Parental Support and Underrepresented Students' Math/Science Interests: The Mediating Role of Learning Experiences

Patton O. Garriott, Lisa Y. Flores, Brinda Prabhakar, Elizabeth C. Mazzotta, Alana C. Liskov and Jaclyn E. Shapiro

Journal of Career Assessment published online 5 December 2013
DOI: 10.1177/1069072713514933

Article

Journal of Career Assessment
201X, Vol XX(X) 1-15

DOI: 10.1177/1069072713514933
jca.sagepub.com
SAGE

Parental Support and Underrepresented Students' Math/Science Interests: The Mediating Role of Learning Experiences

Patton O. Garriott[1], Lisa Y. Flores[2], Brinda Prabhakar[1], Elizabeth C. Mazzotta[1], Alana C. Liskov[1], and Jaclyn E. Shapiro[1]

Abstract

Using social cognitive career theory (SCCT), the present study examined the role of parental support and investigative learning experiences (i.e., performance accomplishments, verbal persuasion, vicarious influence, physiological arousal) in the development of math/science interests among high school students of color ($N = 206$). Results of structural equation modeling analyses suggested the hypothesized model adequately fit the data. Parental support significantly predicted each learning experience variable, with the exception of physiological arousal. Performance accomplishments were the only learning experience variable that predicted both math/science self-efficacy and math/science outcome expectations. Self-efficacy significantly predicted interests, but did not predict outcome expectations. Furthermore, outcome expectations did not predict interests. Mediation tests indicated that performance accomplishments, vicarious learning, and self-efficacy mediated relationships between contextual and person-cognitive variables. Results are discussed in relation to SCCT and the development of career interests in math/science among underrepresented students.

Keywords

social cognitive career theory, parental support, learning experiences, self-efficacy, math/science

Despite the continued growth of science, technology, engineering, and mathematics (STEM) careers in the United States, people of color continue to be underrepresented in STEM fields (National Science Foundation, 2013). Specifically, national data indicate that students of color, compared to their White peers, are less prepared in STEM majors, experience lower persistence rates, and achieve

[1] Department of School and Counseling Psychology, University of Denver, Denver, CO, USA
[2] Department of Educational, School, and Counseling Psychology, University of Missouri, Columbia, MO, USA

Corresponding Author:
Patton O. Garriott, Department of School and Counseling Psychology, University of Denver, 1999 E. Evans Ave., 201A Ruffatto Hall, Denver, CO 80208, USA.
Email: pat.garriott@du.edu

fewer baccalaureate degrees in STEM (National Research Council, 2011). Further, data show that approximately 7 of the 10 STEM workers in the United States are non-Hispanic Whites (U.S. Department of Commerce, 2011).

A recent report from the President's Council of Advisors on Science and Technology (2012) summarized that greater attention must be given to students underrepresented in STEM careers to increase the number of future STEM professionals. To address these disparities, research and intervention efforts promoting STEM career selection among underrepresented students prior to their entry into postsecondary education have been noted as a priority (Kuenzi, 2008). While published accounts of programming intended to reduce underrepresentation of students in STEM fields are available (e.g., Lam, Srivatsan, Doverspike, Vesalo, & Mawasha, 2005; Russomanno et al., 2010), many offer atheoretical or anecdotal accounts of program activities. More exploratory, theory-based research could aid in the design and implementation of future intervention efforts aimed at promoting STEM educational and career pursuits among underrepresented student groups. Therefore, the present study used social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994, 2000) to test a model predicting the math/science interests of secondary students of color.

SCCT (Lent et al., 1994, 2000) posits interactions among contextual and person-cognitive variables (i.e., self-efficacy, outcome expectations) in the development of career interests, goals, and behaviors. Background affordances are one contextual variable in the SCCT framework and refer to "career role models to which one is exposed and the sort of support and discouragement one receives for participating in particular academic or extracurricular activities" (Lent et al., 2000, p. 37). Support provided by parents has been described as a background contextual affordance in prior SCCT research (Byars-Winston & Fouad, 2008). Lent, Brown, and Hackett (1994, 2000) hypothesized that background contextual affordances predict learning experiences, which in turn predict self-efficacy and outcome expectations. Both self-efficacy and outcome expectations play a central role in the development of career interests and goals in a given domain; thus, knowledge pertaining to factors that give rise to both of these variables can provide valuable information in the development of career interventions.

In their delineation of hypotheses related to learning experiences, Lent et al. (1994) asserted that learning experiences in the SCCT framework mirror those defined in Bandura's (1986) social cognitive theory as the sources of self-efficacy and outcome expectations: performance accomplishments, verbal persuasion, vicarious influence, and physiological arousal. The authors also hypothesized that performance accomplishments would account for greater variance in self-efficacy and outcome expectations than other forms of learning experiences and that learning experiences would mediate relationships between background contextual affordances and the person-cognitive variables of self-efficacy and outcome expectations (Lent et al., 1994). However, relatively few SCCT studies have tested the mediating role of learning experiences (Schaub & Tokar, 2005) or the hypothesis that performance accomplishments do indeed account for greater variance in person-cognitive variables (Lopez & Lent, 1992). Researchers have called for additional research to test SCCT hypotheses related to learning experiences (Tokar, Buchanan, Subich, Hall, & Williams, 2012).

Consistent with Lent et al.'s (2000) conceptualization of background contextual affordances and prior research (Byars-Winston & Fouad, 2008), parental support was included as a background contextual variable in the present study. Research has found that home-based parental support with students of color is positively correlated with academic performance (Trask-Tate & Cunningham, 2010). Research examining parental support using the SCCT framework has found that parental encouragement has direct and indirect effects on math/science self-efficacy, through math and science grades (Ferry, Fouad, & Smith, 2000). Additional research with predominantly White college students reported that parental involvement in math and science is more strongly related to math/science outcome expectations than math/science self-efficacy (Byars-Winston & Fouad, 2008).

However, this study did not include a measure of learning experiences. Thus, hypotheses regarding indirect relationships from parental support to person-cognitive variables were not tested.

Although existing research investigating parental support and career outcomes in students of color is limited, prior research with diverse middle school student samples has supported the link between parental support and math/science self-efficacy (Navarro, Flores, & Worthington, 2007) and realistic and investigative self-efficacy (Turner & Lapan, 2002). Further, studies with African American high school students have found positive relationships between parental support and career decision-making self-efficacy (Gushue & Whitson, 2006) and math outcome expectations (Alliman-Brissett & Turner, 2010). Thus, while there is some support for an indirect relationship from parental support to self-efficacy and outcome expectations through performance accomplishments (e.g., Ferry et al., 2000, Trask-Tate & Cunningham, 2010), indirect relationships among these variables through other sources of self-efficacy (i.e., vicarious learning, verbal persuasion, physiological arousal) have not yet been explored.

Investigative performance accomplishments, verbal persuasion, vicarious influence, and physiological arousal were included as learning experience variables in the present study. With some exceptions (e.g., Gainor & Lent, 1998; Hackett, Betz, Casas, & Rocha-Singh, 1992; Navarro et al., 2007), most research investigating learning experiences has been conducted with predominantly White students (e.g., Ferry et al., 2000; Nauta & Epperson, 2003; Nauta, Epperson, & Kahn, 1998; Schaefers, Epperson, & Nauta, 1997; Schaub & Tokar, 2005; Thompson & Dahling, 2012; Williams & Subich, 2006). Other limitations of the extant SCCT learning experience research is that this body of work has primarily examined the contribution of performance accomplishment learning experiences exclusively (e.g., Alliman-Brissett & Turner, 2010; Ferry et al., 2000; Hackett et al., 1992; Nauta & Epperson, 2003; Navarro et al., 2007), or investigated learning experiences represented as a single latent variable (Schaub & Tokar, 2005; Thompson & Dahling, 2012). Most of the former studies have reported significant positive relationships among past performance accomplishments and person-cognitive constructs (e.g., Ferry et al., 2000; Nauta & Epperson, 2003; Nauta et al., 1998; Williams & Subich, 2006).

Career interventions that incorporated learning experiences informed by social cognitive theory and that aimed to increase career-related self-efficacy among diverse high school students and women in college have been shown to be effective. Specifically, a career exploration class for upward bound students that incorporated activities around Bandura's (1986) four sources of self-efficacy enhanced students' career decision-making self-efficacy (O'Brien et al., 2000). Another intervention that included realistic-type activities across all four learning experiences increased the realistic self-efficacy beliefs of women (Betz & Schifano, 2000). However, these studies examined cumulative, rather than individual effects of learning experiences on self-efficacy.

Cross-sectional quantitative studies examining the relative contributions of learning experiences in high school students have found that performance accomplishments are the strongest predictor of math self-efficacy (Lopez & Lent, 1992; Lopez, Lent, Brown, & Gore, 1997). However, these studies were conducted with predominantly White students and only tested the link between learning experiences and self-efficacy, not outcome expectations as hypothesized in the SCCT model (Fouad & Guillen, 2006). In a qualitative study that examined the role of various forms of learning experiences in the career-related interests of adolescent students of color, researchers found participants' qualitative descriptions of different forms of learning experiences were associated with their vocational interests (Jackson et al., 2011). However, the design used in this study did not allow for more nuanced tests of SCCT's hypotheses regarding learning experiences and other social cognitive variables.

The current study extends SCCT research that focuses on the learning experiences portion of the model in three important ways. First, we assess for all four learning experiences and examine the mediating effects of each individual learning experience variable within the model. Second, we

include both self-efficacy and outcome expectations. Third, we test these relations with a racially/ethnically diverse sample of high school students in math/science domains. Study hypotheses are included below:

Hypothesis 1: The hypothesized structural model would adequately fit the data, and variables would relate as hypothesized in SCCT (Lent et al., 1994, 2000).

Hypothesis 2: Of the learning experience variables, performance accomplishments would be the strongest predictor of self-efficacy and outcome expectations.

Hypothesis 3: The relationships between parental support and self-efficacy as well as parental support and outcome expectations would be mediated by each learning experiences variable.

Hypothesis 4: The relationships between learning experiences variables and interests would be mediated by self-efficacy and outcome expectations.

Hypothesis 5: The relationship between self-efficacy and interests would be mediated by outcome expectations.

Method

Participants

Participants were 210 high school students recruited as part of a research study on the educational and career development of students underrepresented in STEM fields. Average age was 15.92 (standard deviation [*SD*] = 1.22). Approximately 60% ($n = 126$) of the sample was female. In terms of race/ethnicity, 31.4% ($n = 66$) identified as "Latina/Latino," 30.9% ($n = 65$) identified as "African American/Black," 25.2% ($n = 53$) identified as "Asian/Asian American," and 11.9% ($n = 26$) identified as "multiracial." In terms of class rank, 30.0% ($n = 63$) were freshmen, 29.0% ($n = 61$) were sophomores, 22.3% ($n = 47$) were juniors, and 18.0% ($n = 38$) were seniors. One participant did not provide this information. A majority (67.6%, $n = 142$) of participants qualified for the free lunch program at their school. The highest level of education reported for participants' female head of household was "high school graduate" (28.0%, $n = 59$), "less than seventh grade" (21.4%, $n = 45$), "partial college" (13.3%, $n = 28$), "partial high school" (12.3%, $n = 26$), "standard college graduate" (7.6%, $n = 16$), and "graduate degree" (4.7%, $n = 10$). Twenty-six (12.3%) participants did not provide this information. The highest level of education reported for participants' male head of household was "high school graduate" (23.3%, $n = 49$), "less than seventh grade" (23.3%, $n = 49$), "partial high school" (9.5%, $n = 20$), "partial college" (8.5%, $n = 18$), "junior high" (5.7%, $n = 12$), "standard college graduate" (4.7%, $n = 10$), and "graduate degree" (3.8%, $n = 8$). Forty-four (20.9%) participants did not provide this information.

Instruments

Demographic Questionnaire. Participants completed questions that assessed their age, gender, race/ethnicity, class rank, and parental education levels.

Learning Experiences. Investigative-themed learning experiences were assessed with the Learning Experiences Questionnaire (LEQ; Schaub & Tokar, 2005). The Investigative subscale of the LEQ includes 20 items rated on a Likert-type scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Sample items include, "I have easily understood new math concepts while learning about them in class" (performance accomplishments), "I have become nervous while solving math problems" (physiological arousal), "in school, I saw teachers whom I admired work on science projects"

(vicarious influence), and "people whom I respect have encouraged me to work hard in math courses" (verbal persuasion). Subscale scores are obtained by averaging items. For consistency of interpretation, items on the physiological arousal subscale were reverse coded such that high scores on each LEQ subscale represented positive learning experiences. Two items on the performance accomplishment subscale were excluded ("I received high scores on the math section of my college entrance exam" and "I have demonstrated skill conducting research for my term papers"), as they did not appear to capture learning experiences representative of the sample used for the present study.

Internal consistency estimates ranging from .71 to .77 have been reported for scores on the LEQ-Investigative subscale (Williams & Subich, 2006) and validity has been established through observed relations with other SCCT constructs (Schaub & Tokar, 2005). Coefficient α for subscale scores in the present study ranged from .70 (performance accomplishment and physiological arousal subscales) to .75 (verbal persuasion subscale).

Math/Science Interests. Participants' interest in math/science activities was measured with the Math/Science Interest scale (MSIS; Smith & Fouad, 1999). The MSIS includes 20 items rated on a Likert-type scale ranging from 1 (*very strongly dislike*) to 6 (*very strongly like*). A sample item is, "reading about science discoveries." Item responses are averaged with high scores indicative of strong interest in math/science activities. Scale scores have demonstrated adequate internal consistency estimates, with Cronbach's αs ranging from .90 to .91 in college and middle school samples (Navarro et al., 2007; Smith & Fouad, 1999). Validity for the MSIS has been established through observed relationships with other SCCT constructs (Navarro et al., 2007; Smith & Fouad, 1999). Coefficient α for MSIS scores in the present study was .95.

Math/Science Outcome Expectations. The 10-item math/science outcome expectations scale (Lent, Lopez, & Bieschke, 1991) assessed perceptions of the positive outcomes that could result from obtaining a degree in a math or science-related career. Items are rated on a Likert-type scale ranging from 0 (*strongly disagree*) to 9 (*strongly agree*). Consistent with recommendations from the literature (e.g., Fouad & Guillen, 2006), item content for the scale is reflective of positive physical sensations (e.g., "Do work that excites me"), social reactions (e.g., "Get respect from other people"), and self-evaluations (e.g., "increase my sense of self-worth") that one might experience as a result of a career-related choice. Items are averaged with high scores indicative of positive anticipated outcomes for pursuing math/science careers.

Cronbach's αs ranging from .90 to .91 have been found for scale scores in prior studies (Lent et al., 1991; Lent et al., 2003). Validity has been established through observed correlations in the expected direction with other SCCT constructs (Lent, Lopez, & Bieschke, 1993). Coefficient α for scale scores on this measure in the present study was .94.

Math/Science Self-Efficacy. Math/science self-efficacy was assessed with the Expanded Skills Confidence Inventory for High School Students (ESCI-HS; Betz & Wolfe, 2005). The ESCI-HS is a 112-item revised version of the original ESCI (Betz et al., 2003) adapted for high school students and designed to measure 14 domains based on Holland (1997) themes. For the purpose of the present study, only two subscales were used: the 8-item Math subscale and the 8-item Science subscale. Items are rated on a 5-point Likert-type scale ranging from 1 (*no confidence*) to 5 (*complete confidence*), with high scores indicative of strong self-efficacy. Sample items include, "solve math word problems" for the Math subscale and "learn about the origin of a species" for the Science subscale. Scores are computed by averaging items.

The Math and Science subscale scores of the ESCI-HS have exhibited adequate internal consistency estimates ranging from .80 to .88 for the Math subscale and .79 to .90 for the Science subscale.

Validity for ESCI-HS scores has been demonstrated through observations of item-total correlations as well as correlations with Holland (1997) theme scores of the Skills Confidence Inventory (Betz & Wolfe, 2005). In the present study, coefficient alphas of .90, .80, and .89 were observed for the Math subscale, the Science subscale, and the full scale, respectively.

Parental Support. Parental support was measured with a modified version of the Fennema–Sherman Math Attitudes scale (FSMA; Fennema & Sherman, 1976). The original FSMA consisted of nine separate 12-item scales assessing a variety of attitudes about math. The FSMA has been abbreviated in prior research and used as an 8-item measure that assesses perceptions of parental encouragement and expectations for pursuing math-related activities (Turner, Steward, & Lapan, 2004). A sample item is, "my mother has encouraged me to do well in mathematics." For the present study, 8 items were added to the version of the FSMA modified by Turner, Steward, and Lapan (2004) that assessed encouragement and expectations for pursuing science-related activities (e.g., "my father has encouraged me to do well in science"). Therefore, the version of the FSMA in the present study consisted of 16 items reflective of encouragement and expectations for pursuing math and science. Participants identified a male and female "head of household" on the demographic form and were asked to reference these individuals when completing items related to their "mother" and "father" on the FSMA. Items were rated on a Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*); item responses were averaged to create a total scale score.

Internal consistency estimates ranging from .70 to .86 have been found for the modified FSMA in prior research with middle school students (Turner et al., 2004). Convergent validity for the modified FSMA has been established through observed correlations with measures of math self-efficacy ($r = .16$), outcome expectations ($r = .38$), and academic performance ($r = .25$; Alliman-Brissett & Turner, 2010). Coefficient α for scale scores on the modified version of the FSMA in the present study was .88.

Procedure

Institutional Review Board approval was received prior to all study procedures. Participants were recruited from a total of 10 federal TRIO programs throughout the Midwestern United States. These programs provide academic services to students who have been historically underrepresented in higher education. Program directors provided students with information about the study and distributed surveys to students. Assent forms were also distributed at this time. Passive consent was obtained from parents. Parents were provided informational letters about the study and asked to contact the primary investigator if they did not approve of their child's participation. No parents requested that their child be excluded from the study. Surveys took approximately 30 min to complete and students entered a raffle for five US$25 gift cards as incentive for participation. Completed surveys and assent forms were returned to the primary investigator via postal mail. Only students with signed assent forms indicating they agreed to participate were included in the study.

Data Analysis Plan

Item parceling was used to develop indicators for the latent constructs of parental support, outcome expectations, and interests. Given the small number of items for each learning experience subscale, these were represented as observed variables in the model and their error terms were allowed to correlate. Item parcels were created using maximum likelihood exploratory factor analysis and principle axis factoring. Assignment of items to parcels was based on averaging of factor loadings across items such that high, low, and medium loadings were balanced for each parcel (Weston & Gore, 2006).

Confirmatory factor analysis (CFA) was used to evaluate adequacy of parcels and the measurement model to be used for future analyses. Structural equation modeling (SEM) was used to examine goodness of fit for the structural model. The comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) were examined to determine adequacy of model fit. In general, CFI values $\geq .95$, RMSEA $\leq .06$, and SRMR $\leq .08$ represent close model-to-data fit (Hu & Bentler, 1999), while CFI $\geq .90$ and RMSEA values $\leq .08$ represent adequate model fit (Kline, 2005).

Sample Size. The adequacy of the sample size for the current study was evaluated using recommendations for SEM proposed by several authors (e.g., Kline, 2005; MacCallum, Browne, & Sugawara, 1996; Weston & Gore, 2006). Kline (2005) designated samples less than 100 as "small," between 100 and 200 as "medium," and over 200 as "large," while Weston and Gore (2006) suggested that at least 200 participants be used for any SEM analysis. MacCallum, Browne, and Sugawara (1996) determined that in models with approximately 85 degrees of freedom (*df*), the minimum sample size required to achieve a power of .80 to test close model fit was $N = 147$, whereas the minimum sample size required to achieve a power of .80 to test poor model fit was $N = 195$. The alternative model in the present study contained the smallest $df (= 85)$ and thus, the sample size of $N = 210$ in the present study was deemed sufficient for primary data analyses. Using MacCallum et al.'s criteria, we estimated power of approximately .76 to test close fit for the measurement model ($df = 48$) and approximately .60 to test inadequate fit.

Results

Four cases were dropped due to excessive (20%) missing data on main study variables (Schlomer, Bauman, & Card, 2010), leaving a final sample of $N = 206$. The full information maximum likelihood function in AMOS 19.0 (Arbuckle, 2010) was used to account for instances of missing data in future analyses. All variables met assumptions of univariate (z scores < 3.29) and multivariate (Mahalanobis distance values < 26.29) normality.

Preliminary Analyses

Intercorrelations among variables are presented in Table 1. A multivariate analysis of variance revealed no main effect of ethnicity, Wilks's $\lambda = .73$, $F(3, 203) = 1.24$, $p > .05$, $\eta^2 = .09$ or class rank, Wilks's $\lambda = .78$, $F(3, 203) = .99$, $p > .05$, $\eta^2 = .07$ on the observed variables. A main effect was observed for gender, Wilks's $\lambda = .69$, $F(1, 205) = 2.36$, $p < .001$, $\eta^2 = .16$. Examination of univariate tests revealed only one significant difference between males and females on one parcel (Parcel 3) of the interests variable, $F(1, 205) = 8.37$, $p < .001$, $\eta^2 = .07$. Because this was the only observed difference and the effect size for the difference was relatively small, main analyses were conducted on the full sample.

Confirming the Measurement Model. Four latent variables were included in the measurement model. Parental support was represented by two 5-item parcels and one 6-item parcel. Self-efficacy was represented by the Math and Science subscales of the ESCI-HS. Outcome expectations were represented by three 3-item parcels and interests was represented by four 5-item parcels. Results of a CFA showed that all factors significantly loaded onto latent variables (see Table 2) and that the model adequately fit the data (see Table 3).

Table 1. Descriptive Statistics and Correlations Among Variables.

Variable	1	2	3	4	5	6	7	8
1. Parental support	—	.35	.34	.33	.34	.43	.52	.09
2. Math/science self-efficacy		—	.35	.73	.61	.51	.55	.28
3. Math/science outcome expectations			—	.36	.39	.31	.28	.05
4. Math/science interests				—	.53	.49	.50	.20
5. Investigative performance accomplishments					—	.58	.57	.25
6. Investigative verbal persuasion						—	.68	.38
7. Investigative vicarious influence							—	.33
8. Investigative physiological arousal								—
M	3.46	3.38	7.16	3.68	4.14	4.05	3.66	3.16
SD	0.72	0.91	1.57	1.12	1.04	1.16	1.28	1.13

Note. *SD* = standard deviation. *N* = 206. All correlations above .20 are significant at the .01 level.

Table 2. Means, Standard Deviations, and Factor Loadings for Latent Variables.

Variable	*M*	*SD*	Score range	Factor loading
Parental support				
Parcel 1	3.83	0.95	1–5	0.91
Parcel 2	3.83	0.93	1–5	0.95
Parcel 3	3.81	0.94	1–5	0.94
Math/science self-efficacy				
Math self-efficacy	3.45	1.04	1–5	0.64
Science self-efficacy	3.32	1.02	1–5	0.87
Outcome expectations				
Parcel 1	7.03	1.70	0–9	0.91
Parcel 2	7.15	1.65	0–9	0.94
Parcel 3	7.34	1.61	0–9	0.87
Interests				
Parcel 1	3.60	1.10	1–6	0.92
Parcel 2	3.72	1.22	1–6	0.91
Parcel 3	3.70	1.26	1–6	0.86
Parcel 4	3.68	1.24	1–6	0.89

Note. *SD* = standard deviation. *N* = 206. All factor loadings are statistically significant at the $p < .01$ level.

Table 3. Goodness-of-Fit Indicators for the Measurement and Structural Models.

Model	χ^2	χ^2/df	CFI	RMSEA	SRMR	90% CI for RMSEA
Measurement	77.76	1.62	.98	.05	.03	[0.03, 0.07]
Hypothesized	167.56	1.92	.97	.06	.05	[0.05, 0.08]
Alternative	158.83	1.86	.97	.06	.03	[0.04, 0.08]

Note. CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual. Alternative model included direct paths from parental support to math/science self-efficacy and outcome expectations.

Primary Analyses

Primary analyses indicated the hypothesized model fit the data well (see Table 3). Parental support predicted each learning experiences variable, with the path from parental support to vicarious influence being the strongest observed relationship. Of the learning experiences variables, performance

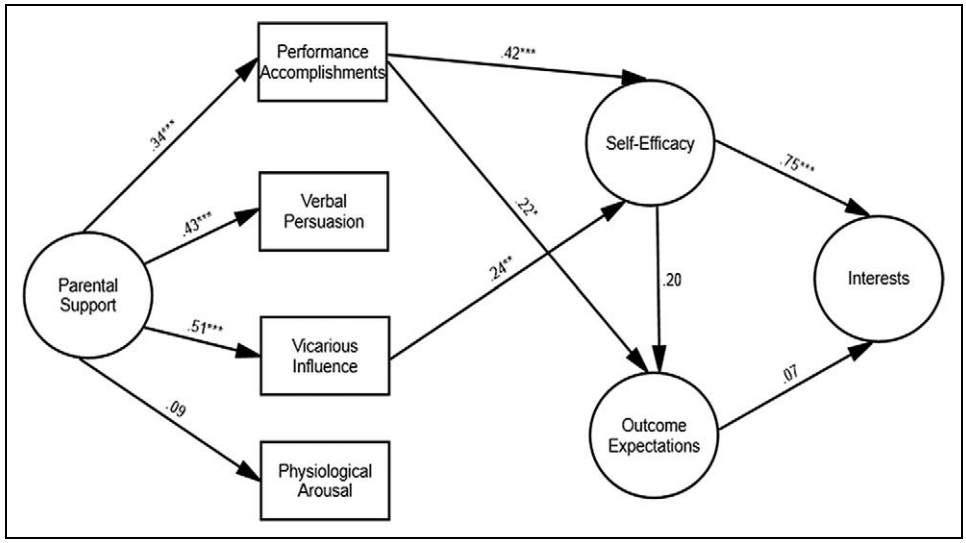

Figure 1. Results of the final structural model. To aid in visual presentation, only significant paths from learning experiences variables to person-cognitive variables are displayed. *$p < .05$. **$p < .01$. ***$p < .001$.

accomplishments was the only variable to significantly predict both self-efficacy and outcome expectations. The path between vicarious influence and self-efficacy was the only additional significant relationship from the learning experiences variables to self-efficacy or outcome expectations. That is, self-efficacy was not significantly predicted by verbal persuasion ($\beta = .12$, $p > .05$) or physiological arousal ($\beta = .03$, $p > .05$) and outcome expectations were not predicted by verbal persuasion ($\beta = .12$, $p > .05$), vicarious influence ($\beta = -.02$, $p > .05$), or physiological arousal ($\beta = -.09$, $p > .05$). Self-efficacy predicted interests, but did not predict outcome expectations. Finally, outcome expectations did not predict interests. This model explained 50%, 19%, and 62% of the variance in self-efficacy, outcome expectations, and interests, respectively.

Because it has been recommended that researchers test plausible alternative structural models (Martens, 2005), a rival model was tested. This nested model included direct paths from parental support to self-efficacy and outcome expectations based on prior research (Byars-Winston & Fouad, 2008). Results indicated this model also adequately fit the data (see Table 3). While the path from parental support to self-efficacy was not significant ($\beta = .07$, $p > .05$), the path from parental support to outcome expectations did reach significance ($\beta = .21$, $p < .01$). Examination of differences in chi-square values suggested that the alternative model provided improved fit to the data ($\Delta\chi^2 = 8.73$, $p < .05$). However, reliance on chi-square values to evaluate the fit of nested models has been questioned in more complex models. Therefore, the more conservative ΔCFI value of >.01 was used to determine relative differences in fit between nested models (Cheung & Rensvold, 2002). Using this criterion, the alternative model did not appear to provide a substantially improved fit over the hypothesized model. Therefore, the hypothesized model was accepted as the final structural model (see Figure 1).

Tests of Mediation. Bootstrapping was used to conduct tests of mediation. A total of 10,000 bootstrap samples were generated with AMOS 19.0 for each test of mediation. Bias-corrected 95% confidence intervals (CIs) were examined for evidence of mediation effects. Specifically, statistically significant CIs not containing zero were deemed a significant mediation effect (Mallinckrodt, Abraham, Wei, & Russell, 2006). Results indicated that there were significant indirect effects from parental

support to self-efficacy (CI = [.221, .466], $p < .001$) and from parental support to outcome expectations (CI = [.086, .282], $p < .002$). To further explore the specific indirect effects, the statistical program RMediation (Tofighi & MacKinnon, 2011) was used. Results indicated that performance accomplishments (CI = [.031, .302]) and vicarious influence (CI = [.042, .211]) mediated the relationship between parental support and self-efficacy, while only performance accomplishments (CI = [.001, .162]) mediated the relationship between parental support and outcome expectations.

Examination of indirect relationships between the learning experience variables and interests revealed that self-efficacy mediated the relationships between performance accomplishments (CI = [.199, .459]) and interests as well as vicarious influence (CI = [.059, .359]) and interests. Outcome expectations did not mediate the relationships between performance accomplishments (CI = [−.021, .071]), verbal persuasion (CI = [−.023, .060]), vicarious influence (CI = [−.022, .014]), or physiological arousal (CI = [−.033, .084]) and interests. The relationship between self-efficacy and interests was not mediated by outcome expectations (CI = [−.010, .090]).

Discussion

This study examined the unique contextual influences of parental support and learning experiences in the development of math/science interests among high school students of color. Tests of the structural model generally supported prior research indicating the SCCT model is an adequate representation of the math/science career interests of students of color (Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010; Lent, Sheu, Gloster, & Williams, 2010; Navarro et al., 2007). The present study extends previous research by including all four proposed learning experiences, examining learning experiences' relationships with both self-efficacy and outcome expectations, and testing the SCCT model in math/science domains with a sample of high school students of color representing various racial/ethnic groups.

Hypothesis 1—that the structural model would fit the data and variables would relate as hypothesized in SCCT—received partial support in the present study. Although the structural model adequately fit the data, not all relationships among variables were significant. Specifically, parental support did not predict physiological arousal, only performance accomplishments predicted both self-efficacy and outcome expectations, self-efficacy did not predict outcome expectations, and outcome expectations did not predict interests. This latter finding replicates studies in which the path between outcome expectations and interests has been found to be nonsignificant in tests of the SCCT model with students in STEM disciplines (e.g., Lent, Lopez, Lopez, & Sheu, 2008; Lent et al., 2010). However, additional research with undergraduate students of color in STEM disciplines found a significant positive relationship between outcome expectations and interests (Byars-Winston et al., 2010). It is possible that the relatively strong relationship between self-efficacy and interests in this study may have attenuated the ability of outcome expectations to account for additional variance in the interest variable. Similarly, the strong relationship between performance accomplishments and self-efficacy may have decreased the ability of other learning experience variables to account for unique variance in self-efficacy. This explanation is consistent with SCCT hypotheses (Lent et al., 1994) and prior research (Lopez & Lent, 1992). Performance accomplishments were also the only learning experience variable that predicted outcome expectations. It is noteworthy that the correlations between learning experiences and outcome expectations in this study were all relatively lower than those observed for math among samples of predominantly White high school students (Lopez et al., 1997) and African American college students (Gainor & Lent, 1998).

Future research is needed to confirm our findings or test other hypotheses that might explain the weaker relationships between learning experiences and outcome expectations found in this study. Furthermore, the finding that self-efficacy did not predict outcome expectations is unique and worthy of future investigation. It is possible that while high school students of color feel confident

in their math/science abilities, this does not necessarily translate into positive outcome expectations for math/science career pursuits. It may also be that some high school students of color have not been exposed to enough information regarding STEM careers to be able to make an accurate determination of the outcomes of such a career choice. Some researchers have also argued that outcome expectations might be influenced by proximal supports and barriers to goal pursuits (Fouad & Guillen, 2006; Gibbons & Borders, 2010). Therefore, future research might examine whether outcome expectations for math/science among students of color are affected by variations in perceptions of supports and barriers that could be present should they pursue math/science careers (e.g., experiences of racial discrimination).

Hypothesis 2—that performance accomplishments would be the strongest predictor of self-efficacy and outcome expectations—was supported. This finding supports Lent et al.'s (1994) original assertion that performance accomplishments are the strongest source of self-efficacy and outcome expectations and replicates findings of other studies (Lopez & Lent, 1992, Lopez et al., 1997). This finding is also in contrast to previous research with African American college students that suggested verbal persuasion was the most robust predictor among the various sources of math self-efficacy (Gainor & Lent, 1998). These results suggest that performance accomplishments are of particular importance in the development of math/science self-efficacy and outcome expectations among high school students of color. Therefore, programs and interventions that provide the opportunity for students underrepresented in STEM fields to have success experiences might be paramount to their interest and pursuit of STEM careers.

Hypothesis 3 received partial support. Specifically, only performance accomplishments mediated both paths from parental support to self-efficacy and outcome expectations. The only other learning experiences variable to serve as a mediator was vicarious influence, which explained the relationship between parental support and self-efficacy. These results suggest that parental support among students of color has an indirect relationship with person-cognitive constructs via success experiences and observational learning. For example, students with parents who encourage them to do well in math/science classes may be more likely to perform well on assignments or be exposed to opportunities to observe others performing math/science-related activities. These experiences would then likely predict higher levels of self-efficacy and outcome expectations for math and science. Future studies might investigate whether these patterns hold in studies examining the influence of other background affordances, such as mentoring relationships with teachers and career counselors. Also, intervention efforts aimed at enhancing the career interests of students of color should involve parents and encourage active supportive behaviors in their child's math/science pursuits.

Although parental support predicted verbal persuasion, there was a nonsignificant relationship between verbal persuasion and the person-cognitive variables. It is possible that participants were referencing parents when completing items for the verbal persuasion subscale of the LEQ, which might explain the strong relationship between these two variables in the structural model. While verbal persuasion was significantly correlated with self-efficacy and outcome expectations, it did not significantly predict either variable in the structural model. This suggests that other learning experiences might be better predictors of person-cognitive variables for students of color when all are taken into account. Notably, none of the paths to or from physiological arousal were significant. Tokar, Buchanan, Subich, Hall, and Williams (2012) suggested that physiological arousal items on the LEQ might function differently than other LEQ items, noting they appeared to represent individual difference variables (e.g., trait anxiety) as well as affective dimensions of past learning experiences. The nonsignificant relationships found physiological arousal and other variables in this study may be attributable to the fact that items on the physiological arousal scale did not purely capture this construct as well as the items for other LEQ subscales.

Hypotheses 4—that self-efficacy and outcome expectations would mediate the relationships between learning experience variables and interests—also received partial support. Only self-

efficacy mediated the relations between performance accomplishments and vicarious influence to interests. Hypothesis 5—that outcome expectations would mediate the relationship between self-efficacy and interests—was not supported. These collective results suggest self-efficacy might be the primary indirect pathway through which learning experiences influence interests among high school students of color.

Limitations

The results of this study should be placed within the context of several limitations. First, participants were recruited from TRIO programs in which students receive positive supports for pursuing post-secondary education. It is possible that participants' exposure to TRIO programming, such as summer enrichment programs and supplemental programming aimed at preparing them for college, influenced their responses on study measures. Furthermore, students in TRIO programs may have relatively more supportive parents compared to their peers. Participants in the current study therefore may not be representative of the general population of high school students of color. Additional research is warranted to confirm this study's findings with other samples.

Furthermore, this study assessed *perceptions* of parental support from students' perspectives. While student reports of support were perhaps the most salient perspective to account for, this may have led to some bias in reports of support in this study. Future studies may consider including reports of support from parents and/or teachers to augment student reports.

Finally, this was a cross-sectional study and causality cannot be inferred. While testing of a structural model may suggest a pattern of relationships among variables, longitudinal research is needed to establish temporal relationships. Additional research is needed that tests the effects of interventions including parents and designed to improve math/science outcomes among students of color. This study suggests that such interventions may impact math/science interests through several indirect pathways. Similarly, research that examines relations between investigative learning experiences and associated outcomes over time is needed.

Results from this study suggest parental support for math/science activities may promote enhanced learning experiences, self-efficacy, and interests for high school students of color. Therefore, programming and pedagogy that incorporates parental support, performance accomplishments (e.g., successes on math/science problems), and vicarious influence (e.g., shadowing programs in STEM fields) in math/science for students of color should be implemented and investigated. These results aid in further contextualizing SCCT as a model for math/science academic and career pursuits in diverse populations as well as understanding the unique roles of specific contextual factors in SCCT.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

Alliman-Brissett, A. E., & Turner, S. L. (2010). Racism, parent support, and math-based career interests, efficacy, and outcome expectations among African American adolescents. *Journal of Black Psychology*, *36*, 197–225. doi:10.1177/0095798409351830

Arbuckle, J. (2010). Amos (Version 19.0) [Computer Program]. Chicago, IL: SPSS.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Betz, N. E., Borgen, F. H., Rottinghaus, P., Paulsen, A., Halper, C. R., & Harmon, L. W. (2003). The expanded skills confidence inventory: Measuring basic dimensions of vocational activity. *Journal of Vocational Behavior*, *62*, 76–100. doi:10.1016/S0001-8791(02)00034-9

Betz, N. E., & Schifano, R. S. (2000). Evaluation of an intervention to increase realistic self-efficacy and interests in college women. *Journal of Vocational Behavior*, *56*, 35–52. doi:10.1006/jvbe.1999.1690

Betz, N. E., & Wolfe, J. B. (2005). Measuring confidence for basic domains of vocational activity in high school students. *Journal of Career Assessment*, *13*, 251–272. doi:10.1177/1069072705274951

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: A multiple-groups analysis. *Journal of counseling psychology*, *57*, 205–218. doi:10.1037/a0018608

Byars-Winston, A. M., & Fouad, N. A. (2008). Math and science social cognitive variables in college students contributions of contextual factors in predicting goals. *Journal of Career Assessment*, *16*, 425–440. doi:10.1177/1069072708318901

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, *9*, 233–255. doi:10.1207/S15328007SEM0902_5

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education*, *7*, 324–326. doi:10.2307/748467

Ferry, T. R., Fouad, N. A., & Smith, P. L. (2000). The role of family context in a social cognitive model for career-related choice behavior: A math and science perspective. *Journal of Vocational Behavior*, *57*, 348–364. doi:10.1006/jvbe.1999.1743

Fouad, N. A., & Guillen, A. (2006). Outcome expectations: Looking to the past and potential future. *Journal of Career Assessment*, *14*, 130–142. doi:10.1177/1069072705281370

Gainor, K. A., & Lent, R. W. (1998). Social cognitive expectations and racial identity attitudes in predicting the math choice intentions of Black college students. *Journal of Counseling Psychology*, *45*, 403–413. doi:10.1037/0022-0167.45.4.403

Gibbons, M. M., & Borders, L. D. (2010). Prospective first-generation college students: A social-cognitive perspective. *Career Development Quarterly*, *58*, 194–208. doi:10.1002/j.2161-0045.2010.tb00186.x

Gushue, G. V., & Whitson, M. L. (2006). The relationship among support, ethnic identity, career decision self-efficacy, and outcome expectations in African American high school students applying social cognitive career theory. *Journal of Career Development*, *33*, 112–124. doi:10.1177/0894845306293416

Hackett, G., Betz, N. E., Casas, J. M., & Rocha-Singh, I. A. (1992). Gender, ethnicity, and social cognitive factors predicting the academic achievement of students in engineering. *Journal of counseling Psychology*, *39*, 527–538. doi:10.1037/0022-0167.39.4.527

Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Odessa, FL: Psychological Assessment Resources.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*, 1–55. doi:10.1080/10705519909540118

Jackson, M. A., Perolini, C. M., Fietzer, A. W., Altschuler, E., Woerner, S., & Hashimoto, N. (2011). Career-related success-learning experiences of academically underachieving urban middle school students. *The Counseling Psychologist*, *39*, 1024–1060. doi:10.1177/0011000010397555

Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). New York, NY: Guilford Press.

Kuenzi, J. J. (2008). Science, technology, engineering, and mathematics (STEM) education: Background, federal policy, and legislative action. *Congressional Research Service Reports* Paper 35. Retrieved February 21, 2013, from. http://digitalcommons.unl.edu/crsdocs/35

Lam, P. C., Srivatsan, T., Doverspike, D., Vesalo, J., & Mawasha, P. R. (2005). A ten year assessment of the pre-engineering program for underrepresented, low income and/or first generation college students at the University of Akron. *Journal of STEM Education*, *6*, 14–21.

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. doi:10.1006/jvbe.1994.1027

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. doi:10.1037//0022-0167.47.1.36

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. doi:10.1037/0022-0167.50.4.458

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1991). Mathematics self-efficacy: Sources and relation to science-based career choice. *Journal of Counseling Psychology*, *38*, 424–430. doi:10.1037//0022-0167.38.4.424

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1993). Predicting mathematics-related choice and success behaviors: Test of an expanded social cognitive model. *Journal of Vocational Behavior*, *42*, 223–236. doi:10.1006/jvbe.1993.1016

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. doi:10.1016/j.jvb.2008.01.002

Lent, R. W., Sheu, H.-B., Gloster, C. S., & Wilkins, G. (2010). Longitudinal test of the social cognitive model of choice in engineering students at historically Black universities. *Journal of Vocational Behavior*, *76*, 387–394. doi:10.1016/j.jvb.2009.09.002

Lopez, F. G., & Lent, R. W. (1992). Sources of mathematics self–efficacy in high school students. *The Career Development Quarterly*, *41*, 3–12.

Lopez, F. G., Lent, R. W., Brown, S. D., & Gore, P. A. (1997). Role of social-cognitive expectations in high school students' mathematics-related interest and performance. *Journal of Counseling Psychology*, *44*, 44–52. doi:10.1037/0022-0167.44.1.44

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, *1*, 130–149. doi:10.1037//1082-989X.1.2.130

Mallinckrodt, B., Abraham, W. T., Wei, M., & Russell, D. W. (2006). Advances in testing the statistical significance of mediation effects. *Journal of Counseling Psychology*, *53*, 372–378. doi:10.1037/0022-0167.53.3.372

Martens, M. P. (2005). The use of structural equation modeling in counseling psychology research. *The Counseling Psychologist*, *33*, 269–298. doi:10.1177/0011000004272260

National Research Council. (2011). *Expanding underrepresented minority participation: America's science and technology talent at the crossroads*. Washington, DC: The National Academies Press.

National Science Foundation, National Center for Science and Engineering Statistics. (2013). *Women, minorities, and persons with disabilities in science and engineering: 2013*. Special Report NSF 13-304. Arlington, VA. Retrieved February 23, 2013, from http://www.nsf.gov/statistics/wmpd/

Nauta, M. M., & Epperson, D. L. (2003). A longitudinal examination of the social-cognitive model applied to high school girls' choices of nontraditional college majors and aspirations. *Journal of Counseling Psychology*, *50*, 448–457. doi:10.1037/0022-0167.50.4.448

Nauta, M. M., Epperson, D. L., & Kahn, J. H. (1998). A multiple-groups analysis of predictors of higher level career aspirations among women in mathematics, science, and engineering majors. *Journal of counseling Psychology*, *45*, 483–496. doi:10.1037/0022-0167.45.4.483

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*, 326–335. doi:10.1037/0022-0167.54.3.320

O'Brien, K. M., Bikos, L. H., Epstein, K. L., Flores, L. Y., Dukstein, R. D., & Kamatuka, N. A. (2000). Enhancing the career decision-making self-efficacy of upward bound students. *Journal of Career Development*, *26*, 277–293. doi:10.1177/089484530002600404

President's Council of Advisors on Science and Technology. (2012, February). Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics. Retrieved May 2013, from http://www.whitehouse.gov/administration/eop/ostp/pcast/docsreports

Russomanno, D., Best, R., Ivey, S., Haddock, J. R., Franceschetti, D., & Hairston, R. J. (2010). MemphiSTEP: A STEM talent expansion program at the University of Memphis. *Journal of STEM Education*, *11*, 69–82.

Schaefers, K. G., Epperson, D. L., & Nauta, M. M. (1997). Women's career development: Can theoretically derived variables predict persistence in engineering majors? *Journal of Counseling Psychology*, *44*, 173–183. doi:10.1037/0022-0167.44.2.173

Schaub, M., & Tokar, D. M. (2005). The role of personality and learning experiences in social cognitive career theory. *Journal of Vocational Behavior*, *66*, 304–325. doi:10.1016/j.jvb.2004.09.005

Schlomer, G. L., Bauman, S., & Card, N. A. (2010). Best practices for missing data management in counseling psychology. *Journal of Counseling Psychology*, *57*, 1–10. doi:10.1037/a0018082

Smith, P. L., & Fouad, N. A. (1999). Subject-matter specificity of self-efficacy, outcome expectancies, interests, and goals: Implications for the social-cognitive model. *Journal of Counseling Psychology*, *44*, 461–471. doi:10.1037//0022-0167.46.4.461

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. doi:10.1016/j.jvb.2011.10.001

Tofighi, D., & MacKinnon, D. P. (2011). RMediation: An R package for mediation analysis confidence intervals. *Behavior Research Methods*, *43*, 692–700. doi:10.3758/s13428-011-0076-x

Tokar, D. M., Buchanan, T. S., Subich, L. M., Hall, R. J., & Williams, C. M. (2012). A structural examination of the learning experiences questionnaire. *Journal of Vocational Behavior*, *80*, 50–66. doi:101016/j.jbv2011.08.003

Trask-Tate, A., & Cunningham, M. (2010). Planning ahead: Examining the relation between school support and parental involvement in the development of future academic expectations in resilient African American adolescents. *The Journal of Negro Education*, *79*, 137–150.

Turner, S., & Lapan, R. T. (2002). Career self–efficacy and perceptions of parent support in adolescent career development. *The Career Development Quarterly*, *51*, 44–55. doi:10.1002/j.2161-0045.2002.tb00591.x

Turner, S. L., Steward, J. C., & Lapan, R. T. (2004). Family factors associated with sixth–grade adolescents' math and science career interests. *The Career Development Quarterly*, *53*, 41–52. doi:10.1002/j.2161-0045.2004.tb00654.x

U.S. Department of Commerce. (2011, July). *STEM: Good jobs now and for the future* (Issue Brief No. 03-11). Washington, DC: Author.

Weston, R., & Gore, P. A. (2006). A brief guide to structural equation modeling. *The Counseling Psychologist*, *34*, 719–751. doi:10.1177/0011000006286345

Williams, C. M., & Subich, L. M. (2006). The gendered nature of career related learning experiences: A social cognitive career theory perspective. *Journal of Vocational Behavior*, *69*, 262–275. doi:10.1016/j.jbv.2006.02.007