Role Conflict and Engineering Career Choice

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Abstract

Although many factors influence career goals, recent research in women's career development have focused on issues such as gender role attitudes, family issues, multiple role conflict, and the effects of support and barriers (Hackett 1997). In this study, senior engineering students were given surveys designed to measure their self-concept of actual self, ideal self, and a generic engineer (career self). The 50 adjectives female engineering students used to describe actual self, ideal self, and career self were compared with their male engineering counterparts and female education students. These descriptors were split into the following four categories: 1) self-confident/ goal-directed 2) emotional/ positive attitude 3) creative /unconventional and 4) sociable/outgoing. Significant differences were found for both sets of comparisons, especially in the emotional and sociable categories.

In addition to the quantitative data, students were asked to explore what a standard working day might be like for them in the future. These answers were then analyzed using qualitative research techniques. Both quantitative and qualitative data indicate that female engineering students appear to be stuck in the middle of trying to balance personal needs or goals with professional ones. This study suggests that role conflict may create more problems for women who enter a non-traditional field such as engineering.

Summary

Although many factors influence career goals, recent research in women's career development have focused on issues such as gender role attitudes, family issues, multiple role conflict, and the effects of support and barriers (Hackett 1997). Social cognitive career development theories focus heavily on self-efficacy beliefs. Hackett and Betz (1981) have suggested that women's gender role socialization process does not provide them many opportunities to develop self-efficacy in tasks that are necessary for traditionally male occupations.

Although self-efficacy has been linked to career gender role stereotypes, in this presentation we will focus on self-concept. Self-efficacy judgments emphasize mastery criteria (Zimmerman, 1995) and are influenced by evaluating the self in comparison with past performance (Bong & Clark, 1999). Self-concept, which is related to self-efficacy, stresses normative assessment of ability, such as being better than others (Zimmerman, 1995; Bong, 1998). As gender role stereotypes are more strongly influenced by norm-referenced comparisons than criterion-referenced comparisons, we examined students' self-concept to reveal an underlying mechanism of gender role stereotype and its relation with career commitment. Specifically, we recruited

students belonging to traditionally gender stereotyped majors such as education and engineering.

Traditionally, teaching has been seen as an acceptable career choice for women, even when other fields remained all but closed to them. Today, women have joined the workforce en mass and have more freedom to choose their occupations, yet the teaching profession continues to draw a large percentage of females. Just 21% of teachers are male (National Education Association 2004). In contrast, female students receive only 20% of bachelors degrees awarded in engineering (American Society of Engineering Education 2003 Survey). Despite gender equity advances in other traditionally male dominated fields, engineering has lagged behind. In our presentation we will argue that students' self-concepts, for both their present and future selves may serve a one motivational mechanism for the lack of progress (Greene & DeBacker 2004.)

Students who chose non-gender stereotyped majors may find it challenging to match the person they want to become with the person they think their academic discipline is preparing them to be. The disconnect between what type of person the student wants to become and where they think their career will take them may negatively effect their career commitment.

For this study we analyzed both education and engineering majors actual self, ideal self, career self (for the education majors), and imagined engineer (for the engineering majors). According to Higgins (1987), ideal self is your representation of the attributes that you would like, ideally, to possess, and actual self is your representation of the attributes that you believe you actually possess. Higgins showed that there can be a significant difference between the actual self and ideal self and referred to it as a "self-discrepancy" (Higgins, 1985). We propose that for female education major students (female stereotyped career) their career self will be congruent with their ideal self believing that, the self-discrepancy between their ideal-self (who they want to be) and their actual self (who they are now) will be reduced by obtaining the goal of becoming a teacher.

We also propose that the closer the career self moves a female education major towards her ideal self, the more she will perceive the career as instrumental to achieving her future goals, leading to higher career commitment. However, for male education majors, these correlations may not be as strong. It is expected that the same correlations would hold true for the male engineering students (male stereotyped career), perceptions of career instrumentality will be positively and significantly related to self-discrepancy reduction (the degree to which becoming an "engineer" will reduce their perceived current discrepancy between the ideal and actual self). In addition to examining the differences that may exist in the strength of these relationships to student commitment and motivation, the adjectives that have been used to assess self concept will be specifically examined to determine if there are specific aspects of the actual-self, for example, that are different between genders and majors.

Methods

Participants

The sample was drawn from the main campus of Arizona State University. The participants included College of Education (COE) students recruited from multiple sections of a required teacher education course and engineering students recruited from a bioengineering senior design

class. All of the students in the teacher education course are required to indicate that they have the goal of becoming a teacher when they enroll in the teacher education course, while some of the bioengineering students indicated goals other than engineering, such as medical or dental school. As noted in the analysis, these 13 (8 male, 5 female) students were separated out when appropriate. Complete data was obtained for 40 senior COE students, 27 female and 13 male and 41 senior engineering students, 21 female and 20 male.

Procedure

For both studies, six surveys were administered: actual self scale, ideal self scale, career self scale, career commitment scale, instrumentality scale, and demographic information survey. Additionally, prior to career self survey, a priming activity was administered. The order of administration of the surveys was counterbalanced.

Measures

Self-discrepancy scale. Current studies have utilized Setterlund and Niedenthal's (1993) 50 adjective lists including ratings of each adjective. To measure actual self, participants were asked to rate each adjective according to their beliefs that they actually possess. For ideal self, participants were asked to rate each adjective according to their beliefs that they would like ideally to possess, that is, their ultimate goals for their life. Participants responded to the items using it 7-point Likert scale ranging from 1 to 7 (1= *does not describe you at all*, 4 = *sort of describes you*, and 7 = *describe you extremely well*). A self-discrepancy score for individuals was obtained by subtracting the rating of each adjective for ideal self from the rating of the adjective for actual self and used the absolute difference.

Priming activity. In order to make participant's career choice more salient, immediately prior to obtaining the "career self" scale, participants were asked to write down their chosen career, and then imagine about themselves in that career. Participants were then asked to describe themselves: 1) Getting ready for work at home 2) half-way through the workday at work place. In the case of the engineering group, students were asked to discuss the day of a generic "engineer", and to rate this person for the career-self scale. This data was analyzed following the methods described in Erickson (1986).

Career commitment measure. Fisher and Stafford's (2003) career commitment measure and Hollenbeck, Klein, O'Leary, and Wright's (1989a) goal commitment scale were combined to measure career commitment. Participants were asked to respond using 5-point scale ranging from -2 to 2 (-2 = *Strongly Disagree*, 0 = *I don't know*, 2 = *Strongly Agree*).

Instrumentality scale. Instrumentality scale was adopted from Husman, McCann, and Crowson's (2000) instrumentality measure and utilized three out of four endogenous instrumentality items. Endogenous instrumentality can be described as internal or intrinsic achievement motivation. Participants were asked to respond using 5-point scale ranging from -2 to 2 (-2 = *Strongly Disagree*, 0 = *I don't know*, 2 = *Strongly Agree*).

Demographic information. To prevent stereotype threat, the demographic information was asked at the end of the survey. Participants were asked to report their gender, major, and year in school.

Analysis

First the discrepancy between ideal self and actual self was calculated, then discrepancy between ideal self and career self was calculated. The results were used to calculate the potential discrepancy reduction. The potential discrepancy reduction was correlated with instrumentality. Instrumentality was also correlated with career commitment. Mean differences between four groups (male engineering majors, female engineering majors, male education majors, female education majors) on particular adjectives used in the self-discrepancy scale were investigated.

Calculation of discrepancy between ideal-self and actual-self (IS-AS). Self-discrepancy between the actual and ideal selves will be the sum of the absolute differences between actual and ideal self ratings of each adjective, based on Equation 1.

$$(Ideal-Actual)_j = \sum_{i=1}^{N} \left| is_{ij} - as_{ij} \right| \qquad (1)$$

Where is_{ij} is the rating of adjective *j* for ideal self by subject *i*, and as_{ij} is the rating of adjective *j* for actual self by subject *i*.

Calculation of discrepancy between ideal-self and career-self (IS-CS). Self-discrepancy between the ideal and career selves will be the sum of the absolute value of the difference between ideal and career self ratings of each adjective, based on Equation 2.

$$(Ideal-Career)_j = \sum_{i=1}^{N} \left| is_{ij} - cs_{ij} \right| \qquad (2)$$

Where is_{ij} is the rating of adjective *j* for ideal self by subject *i*, and cs_{ij} is the rating of adjective *j* for career self by subject *i*.

Calculation of self-discrepancy reduction (ISAS-ISCS). The self-discrepancy reduction is the absolute value of the difference between the discrepancy between ideal-self and career-self (IS-CS) and the discrepancy between ideal-self and actual-self (IS-AS), based on Equation 3.

$$= \sum_{i=1}^{N} \left(\left| is_{ij} - as_{ij} \right| - \left| is_{ij} - cs_{ij} \right| \right) \qquad (3)$$

Where is_{ij} is the rating of adjective *j* for ideal self by subject *i*, as_{ij} is the rating of adjective *j* for actual self by subject *i,* and cs_{ij} is the rating of adjective *j* for career self by subject *i.*

Career commitment. Career commitment score was calculated by summing up the score of each answer. As there were 12 items, possible score range from -24 to 24. Career commitment measure showed strong reliability coefficient (Cronbach's α= .85).

Instrumentality. Instrumentality was calculated by summing up the score of each answer. As there were 3 items, possible score range is from -6 to 6. Instrumentality showed satisfactory reliability coefficient (Cronbach's α= .66).

Group comparisons. Preliminary examination of the data showed significant differences in the adjective ratings tended to cluster around two main themes, emotion and social related words. ANOVA analysis was done for the cluster of words of interest. We examined between group differences for four groups of students: female engineering majors, male engineering majors, female education students, and male education students.

Factor Analysis. Data from a larger set was used for factor analysis. Among the 174 participants, 117 were COE students and 57 were Non-COE students. There were 108 women, 59 men, and 7 students did not report their sex. The ages ranged from 17 to 50. Data from a larger set was used for factor analysis. A factor analysis was carried out on participants' responses to the 50-item Self-discrepancy scale to determine the key components of college students' self-concept. Varimax rotation of the principal components solution yielded four factors with eigen values greater than one. These factors accounted for 40.32 % of the variance. A loading of .40 or greater was considered necessary for an item to be considered to load on a particular factor. The first factor consisted of nine adjectives predominantly relating to concepts about goal-directed and cognitive aspects of human nature (e.g., logical, responsible, efficient, practical, intelligent, successful, persistent, dependable, and ambitious). For this reason we labeled this factor as 'Successful Analytic Self'. The second factor consisted of six items relating to the emotional aspects of self (e.g., sympathetic, tender, sentimental, emotional, forgiving, and tolerant). Thus, it was labeled 'Empathetic Self". The third factor consisted of eight adjectives relating to unconventional and creative traits (e.g., unconventional, spontaneous, impulsive, adventurous, non-conforming, individualistic, and creative). The third factor was, therefore, labeled 'Creative Self". The fourth factor consisted of three items predominately relating to extroverted and outgoing characteristics (e.g., talkative, sociable, and unreserved). The final factor was, therefore, labeled 'Sociable Self'.

Results

Table 1. *Pearson Product Moment Correlation for Education Students (N=40)*

Variable	Correlations	
	Career Commitment	Endogenous Instrumentality
Female (*n* = 27)		
Self-Discrepancy Reduction	.19	.42**
Career Commitment	—	.72**
Endogenous Instrumentality		—
Male (*n* = 13)		
Self-Discrepancy Reduction	-.26	-.40
Career Commitment	—	.31
Endogenous Instrumentality		—

** Correlation is significant at the 0.01 level

Only for female education students, perceptions that obtaining their career is instrumental for achievement of their future goals (endogenous instrumentality) are significantly related to both their career commitment and discrepancy reduction rate (See Table 1). Although a much smaller sample, it is interesting that male education majors self-discrepancy reduction is actually negatively (although not significantly) correlated to perceptions of instrumentality which is not significantly related to career commitment. This result shows that for women in female-stereotyped careers, the degree to which the career shrinks the discrepancy between who they want to be and who they are, supports perceptions of instrumentality and commitment. Additional analysis of the data will be required but we expect that this difference is related to self-concept conflict issues.

Table 2. *Pearson Product Moment Correlation for Engineering Students (N=41)*

Variable	Correlations			
	Career Commitment	Endogenous Instrumentality	Career Commitment	Endogenous Instrumentality
	Female with Engineering Goal (*n* = 16)		Female with Non-Engineering Goal (*n* = 5)	
Self-Discrepancy Reduction	-.19	.18	.16	.21
Career Commitment	—	.42	—	.80
Endogenous Instrumentality		—		—
	Male with Engineering Goal (*n* = 12)		Male with Non-Engineering Goal (*n* = 8)	
Self-Discrepancy Reduction	-.24	.16	-.76*	-.41
Career Commitment	—	.67*	—	.44
Endogenous Instrumentality		—		—

* Correlation is significant at the 0.05 level

Engineering students were divided into four groups based on their gender and future goal: female with engineering goal, female with non-engineering goal, male with engineering goal, and male with non-engineering goal. We expected those whose gender and career stereotype matches (i.e., male with engineering goal) would show different result than non-matching cases. The results shows that only for male with engineering goals, perceptions that obtaining their career is instrumental for the achievement of their future goals (endogenous instrumentality) is significantly correlated with career commitment. It is interesting that for male with non-engineering goal, self-discrepancy reduction is negatively correlated to career commitment. This finding is consistent with male education major students. For female engineering students, perceptions that obtaining their career is instrumental for the achievement of their future goals (endogenous instrumentality) is not significantly related to both their career commitment or the discrepancy reduction rate.

The immediate implications of these findings are that our current model for thinking about the relationship of career commitment and self-discrepancy does not adequately account for gender role conflict. When students indicate that their career goals fall within expected gender stereotypes the relationship between endogenous instrumentality, career commitment, and self-discrepancy reduction fall out as predicted. When student are pursuing careers that do not fall into well warn stereotypic patterns the relationships are far different than we would have predicted. Interestingly this is true for both male and female students. Clearly we have tapped

into an underlying conflict between the career self and ideal/actual selves of these students that has implications for their motivation. In an effort to better understand the ways that the stereotypic and non-stereotypic students in our study differ we examined the students responses further.

The tables below summarize the between group differences for four groups of students: female engineering majors, male engineering majors, female education students, and male education students, and look at the self-discrepancy for actual and ideal-self compared with a students future career self (education students) or a generic engineering concept (engineering students).

Table 3 *Summary of Actual Self Significant Differences*

	Actual Self			
Self-descriptive Adjectives	Education Majors		Engineering Majors	
	Male	Female	Male	Female
Sentimental	4.62[b]	6.15[a,c]	4.20[b]	5.14
Tender	5.08	5.70[c]	3.95[b]	4.86
Emotional	4.39[b]	6.26[a,c]	3.55[b]	5.10[c]
Proud	5.69	5.63[c]	4.60[b]	4.91
Talkative	5.39	5.82[c]	4.20[b]	4.76
Sympathetic	5.23	6.22[c,d]	4.10[b]	5.05[b]

Mean differences significant at the $p < .01$ level

[a] mean difference from male education majors
[b] mean difference from female education majors
[c] mean difference from male engineering majors
[d] mean difference from female engineering majors

Strong differences in actual self mean comparisons are found between for all words above for female education majors and male engineering majors, which would correspond to the perceived opposite ends of the gender stereotyped careers. Female education majors were significantly different than their male peers in traditional "female" descriptors such as sentimental and emotional, while female engineering students only differed significantly from their male peers on the word emotional. Overall, the female engineering students fell closer to their male students for all words than to other female students, in fact most were close to significance, using the conservative p value of .01.

Table 4 *Summary of Ideal Self Significant Differences*

Ideal Self				
Self-descriptive Adjectives	Education Majors		Engineering Majors	
	Male	Female	Male	Female
Sentimental	5.15	5.85[c]	3.85[b]	4.91
Tender	5.77[c]	6.04[c,d]	4.50[a,b]	4.86[b]
Emotional	4.85	5.19[c]	3.75[b]	4.24
Successful	5.39[c,d]	6.19	6.60[a]	6.48[a]
Idealistic	5.08	5.52[d]	5.00	4.19[b]
Sympathetic	5.46[c]	6.30[c,d]	4.00[a,b]	5.00[b]

Mean differences significant at the p< .01 level

[a] mean difference from male education majors
[b] mean difference from female education majors
[c] mean difference from male engineering majors
[d] mean difference from female engineering majors

For ideal self, differences were still found for traditional "female words" such as sentimental, emotional, tender and sympathetic, with the continued pattern of the strongest differences between female education and male engineering students. In this case however, no differences were found between the engineering students with the females trending towards numbers that more closely match with the male ideal. It is interesting that male students rate themselves lower on successful as compared to all other students, with significant differences to the engineering students. This is in line with the gender stereotype that male teachers would not be considered "successful" as opposed to other potential career choices. All of the significant differences fall in the emotional and social self categories created by factor analysis.

Table 5 *Summary of Career/Engineer Self Significant Differences*

Career/Engineer Self				
	Education Majors		Engineering Majors	
	Male	Female	Male	Female
Difference Actual Self vs. Career Self/Engineer*	38.15[d]	50.02[d]	59.27	79.50[a,b]
Difference Ideal Self vs. Career Self/Engineer*	30.77[c,d]	32.94[c,d]	72.73[a,b]	82.56[a,b]

Difference is the sum of the absolute values of the differences between ratings for each individual for set of adjectives. (See equation 1 and 2)

*Engineering students were asked to rate an "engineer" rather than their career self. Only students who declared engineering as their career goal were compared in this analysis.

Mean differences significant at the p< .01 level

[a] mean difference from male education majors
[b] mean difference from female education majors
[c] mean difference from male engineering majors
[d] mean difference from female engineering majors

It appears that education students are closer (than their actual selves) to their ideal selves when they become teachers (both male and female) but engineers are farther away from their ideal selves (than their actual selves). This may be do to both males and females rejecting the concept of "an engineer", since they were asked to describe that individual rather than their career self.

Qualitative Analysis

Students were asked to write either about a typical day for themselves 5 yrs from now (teacher) or about a typical day for an engineer (though it was clear from responses that many of them were writing about themselves). Several themes were common among the qualitative responses: self care (dressing, eating breakfast etc.), planning, communication or socialization, feelings of being happy or excited, feelings of being stressed, tired or bored, family interactions, and recreation.

Both male and female education majors were much more likely to mention self care as a part of their narrative, though male engineering majors spoke of self care twice as much as their female peers. Communication or socialization was commonly discussed by both majors, though teachers spoke of "discussing students or problems with other teachers" while engineers spoke more about eating lunch with co-workers or meetings. Education majors were twice a likely to mention planning as a part of their day, while engineering majors were almost three time times as likely to mention feelings of stress, bored or being tired. When education students mentioned this, it was most likely to be being tired or anxious but was almost always accompanied by comments about being happy or excited. Very few of the engineers spoke of being happy or excited about work, this could be however because they were told to write about a "typical engineer". Male and female engineers were just as likely to mention "feelings" but female education reported feelings as a part of their narratives much more frequently than their male peers. Finally, male education majors spoke of family at a much higher percentage than females, but female engineering majors were over twice as likely to mention family verses male engineers.

As one might guess from the quantitative data, male engineering students were much more likely to use the male pronouns to describe their fictional engineer, or take on the first person in their narrative. Females often used they or "he/she" as pronouns. Interestingly, one female reflected the male engineering stereotype in her response to Situation 1, "Read newspaper with wife at table, get ready for work, feel like it is just another day." This particular students feelings about engineering work were reflected as well in Situation 2 "Cubicle, meetings, bored, looking forward to the time to leave, sick of upper management" Those feelings of hating the job were common among the responses for the engineering students, but nonexistent for the education majors.

Discussion

There is a need for further analysis to draw additional conclusions from the data and there are plans to further analyze the data using the categories created through factor analysis. However, the findings presented in this paper have significant implications for the fields of motivation and engineering education. It is evident that the way students think about who they want to become

does play a role in their motivation and commitment to the careers they are preparing for. The qualitative analysis shows that both males and females reject the idea of the "typical engineer" which might explain why ideal self and engineering self are not highly correlated for these students. These findings also indicate that gender differences, both in who students think they are and who they want to become are not as "clean" or as stereotypical as they once might have been. The findings do indicate, however, that role conflict continues to create problems for women and men who enter non-traditional fields.

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