Journal of the Scholarship of Teaching and Learning, Vol. 13, No. 2, May 2013, pp. 116 – 132.

Family context predictors of math self-concept among undergraduate STEM majors: An analysis of gender differences

Anne N. Rinn[1], Kathi Miner[2] and Aaron B. Taylor[3]

Abstract: The purpose of the current study was to examine four family context variables (socioeconomic status, mother's level of education, father's level of education, and perceived family social support) as predictors of math self-concept among undergraduate STEM majors to better understand the gender differential in math self-concept. Participants included 499 undergraduates (75% of whom were female) at a large research university in the southwestern United States. Results indicated that males had higher math self-concepts than females and that social support predicted math self-concept, particularly for males.

Keywords: STEM, math self-concept, college students, undergraduate major, gender

I. Introduction.

There has been great concern, both from academics and the general public, about the small number of women in the fields of science, technology, engineering, and mathematics (STEM). Despite an increase in the percentage of women earning STEM degrees, the number is still relatively small (National Science Foundation, 2007); and women who initially decide to pursue degrees in STEM fields leave them at a significantly higher rate than men. This higher rate of leaving STEM fields is especially seen among women of color (Kohlstedt, 2004). Even intellectually advanced women drop out of STEM fields at a higher rate than intellectually advanced men (Johnsen & Kendrick, 2005).

One possibility for the low number of women in STEM is that females consistently report lower perceptions than males of their abilities in math, or lower math self-concepts, across all age and grade levels, often grossly under representing their actual ability levels (Else-Quest, Hyde, & Linn, 2010; Furnham, 2001; Furnham, Hosoe, & Tang, 2002; Heller & Ziegler, 1996; Juang & Silbereisen, 2002; Marsh & Yeung, 1998; Meece & Jones, 1996; Pajares, 1996; Sax, 1994; Skaalvik & Skaalvik, 2004; Steinmayr & Spinathm, 2009; Watt, 2005).

This gender difference in math self-concept may lead to differences in later math achievement, which may in turn lead to differences in STEM undergraduate degree attainment, STEM graduate degree attainment, and STEM career aspirations. Indeed, math self-concept is a known predictor of persistence in math courses, performance on standardized tests measuring math ability, achievement in math, and advanced math coursework selection (Lee, 2009; Marsh & Yeung, 1998). All of these differences could easily affect STEM-related outcomes in undergraduate or graduate study.

[1] Anne N. Rinn, Department of Educational Psychology, University of North Texas, 316 Matthews Hall, 1155 Union Circle #311335, Denton, TX 76203. E-mail: anne.rinn@unt.edu Research for this study was supported by Grant #0936780 from the National Science Foundation.
[2] Department of Psychology and Women's and Gender Studies Program, Texas A&M University
[3] Department of Psychology, Texas A&M University

Numerous educational and institutional factors contribute to the educational experiences of women majoring in STEM fields in college. These factors likely include such things as having female role models (Lockwood, 2006; Sonnert, Fox, & Adkins, 2007) and the overall educational climate (Cabrera, Nora, Terenzini, Pascarella, & Hagedorn, 1999; Eimers & Pike, 1997; Graham & Gisi, 2000). Researchers have typically examined educational and institutional factors such as these when studying predictors of persistence in the STEM fields, such as a high math self-concept. Few research studies, though, have considered the influence of one's family in predicting STEM degree persistence and attainment, and research has not adequately addressed family context predictors of math self-concept. As family context variables greatly influence an individual's educational opportunities, and families are among the first to expose children to gender stereotypes and gender roles, the purpose of the present study is to examine multiple family context variables as predictors of math self-concept among male and female undergraduate STEM majors. Economic resources, parent education levels, and parental social support, in particular, have the potential to influence student's experiences in higher education (Marable, 2003; Perna & Titus, 2004) and are therefore examined in the present study.

Math Self-Concept. Shavelson, Hubner, and Stanton (1976) were among the first to assert that self-concept is both multifaceted and hierarchical. Self-concept is multifaceted "in that people categorize the vast amount of information they have about themselves and relate these categories to one another" and is hierarchically arranged "with perceptions of behavior at the base moving to inferences about self in sub areas (e.g., academic-English, science, history, math), then to inferences about self in general" (Marsh & Shavelson, 1985, p. 107). Thus, self-concept can be defined as "a person's perceptions of him- or herself … formed through experience with and interpretations of one's environment" (Marsh & Shavelson, p. 107). Math self-concept, then, pertains to one's perceptions of his or her ability related to math.

Self-concept becomes more differentiated with age. As individuals get older, they are better able to determine their strengths and weaknesses in various areas (e.g., math, English, social skills). Math self-concept is a facet of self-concept that typically declines throughout the college years for both males and females (Astin, 1993; Pascarella & Terenzini, 2005; Sax, 1994). The rate of decline is not equal, though. Gender differences in STEM related self-concept appear to be larger among high school and college students than among younger students (Hyde, Fennema, Ryan, Frost, & Hopp, 1990). Hence, while both males and females experience a decrease in math self-concept throughout college, females experience that decline at a greater rate. In fact, women undergraduates may enter a STEM major relatively confident in their STEM-related abilities, but will likely experience a significant drop in confidence during their first year of STEM coursework (Brainard & Carlin, 2001; Seymour, 1995), larger than what is experienced by their male STEM major classmates.

Many researchers have also suggested academic self-concept and other academic self-beliefs are important factors in choosing a career path (e.g., Bandura, 1986; Farmer, 1985; Gottfredson, 2002; Rottinghaus, Lindley, Green, & Borgen, 2002), and the direct relationship between academic self-concept and aspirations is supported by several meta-analyses (e.g., Lent, Brown, & Hackett, 1994; Multon, Brown, & Lent, 1991). This relationship is likely to occur because "people evaluate themselves in terms of their ability to be successful in certain occupational roles" (Quilter, 1995, p. 40).

In particular, a positive relationship between math self-concept and math achievement has been documented extensively (Watt, 2005). Students are generally more likely to select STEM related courses and careers when they have high math, science, and/or technology self-concepts (Jacobs, 2005) and are more likely to persist with STEM related aspirations when they have high math self-beliefs (Mau, 2003) and science self-beliefs (Larose, Ratelle, Guay, Senécal, & Harvey, 2006). Gainor and Lent (1998) found math self-beliefs predicted math interests, which predicted math career choice intentions among a sample of undergraduate students. Byars-Winston, Estrada, Howard, Davis, and Zalapa (2010) found similar results with a sample of racial minority undergraduate students.

Because of the importance of math self-concept in predicting later achievement related outcomes, and because of the known discrepancy between males and females with regard to math self-concept, it is critical that research examine factors that may contribute to decreases in math self-concept. If low math self-concept is a factor that prevents women from pursuing a degree in a STEM field, finding ways to address this issue can aid researchers and administrators in directly addressing a cause for women's attrition from STEM fields and begin to create educational environments where women can intellectually thrive and progress toward their educational and career goals. In so doing, women will be more apt to continue in STEM, strive to reach the highest levels in their field, and ultimately become role models for other women. Retaining women in STEM via positive educational climates will also equip women with the skills and knowledge to compete in the global economy with its increasing focus on technological advancements and scientific complexity.

For these reasons, then, the examination of potential predictors of math self-concept is a necessity. The following section will examine what research has already shown with regard to family context variables and math self-concept before discussing the current study.

Family Context Variables and Math Self-Concept. While researchers have already documented several known predictors of math self-concept, such as math achievement and the number of math and science courses taken (Sax, 1994), several family context variables also have the potential to impact an individual's math self-concept, including socioeconomic status, parents' level of education, and family social support.

Socioeconomic Status. The term *socioeconomic status* (SES) is used by researchers to designate a family's rank in an economic hierarchy and is usually measured by some combination of parents' level of education, family income, and parents' occupational prestige (Sirin, 2005). A family with a low SES, for example, might be characterized by parents who did not attend college, a limited amount of monthly income, and blue-collar or hourly wage positions. A family with high SES, then, would be characterized by college educated parents, disposable income, and white-collar positions or professional employment.

Students from lower SES backgrounds show disadvantages in educational settings. For example, at the elementary and secondary school levels, a medium to strong correlation exists between SES and academic achievement (Sirin, 2005). In addition, students from low SES backgrounds, and in particular those whose parents did not attend college, are far less likely to score at an average or above average level on the SAT, as compared to those students from higher SES backgrounds and whose parents graduated from college (Bowen, Kurzweil, & Tobin, 2005). Further, only about one-fourth of academically qualified students from low SES backgrounds even attend college (Marable, 2003). Students from low SES backgrounds are less likely to persist to a bachelor's degree and have graduate degree aspirations than students from higher SES backgrounds (Pascarella & Terenzini, 1991; Walpole, 2003).

Family SES likely influences one's math self-concept, either directly, or indirectly with academic achievement as a mediating variable. For example, SES has been shown to have a direct effect on math and science test scores (Yavuz, 2009), and because the relationship between achievement and self-concept is reciprocal (Hamachek, 1995; House, 2000), SES likely indirectly affects academic and math self-concept. The direct relationship between SES and math self-concept is also supported. In a study examining math self-efficacy (a construct conceptually related to math self-concept) among adolescents across 33 countries, SES had a direct positive effect on adolescents' math self-efficacy in 19 of the countries (Williams & Williams, 2010). In addition, middle and high SES parents are more likely to have higher educational aspirations for their children than low SES parents (Khattri, Riley, & Kane, 1997), which may also impact children's sense of self. Further, research suggests that SES may be an important predictor of math self-concept for white men, but not for white women, black men, or black women (Pascarella, Smart, Ethington, & Nettles, 1987).

It is important to note, though, that there is no "automatic privilege" that comes with being raised in a middle or high SES family (Ozturk & Singh, 2006, p. 31). Parental involvement, through modeling, expectations, and support, likely remains essential for children to benefit from a middle or high SES home.

Parents' Level of Education. Parents' level of education is often included as a control variable in studies of children's achievement, aspirations, and other educational outcome variables. Parents' education levels are known to impact children's test scores, particularly math and science test scores (Yavuz, 2009), as well as their levels of academic achievement (Orr & Dinur, 1995). Among women, in particular, having parents who attended college is associated with entering a high-paying, male-dominated occupation (Pascarella & Terenzini, 2005).

Research findings are somewhat mixed with regard to the effects of parents' level of education on children's academic self-concepts. Fathers' level of education has been shown to have a direct effect on children's perceptions of academic efficacy, or sense of competence (Hortaçsu, 1995). However findings also differ by gender of the parent. Having a highly educated father has been found to have a negative effect on females' math self-concepts and having a highly educated mother has been found to have a negative effect on males' math self-concepts (Sax, 1994).

Family Social Support. Social support can be defined as an individual's perception of "general support or specific supportive behaviors (available or enacted upon) from people in their social network, which enhances their functioning and/or may buffer them from adverse outcomes" (Malecki, Demaray, & Elliott, 2000, pg. 3). Social support systems may include people such as friends, family members, and peers, as well as groups of individuals in specific institutions or circumstances (e.g., schools, classmates, athletic team members). Utilizing social support systems may help college students cope with the diverse academic and social demands they face (Azmitia & Cooper, 2001; Budny & Paul, 2003; Jacobs, 2005; Maccoby & Martin, 1983).

Perceived family support, in particular, has been shown to affect a variety of educational and academic outcomes among college students. For example, research consistently indicates parents are among the most important influences on late adolescents' and young adults' career aspirations and educational persistence (Flores & O'Brien, 2002; Otto, 2000; Whiston & Keller, 2004). Multiple studies have also reported that supportive environments in general lead to persistence in STEM fields (Bonous-Hammarth, 2000; Grandy, 1998).

Especially relevant to the present study, Ahmed, Minnaert, Werf, and Kuyper (2010) found perceived social support (in this case, from parents, peers, and teachers) influenced math achievement among early adolescents, as mediated by a combination of competence beliefs (i.e., math self-concept), value of the subject, anxiety, and enjoyment. In other words, perceived social support influenced math self-concept (and other variables), which in turn influenced one's math achievement. Among a sample of Mexican American adolescents, perceived parent social support significantly predicted math and science self-efficacy for both males and females (Navarro, Flores, & Worthington, 2010).

II. The Current Study.

The purpose of the current study was to examine family context variables, including SES, mother's level of education, father's level of education, and perceived family social support, as predictors of math self-concept among undergraduate STEM majors while including gender as a moderator. We predict that the family context variables will show direct relationships with math self-concept. Research and theory, however, suggest that gender may also moderate these relationships. Such variables as SES (Pascarella et al., 1987) and father's level of education (Sax, 1994), for example, have been shown to differentially affect females' and males' math self-concepts.

This study is important for both theoretical and practical reasons. Males' and females' math self-concepts have been examined at the elementary and secondary levels, but less so at the university level, and particularly not among declared STEM majors. This study thus adds valuable information to the available research literature. Further, but few research studies have examined the influence of one's family in predicting factors that might lead to STEM degree persistence and attainment. By including family context variables as predictors of math self-concept, the findings from this study might provide insight regarding the causes of lower and steeper declining math self-concept among women. Using this information, researchers, administrators, educators, and parents could work to potentially improve the math self-concepts of women, and men, and to increase retention rates within STEM undergraduate majors.

Specifically, we make the following hypotheses about declared STEM majors:

1) Females will report lower math self-concepts than males.
2) Higher SES will predict higher math self-concept.
3) Mothers' higher level of education will predict higher math self-concept.
4) Fathers' higher level of education will predict higher math self-concept.
5) Higher perceived family social support will predict higher math self-concept.
6) Because we examine gender exploratory, we make no formal hypotheses regarding gender as a moderator of Hypotheses 2-5.

III. Method.

A. Participants.

Participants for this study were recruited from a large, research university located in the southwestern United States. This university serves approximately 40,000 undergraduate students (nearly half female) and is White-dominated (more than 75% White). Of these, approximately 12,000 students are declared STEM majors. Of the 499 students who participated in the current study, 373 were female and 126 were male. Of these, 25 identified as African American/Black, two as American Indian/Alaska Native, 49 as Asian, 107 as Hispanic/Latino, two as Native Hawaiian/Pacific Islander, 298 as White, and 16 as Bi- or Multi-racial. Regarding the students' year in school, 388 were freshmen, 76 were sophomores, 17 were juniors, and 12 were seniors (with the remaining six labeling themselves as "other" or not responding to this question). Regarding students' mothers' levels of education, 33 indicated their mothers did not graduate from high school, 76 had mothers with a high school diploma, 114 had mothers with some college experience, 184 had mothers who were college graduates, 23 had mothers with some graduate level training, and 69 had mothers with a Master's degree or higher. Regarding students' fathers' levels of education, 32 indicated their fathers did not graduate from high school, 64 had fathers with a high school diploma, 83 had fathers with some college experience, 178 had fathers who were college graduates, 24 had fathers with some graduate level training, and 114 had fathers with a Master's degree or higher. Regarding students' family finance levels, or SES, one student indicated his/her family was "very poor/not enough to get by", 46 students had "barely enough to get by", 173 had "enough to get by, but not many extras", 174 had "more than enough to get by", 87 were "well-to-do", 17 were "extremely well-to-do", and one student did not answer this question. Finally, about half of the students (49.5%) reported taking between seven and nine high school math and science classes.

B. Materials.

Data for this study were gathered as part of a larger study. Only the variables used in the current research are discussed here.

Demographic information. A demographic questionnaire was administered to assess participants' major, age, gender, race, number of science and math courses taken during high school, and other information.

Math self-concept. The Self Description Questionnaire III (SDQ-III) was designed to measure the self-concepts of late adolescents, and was created in response to a need for high quality measurement instruments with a strong theoretical basis that provide support for the multidimensionality of self-concept (Marsh, 1989). The SDQ-III is based on the Shavelson model of self-concept, which assumes that self-concept is both multifaceted and hierarchical, as previously mentioned (Shavelson et al., 1976).

The SDQ-III contains 136 items and measures 13 facets of self-concept (Marsh & O'Neill, 1984). Each facet is measured by 10 to 12 items, for which responses range from 1 (definitely false) to 8 (definitely true). Half of the items are negatively worded (Marsh, 1989). The SDQ-III assesses four areas of academic self-concept (math, verbal, general academic, and problem solving), eight areas of nonacademic self-concept (physical ability, physical appearance, relations with the same sex, relations with the opposite sex, relations with parents, spiritual values/religion, honesty/trustworthiness, and emotional stability), and general self-concept.

For the purposes of this study, we only used data from the math self-concept subscale. Sample items include, "I have hesitated to take courses that involve mathematics", "I have generally done better in mathematics courses than other courses", and "I am quite good at mathematics." Marsh (1989) reports strong psychometric support for the SDQ-III, based on scores of reliability, correlations with external criteria, and self-other agreement. Scores of internal consistency range from $\alpha = .74$ to $\alpha = .95$ for the subscales of the SDQ-III. Studies of discriminant validity are extensive. For example, the relationship between one's math self-concept and math achievement score has been noted as $r = .58$, $p < .01$ (Marsh & O'Neill, 1984).

Social support. Perceived social support was measured by the Child and Adolescent Social Support Scale (CASSS; Malecki et al., 2000) The CASSS is designed to measure social support as perceived by children and adolescents. It is made up of 60 items, evenly divided between five subscales (Parent, Teacher, Classmate, Close Friend, and School). Responses range from 1 (never) to 6 (always).

For the purposes of this study, we only used data from the Parent subscale. Sample items include, “My parents show they are proud of me”, “My parents listen to me when I need to talk”, and “My parents make suggestions when I don’t know what to do.” Internal consistency scores on subscales of the CASSS range from .92 to .96 (Malecki et al., 2000). Validity evidence for the CASSS has been documented through correlations with other measures of social support including the Social Support Scale for Children (r = .55) and with the Social Support Appraisals Scale (r = .56; as cited in Malecki et al.).

C. Procedure.

A random sample of female students who were declared STEM majors at a large research university in the southwestern United States (N = 758) were invited to participate in a study examining “women’s experiences in math and science.” A subset of male students (N = 300) was also invited to participate to serve as a comparison group. From the 1058 students who were invited to participate, a total of 499 students participated in the current study resulting in a convenience sample. Students completed a series of online questionnaires after electronically signing an informed consent document, and were compensated with a gift card.

IV. Results.

Means, standard deviations, and intercorrelations for all variables in the present study are presented in Table 1. Most noteworthy, math self-concept is correlated with family social support (r = .17, p < .001), mother’s level of education (r = .13, p < 0.01), father’s level of education (r = .10, p < 0.05), and SES (r = .13, p < 0.01). An independent samples t-test shows a significant difference between the math self-concepts of females (M = 6.22, SD = 1.38) and males (M = 6.68, SD = 1.02), t(498) = 3.44, p =.001, but not between the family social support of females (M = 4.85, SD = .86) and males (M = 4.69, SD = .88), t(498) = -1.80, p = .07.

Table 1. Means, Standard Deviations, and Intercorrelations of Variables of Interest.

Variable	***Females***		***Males***		**1**	**2**	**3**	**4**	**5**
	M	*SD*	*M*	*SD*					
1. Math SC	6.22	1.37	6.69	1.01	--				
2. Family SS	4.85	.86	4.70	.88	.17***	--			
3. Mother E					.13**	.08	--		
4. Father E					.10*	.04	.56***	--	
5. SES					.13**	.11*	.33***	.43***	--

Note. The correlation matrix includes both females and males. **1** Math SC = Math Self-Concept. **2** Family SS = Family Social Support. **3** Mother E = Mother’s Level of Education. **4** Father E = Father’s Level of Education. **5** SES = Family Socioeconomic Status. * p < .05, ** p < .01, ***p < .001

Hypotheses were tested via moderated regression. Gender, family income, mother’s education, father’s education, family support and the interactions between gender and each of the family variables were entered simultaneously as predictors of math self-concept. Race (entered as five dummy codes, with Black as the reference group) and numbers of science and math classes taken in high school were entered as covariates in the analysis. All quantitative predictors were standardized, as was the quantitative covariate (number of science and math classes) and the outcome variable (math self-concept). Categorical variables entered using dummy codes (gender and race) were not standardized.

Results from the moderated regression appear in Table 2. It is worth noting that several of the covariates were significant predictors of math self-concept. Both Asians and Whites had significantly higher math self-concepts than did Blacks (Asians: $B = .499$, $p = .040$; Whites: $B = .554$, $p = .007$). In addition, respondents who had taken more science and math classes in high school had significantly higher math self-concepts than did those who had taken fewer such classes ($B = .157$, $p < .001$).

Table 2. Math Self-Concept Regression Results.

Predictor	B	SE	*t*	*p*
Intercept	-.138	.209	-0.663	.508
American Indian	.077	.701	0.110	.913
Asian	.499	.242	2.057	.040
Hispanic	.330	.216	1.526	.128
Pacific Islander	1.092	.702	1.555	.121
White	.554	.206	2.695	.007
Multiracial	.124	.315	0.393	.695
Science/math classes	.157	.044	3.538	< .001
Family finance	.062	.105	0.591	.555
Mother's education	-.105	.101	-1.042	.298
Father's education	.031	.112	0.274	.785
Family support	.351	.087	4.030	< .001
Gender	-.415	.100	-4.155	< .001
Gender × Family finance	.005	.119	0.042	.966
Gender × Mother's education	.219	.119	1.844	.066
Gender × Father's education	-.056	.129	-0.436	.663
Gender × Family support	-.229	.101	-2.269	.024

Hypothesis 1 predicted that women would report a lower math self-concept compared to men. Supporting our hypothesis, results showed that after controlling for race and number of math/science classes, gender significantly predicted math self-concept in that women reported a lower math self-concept than did men ($B = -.415$, $p < .001$). There was also a main effect for family support on math self-concept; students who felt more supported by their family reported a higher math self-concept ($B = .351$, $p < .001$). These main effects were qualified by an interaction between gender and family support on math self-concept. To examine the nature of the relationships, an analysis of simple slopes was conducted (Aiken & West, 1991). Supporting Hypothesis 2, results showed that higher family social support predicted higher math self-concept for both women ($B = .123$, $p = .017$) and men ($B = .351$, $p < .001$), but the association was more than twice as strong for men as for women. Figure 1 displays these relationships.

The main effect for gender was also nearly qualified by an interaction between gender and mother's education on math self-concept ($p = .066$), thus somewhat supporting Hypothesis 3. An analysis of simple slopes revealed a positive association between mother's education and math self-concept for women (B = .114, p = .071), but a negative association for men (B = -.105, p = .298). The other hypothesized relationships were not significant.

***Figure 1.* Interaction between Gender and Family Support of Math Self-Concept**.

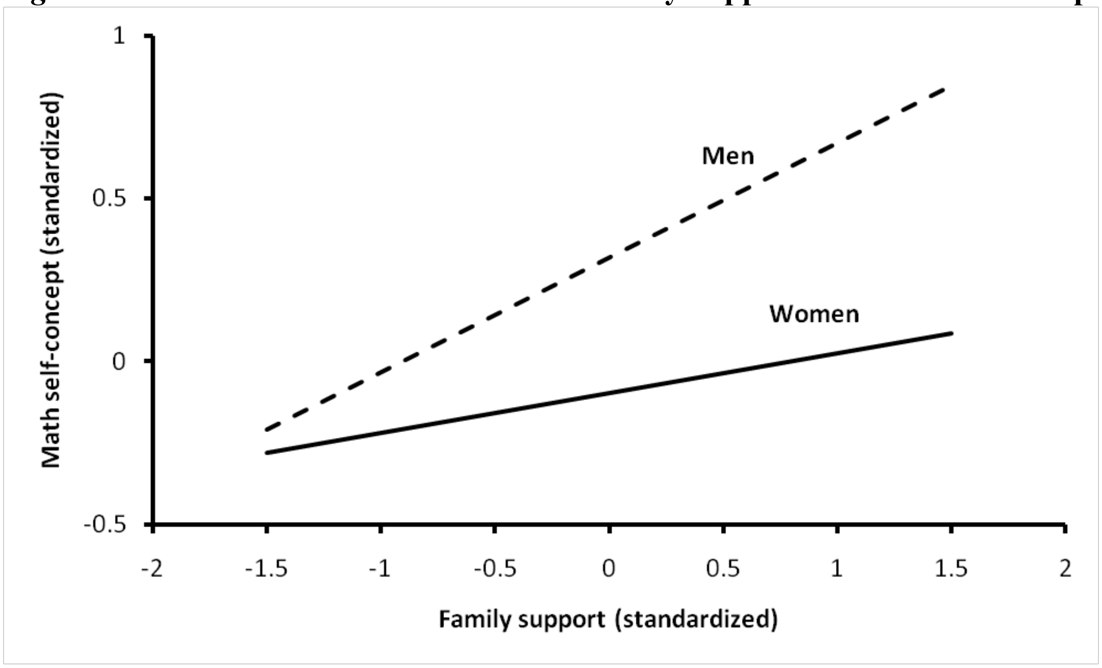
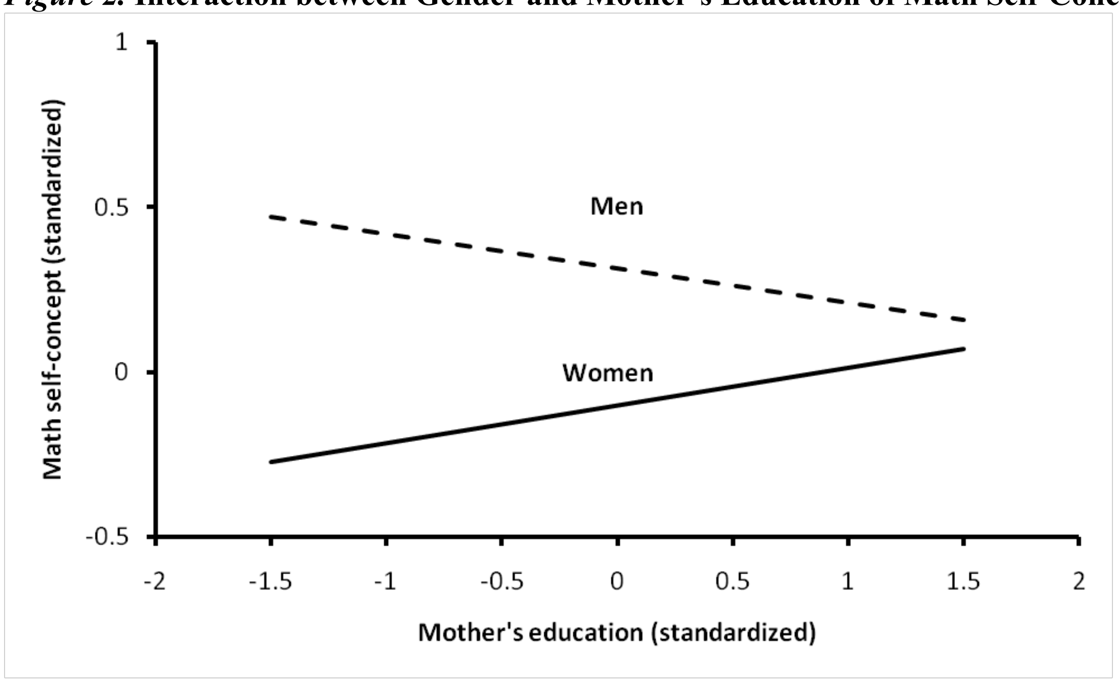


***Figure 2.* Interaction between Gender and Mother's Education of Math Self-Concept.**



V. Discussion.

The purpose of the current study was to examine family context variables, including SES, mother's level of education, father's level of education, and perceived family social support, as predictors of math self-concept among undergraduate male and female STEM majors. Results indicate that Asians, Whites, and those who took more science/math classes while in high school had the highest math self-concepts. Males had higher math self-concepts than females, even after controlling for race and the number of science/math classes taken while in high school. Social support predicted math self-concept for males and females, but more than twice as strongly for males as for females. Finally, mothers' level of education nearly predicted math self-concept among females.

African American and Hispanic students, both males and females, are less likely to have access to advanced math and science courses while in high school (May & Chubin, 2003; Tyson, Lee, Borman, & Hanson, 2007), so it is not surprising to find, in the current study, that Asians and Whites had higher math self-concepts than other racial/ethnic groups.

Even though all participants surveyed in this study were declared STEM majors, males in the current sample had higher math self-concepts than females, even after controlling for race and the number of science/math classes taken while in high school. This finding is consistent with previous findings that have shown females report lower math self-concepts than males, regardless of actual ability levels in math (Else-Quest et al., 2010; Furnham, 2001; Furnham et al., 2002; Heller & Ziegler, 1996; Juang & Silbereisen, 2002; Marsh & Yeung, 1998; Meece & Jones, 1996; Pajares, 1996; Sax, 1994; Skaalvik & Skaalvik, 2004; Steinmayr & Spinathm, 2009; Watt, 2005). This gender difference in math self-concept is important and worth following longitudinally to determine whether math self-concept significantly predicts attrition from an undergraduate STEM major, STEM undergraduate degree attainment, STEM graduate degree attainment, or STEM career aspirations.

In the current study, higher family social support predicted math self-concept for both men and women, but this relationship was more than twice as strong for men as for women. This finding is in line with previous research that has shown perceived social support from parents has an impact on one's math self-concept and math self-efficacy (Ahmed et al., 2010; Navarro et al., 2007). Considering there was no significant difference in the amount of perceived parental social support between males and females in the current study, we are left to wonder why parental social support has such a stronger effect on males' math self-concepts than on females' math self-concepts. We did not ask participants to elaborate about the social support messages they are receiving from their parents, particularly with regard to their STEM major, but future research should consider this as an option. If parents are providing support based on their perceptions of their children's abilities in STEM areas, or based on the perceived appropriateness of majoring in a STEM area, this type of support could differentially impact a male versus a female's math self-concept. Generic parental support related to college (i.e., financial support, praise, positive feedback), then, might not affect math self-concept in the same way.

Mother's education nearly predicted math self-concept among females, but there would have been a negative trend among males, such that more educated mothers would have resulted in lower math self-concepts among males. Father's education did not significantly predict math self-concept for either males or females. This trend partially replicates Sax's (1994) finding that having a highly educated mother has a negative effect on males' math self-concepts. Sax provides the following explanation for this seemingly contradictory finding: "…perhaps men with highly educated mothers would not be as overconfident as other men, because they have contact with, and are influenced by, highly educated, intelligent women… although men with highly educated mothers have overall greater confidence in math, these men might be less likely to *overestimate* their math abilities" (p.155-157). As Sax's findings might now be outdated, more research is certainly needed to tease apart the relationship between parents' level of education and children's math self-concepts.

Although the two variables were correlated, SES was not a predictor of math self-concept in the current study. As there was little variation among participants with regard to SES, this finding is not entirely surprising. Replicating this study on a more diverse university campus, or across multiple institutions, might provide further conclusive evidence regarding the relationship between SES and math self-concept.

Limitations and Directions for Future Research. The current sample was obtained at a single institution and by using a convenience sampling method, both of which naturally limit the generalizability of the findings. Future research should replicate the current study across multiple institutions and multiple groups of undergraduates. The following limitations should be understood with the lack of generalizability of the current study in mind.

Future research examining math self-concept among those undergraduates majoring in a STEM field should include undergraduates' particular STEM fields of study (e.g., math, physics, chemistry, engineering) as a covariate or predictor. Researchers, administrators, and educators assume math self-concept is predictive of persistence in a STEM field, but it might not be for each individual STEM major. For example, math self-concept might not be as important or predictive of success in less mathematically demanding STEM fields such as biology, as it is in more mathematically demanding STEM fields such as physics.

While we included the number of math and science classes taken during high school as a covariate in the current study to account for academic preparation, future research should include undergraduates' total SAT or ACT scores, or their SAT or ACT math subscale scores, as a covariate to account for the potential relationship between aptitude and self-concept.

Finally, in order to gain more conclusive evidence regarding the predictive aspects of family context variables on math self-concept, the experiences of undergraduate STEM majors should be compared to undergraduate non-STEM majors.

Conclusion. Even among declared STEM majors, females are still reporting lower math self-concepts than males. Among the family context variables examined in the current study, only parental social support played a significant role in predicting math self-concept among female undergraduate STEM majors. Future research should continue the examination of math self-concept among female and male STEM majors, as the gender difference in math self-concept may lead to differences in later math- and STEM-related achievement, which may lead to differences in STEM undergraduate and graduate degree attainment.

References

Ahmed, W., Minnaert, A., Werf, G., & Kuyper, H. (2010). Perceived social support and early adolescents' achievement: The mediational roles of motivational beliefs and emotions. *Journal of Youth and Adolescence, 39*, 36-46.

Aiken, L. S., & West, S. G. (1991). *Multiple Regression: Testing and Interpreting Interactions.* Newbury Park, CA: Sage.

Astin, A. W. (1993). *What Matters in College? Four Critical Years Revisited.* San Francisco: Jossey-Bass.

Azmitia, M., & Cooper, C. R. (2001). Good or bad? Peer influences on Latino and European American adolescents' pathways through school. *Journal of Education for Students Placed at Risk, 6*, 45-71.

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Approach.* Englewood Cliffs, NJ: Prentice Hall.

Bonous-Hammarth, M. (2000). Pathways to success: Affirming opportunities for science, mathematics, and engineering majors. *Journal of Negro Education, 69*, 92-111.

Bowen, W. G., Kurzweil, M. A., & Tobin, E. M. (2005). *Equity and Excellence in American Higher Education.* Charlottesville, VA: University of Virginia Press.

Brainard, S. G., & Carlin, L. (2001). A six-year longitudinal study of undergraduate women in engineering and science. In M. Lederman & I. Bartsch (Eds.), *The Gender and Science Reader.* New York: Routledge.

Budny, D. D., & Paul, C. A. (2003). Working with students and parents to improve the freshman retention. *Journal of STEM Education: Innovations and Research, 4*, 1-9.

Byars-Winston, A., Estrada, Y., Howard, C., Davis, D., & Zalapa, J. (2010). Influence of social cognitive and ethnic variables on academic goals of underrepresented students in science and engineering: A multiple-groups analysis. *Journal of Counseling Psychology, 57*, 205-218.

Cabrera, A. F., Nora, A., Terenzini, P. T., Pascarella, E., & Hagedorn, L. S. (1999). Campus racial climate and adjustment of students in college: A comparison between White and African-American students. *The Journal of Higher Education, 70,* 134-155.

Eimers, M. T., & Pike, G. R. (1997). Minority and nonminority adjustment to college: Differences or similarities? *Research in Higher Education, 38,* 77-97.

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin, 136*, 103-127.

Farmer, H. S. (1985). Model of career achievement motivation for women and men. *Journal of Counseling Psychology, 32*, 363-390.

Flores, L. Y., & O'Brien, K. M. (2002). The career development of Mexican American adolescent women: A test of social cognitive career theory. *Journal of Counseling Psychology, 49*, 14-27.

Furnham, A. (2001). Self-estimates of intelligence: Culture and gender difference in self and other estimates of both general (g) and multiple intelligences. *Personality and Individual Differences, 31,* 1381-1405.

Furnham, A., Hosow, T., & Tang, T. L.-P. (2002). Male hubris and female humility? A cross-cultural study of ratings of self, parental, and sibling multiple intelligence in America, Britain, and Japan. *Intelligence, 30,* 101-115.

Gainor, K. A., & Lent, R. W. (1998). Social cognitive expectations and racial identity attitudes in predicting the math choice intentions of black college students. *Journal of Counseling Psychology, 45*, 403-413.

Gottfredson, G. D. (2002). Interests, aspirations, self-estimates, and the self-directed search. *Journal of Career Assessment, 10*, 200-208.

Graham, S. W., & Gisi, S.L. (2000). The effects of instructional climate and student affairs services on college outcomes and satisfaction. *Journal of College Student Development, 41,* 279-291.

Grandy, J. (1998). Persistence in science of high-ability minority students: Results of a longitudinal study. *The Journal of Higher Education, 69*, 589-620.

Hamachek, D. (1995). Self-concept and school achievement: Interaction dynamics and a tool for assessing the self-concept component. *Journal of Counseling and Development, 73*, 419-425.

Heller, K. A., & Ziegler, A. (1996). Gender differences in mathematics and the sciences: Can attributional retraining improve the performance of gifted females? *Gifted Child Quarterly, 40,* 200-210.

Hortaçsu, N. (1995). Parents' education levels, parents' beliefs, and child outcomes. *The Journal of Genetic Psychology: Research and Theory on Human Development, 156,* 373-383.

House, J. D. (2000). The effect of student involvement on the development of academic self-concept. *Journal of Social Psychology, 140*, 261-263.

Hyde, J. S., Fennema, E., Ryan, M., Frost, L. A., & Hopp, C. (1990). Gender comparisons of mathematics attitudes and affect: A meta-analysis. *Psychology of Women Quarterly, 14*, 299-324.

Jacobs, J. E. (2005). Twenty-five years of research on gender and ethnic differences in math and science career choices: What have we learned? *New Directions for Child and Adolescent Development, 110*, 85-94.

Johnsen, S. K., & Kendrick, J. (Eds.). (2005). *Teaching and Counseling Gifted Girls.* Waco, TX: Prufrock Press.

Juang, L. P., & Silbereisen, R. K. (2002). The relationship between adolescent academic capability beliefs, parenting, and school grades. *Journal of Adolescence, 25,* 3-18.

Khattri, N., Riley, K. W., & Kane, M. B. (1997). Students at risk in poor, rural areas: A review of the research. *Journal of Research in Rural Education, 13*, 79-100.

Kohlstedt, S. G. (2004). Sustaining gains: Reflections on women in science and technology in 20th-century United States. *NWSA Journal, 16,* 1-26.

Larose, S., Ratelle, C. F., Guay, F., Senécal, C., & Harvey, M. (2006). Trajectories of science self-efficacy beliefs during the college transition and academic and vocational adjustment in science and technology programs. *Educational Research and Evaluation, 12*, 373-393.

Lee, J. (2009). Universals and specifics of math self-concept, math self-efficacy, and math anxiety across 41 PISA 2003 participating countries. *Learning and Individual Differences, 19*, 355-365.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45*, 79-122.

Lockwood, P. (2006). “Someone like me can be successful”: Do college students need same-gender role models? *Psychology of Women Quarterly, 30*, 36-46.

Maccoby, E. E., & Martin, J. A. (1983). Socialization in the context of the family: Parent-child interaction. In E. M. Hetherington (Ed.) & P. H. Mussen (Series Ed.), *Handbook of child psychology:* Vol. 4. *Socialization, personality, and social development* (pp. 1-101). New York, NY: Free Press.

Malecki, K. C., & Demaray, M. K. (2003). Perceptions of the frequency and importance of social support by students classified as bullies, victims, and bully/victims in an urban middle school. *School Psychology Review, 32,* 471-489.

Malecki, C. K., Demaray, M. K., & Elliott, S. N. (2000). *A working manual on the development of the child and adolescent social support scale.* DeKalb, IL: Northern Illinois University.

Marable, M. (2003). *The great wells of democracy: The meaning of race in American life.* Cambridge, MA: BasicCivitas Books.

Marsh, H. W. (1989). *Self Description Questionnaire (SDQ) III: A Theoretical and Empirical Basis for the Measurement of Multiple Dimensions of Late Adolescent Self-Concept: An Interim Test Manual and a Research Monograph.* New South Wales, Australia: University of Western Sydney.

Marsh, H. W., & O'Neill, R. (1984). Self Description Questionnaire III: The construct validity of multidimensional self-concept ratings by late adolescents. *Journal of Educational Measurement, 21,* 153-174.

Marsh, H. W., & Shavelson, R. (1985). Self-concept: Its multifaceted, hierarchical structure. *Educational Psychologist, 20*, 107-123.

Marsh, H. W., & Yeung, A. S. (1998). Longitudinal structural equation models of academic self-concept and achievement: Gender differences in the development of math and English constructs. *American Educational Research Journal, 35*, 705-738.

Mau, W. C. (2003). Factors that influence persistence in science and engineering career aspirations. *The Career Development Quarterly, 51*, 234-242.

May, G. S., & Chubin, D. E. (2003). A retrospective on undergraduate engineering success for underrepresented minority students. *Journal of Engineering Education, 92*, 27-40.

Meece, J. L., & Jones, M. G. (1996). Gender differences in motivation and strategy use in science: Are girls rote learners? *Journal of Research in Science and Teaching, 33*, 407-431.

Multon, K. D., Brown, S. D, & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology, 38*, 30-38.
National Science Foundation. (2007). *Women, minorities, and persons with disabilities in science and engineering: NSF 07-315.* Division of Science Resource Statistics: Arlington, VA.

Navarro, R. L., Flores, L. Y., & Worthington, R. L. (2007). Mexican American middle school students' goal intentions in mathematics and science: A test of social cognitive career theory. *Journal of Counseling Psychology, 54*, 320-335.

Orr, E., & Dinur, B. (1995). Actual and perceived parental social status: Effects on adolescent self-concept. *Adolescence, 30*, 603-616.

Otto, L. B. (2000). Youth perspectives on parental career influence. *Journal of Career Development, 27*, 111-117.

Ozturk, M. A., & Singh, K. (2006). Direct and indirect effects of socioeconomic status and previous mathematics achievement on high school advanced mathematics course taking. *The Math Educator, 16*, 25-34.

Pajares, F. (1996). Self-efficacy beliefs and mathematical problem-solving of gifted students. *Contemporary Educational Psychology, 21,* 325-344.

Pascarella, E. T., Smart, J. C., Ethington, C. A., & Nettles, M. T. (1987). The influence of college on self-concept: A consideration of race and gender differences. *American Educational Research Journal, 24*, 49-77.

Pascarella, E., & Terenzini, P. (1991). *How College Affects Students.* San Francisco: Jossey-Bass.

Pascarella, E. T., & Terenzini, P. T. (2005). *How College Affects Students. Volume 2: A Third Decade of Research.* San Francisco, CA: Jossey-Bass.

Perna, L. W., & Titus, M. A. (2004). Understanding differences in the choice of college attended. *The Review of Higher Education, 27*, 501-525.

Quilter, S. M. (1995). Academic self-concept and the first-year college student: A snapshot. *Journal of the Freshman Year Experience, 7*, 39-52.

Rottinghaus, P. J., Lindley, L. D., Green, M. A., & Borgen, F. H. (2002). Educational aspirations: The contribution of personality, self-efficacy, and interests. *Journal of Vocational Behavior, 61*, 1-19.

Sax, L. J. (1994). Mathematical self-concept: How college reinforces the gender gap. *Research in Higher Education, 35*, 141-166.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Validation of construct interpretations. *Review of Educational Research, 46*, 407-441.

Seymour, E. (1995). The loss of women from science, mathematics, and engineering under-graduate majors: An explanatory account. *Science Education, 79*, 437-473.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research, 75*, 417-453.

Skaalvik, S., & Skaalvik, E. M. (2004). Gender differences in math and verbal self-concept, performance expectations, and motivation. *Sex Roles, 50,* 241-252.

Sonnert, G., Fox, M. F., & Adkins, K. (2007). Undergraduate women in science and engineering: Effects of faculty, fields, and institutions over time. *Social Science Quarterly, 88,* 1333-1356.

Steinmayr, R., & Spinath, B. (2009). What explains boys' stronger confidence in their intelligence? *Sex Roles, 61*, 736-749.

Tyson,W., Lee, R., Borman, K. M., & Hanson, M. A. (2007). Science, technology, engineering, and mathematics (STEM) pathways: High school science and math coursework and postsecondary degree attainment. *Journal of Education for Students Placed at Risk, 12*, 243-270.

Walpole, M. (2003). Socioeconomic status and college: How SES affects college experiences and outcomes. *The Review of Higher Education, 27*, 45-73.

Watt, H. M. G. (2005). Explaining gendered math enrollments for NSW Australian secondary school students. *New Directions for Child and Adolescent Development, 110*, 15-29.

Whiston, S. C., & Keller, B. K. (2004). The influences of the family of origin on career development: A review and analysis. *The Counseling Psychologist, 32*, 493-568.

Williams, T., & Williams, K. (2010). Self-efficacy and performance in mathematics: Reciprocal determinism in 33 nations. *Journal of Educational Psychology, 102*, 453-466.

Yavuz, M. (2009). Factors that affect mathematics-science (MS) scores in the secondary education institutional exam: An application of structural equation modeling. *Educational Sciences: Theory and Practice, 9*, 1557-1572.