and values for Men are below the diagonal on the left side of the table; Values for Whites are above the diagonal and values for Latino/as are below the diagonal on the right side of the table. Bold correlations are not significant. T1 = Time 1; T2 = Time 2; PPA = past performance accomplishments; VL = Vicarious Learning; VP = verbal persuasion; EA = Emotional Arousal; SE = self-efficacy; OE = outcome expectations.

Table 3

Correlations among four sources of learning experiences, self-efficacy, and outcome expectations within the Investigative domain across time by gender and race/ethnicity.

	Gender												***Race/Ethnicity***											
Variable	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1. T1_PPA	---	.39	.43	.41	.44	**.08**	.70	.32	.40	.32	**.10**	**-.07**	---	.39	.41	.24	.53	.20	.66	.19	**.16**	.35	**.09**	**.09**
2. T1_VL	.44	---	.69	**.10**	.34	.14	.36	.58	.46	.22	**.02**	**.00**	.43	---	.70	**-.04**	.32	.17	.19	.65	.58	**.09**	**.08**	**.12**
3. T1_VP	.36	.71	---	**.05**	.29	.15	.40	.55	.70	.18	**.16**	**.08**	.37	.71	---	**-.00**	.37	.19	**.16**	.46	**.57**	**.05**	**.07**	**.08**
4. T1_EA	.21	-.11	**-.08**	---	.39	**.07**	.32	.16	**.08**	**.52**	**-.06**	**.05**	.28	**-.07**	**-.08**	---	.22	**.13**	.33	**.02**	**-.02**	.47	**.03**	**.09**
5. T1_SE	.51	.31	.33	.17	---	.18	.43	.18	.20	.47	.18	**.03**	.46	.31	.27	.25	---	.26	.31	**.13**	**.02**	.37	.33	**.10**
6. T1_OE	.20	.16	.17	.11	.21	---	.12	**.06**	**.14**	**.11**	.25	.61	.15	.13	.13	**.08**	.16	---	**.13**	**.00**	**.03**	.21	**.06**	.63
7. T2_PPA	.62	.28	.27	.30	.30	.14	---	.49	.50	.42	.23	**.09**	.62	.35	.38	.31	.32	.16	---	.36	.32	.42	.22	.18
8. T2_VL	.31	.62	.47	**-.00**	.19	**.01**	.46	---	.68	.12	**.08**	**.09**	.37	.61	.51	**.05**	.18	**.02**	.52	---	.68	**-.02**	**.14**	**.12**
9. T2_VP	.31	.56	.55	**.02**	.11	**-.04**	.44	.74	---	.21	.19	**.16**	.41	.50	.63	**.08**	.15	**-.00**	.52	.75	---	**.03**	.18	**.12**
10. T2_EA	.25	**.05**	**.01**	.46	.32	**.07**	.28	**-.10**	**-.04**	---	**.15**	**.02**	.25	.12	**.08**	.49	.38	**.03**	.29	**-.04**	**.02**	---	**.12**	**.11**
11. T2_SE	.13	**.07**	**.04**	**.07**	.23	**-.05**	.23	.23	.23	**-.02**	---	.23	**.10**	**.00**	**.13**	**-.02**	**.10**	**.05**	.21	**.12**	.24	**-.02**	---	**.15**
12. T2_OE	.20	.21	.20	**.05**	.18	.58	.21	.20	.17	**-.04**	**.04**	---	**.13**	.14	.17	**.02**	**.13**	.57	.18	.19	.19	**-.08**	**.08**	---

Note. Values for Women are above the diagonal and values for Men are below the diagonal on the left side of the table; Values for Whites are above the diagonal and values for Latino/as are below the diagonal on the right side of the table. Bold correlations are not significant. T1 = Time 1; T2 = Time 2; PPA = past performance accomplishments; VL = Vicarious Learning; VP = verbal persuasion; EA = Emotional Arousal; SE = self-efficacy; OE = outcome expectations.

Table 4

Summary of Fit Statistics for the Multiple Groups Analyses and the Chi-Square Tests of Difference

Model		χ^2	*df*	χ^2/df	CFI	SRMR	RMSEA	95% CI	$\Delta\chi^2$	Δdf
Gender										
Unconstrained	***Realistic Domain***	113.36*	42	2.70	.95	.10	.08	.060, .094		
Fully constrained		144.75*	57	2.54	.93	.10	.07	.059, .088		
Partially constrained		136.65*	56	2.44	.94	.10	.07	.056, .086		
Unconstrained vs. Fully Constrained									31.60*	15
Unconstrained vs. Partially Constrained									23.94	14
Partially constrained vs. Fully Constrained									6.05*	1
Unconstrained	***Investigative Domain***	102.77*	42	2.45	.94	.08	.07	.054, .089		
Fully constrained		115.63*	57	2.03	.94	.08	.06	.044, .076		
Unconstrained vs. Fully Constrained									12.99	9
Race/Ethnicity										
Unconstrained	***Realistic Domain***	80.12*	42	1.91	.97	.07	.06	.038, .077		
Fully constrained		97.48*	57	1.71	.97	.08	.05	.033, .069		
Partially constrained		89.13*	55	1.62	.97	.07	.05	.029, .066		
Unconstrained vs. Fully Constrained									18.42	15
Unconstrained vs. Partially Constrained									10.97	13
Partially constrained vs. Fully Constrained									9.15*	2
Unconstrained	***Investigative Domain***	95.02*	42	2.26	.94	.08	.07	.050, .087		
Fully constrained		112.18*	57	1.97	.94	.14	.09	.044, .077		
Partially constrained		105.11*	56	1.88	.95	.08	.06	.040, .074		
Unconstrained vs. Fully Constrained									17.66	15
Unconstrained vs. Partially Constrained									10.75	14
Partially constrained vs. Fully Constrained									7.34*	1

Note. * = $p < .05$; χ^2 = chi-square; *df* = degrees of freedom; CFI = Comparative Fit Index; SRMR = standardized root mean residual; RMSEA =

Root mean-square error of approximation; CI = Confidence Interval; $\Delta\chi^2$ = chi-square difference; Δdf = *df* difference.

Table 5

Summary of Standardized Path Coefficients for the Longitudinal Model by Domain, Gender, and Race/Ethnicity

	Realistic Model				Investigative Model			
Path	Men	Women	Latino/a	White	Men	Women	Latino/a	White
T1_Past Performance Accomplishments to T2_Past Performance Accomplishments	.69***	.80***	.71***	.88***	.61***	.64***	.61***	.62***
T1_Vicarious Learning to T2_Vicarious Learning	.63***	.62***	.61***	.72***	.56***	.55***	.60***	.58***
T1_Verbal Persuasion to T2_Verbal Persuasion	.64***	.61***	.58***	.71***	.55***	.61***	.60***	.57***
T1_Emotional Arousal to T2_Emotional Arousal	.63***	.67***	.62***	.63***	.47***	.50****	.48***	.45***
T1_Self-Efficacy to T2_Self-Efficacy	.11	.10	.07	.07	.30***	.23***	.16**	.43**
T1_Outcome Expectations to T2_Outcome Expectations	.48***	.51***	.49***	.53***	.59***	.57***	.60***	.60***
T1_Past Performance Accomplishments to T2_Self-Efficacy	-.05	-.05	.07	.08	.06	.04	.03	.03
T1_Vicarious Learning to T2_Self-Efficacy	.05	.04	.06	.06	-.15	-.10	-.24**	-.16**
T1_Verbal Persuasion to T2_Self-Efficacy	.06	.05	.13	-.13	.08	.06	.20**	.15*
T1_Emotion Arousal to T2_Self-Efficacy	.24***	.18**	.19**	.20**	-.09	-.06	-.13*	-.11*
T1_Past Performance Accomplishments to T2_Outcome Expectations	.23**	.25**	.18**	.26**	-.01	-.01	-.02	-.02
T1_Vicarious Learning to T2_Outcome Expectations	-.17**	-.18**	-.15*	-.18*	-.05	-.05	-.04	-.04
T1_Verbal Persuasion to T2_Outcome Expectations	.13*	.14*	.12*	.14*	.12*	.11	.10	.10
T1_Emotion Arousal to T2_Outcome Expectations	-.21***	-.19***	-.19***	-.24***	-.06	-.06	-.06	-.07

T1_Self-Efficacy to T2_Outcome Expectations	-.02	-.03	.02	.03	.05	.05	.05	.06

Note. T1 = Time 1 and T2 = Time 2; * = p < .05; ** = p < .01; *** = p < .001

Figure 1. Longitudinal model depicting learning experiences and self-efficacy as antecedents of outcome expectations. Dotted lines represent autoregresive paths; solid lines represent cross-lagged paths. Covariances among variables at Time 1 and Time 2 are not depicted for ease of reading.