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Expanding Women's Participation in STEM: Insights From Parallel Measures of Self-Efficacy and Interests

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Abstract

Despite social cognitive and cultural barriers, women continue to consider and declare science, technology, engineering, and math (STEM) majors. Research suggests that both self-efficacy and interest are necessary to approach a career goal; however, women in STEM report lower interest and confidence compared to their male counterparts. Using integrative career profiles of 448 potential and declared STEM majors, we investigated Realistic, Investigative, Artistic, Social, Enterprising, and Conventional thresholds of self-efficacy and interest among women and men using the career and personality assessments integrative online system. Results indicated gender as a moderator for the Realistic threshold, where women have a lower threshold for approaching and declaring a STEM major compared with men. Women in this sample showed similar levels of Investigative self-efficacy and interests compared with men. This study adds to prior literature investigating people–thing orientations among men and women in STEM. These results may be utilized in broadening female participation in STEM and alleviating underrepresentation.

Keywords

STEM majors, underrepresentation, women, RIASEC, self-efficacy, interest

According to several federal reports and commissions, the United States has an urgent need to increase the amount of highly educated and diverse science, technology, engineering, and math (STEM) workers (Hill, Corbett, & Rose, 2010; National Research Council, 2011; National Science

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and Technology Council, 2013). The metaphor of a multistage "shrinking and leaky" pipeline emerged as a helpful framework for exploring this issue (Blickenstaff, 2005). This pipeline prevents diverse individuals from considering STEM as an academic path, drives out those who chose STEM majors as they switch into other majors, and prevents them from entering the STEM career field even after obtaining a degree. For the past 35 years, Betz and Hackett's (1981) application of Bandura's (1977, 1986) self-efficacy construct continues to be utilized to understand these phenomena.

The literature consistently highlights that despite comparable performance scores, women have lower math and science self-efficacy than men, and as other marginalized identities intersect, self-efficacy is further diminished (Betz, 1997; MacPhee, Farro, & Canetto, 2013). Lacking self-efficacy for STEM tasks consistently has been shown to contribute to attrition from an STEM major, thus the students who enter into STEM with lower levels of interest and confidence are already at high risk (Heilbronner, 2013; Hill et al., 2010). Regardless of these barriers, underrepresented students continue to approach and declare STEM majors (Moakler & Kim, 2014). Even in an introductory STEM course with relatively high percentages of women (45.4%) and ethnic minorities (43.8%), women continue to remain at a disadvantage to their male counterparts in terms of self-efficacy and support (Hardin & Longhurst, 2015). Women not only reported lower STEM interest and self-efficacy but also reported lower coping self-efficacy. Male students, on the other hand, reported perceiving an increase in support for pursuing STEM across the semester.

Bandura's (1986) threshold effect postulated that at least moderate self-efficacy was necessary to generate interest in an activity, but additional increases in self-efficacy above the threshold level would not produce further gains in interest. Betz and Hackett (1981) showed that both variables were important to considering and choosing career options, and Lenox and Subich (1994) investigated this threshold effect further. They found that the relationship between self-efficacy and interest was curvilinear as opposed to linear for Realistic and Investigative domains. That is, as self-efficacy increases from low to moderate for a certain activity, there is a little change in interests. However, as self-efficacy increases to high levels, interests increase beyond this threshold. Furthermore, they noted that sex contributed to the curvilinearity for efficacy and interest relationships.

Thus, self-efficacy and interest can be understood on an *x*-axis and *y*-axis that yields a threshold of an individuals' intention to approach and choose an academic major or career. Standard thresholds for examining self-efficacy and interest levels on a scale of 1–5 are 3.5–4.49 for moderate confidence and interest and 4.5 and above for high confidence and interest (Betz, Borgen, & Harmon, 2004). However, the aforementioned literature indicates that this threshold may be moderated by gender, where women's self-efficacy and interest threshold for declaring a STEM major is lower compared with men. This lower threshold would indicate that a woman may have low self-efficacy and interest in STEM but may still perceive it as a viable academic major and career option. The authors are guided by the following research question: What are the gender differences in self-efficacy and interest thresholds for women and men in STEM?

Therefore, this article aims to investigate the different patterns of self-efficacy and interests of potential and declared STEM majors. In the interest of capturing an integrative career profile, the career and personality assessments (CAPA) integrative online system (Betz & Borgen, 2010) was utilized to broadly examine self-efficacy and interests. Holland's (1997) Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC) codes will be compared among male and female STEM majors. Ultimately, these findings may provide implications for recruitment of college-bound students as well as retention strategies.

Diverse STEM Workforce Advancement

The gender gap in obtaining a college education has reversed, favoring women over men across all racial and ethnic groups in the United States (Buchmann & DiPrete, 2006). Regardless of this gender

gap reversal, women continue to be underrepresented in STEM. There has been a plethora of research examining the lack of diverse individuals in STEM in the past few decades. This research began by focusing specifically on the gender disparities within STEM and then expanded into an intersectional view of how gender, race, ethnicity, social economic status, and other factors function in the underrepresentation.

Understanding diverse underrepresentation in STEM began to be commonly understood through the metaphor of a shrinking and leaky pipeline (Blickenstaff, 2005). This pipeline leaks diverse students at different stages: Some who show STEM interest in high school do not apply to this area of study in college, some enter college in a STEM major but switch before graduation, and some choose not to enter the STEM field after graduating with a degree (Blickenstaff, 2005; N. Fouad, Fitzpatrick, & Liu, 2011). Low faculty expectations combined with a "Here let me show you" attitude sends a message to female students and students of color that the STEM environment is masculine and that male assistance is necessary to succeed (Seymour & Hewitt, 1997). Underrepresented students also report experiencing a "chilly" academic environment (Flam, 1991). Like the "here let me show you" attitude, overt sexism and sexual harassment play a small role in this chilly atmosphere. Instead, covert acts of isolation and exclusion are the main method in creating this unwelcoming environment. The experience of this chilly climate compounded with a myriad of other well-researched barriers such as family responsibilities and low workplace support (N. A. Fouad, Singh, Cappaert, Chang, & Wan, 2016; Swanson, Daniels, & Tokar, 1996) ultimately dissuades diverse individuals from participating in STEM during college and persisting into the field.

Self-Efficacy and Interest Threshold

Self-efficacy refers to one's beliefs about the ability to organize and execute actions for accomplishing a given task successfully (Bandura, 1977). These beliefs guide individual behavior, including effort expended on tasks and persistence despite barriers to success. The threshold effect was first introduced by Bandura (1986) and suggested that at least moderate self-efficacy was necessary to produce and maintain interest in an activity. In their conceptual work (Hackett & Betz, 1981) and seminal study, Betz and Hackett (1981) applied Bandura's (1977) theory to conclude that both self-efficacy and interests were important to the perception of career options. This model has been expanded by social cognitive career theory (SCCT) to include variables such as outcome expectations, person inputs, and background contextual affordances (Lent, Brown, & Hackett, 1994, 2000). Although the SCCT choice model has enhanced the understanding of career development through the incorporation of additional constructs, the connections between parallel measures of self-efficacy and interests remain central to the model (Betz & Rottinghaus, 2006).

Rottinghaus, Betz, and Borgen (2003) investigated this threshold by examining the high interest–low confidence and low interest–high confidence score patterns as a function of gender traditionalism in a sample of undergraduate students. They found that students reported more frequent patterns of higher interest–lower confidence in gender nonstereotypic (nontraditional) areas such as teaching for men and engineering for women. For example, 27% of women reported more interest than confidence on mechanical activities, whereas 32% of men reported higher confidence than interest in this area. This lack of self-efficacy, despite high interest, may partly explain the tendency for women to not approach STEM majors. However, women, ethnic minorities, and other marginalized groups who have declared STEM majors report significantly lower self-efficacy *and* interest compared to their male or White counterparts (N. A. Fouad, 1995; Inda, Rodriguez, & Pena, 2013; Moakler & Kim, 2014). The fact that these underrepresented students are approaching STEM majors with low confidence and interest in their STEM abilities seems to contradict Bandura's (1986) threshold theory. This study investigates the nature of this threshold within an STEM-specific sample.

RIASEC

STEM-related occupations align with Holland's (1997) Realistic and Investigative interests. Although this corresponds well with a male gender stereotypic desire to work with objects and abstract ideas, women who enter into an STEM major may view their education as an opportunity to fulfill their gender stereotypic Social and Artistic interests. In a sample primarily consisting of women (82%), Kaufman (2013) found that students in traditionally Investigative majors scored high on measures of openness and creativity. In fact, results of this study also indicated Investigative-STEM majors and Artistic majors had comparable creative metacognition scores. Since diverse individuals are declaring STEM majors despite this lower interest and confidence pattern, Social and Artistic aspects may be drawing them in (Moakler & Kim, 2014).

Indeed, gender differences emerge when comparing reasons for entering an STEM major for men and women. Women often emphasize helping and connecting with others, whereas men cite financial reward and desire to work with objects (Feist, 2006; Tillberg & Cohoon, 2005). These preferences reflect men's focus on working with things versus women's preference for working with people (Su, Rounds, & Armstrong, 2009). Desire for social connection may also be especially important to women of color in STEM. Ong, Wright, Espinosa, and Orfield (2011) found that women of color actively sought academic and personal relationships in order to build a sense of support and that these relationships were vital to persisting in their major. N. Fouad, Singh, Cappaert, Chang, and Wan (2016) found that lack of empathic support, not Realistic and Investigative interests, was most important to the attrition decisions of female engineers. Research also indicates women have stronger Artistic interests compared with men (Su et al., 2009). Root-Bernstein (2015) reported that 82% of midcareer scientists and engineers believe arts and crafts should be a part of the STEM education due to its correlation with measures of success in STEM, such as Nobel Prizes.

Current Study

If women are approaching STEM with low self-efficacy in Realistic and Investigative skills, they may have a lower threshold for declaring this major compared with men. They may also have strengths in other important areas that allowed them to perceive STEM as an option because it serves as an avenue for expressing Social and Artistic interests to fulfill personal values. As stated previously, parallel measures of interests and self-efficacy yield a threshold that indicates a student's ability to perceive STEM as a career option and declare the major. Using 3.0 as the midpoint for moderate interest and self-efficacy, four quadrants were created to indicate high interest–high self-efficacy, high interest–low self-efficacy, low interest–high self-efficacy, and low interest–low self-efficacy. The present study aimed to examine integrative career assessment profiles of female and male students approaching STEM majors. Specifically, parallel measures of RIASE Scales for self-efficacy and interests were compared between gender groups. Differences in Conventional scores were not hypothesized due to lack of support in the literature. According to the aforementioned literature, the following hypotheses were investigated:

Hypothesis 1: RIASE interest and confidence thresholds will be moderated by gender.

Hypothesis 1a: A higher proportion of male participants are located in the high interest–high confidence quadrant of Realistic, Investigative, and Enterprising compared with women.

Hypothesis 1b: A higher proportion of female participants are located in the high interest–high confidence quadrant of Artistic and Social compared with men.

Method

Procedure

We used data from a sample of 4,707 students enrolled in a career exploration course at a large Midwestern university. Following the 2010 Standard Occupational Classification system, STEM majors were operationally defined as life and physical science, engineering, mathematics, and information technology. In order to capture the pipeline of STEM majors, two coding steps were used to include intending and declared STEM students. First, *academic major* was coded to include students who reported a declared STEM major. Second, an open-ended *career aspiration* question was coded to include intending STEM students who aspire to STEM-related fields but had not yet declared the major.

Participants

The sample included 448 (99 women, 349 men) undergraduate students who met the criteria for considering or declaring a STEM major. Regarding race/ethnicity, 330 (73.7%) of the participants identified as White, 61 (13.6%) Black, 30 (6.7%) Asian, 12 (2.7%) Other, 11 (2.5%) Hispanic, 3 (0.7%) American Indian, and 1 (0.2%) Hawaiian/Pacific Islander. The highest reported STEM major for both genders was engineering with 21% of women and 39.4% of men reporting this major. Biology was the second highest reported major for women (15.2%) and men (3.2%). Lastly, 55.7% of women and 54.9% of men comprised a combination of all other STEM majors, including actuarial science, animal science, biochemistry, chemistry, crop science, molecular genetics, environmental science, computer and information science, food science, mathematics, microbiology, and physics.

Measures

CAPA online (Betz & Borgen, 2010) is comprised of the CAPA Confidence Inventory (CCI) and the CAPA Interest Inventory (CII). The top confidence and interest scores are weighted to yield clusters of college majors with best fit for that person's pattern of strengths. The responses are measured on a 5-point scale ranging from *no confidence/interests at all* (1) to *complete confidence/interest* (5). The CAPA has been shown to lead to significant increases in career decision self-efficacy and college major decidedness with diverse samples (Betz & Borgen, 2009).

CCI. The CCI is a 190-item scale that measures self-efficacy or confidence related to the six RIASEC themes or general confidence themes (GCT), and 27 basic dimensions of vocational activity or basic confidence scores (BCS; e.g., mathematics). The number of items for each of the Holland GCTs range from 18 to 35 with corresponding Cronbach's αs ranging from .89 to .94. BCS items range from 4 to 12 for each scale with αs ranging from .78 to .91 (Betz & Borgen, 2009). Factor analysis consistently yielded stable dimensions of basic confidence that linked to college majors and career choices (Betz & Borgen, 2016).

CII. The CII is a 292-item scale that measures interest in activities, school subjects, and settings related to the 6 RIASEC themes and 35 basic interest areas. The numbers of items per basic interest scales range from 5 to 14, with Cronbach's αs ranging from .83 to .94. Cronbach's αs for the RIASEC Scales ranged from .89 to .96 (Betz & Borgen, 2009). Similar to the confidence inventory, the interest dimensions have demonstrated concurrent validity with occupational and college major choices (Borgen & Betz, 2016).

Table 1. Intercorrelations Between Variables Under Investigation by Gender.

	Scale	1	2	3	4	5	6	7	8	9	10
1	R interest	—	.25	.48	.37	.46	.78	.26	.49	.40	.51
2	I interest	.43	—	.11	.48	.24	.22	.81	.18	.37	.35
3	A interest	.35	.32	—	.42	.42	.42	.14	.84	.45	.39
4	S interest	.44	.47	.49	—	.67	.25	.38	.42	.85	.73
5	E interest	.44	.31	.35	.63	—	.25	.20	.38	.62	.81
6	R confidence	.76	.34	.33	.34	.33	—	.42	.56	.40	.47
7	I confidence	.39	.76	.28	.40	.31	.53	—	.30	.46	.43
8	A confidence	.33	.24	.82	.40	.36	.49	.42	—	.54	.51
9	S confidence	.34	.35	.51	.79	.56	.49	.54	.61	—	.78
10	E confidence	.44	.25	.38	.57	.76	.57	.52	.59	.77	—

Note. Correlations above the diagonal are female; correlations below the diagonal are male. All correlations below the diagonal are significant at the .01 level. All correlations above the diagonal above .30 are significant at the .01 level. R = realistic; I = investigative; A = artistic; S = social; E = enterprising.

Analysis of the Data

First, bivariate correlations analyses reported the relationships between the variables under investigation. Second, a multivariate analysis of variance (MANOVA) was conducted to determine whether gender differences were present among the RIASE Self-Efficacy and Interest Scales. Differences in Conventional scores were not hypothesized due to lack of support in the literature. This was followed by F tests to determine the direction and magnitude of differences between the variables. Following similar methods of examining interest and confidence thresholds (Rottinghaus, Betz, & Borgen, 2003), RIASE scores were classified into a high or low split using the median scale cutoff point (3.0). Following the classification of the RIASEC Scales into either high or low, cross classification of these dimensions was accomplished yielding a 2×2 category system providing percentages of participants comprising each of the resulting quadrants (high and low confidence crossed with high and low interest). χ^2 analyses were used to examine the independence versus dependence of the two categories. Scatterplots were generated to display self-efficacy and interest quadrants along with the gender thresholds.

Results

Correlations between all variables are reported in Table 1. Highest correlations were generally between Holland interest and confidence theme areas. They were highest for Social (.85), Artistic (.84), and Investigative (.81) for women and Artistic (.82), Social (.79), and Investigative (.76) for men. Social confidence and Enterprising confidence were also highly correlated for men (.77) and women (.78).

MANOVA Results

Results of a MANOVA showed a significant effect for gender among the five Holland Interest and Confidence Scales, Wilks's $\lambda = .71$, $F(10, 437) = 18.19$, $\eta^2 = .088$, $p < .001$. Table 2 reports the results and effect sizes of the univariate analyses of variance following the significant F for gender.

Univariate analyses indicated significant gender differences for both Realistic interest, $F(1, 446) = 110.36$, $\eta^2 = .20$, $p < .001$, and Realistic confidence, $F(1, 446) = 61.75$, $\eta^2 = .12$, $p < .001$, where men had significantly higher scores. Men also scored significantly higher on Enterprising interest, $F(1, 446) = 9.91$, $\eta^2 = .02$, $p < .01$, and Enterprising confidence, $F(1, 446) = 7.97$, $\eta^2 = .02$, $p < .01$.

Table 2. Means, Standard Deviations, and Univariate *F* Tests of Gender Effects.

	Women		Men			
Scales	*M*	*SD*	*M*	*SD*	*F*(1, 446)	Partial η^2
RIASEC						
Realistic interest	2.42	.70	3.25	.69	110.36***	.20
Investigative interest	3.32	.86	3.34	.74	0.02	.00
Artistic interest	2.87	.82	2.69	.76	4.22*	.01
Social interest	3.20	.74	3.10	.65	2.25	.01
Enterprising interest	2.55	.80	2.83	.77	9.91**	.02
Realistic confidence	2.70	.80	3.42	.81	61.75***	.12
Investigative confidence	3.55	.78	3.56	.65	0.04	.00
Artistic confidence	2.71	.75	2.61	.76	1.50	.00
Social confidence	3.37	.74	3.27	.70	1.76	.00
Enterprising confidence	2.79	.69	3.02	.71	7.97**	.02

Note. $N = 448$.
*$p < .05$; **$p < .01$; ***$p < .001$.

Artistic interest also yielded gender differences, $F(1, 446) = 4.23$, $\eta^2 = .01$, $p < .05$, with women scoring significantly higher than men.

Cross Classification of Interest and Confidence

Following the MANOVA, Holland themes that showed a significant gender effect for parallel interest and confidence were classified into high or low confidence. Cross classification of these dimensions yielded a 2 × 2 quadrant system, providing percentages of participants who fell into each quadrant (low interest and high interest crossed with low confidence and high confidence). χ^2 analysis indicated the Realistic classification was statistically significant at the $p < .001$ level. Enterprising was not statistically significant ($p = .06$). These results indicated that the Realistic quadrant categories were not independent. Scatterplots report plotted individual scores into quadrants to depict the significant gender threshold for *R* (Figure 1) and nonsignificant IASE (Figure 2).

Table 3 provides the percentages of women and men classified into each quadrant for Realistic and Enterprising. It was hypothesized that within gender-stereotypic domains, STEM students would have more frequent occurrence of high interest and high confidence. This hypothesis was partly supported, especially with respect to male-stereotypic domains. Examining the high interest–high confidence and low interest–low confidence scores in Realistic shows that 60.6% of women and 22.9% of men were classified into Quadrant 1, whereas 60.7% of men and 19.2% of women were classified into Quadrant 4. According to the χ^2 analysis, these paired percentages were significantly different and resulted in a lower Realistic threshold for women compared with men (Figure 1). This threshold effect was not evident for Investigative, Artistic, Social, or Enterprising (Figure 2).

Discussion

The present research studied the RIASE threshold differences among women and men in STEM majors using the CAPA self-efficacy and interest measures (Betz & Borgen, 2010). Our hypotheses were partially supported. The MANOVA indicated overall mean-level differences for RIASE. χ^2 Analysis found that the Realistic threshold was moderated by gender as hypothesized with a medium effect size. Although we found a gender-moderated threshold for Realistic activities, our other

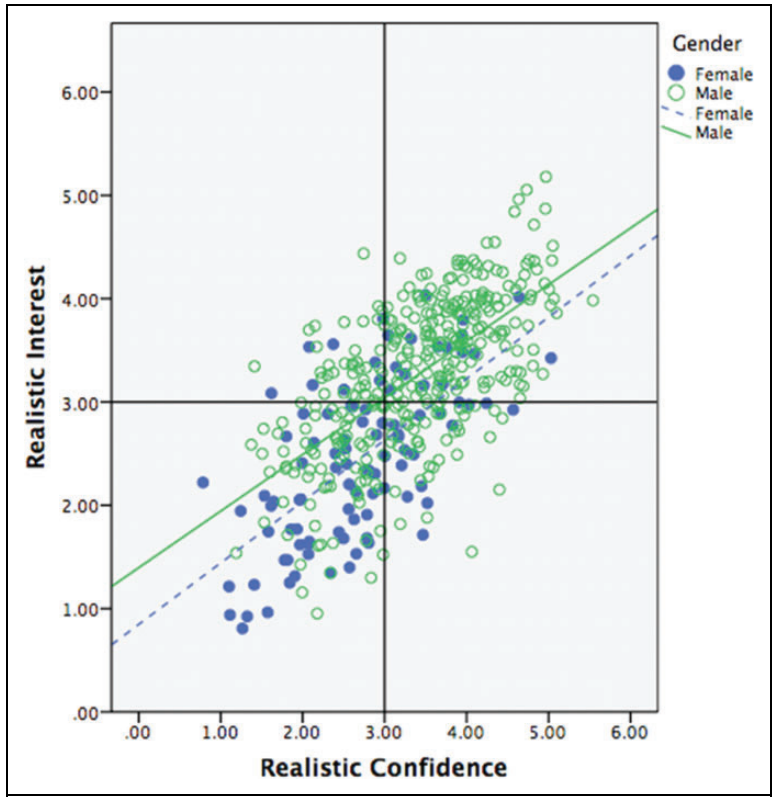

Figure 1. Individual Realistic scores and gender threshold. $N = 448$. Lines at 3.0 indicate midpoint of the scale for moderate confidence and interest.

hypothesized thresholds were not supported. Men and women in STEM did not significantly differ on Investigative, Artistic, Social, and Enterprising self-efficacy and interest thresholds. Group differences did emerge on Enterprising interest and confidence as well as on Artistic interest; however, the effect sizes were small. Results indicated a lower Realistic self-efficacy and interest threshold for female STEM majors compared with male STEM majors; 60.7% of male STEM majors in this sample fell into the high interest–high confidence quadrant compared with only 19.2% of women. The majority of the women in this sample (60.6%) fell into the low interest–low confidence quadrant, regardless of already entering the STEM pipeline. Interestingly, we did not find gender differences in Investigative self-efficacy and interest thresholds. Given that many STEM majors involve some combination of both Investigative and Realistic skills, along with the representation of many STEM domains in our sample, these null results are intriguing. This may indicate that high interest and confidence in Realistic activities is not mandatory for women to approach the broader STEM pipeline. This finding supports prior research that indicates women and men in STEM do not differ on Investigative dimensions. Instead, a large gender difference in Realistic, or "things orientation," favoring men seems to characterize gender differences in STEM (Yang & Barth, 2015). Researchers have continued to explore this people–thing interest dimension across STEM domains (Su & Rounds, 2015). The current study aimed to add to this literature by examining RIASEC self-efficacy and interest among these men and women.

Because many STEM majors are considered both Investigative and Realistic, this poses a potential concern for women's persistence in STEM. Although female students managed to enter into

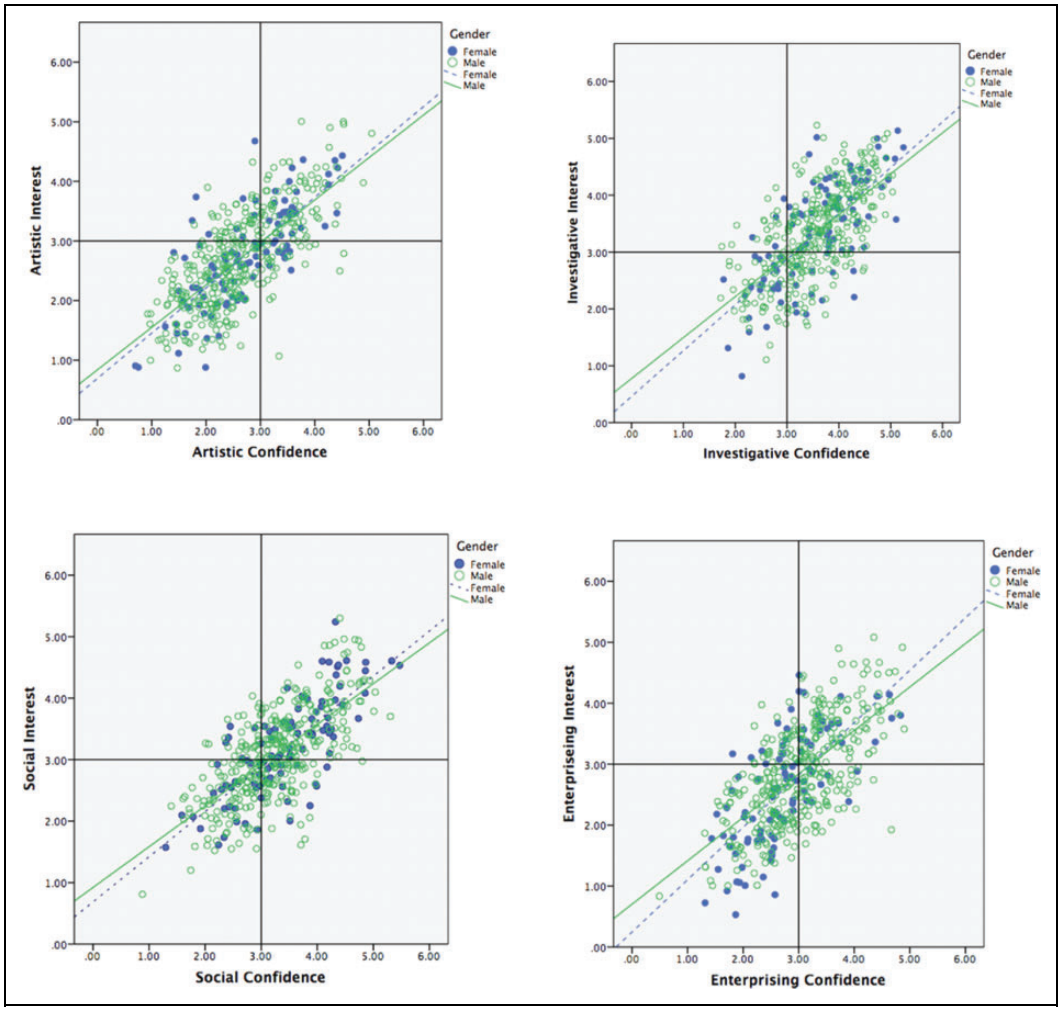

Figure 2. Individual Investigative, Artistic, Social, Enterprising scores and gender thresholds. $N = 448$. Gender thresholds were not significantly different.

Table 3. Cross Classification of Gender-Moderated RIASEC Confidence and Interests (in Percentages).

	Low I, Low C[a]		High I, Low C[b]		Low I, High C[c]		High I, High C[d]	
Scales	Women	Men	Women	Men	Women	Men	Women	Men
Realistic***	60.6	22.9	16.2	9.5	4.0	6.9	19.2	60.7
Enterprising	53.5	41.0	11.1	15.2	11.1	8.3	24.2	35.5

Note. $N = 448$. I = interest; C = confidence; RIASEC = realistic, investigative, artistic, social, enterprising, and conventional.
[a]Quadrant 1. [b]Quadrant 2. [c]Quadrant 3. [d]Quadrant 4.
***Pearson $\chi^2 < .001$.

STEM majors, low interest and confidence in Realistic skills may ultimately drive them out. Female STEM majors may be entering the pipeline as a way to fulfill interests and strengths, despite having lower Realistic interests and confidence. For example, women typically show a preference for

helping and working with people (Konrad, Ritchie, Lieb, & Corrigall, 2000). Women who view science as an altruistic career may show interest in approaching STEM, despite having a lower self-efficacy (Weisgram & Bigler, 2006). Given these social interests, women may also have communal goals that are ultimately ignored or not emphasized in their curriculum (Diekman, Brown, Johnston, & Clark, 2010). Our findings suggest that high Investigative self-efficacy and interest may allow these underrepresented students to perceive STEM as a potential career; however, their lower Realistic threshold may ultimately contribute to high attrition rates. Furthermore, research indicates that women in STEM struggle to maintain a sense of belonging in their major and often exit the pipeline into the humanities or liberal arts (Seymour & Hewitt, 1997; Thoman, Arizaga, Smith, Story, & Soncuya, 2014). With high math and high verbal ability comes a greater range of career options, and more women than men tend to have this combination of these abilities (Wang, Eccles, & Kenny, 2013). In order to retain these multitalented women, STEM fields may need to begin both reframing their work in a way that fulfills these social interests and employing interventions that will increase Realistic self-efficacy and interest.

Implications

The results of our study indicated that women are approaching STEM majors in a lower Realistic interest and confidence threshold compared to male students. Thus, these students may require unique career counseling needs compared to their male counterparts. Our results indicated that gender did not moderate Investigative scores, thus focusing an intervention on this lower Realistic threshold may be imperative for underrepresented students in STEM. Betz, Borgen, and Harmon (2004) suggest multiple interventions for increasing self-efficacy in a certain area that bode well for students studying STEM. For example, locating same-gender or same-race role models and mentors in STEM allows an opportunity for vicarious learning. Indeed, research has indicated that contact with successful in-group experts or peers acts as a ''social vaccine'' that can protect students from self-doubt (Dasgupta, 2011). Another option may be exploring and managing anxiety the client experiences when performing Realistic tasks. Lab work may be an area where lack of confidence in hands-on Realistic skills creates anxiety and self-doubt. Johnson (2007) found that women of color had a wide range of experiences in research labs. Although some students cited working in their lab as a launching pad for entering a doctoral program, other students experienced such a hostile environment that it caused them to switch majors.

The results of this study also have important assessment implications. Research suggests that both self-efficacy and interests are necessary to approach a career goal, and Bandura's (1986) threshold effect postulated that at least moderate self-efficacy was necessary to maintain interest in an activity. However, the majority of the women in STEM in the present study fell into the low interest–low confidence quadrant. Clinicians following the proposed cutoffs for moderate self-efficacy and interest may overlook the potential of women in these quadrants to enter the STEM pipeline. Women within this quadrant who also indicate high Investigative interest and self-efficacy may be successfully recruited and retained in STEM with proper interventions aimed at increasing Realistic self-efficacy and interest.

Group interventions may be an excellent option for these students. For example, Betz and Schifano (2000) created a self-efficacy intervention aimed at increasing Realistic confidence in college women. This 1-day workshop included all four sources of Bandura's (1977) self-efficacy information and focused on using and identifying tools, building and repairing objects, and architectural design and construction. Equal numbers of men and women modeled these behaviors and then ensured each participant successfully completed the task. Instructors and students encouraged one another, and relaxation techniques were practiced during break times. Results indicated that Realistic confidence increased significantly, with 62% of women reporting very high Realistic confidence at posttreatment compared to 0% at pretreatment. A group intervention such as this can

be easily adapted for underrepresented students in STEM with successful female and ethnically diverse instructors.

Limitations and Future Research

Although there are many important implications to this study, there are also several limitations. A principal limitation of the present study is the small sample size of women. The low number of women might not provide a large enough sample to detect statistical significance among groups. Thus, the results of this study should be interpreted with caution. Due to underrepresentation in the field, recruiting equal numbers of men, women, and students of color poses a challenge to this line of research. Along with examining gender, race/ethnicity is an important variable to consider when studying underrepresentation in STEM. However, we were unable to do so due to sample size constraints. Future research must continue to identify and recruit racial/ethnic minority students in STEM in order to accurately depict underrepresentation and conclude implications about the relationship between self-efficacy and interest. In addition to unequal sample sizes across gender and ethnicity, the present study collapsed across STEM domains in order to increase the sample size and explore the broader introductory phase of the STEM pipeline. However, different STEM domains require different levels of Realistic and Investigative skills, thus additional research is needed to explore field-specific RIASEC thresholds. Finally, this study examined students who are pursuing STEM majors at one Midwestern university in a cross-sectional design. Future longitudinal studies examining different university samples are important to understanding the progression of students from college into an STEM career.

One particularly promising direction for these parallel measures is the use of computer-assisted career guidance systems (Sampson & Osborn, 2015). Such career assessments may be an important tool in increasing the recruitment and retention of diverse individuals in STEM. There appears to be a direct need for STEM interventions targeted at middle school and high school students in order to shape developing self-efficacy and interest (Shoffner & Dockery, 2015). Administering a web-based career assessment to high school students or undeclared college students may act as a "screening" tool used to identify diverse individuals who are interested in STEM, increase their self-efficacy, and support them toward degree obtainment. Following emerging theoretical frameworks toward multicultural STEM interventions will allow career counselors to increase client awareness of opportunities and develop talent in a culturally relevant fashion (Byars-Winston, 2014).

Declaration of Conflicting Interests

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