# A Semi-Qualitative Analysis of Women's Adjustment to STEM Majors

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## Abstract

This analysis of 118 women engineering majors extends prior social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994) research by examining social-contextual and personal factors that promote successful adjustment. Participants reported experiencing several types of academic, social, and financial hurdles during their first semester. They also described factors that facilitated their academic progress and additional elements that, if available, could have further assisted their adjustment. Implications for research, recruitment, and retention will be discussed

## Introduction

Government planners, industry groups, and academics all have expressed concern about the need to attract and retain more students and workers within science, technology, engineering, and mathematics-intensive (STEM) fields, and there are clear data that women, in particular, continue to be underrepresented in many STEM specialties (NSF 2007; WEPAN, 2006). Not surprisingly, over the past several years, researchers have employed a number of theories and methodologies to further elucidate the academic and career development experiences of women in STEM fields.

One theoretical approach that has been applied to understanding the factors that attract students to, and that affect their persistence within, STEM fields is social cognitive career theory (SCCT). SCCT originally focused on three key aspects of academic and career development: (a) how basic academic and career *interests* develop, (b) how educational and career *choices* are made, and (c) what factors affect academic and career *success* (i.e., achievement and persistence). Developed by Lent, Brown, and Hackett (1994, 2000), SCCT is based on Bandura's (1986) more general social cognitive framework – an influential theory of cognitive and motivational processes that has been extended to the study of many areas of psychosocial functioning. More recently, SCCT has been expanded to illuminate the factors responsible for educational and occupational *satisfaction* and other aspects of positive adjustment to school and work contexts (Lent & Brown, 2006, 2008).

SCCT offers a useful perspective from which to understand and promote the career development of women in STEM fields. A theory-based approach also may lend added coherence, organization, and comprehensiveness to current STEM workforce development efforts, including efforts to understand the role of gender, race/ethnicity, and other individual difference factors in choice of, and persistence in, STEM fields. For instance, knowledge of such issues as students' developmental needs and tasks at various ages, the cognitive mechanisms through which educational intervention effects operate, or the social-contextual factors (e.g., family and peer supports or discouragement) that facilitate and constrain choice options for particular groups of students could be quite beneficial to STEM workforce preparation efforts. Yet to this point, the career development literature has been largely underutilized as a wellspring for STEM workforce development planning.

While it is useful to test SCCT using *nomothetic*, quantitative methods, it is valuable to complement such research with *idiographic*, qualitative methods capable of elaborating specific self and environmental percepts that could inform educational interventions. For example, prior work on SCCT has established that social supports and barriers generally have been linked to persistence in engineering majors (largely indirectly, through their relation to self-efficacy), but the mostly nomothetic research on this issue has focused on global aspects of supports and barriers. Idiographic (i.e., more individually-oriented) research could identify which specific aspects of supports and barriers are experienced as crucial to women in STEM majors, and what coping resources they use more or less effectively to negotiate barriers to their academic persistence.

In sum, this study extends prior research on SCCT in the context of women's STEM field choice and persistence  Specifically, by employing qualitative methods, we explored the environmental barriers experienced by women entering engineering majors, along with the environmental resources and coping strategies that help them to negotiate these barriers.  The advantage of this discovery-oriented methodology is that it enabled us to explore women's experiences from their own phenomenological perspectives and in their own words.

## Methods

**Participants**. Participants were 118 women enrolled in their first year of engineering at a major university on the East coast with a large engineering program. Mean age for the sample was 18.14 (*SD* = .38). These women identified as European American (*n* = 88), Asian American (*n* = 12), African American (*n* = 8), Latina (*n* = 6), and "other" (*n* = 4). Four participants were international students.

**Procedures**. Incoming first-year engineering students were invited to participate in a mixed-methods study of women's adjustment to engineering majors. Online data collection was conducted during the last four weeks of the 2008 fall semester. Students were offered a $15 gift card for their participation. The online survey included both (a) a battery of structured measures for formal theory-testing purposes, and (b) a set of four open-ended questions for discovery-oriented purposes.  The four questions asked about students' access to environmental resources, experience of environmental barriers, and barrier-coping strategies within the context of engineering field choice. The responses were reviewed and coded by a team of doctoral students (*n* = 5) and faculty (*n* = 2) in counseling psychology.

We used common content-analysis methods adapted from Fraenkel and Wallen (2003) to code participants' responses. We also incorporated aspects of the consensual qualitative research paradigm (Hill et al., 1997); specifically, we used a consensus-driven process to arrive at final coding decisions. First, for each question, participant responses were unitized such that each individual thought unit within an individual response was identified; thus it was possible for one response to include multiple thought units. Second, each research member individually reviewed all participant responses and then developed a tentative list of categories and subcategories to encompass them. Third, the entire coding group met to discuss and eventually come to a consensus regarding response categories and subcategories. Fourth, approximately 5% of participant responses from each of the four questions were selected in order to conduct coder training. During this training, all team members individually coded the set of training responses using the preliminary list of categories and subcategories. Fifth, the entire group met again to review the coding training and to further discuss and finalize the list of categories and subcategories. Next, the five students were divided into 10 2-member coding teams. Each team coded one-fifth of the participant responses. Each member of the dyad coded the responses independently, placing each thought unit into the most appropriate category and sub-category. Dyad coding consistency was then evaluated by another research team member. Any coding inconsistencies were reported to the original coding dyad; members of the coding dyad were then responsible for coming to a consensus regarding the final category and subcategory placement.

## Results

**Major hurdles or challenges faced during the semester.** Our first research question asked about the major hurdles or challenges women engineering majors face during their first semester and whether these challenges hindered academic success or willingness to continue in engineering. Participant responses reflected five broader categories including academic-internal, academic-external, social, financial, and health barriers. Common *academic-internal* (i.e., intrapersonal) *barriers* included student disinterest (e.g., in course material), negative affect (e.g., feeling overwhelmed or frustrated), problems with academic, organizational, and developmental skills and adjustment (e.g., time management, academic performance problems, negotiating competing demands), and career indecision. Common *academic-external barriers* were program and university barriers (e.g., difficulties with registration), and problems with instructors, teaching assistants, and advisors (e.g., difficulty understanding instructors' speech patterns, poor advising). One relatively infrequent, but perhaps important reported academic-external barrier was the lack of representation of other women enrolled in the engineering program. Common *social barriers* were lack of social support, lack of friends in the major, and relationship problems. The primary *financial and health barriers* were tuition costs and sickness, respectively.

**Strategies employed to cope with challenges.** Our second question asked about the coping strategies that participants employed to deal with the hurdles they had experienced. The first category was labeled *social interactions* and referred to the peer, familial, professional, and romantic relationships participants used to cope with challenges. One important finding was that a number of participants indicated that seeking support from other women engineering students was helpful in dealing with the challenges associated with their underrepresented status. Using *personal resources* was another coping strategy and referred to participants' own character qualities, skills, attitudes, and perceived abilities employed to cope with the challenges. The final two categories were *academic and non-academic resources*. Common academic coping strategies were seeking assistance from instructors, participating in academic programs (e.g., living-learning and mentoring), and seeking academic assistance (e.g., tutor and review sessions). Some common non-academic coping strategies were getting involved with non-engineering student organizations, self-care (e.g., exercise), pursuing sources of funding, and spiritual and religious practices.

**Additional resources to help cope with challenges.** The third question asked participants to identify any additional resources that, if available, would have helped them to cope with the challenges faced during the semester. Participants indicated that increased *social support* would have helped. Participants also stated that *academic – teaching adjustments* (e.g., improved instruction, revising course materials to increase interest) and additional *academic resources* (e.g., mentoring programs, theme housing, information and test review sessions, increased office hours, access to writing centers, technical assistance with computers) would have been beneficial during the semester. In addition, some participants felt that *personal adjustments* (e.g., being more organized or assertive in seeking assistance from instructors, putting forth more effort) and engaging in *extracurricular activities and resources* (e.g., religious activities, sports, exercise) would have been helpful when coping with the semester's challenges.

**Positive factors that affected academic progress**. Our final question asked about the presence of any positive factors that affected academic progress or willingness to persist in engineering during the semester. Participants' responses reflected five categories of positive factors including social support, departmental and university support, non-academic organizations, personal resources, and academic interest. Positive *social support* experiences with friends, peers, study groups, family members, mentors, and romantic partners were all listed as facilitating academic progress. In addition, connecting with other members of underrepresented groups (racial and gender) in engineering was also mentioned. A majority of participants indicated that *departmental and university support* such as mentoring and summer orientation programs, theme housing, honors society, academic assistance programming (e.g., teaching assistants who go above and beyond the call of duty, information sessions, tutoring, writing center, workshops, online materials) also facilitated their academic progress. *Personal resources* (e.g., performance accomplishments, short and long-term expectations, stress management, traits such as motivation, and study skills) and *interest* in engineering were also helpful in facilitating academic progress. Positive experiences with *non-academic organizations* such as religious, military, and non-engineering student organizations were also mentioned.

## Discussion

Women continue to be underrepresented in engineering and many other STEM fields. In order to further understand this phenomenon, we employed a semi-qualitative methodology to elucidate the academic adjustment of women in engineering. Our participants reported (actual percentages will be reported in the presentation) experiencing several types of academic (e.g., study skill deficits), social (e.g., lack of support), and financial (e.g., tuition) challenges to their academic progress during their first semester. They also described several factors that facilitated their progress – such as university programs (e.g., mentoring, living-learning housing), social support from peers, and development of personal resources (e.g., time and stress management skills) – as well as additional elements that, if available, could have further assisted their adjustment.

Given the numerous challenges faced by study participants, we offer the following recommendations for program administrators and faculty, with the hope of facilitating the retention of women in engineering. First, the findings suggest a focus on both external/environmental and intrapersonal academic barriers. For example, when addressing internal academic barriers, it might be important to normalize negative feelings (e.g., frustration and feeling overwhelmed) experienced during the first semester. In addition, it might be helpful to provide resources (e.g., peer counseling with advanced students) to help students cope as they transition into the major. Indeed, the literature on modeling suggests the particular value of "coping models" (e.g., more experienced women students who have themselves coped successfully with first-year challenges). Such peer models can offer both support and credible coping advice.

Second, providing workshops to teach time management, study, and interpersonal skills may help many students to achieve academic success and remain in engineering. One of the most frequently endorsed external academic barriers was the poor quality of certain aspects of instruction and course curriculum. Based on the present findings, it seems that supplying supplemental course materials and additional course review sessions might help students who have difficulty comprehending material and those who have difficulty understanding their course instructors. Faculty might also be sensitized to the need to communicate clearly and to present course material in ways that cultivate and maintain students' interest.

Third, given the central perceived role of social support in bolstering persistence in engineering, program administrators and faculty advisors might consider ways to more systematically organize social support systems for students – both prior to entering and throughout the program. For example, one strategy might be to provide resources (e.g., meeting rooms) and leaders for extracurricular social, mentoring, and networking events. Also, it might be beneficial to provide targeted support for women (and other underrepresented populations) such as an ongoing workshop (e.g., meeting multiple times throughout the year) in which academic, professional, and interpersonal issues are discussed.

**Limitations**. Given the qualitative nature of the study, the generalizability of findings to all women in engineering is limited. Causal inferences would also be premature. Finally, because data were gathered at a highly resourced engineering program at a large state university, the experiences of our study participants might not reflect the experiences of women in other engineering programs across the country. However, the data do suggest that there may be room to improve on even well-structured and resourced student support programs.

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