

# Gender and Racial Differences in Career Decision-making Dispositions of College Students Enrolled in STEM Majors

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**Abstract** Anticipated shortfall in the science, technology, engineering, and mathematics (STEM) workforce in the United States has prompted researchers and policy-makers to examine the supply pipeline and factors influencing the supply pipeline. Applying Social-Cognitive Career Theory, this study examined decision-making predisposition of college students who were interested in STEM majors. Results show significant gender and racial differences in decision-making self-efficacy, decision-making style, and career indecision. Logistic analyses show that race, decision-making style, and career decision-making self-efficacy significantly predict enrollment in STEM majors. Implications for counseling interventions are discussed.

**Keywords** Career Decision Making, STEM Career, Choice of Major, Social Cognitive Career Theory

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## 1. Background/Objectives and Goals

There is an increasing concern about the workforce shortage in STEM careers due to the retirement of baby boomers, strong global competition, and job growth of STEM careers. Compared with other nations, STEM degree in the United States makes up a much smaller proportion of overall bachelor's degree. It is predicted that STEM job growth will soon outpace other fields (Lacey & Wright, 2009; National Science Foundation, 2010). Nationwide in US, there are 2.4 million job vacancies for STEM workers projected between the years 2008 and 2018, and 65% of these jobs will require a Bachelor's degree or beyond (Scott, A. & Martin, A. (2012). The importance of increasing the number of college students completing degrees in STEM has been recognized by the National Governors Association and by American Congress in the Goals 2000 Educate America

Act and STEM Education Innovation Act of 2011. To understand what influences college students to enter majors in STEM fields; this study examines gender and racial factors, and career decision-making dispositions shaping the decision to pursue STEM fields of study.

There is also an increasing concern about the underrepresentation of women and minority worker in the STEM fields (Hill, Corbett, & St Rose, 2010). In the United States, White males have been dominated STEM occupations (Riegle-Crumb & King, 2010). American workforce is increasingly diversified. Women and minorities contributed to the largest workforce growth. Meeting the increasing demand for STEM graduates will require that a greater share of women and racial/ethnic minorities are entering the STEM career pipeline. In 2011 the National Research Council (2011) called on educators to increase the number of students pursuing STEM career pathways after high school, including students from groups traditionally underrepresented in STEM—students of color, women, and students from low socioeconomic backgrounds. A lack of participation from women and minorities in STEM careers has prompted researchers to investigate why these underrepresented populations are not participating or persisting in STEM activities (e.g., Chen & Weko, 2009; Griffith, 2010; Quinn & Cooc, 2015; Riegle-Crumb & King, 2010). While the participation of women or minorities in STEM careers has received a great deal of attention by researchers and theorists (e.g., Betz & Fitzgerald, 1987; Fouad et al, 2010; Lent, Brown, & Hackett, 2000; Lent et al, 2005; Swanson & Tokar, 1991), there are very few studies examining the influence of the career decision-making predispositions on STEM career choices.

Longitudinal studies have shown that subject-specific self-efficacy (Zarrett & Malanchuk, 2005; Mau 2003, 2013; Nauta & Epperson, 2003 ), interests (Fouad, et al, 2010; Nauta & Epperson, 2003; NCES, 2000; National Science Foundation, 2013), course selection (NCES, 2000; Zarrett &

Malanchuk, 2005), STEM-related activities, school engagement (NCES, 2000), academic proficiencies, familial background (Mau, 2013; NCES, 2000), and educational aspirations (Mau, 1995, 2003) are predictive of STEM related career paths.

Although over the last few decades many study investigation factors influencing individuals to aspire to, enroll in, and persist in STEM careers, there is no study focus on how individuals' decision-making repertoires contribute to decision to pursue a STEM career.

### 1.1. Conceptual Framework

The present study utilized Social Cognitive Career Theory (SCCT) developed by Lent, Brown, & Hackett (1994, 2000). SCCT, which is derived from Bandura's (1986) social cognitive theory, providing a useful framework for understanding the interrelationships of the variables under investigation: career certainty/indecision, decision-making self-efficacy, career decision-making styles, and STEM major choices. The relationships among these variables are depicted in Figure 1. According to SCCT, personal input and contextual factors influence people's learning experiences, which are later referenced as sources of self-efficacy. Person inputs and contextual factors, according to SCCT, are defined as individual difference variables, such as decision-making styles, gender, ethnicity, or other personal factors that may influence career development (Lent et al., 1994). Self-efficacy, the key construct of SCCT, affects thought patterns and partly determines individuals' actions, their decisions to engage in a task, to put forth effort, and to persevere under failure (Bandura, 1986).

### 1.2. Career Decision-Making Style

Career decision-making style as a cognitive construct has been shown to represent a unique component of vocational behavior and career development (Harren, 1979; Super, 1980). Decision-making style has been defined as a habitual pattern individuals use in decision making or individuals' characteristic model of perceiving and responding to decision-making tasks. Among many different taxonomic classifications of decision-making styles, Harren's (1979) typology is the most widely recognized. The three different styles namely *rational*, *intuitive*, and *dependent*, represent distinct sets of attitudes and behaviors used in decision-making tasks and vary as a function of the degree to which individuals take personal responsibility for decision making and the extent to which they use logic as differentiated from emotional decision-making approaches. We hypothesize that individuals who endorse rational decision-making style tend to have higher CDM self-efficacy, in turn, are more likely to be interested in STEM majors, whereas individuals endorse dependent decision-making style tend to have lower CDM-self-efficacy, in turn, less likely to choose STEM major.

### 1.3. CDM-Self-Efficacy

Self-efficacy expectations refer to an individual's beliefs about his/her ability to perform a behavior that will produce desired outcomes. Bandura (1977) suggested that individuals who perceive themselves as capable tend to attempt and successfully execute tasks or activities. Self-efficacy serves as a generative mechanism through which individuals integrate and apply their existing cognitive, behavioral, and social skills to a task. The self-efficacy theory has been applied to many specific domains of vocational behavior, such as occupational tasks and career exploratory behavior. Betz, Klein, and Taylor (1996) have applied the self-efficacy theory to form an assessment model of career decision-making self-efficacy. The model assesses self-efficacy beliefs in self-appraisal, gathering occupational information, goal selection, making plans for the future, and problem solving. Studies have found a strong relation between self-efficacy expectations and career indecision (for a review see Betz & Luzzo, 1996), career decision making (Luzzo, 1993, 1995), patterns of career choices (Gianakos, 1999). We hypothesize that individuals who have high CDM-self-efficacy are more likely choose STEM majors.

### 1.4. Career Indecision

A number of investigators have noted the following variables as antecedents to career indecision: lack of self-confidence in decision making skills, lack of a clear sense of identity, perceived external barriers to preferred choices, and lack of the immediacy of a perceived need to make a decision (Holland & Holland, 1977; Osipow, Carney, & Barak, 1976; Slaney, Palko-Nonemaker, & Alexander, 1981).

Although Lent et al. (2002) employed the term "career" in developing SCCT, they argued that this framework is as relevant to academic development, primarily because models of academic and career choice and success share similar causal mechanisms, and academic development dovetails with career development.

The purpose of this study is to examine if interest and enrollment in STEM college majors is a function of career decision-making predispositions (decision-making self-efficacy, decision-making style, career indecision), and racial/gender group of college students. Specifically, we compared students who majored in STEM studies ( $n = 165$ ) with those who majored in non-STEM studies ( $n = 250$ ) on these variables. Differences in career decision-making between race and sex are also examined. Interaction effects (Sex by Race) were also examined. Understanding the decision-making characteristics of students would allow counselors and policy makers to take a proactive approach to tailoring developmentally appropriate and culturally sensitive career interventions for individuals who are under-represented in the STEM career work force.

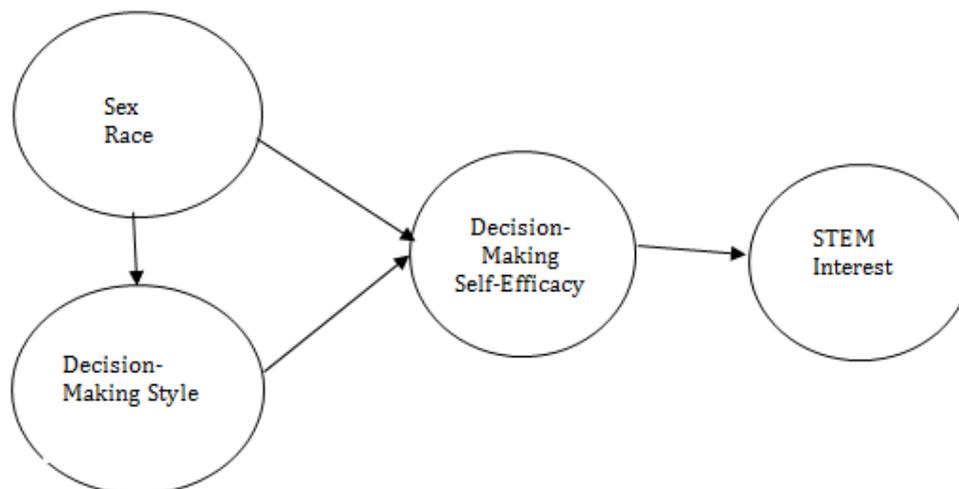


Figure 1. Social-Cognitive Model of STEM Career Interest

## 2. Methods

### 2.1. Participants

The participants consisted of 540 undergraduate students (212 men, 323 women, 5 did not indicate) enrolled in a college algebra course at a large mid-west university in the United States. Age ranged from 15 to 54 (Mean = 22; Mode = 18;  $SD = 6.80$ ). The majority of the students were freshmen (58%), with 23% sophomores, 10.3% juniors and 8.3% seniors. Ethnicity composition was: 74% Caucasian, 7.4% African American, 4.5% Hispanic, 5.6% Asian, 1.1% Native American, 2.6% International, 2.8% mix race, and 2% did not indicate.

### 2.2. Measurements

Assessment of Career Decision Making (ACDM; Harren, 1978), Part I, consists of 30 items developed to assess the degree to which individuals rely on each of three decision making styles, Rational (R), Intuitive (I), and Dependent (D). Each style is measured by a separate 10-item scale considered to be relatively independent. Sample items include, "I am very systematic when I go about making an important decision," "I often make a decision which is right for me without knowing why I made the decision," and "When I make a decision it is important to me what my friends think about it." Harren (1978) reported the test-retest reliabilities for these scales to be .85 for Rational, .76 for Intuitive, and .85 for Dependent. Alpha coefficients estimated based on college students ( $n=528$ ) were .77 (R), .62(I), and .77(D) respectively.

Career Decision-Making Self-Efficacy Scale-Short Form (CDMSE-SF; Betz, Klein & Taylor, 1996) is a 25-item scale that assesses an individual's belief that he or she can successfully complete tasks necessary to make career decisions. Sample items include, "Make a plan of your goals for the next five years," and "Find information about graduate or professional schools." Items were rated on a

5-point scale from 1 (no confidence at all) to 5 (complete confidence). The CDMSE consists of five subscales: accurate self-appraisal (CDMSEsa), gathering occupational information (CDMSEoi), goal selection (CDMSEgs), making plans for the future (CDMSEpl), and problem solving (CDMSEps). Estimates of internal consistency ranged from .73 to .83 for the subscales and .94 for the total score (Betz, Klein & Taylor, 1996). There is considerable evidence of reliability and validity of this scale (Betz & Luzzo, 1996). The estimated alpha coefficient is .94.

Career Decision Scale (CDS; Osipow, Carney, Winer, Yanico, & Koschier, 1976) The CDS is a 19-item, 4-point Likert type scale assessing choice certainty and indecision. This scale has reliability coefficients ranging from .70 to .90 (Osipow, 1987). Rogers and Westbrook (1983) found clear support for the construct and concurrent validity of the scale.

### 2.3. Data Analyses

First, Chi square statistical analyses were conducted to examine gender and racial differences in STEM enrollment. Second, MANOVAs were conducted to examine the career decision-making characteristics by sex and race. Third, Bivariate correlations among dependent variables were analyzed. Finally, logistic regression analyses were conducted to examine the factors predicting STEM major. Guided in part by SCCT, variables were entered in block for regression analyses with demographic variables (sex and race) entered first, then decision-making styles (Rational, Intuitional, Dependent), then decision-making self-efficacy subscales (CDMSEsa, CDMSEoi, CDMSEgs, CDMSEpl, CDMSEps), and finally Career Indecision (CDS).

## 3. Results

### 3.1. STEM Major Enrollment

Students' reported majors were first classified into STEM,

non-STEM and undecided categories ( $n=130$ ). Of 540 participants, STEM ( $n=250$ ), non-STEM ( $n=160$ ), and 130 were undecided which were excluded from the analyses. Classification of STEM majors was based on based on the taxonomy of the Classification of Instructional Program (CIP) codes.

Difference in enrollment of STEM major by race and sex were examined using chi-square statistics. Results of chi square analysis suggest that Asian students (73%) were more likely than White (38%) and minority students (35%) to major in STEM fields [ $\chi^2 (2) = 9.62; p = .008$ ]. Female students (44%) were more likely than male students (33%) to major in STEM field of studies. [ $\chi^2 (1) = 3.90; p = .048$ ].

### 3.2. Decision-making Characteristics CDMSE, STYLE, CDS

Results of MANOVAs indicate that there is a significant difference between subject effect found in three dependent variables: Career Decision-Making Self-Efficacy Problem-Solving subscale [ $F (11, 30.69) = 2.39; p = .007$ ], Dependent Decision-Making Style [ $F (11, 10.82) = 1.88; p = .04$ ], and Career Indecision [ $F (11, 353.60) = 3.72; p = .001$ ].

Subsequent analyses suggest that female students ( $M=3.56$ ) scored significantly higher on dependent decision-making style than those of male students ( $M=2.58$ ). Asian students scored significantly higher on dependent decision-making style than white students and other minority students. Other minority students ( $M=19.63$ ) scored significantly higher on problem-solving self-efficacy than Asian students ( $M=16.92$ ). Subsequence analyses also indicated a sex by race interaction on career indecision. Follow-up analyses with simple effect suggest that Asian female students ( $M=34.84$ ) scored significantly higher on career indecision than White ( $M=26.13$ ) and minority students ( $M=25.57$ ). There is no male by race difference.

### 3.3. Factors Predicting STEM Major

Results of logistic analysis with the Hosmer and Lemeshow Goodness fit Test shows an adequate fit of the model [ $\chi^2 (8) = 6.64, p = .57$ ]. The proportion of variance in the dependent variable associated with the predictors is about 12% ( $R^2 = .122$ ). As can be seen in Table 2, Race, decision-making style, and career decision-making self-efficacy significantly predict STEM major. Specifically, holding other factors constant, Asian students were more likely than other minority students to major in STEM [odds ratio = 9.141,  $p < .006$ ]; students endorsing a dependent decision-making style were less likely than students with other decision-making styles to major in STEM [odds ratio = .868,  $p < .010$ ]; students with higher decision-making efficacy in gathering occupational information (CDMSEoi) had a greater likelihood to major in STEM [odds ratio = 1.114,  $p < .032$ ].

## 4. Conclusions

This study examined gender and racial differences in career decision-making characteristics of college students who were interested in STEM majors. This study also integrates Social-Cognitive Career theory to investigate factors shaping student interest in and choice of STEM fields of postsecondary study. We hypothesized that student's decision to major in STEM field of study is a function of decision-making style, career certainty, race, and gender; these factors were mediate through decision-making self-efficacy. Results suggest that Asian students were more likely than White and minority students to major in STEM fields. Female students were more likely than male students to major in STEM field of studies. Findings also suggest gender and racial difference in decision-making self-efficacy, decision-making style, and career indecision. Logistic analyses show that race, decision-making style, and career decision-making self-efficacy significantly predict enrollment in STEM majors. These findings, in general, conformed to SCCT expectation.

There are a number of implications one may infer from the findings. First, consistent with other studies, minority students, except for Asian students continue to be under-represented in the STEM majors. Although studies have shown improvement of enrollment and degree completion of minority students over recent decades, we found they continue to be underrepresented in the STEM career pipeline. It is critically important that early interventions occur to recruit and guide underrepresented students into the STEM pipeline. Counselors serve an important role in identifying students who have potential to enter STEM careers and providing counseling guidance to achieve their dreams.

Applying SCCT, this study reveals a number of findings that may illuminate specific points of intervention along students' educational pathway into STEM. Counseling interventions can be developed to enhance student's decision-making self-efficacy. Career exploration program such as the one described by O'Brien et al. (1996) have empirical evidence in increasing confidence in performing tasks related to investigating, selecting, and implementing a career choice. Teach women and minority students to use formal decision making strategies and accept responsibility for decision-making that carry through deliberately and logically would increase the likelihood of their interests in STEM careers (Mau & Jepsen, 1992)

There are several limitations of the study which may affect the generalizability of the findings and provide implications for future research. Many of the female participants were enrolled in health related majors such as nursing, physical therapy, physician assistant. Classifying these majors into STEM fields may have over-identified female participants into the STEM major pool. The potential weakness associated with survey study is that participants may respond to questions in the manner that is socially desirable. The academic major reported in the study were not based on official enrollment records, and therefore, may not represent

the actual major one eventually enrolled. It also should be noted that the characteristics of students in a primarily agricultural state may differ from other states in the demand/supply of STEM majors. Generalization of the findings from this study is limited to students from an agricultural state in the Midwest.

**Table 1.** Mean and Standard Deviation of Dependent Variables by Sex, Race, and STEM

	Female	Male		Minority	White	Asian	
	(F)	(M)	Difference	(Mi)	(W)	(A)	Difference
Self-Appraisal							
M	20.15	19.39		20.02	20.05	19.23	
SD	0.41	0.49		0.47	0.21	0.80	
Occupational Information							
M	19.75	19.49		20.40	19.84	18.62	
SD	0.46	0.55		0.53	0.23	0.91	
Goal Selection							
M	19.16	19.14		20.05	19.47	17.93	
SD	0.46	0.54		0.52	0.23	0.89	
Future Planning							
M	19.13	18.80		19.76	19.15	17.98	
SD	0.46	0.54		0.52	0.23	0.89	
Problem Solving*							
M	18.67	18.21		19.63	18.77	16.92	A < Mi, W
SD	0.45	0.53		0.52	0.23	0.88	
Rational Style							
M	7.08	6.91		7.00	7.40	6.58	
SD	0.32	0.37		0.36	0.16	0.62	
Intuitive Style							
M	4.93	4.65		4.69	4.39	5.28	
SD	0.29	0.34		0.33	0.15	0.57	
Dependent Style*							
M	3.56	2.58	F > M	2.40	2.76	4.06	
SD	0.30	0.36		0.35	0.15	0.59	
Career Indecision**							
M	27.79	28.05		26.78	25.90	31.08	A <sub>f</sub> > Mi <sub>f</sub> , W <sub>f</sub>
SD	1.23	1.45		1.41	0.62	2.40	

\*Significant differences were found as a result of MANOVA

\*\*Significant Race by Sex interaction

**Table 2.** Logistic Model of Factor Predicting STEM Majors

	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>p</i>	<i>Exp(B)</i>
Male	.008	.601	.000	1	.989	1.008
Race			7.660	2	.022	
White	.250	.381	.429	1	.512	1.284
Asian	2.213	.809	7.473	1	.006	9.141
Race * Sex			1.136	2	.567	
White by Male	-.609	.659	.856	1	.355	.544
Asian by Male	-1.088	1.216	.800	1	.371	.337
Rational DM Style	.072	.054	1.737	1	.188	1.074
Intuitive DM Style	.025	.060	.180	1	.672	1.026
Dependent DM Style	-.142	.055	6.548	1	.010	.868
CDMSE-Self Appraisal	.015	.060	.058	1	.809	1.015
CDMSE-Occupational Info	.108	.050	4.596	1	.032	1.114
CDMSE-Goal Selection	-.023	.052	.198	1	.656	.977
CDMSE-Future Planning	-.092	.058	2.544	1	.111	.912
CDMSE-Problem Solving	-.072	.050	2.050	1	.152	.931
CDS-Indecision	-.024	.016	2.254	1	.133	.976

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