Self-Efficacy and Interest Patterns for Women and Men Pursuing STEM Fields

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Introduction

- Previous research shows high interest-low confidence patterns in gender-nontraditional areas and high confidence-low interest patterns in gender-stereotypic areas (Rottinghaus, Betz, & Borgen, 2003). When focusing specifically on Science, Technology, Engineering, and Mathematics (STEM) domains in undeclared majors, the following hypotheses were examined:
- **Hypothesis 1**
1A. Males with undeclared majors have higher mean skills confidence-lower interest patterns in STEM domains.
1B. Females with undeclared majors have lower mean skills confidence-higher interest patterns in STEM domains.
- STEM-related occupations correspond to Realistic and Investigative Holland code skills (Gottfredson & Holland, 1996; Holland, 1985).
- Both self-efficacy and interests are necessary for individuals to approach a particular field (Betz, 1993; Betz & Hackett, 1981; Lent, Brown, & Hackett, 1994).
- Self-efficacy in STEM has been found to be significantly higher for men than for women (Dweck, 2007; Heilbronner, 2012; Pajares & Miller, 1994).
- Interests are crucial on STEM majors' occupational selection, rating interest as the most influential factor in their decision in selecting their chosen occupation (Heilbronner, 2013).
- **Hypothesis 2 (RIASEC)**
2A. There are more frequent rates of high skills confidence-high interest in Realistic and Investigative skills for male STEM majors.
2B. There are more frequent rates of low skills confidence-high interest in Realistic and Investigative skills for female STEM majors.
- Positive attitudes toward mathematics are fundamental to persistence and success in math-based learning (Hackett & Betz, 1989). Stronger mathematics self-efficacy results in a higher likelihood of majoring in STEM fields (Wang, 2013). Despite comparable achievement, males have shown greater levels of math self-efficacy than their female counterparts (Eccles, 1994; Pajares, 2005; Watt, 2006).
- **Hypothesis 3 (STEM Domain- Mathematics)**
3A. There are more frequent rates of high skills confidence-high interest for male STEM majors.
3B. There are more frequent rates of low skills confidence-high interest for female STEM majors.

Method

Participants
- A total of 224 (75.9% male) undergraduates who met the criteria for a declared STEM major were selected from a sample of 4707 students enrolled in a career exploration course at a large Midwestern University. Racial/ethnic backgrounds of participants included 157 (70.1%) White, 29 (12.9%) Black, 21 (9.4%) Asian, 7 (3.1%) Other, 6 (2.7%) Hispanic, 3 (1.3%) American Indian, and 1 (0.4%) Hawaiian/Pacific Islander. Participants represented the following STEM majors.

Figure 1. Number of Participants across STEM Majors in the Current Sample
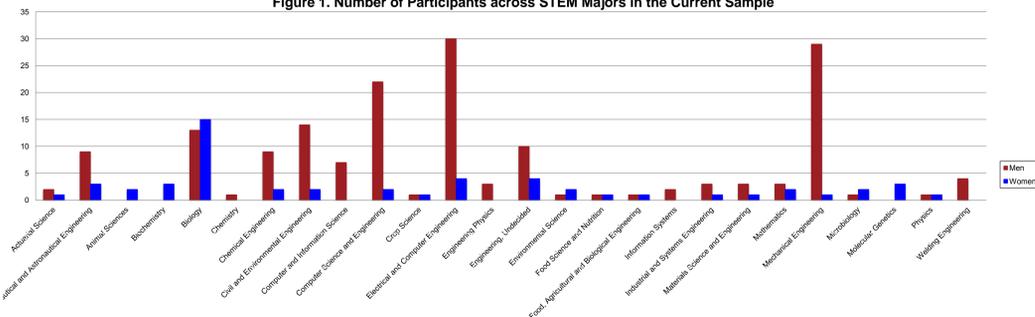
Measures

The Career and Personality Assessments (CAPA) online (Betz & Borgen, 2010) is comprised of the CAPA Confidence Inventory (CCI) and the CAPA Interest inventory. Regression analysis generates interest and confidence scores for each major cluster and a combined score for interests and confidence. The major clusters with the highest scores top the profile and show the strengths in interest in confidence.
- **CCI.** The CCI is a 190-item inventory that measures self-efficacy or confidence related to the six Holland themes, 27 specific dimensions of vocational activity, and 6 "Life Engagement" styles. The responses are measured on a 5-point scale ranging from *No Confidence At All* (1) to *Complete Confidence* (5).
- **CII.** The CII is a 292-item inventory that measures interests related to the six Holland themes, 35 specific dimensions of vocational activity, and six "Life Engagement" styles. The responses are measured on a 5-point scale ranging from *Strongly Dislike* (1) to *Strongly Like* (5).
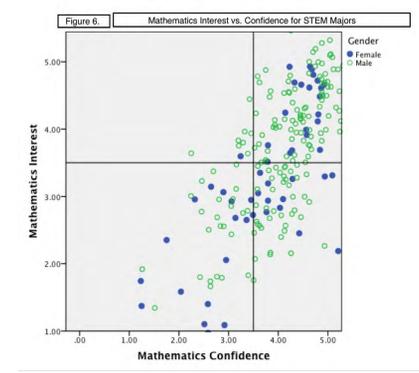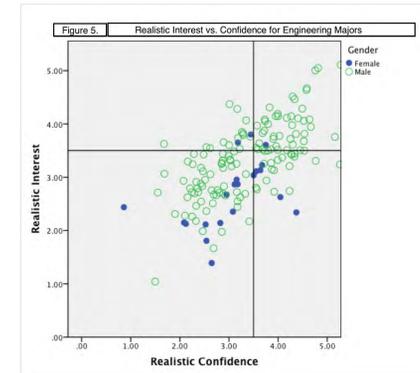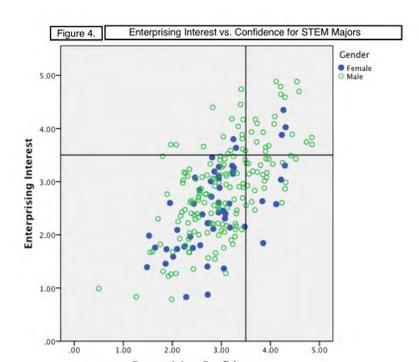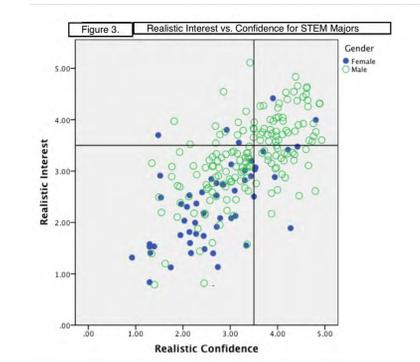
Results

Hypothesis 1
- A MANOVA indicated that there was a significant gender effect for STEM domains on interest and confidence for male and female undeclared majors, $F(8, 4031) = 167.44$, $p < .001$; Wilks's $\Lambda = 0.75$ (Figure 2).
- Male undeclared majors reported significantly higher interests in Mechanics & Engineering, ($F(1, 4038) = 1223.01$, $p < .001$), Information Technology ($F(1, 4038) = 465.46$, $p < .001$), Science ($F(1, 4038) = 107.81$, $p < .001$), and Mathematics ($F(1, 4038) = 195.52$, $p < .001$).
- Male undeclared majors reported significantly higher confidence in Mechanics & Engineering, ($F(1, 4038) = 653.78$, $p < .001$), Information Technology ($F(1, 4038) = 495.74$, $p < .001$), Science ($F(1, 4038) = 137.93$, $p < .001$), and Mathematics ($F(1, 4038) = 216.54$, $p < .001$).

Figure 2. Interest and Confidence Mean Scores for Undeclared Majors across STEM Domains
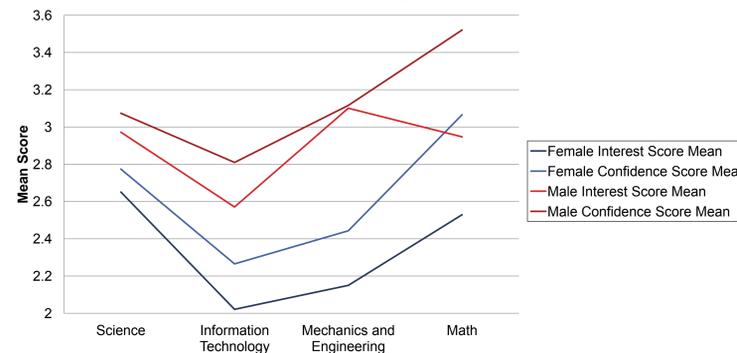
Hypothesis 2: RIASEC Themes
- A MANOVA indicated that there was a significant gender effect for RIASEC themes on interest and confidence for male and female STEM majors, $F(12, 211) = 9.18$, $p < .001$; Wilks's $\Lambda = 0.66$.
- Male STEM majors reported a significantly higher interest in Realistic ($F(1, 222) = 58.88$, $p = .000$) and Enterprising ($F(1, 222) = 7.67$, $p < .01$) (Figures 3 and 4).
- Male STEM majors reported a significantly higher confidence in Realistic ($F(1, 222) = 32.06$, $p < .001$).
- A MANOVA indicated that there was a significant gender effect for RIASEC themes on interest and confidence for male and female Engineering majors, , $F(12, 146) = 5.16$, $p < .001$; Wilks's $\Lambda = 0.70$ (Figure 5).
- Male Engineering majors reported a significantly higher interest in Realistic ($F(1, 157) = 17.39$, $p < .001$) and Enterprising ($F(1, 157) = 5.81$, $p < .02$).

Figure 3. Realistic Interest vs. Confidence for STEM Majors

Figure 4. Enterprising Interest vs. Confidence for STEM Majors

Figure 5. Realistic Interest vs. Confidence for Engineering Majors

Figure 6. Mathematics Interest vs. Confidence for STEM Majors

Hypothesis 3: STEM Domains
- A MANOVA indicated that there was a significant gender effect on Mathematics interest and confidence for male and female STEM majors, $F(2, 221) = 6.20$, $p < .01$; Wilks's $\Lambda = 0.95$ (Figure 6).
- Male STEM majors reported a significantly higher interest in Mathematics, ($F(1, 222) = 11.98$, $p < .001$). Male STEM majors reported a significantly higher confidence in Mathematics, ($F(1, 222) = 9.99$, $p < .01$).

Conclusions

- Male undeclared majors showed higher mean skills confidence and higher interest in STEM domains than female undeclared majors. Unlike hypothesized, both undeclared males *and* females tend to be more confident than interested in STEM domains. This may suggest that recruitment efforts should be focused on increasing women's interest in STEM since it produced the lowest scores.
- Male STEM Majors were more confident and interested in Realistic activities than their female counterparts. More men tended to fall in the high interest-high confidence section (>3.5), whereas women tended to fall in the low confidence-low interest section (<3.5). There was not a significant difference between female and male STEM majors on confidence and interests for the Investigative domain.
- Male STEM majors were more confident and interested in Mathematics than female STEM majors. More men tended to fall in the high interest-high confidence section (>3.5), whereas women tended to fall in the low confidence-low interest section (<3.5). Mathematics may be a key aspect of STEM that dissuades women from entering the field, and the low trends of interest and confidence may continue even as women enter the field.
- The results showed that women are still declaring STEM majors even though they are scoring lower on STEM-related interest and confidence scores. This may suggest that women have a lower interest and confidence threshold for choice of a STEM major and career. Future research should continue to investigate why this lower threshold exists for women in STEM and how it affects recruitment and retention of women within these fields.