

# Understanding Women's Underrepresentation in Science, Technology, Engineering, and Mathematics: The Role of Social Coping

Valerie J. Morganson  
Meghan P. Jones  
Debra A. Major

Enrollment of women in science, technology, engineering, and mathematics (STEM) majors is disproportionately small and declining. This study examines social coping to explain the gender gap. Women undergraduates reported using significantly more social coping than did men. Multiple regression analyses revealed that social coping was a stronger predictor of commitment to major for women than for men. Social coping negatively predicted intent to turn over, or withdraw from, their major for women, but not for men. Unexpectedly, social coping negatively predicted academic course grade for men but not for women. Results suggest that women benefit more from social coping than do men. Implications for counselors and policy are discussed.

Whereas women are attending college at unprecedented rates and constitute more than half of university and college populations, they continue to be underrepresented in science, technology, engineering, and mathematics (STEM) fields (Planty, Kena, & Hannes, 2009). The decline in STEM enrollments along with retention problems raise concerns about the “shrinking” and “leaking” pipeline, the metaphor most often used to describe declining enrollments and the differential retention of women in STEM fields (e.g., Camp, 2002; Major & Morganson, 2008). As enrollments of women in STEM majors continue to decline, the pipeline “supplying” them to these fields is said to be shrinking (Camp, 2002). College-age women have been reported to be less likely to major in STEM fields and to be retained at a lower rate than are men (Freeman, 2004; Planty et al., 2009). When women complete undergraduate training, they continue to be underrepresented in and are more likely to leave the workforce than are men (Freeman, 2004). In the current article, we focused on understanding and addressing the retention of women in STEM majors at the undergraduate college level.

## Coping in the STEM Context

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The STEM environment is often characterized as a *chilly climate*, which tends to be male-dominated, highly impersonal, and individualistic (Foster

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*Valerie J. Morganson, Meghan P. Jones, and Debra A. Major, Department of Psychology, Old Dominion University. This research was supported by Grant CNS 0420365 from the National Science Foundation. Correspondence concerning this article should be addressed to Valerie J. Morganson, Department of Psychology, Old Dominion University, 250 Mills Godwin Building, Norfolk, VA 23529 (e-mail: vmorgans@odu.edu).*

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et al., 1994; Seymour & Hewitt, 1997; Suresh, 2006). The lack of support in the traditional STEM environment may be particularly harmful to women given that researchers and theorists (e.g., Fletcher, 2004; Jordan, Kaplan, Miller, Stiver, & Surrey, 1991) have repeatedly emphasized the importance of relationships and interpersonal connections to women's psychological development and well-being. Scholars (e.g., Camp, 2002; Güner & Camp, 2002; Margolis & Fisher, 2002) have identified numerous barriers to the success and persistence of women in STEM curricula, including lack of viable mentors, low self-efficacy, and the glass ceiling effect. Expanding on efforts to understand the underrepresentation of women in STEM curricula, we turn to coping.

Exploring which coping strategies are effective for girls and women in STEM curricula has implications for school and career counselors and for academic policies. By understanding the barriers that women in STEM curricula face and the coping strategies known to be effective in STEM environments, counselors can help clients recognize obstacles and learn to cope in ways that are likely to be effective. Coping is a transportable skill that can continue to assist girls and women in overcoming barriers as they move forward in their careers. In terms of policy, identifying the most effective coping strategies for women in STEM fields can provide information regarding where additional resources should be allocated and what kinds of resources are likely to help girls and women in STEM curricula to cope (cf. N. W. Brown & Cross, 1997).

## A Review of Coping Research

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Backed by decades of research, coping has been recognized as a tool that enables individuals to deal with challenges and problems in their environments (Folkman & Moskowitz, 2004). The construct coping has appeared in the higher education, counseling, and workplace literatures and is regarded as a useful way to overcome barriers and mitigate stress at various stages in one's career path (e.g., Carver & Scheier, 1994; Dwyer & Cummings, 2001; González-Morales, Perió, Rodríguez, & Green-glass, 2006; Neville, Heppner, & Wang, 1997). In addition, empirical research (Lent et al., 2001; Lent et al., 2003; Lent, Lopez, Lopez, & Sheu, 2008) using social cognitive career theory has found that coping efficacy (i.e., individuals' perceptions about their ability to manage and overcome obstacles) influences persistence and performance outcomes and that coping efficacy was negatively related to social barriers and positively related to outcome expectations, interests, goals, beliefs that one can succeed academically, and persistence in one's major. Whereas these findings suggest that coping is an important predictor, few studies have examined which coping strategies are useful for undergraduates. One exception is a study by Struthers, Perry, and Menec (2000); using a sample of psychology students, they found that coping strategies differentially related to stress management and motivational outcomes.

## The Role of Gender in Coping

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Men and women cope in different ways. In general, men tend to cope either by attempting to change the stressor (i.e., problem-focused coping) or by ignoring the stressor (i.e., avoidant coping; Tamres, Janicki,

& Helgeson, 2002). In contrast, women engage in social support coping (e.g., Hovanitz & Kozora, 1989; Ptacek, Smith, & Zanas, 1992). Social support coping includes looking to others for emotional support as a way of dealing with challenges and seeking aid from others to overcome stressors (Carver, Scheier, & Weintraub, 1989). Women's tendency to engage in social coping more than men do may reflect physiological differences between men and women or due to differences in socialization beginning in early childhood (see Tamres et al., 2002, for a review); this tendency is consistent with cultural typologies of women as communal and relationship-oriented (Fletcher, 2004).

Research (Abraham & Hansson, 1996; Feldman, Fisher, Ransom, & Dimiceli, 1995; Hovanitz & Kozora, 1989) has also shown that coping strategies are not equally effective for men and women. Abraham and Hansson (1996) found that goal-directed (i.e., problem-focused) coping, a form of coping associated with masculinity (Ptacek, Smith, & Dodge, 1994), was more important in predicting occupational satisfaction for men than for women. Feldman et al. (1995) studied the effect of adolescents' use of feminine coping strategies (e.g., turning to religion and turning to friends) on their young-adult adaptation and found that these strategies predicted good adaptation for girls and poor adaptation for boys. Overall, research supports the proposition that different coping strategies are more or less effective depending on the gender of the person using them.

## Scope of the Current Study

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Our goal in the current research is to help explain the underrepresentation of women in STEM fields to provide guidance for career development professionals. As previously reviewed, multidisciplinary research suggests that coping is a useful and underresearched framework for this purpose.

The coping literature supports the finding that individuals select coping strategies partly on the basis of context (Folkman & Moskowitz, 2004). Thus, our first research question sought to extrapolate research findings in non-STEM contexts—that women tend to use social coping more than men do (Tamres et al., 2002)—to the STEM context.

*Research Question 1:* Will women in STEM majors report greater use of social coping than will men in STEM majors?

Given that (a) women use social coping more than men, (b) social coping may not be supported by the chilly STEM environment, and (c) coping strategies are differentially effective depending on gender, our next three research questions examined gender differences in the relationship between social coping and persistence and performance outcomes. Generally, we expected that social coping would enable individuals to overcome barriers, thereby increasing persistence and performance, especially for women. This expectation parallels other STEM research and career theory (e.g., Lent & Brown, 2006; Lent et al., 2003). First, we examined commitment, defined as individuals' emotional attachment to their major. Second, we examined individuals' intent to turn over, or withdraw from, their major. Both commitment and turnover intent are considered persistence outcomes (Meyer, Stanley, & Herscovitch, 2002). They are viewed as precursors to actual withdrawal from the major (cf. Hulin, 1991). Finally, we examined how social coping relates

to individuals' academic course grades (a performance outcome) with the rationale that coping allows individuals to overcome barriers and perform well in their courses.

*Research Question 2:* Will the relationship between social coping and commitment to major be more positive for women compared with men?

*Research Question 3:* Will the relationship between social coping and intent to turnover from one's major be more negative for women than for men?

*Research Question 4:* Will the relationship between social coping and academic course grade be more positive for women than for men?

## Method

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### Participants

Participants in the study were undergraduate students ( $N = 1,061$ ) from two urban universities in the eastern United States. The majority of the participants were men (75.3%) and were between the ages of 18 and 20 years (69.2%). Forty-eight percent of participants were Caucasians, followed by African Americans (37.8%), Asian/Pacific Islanders (7.4%), Hispanics (2.9%), American and Asian Indians (1.4%), Middle Easterners (1.0%), and 1.5% not reporting their race. The first university was a historically Black university (University A). The second (University B), whose students made up the majority of the sample (72.4%), was a large university with a culturally and racially diverse student body. A larger portion of the sample participants were from University B because of its large size, larger computer science program, and higher response rate. Participants were enrolled in at least one of three computer science courses required by multiple STEM major programs: Introduction to Computer Science, Programming 1, or Programming 2.

### Procedure

Data were collected via an online survey from all students enrolled in the classes just described. Data collection was cross-sectional and spanned four semesters. Students earned extra credit for their participation. Instructors provided e-mail addresses of students in their classes; these lists were used to solicit participation. E-mail invitations describing the study and containing a secure link to the questionnaire were sent to all students listed on the class rosters. The invitation was followed by a weekly reminder for the month that data were collected. The overall response rate was 68.3%.

### Measures

*Social coping.* Social coping was measured using items from the COPE scale created by Carver et al. (1989). Participants responded to eight items using a 4-point rating scale ranging from 1 = *I usually don't do this at all* to 4 = *I usually do this a lot*. Examples of social coping items are "I try to get advice from someone about what to do" and "I discuss my feelings with someone." The alpha reliability for this measure was .90.

*Commitment to major.* Commitment was measured using an adapted version of Meyer, Allen, and Smith's (1993) Career Commitment Scale. Items were adapted to make them relevant to commitment to major. Par-

Participants responded to six items using a 7-point rating scale ranging from 1 = *strongly disagree* to 7 = *strongly agree*. An example of an item is “My major is important to my self-image.” The alpha reliability for this measure was .83.

*Turnover intent.* Intention to turn over from the major was measured using a single self-report item, “I will likely change my major in the next year,” to which participants responded on a 5-point scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*.

*Grade.* We obtained permission from participants to collect their academic course grade from university records. Course grades ranged from F (0) to A (11).

## Results

Means, standard deviations, alpha reliabilities, and bivariate correlations that we calculated for each measured variable are presented in Table 1. Final sample sizes were different for the outcome of academic course grade because this information was not provided by institutional research for all participants. As a result, the sample sizes for commitment to major and turnover intent were 713 (men) and 191 (women) and for academic course grade were 634 (men) and 157 (women). We checked statistical assumptions, and we identified outliers for each regression equation and these cases were deleted.

Research Question 1 sought to determine if women would use more social coping than would men. To assess whether women reported higher levels of social coping than did men, we compared mean levels. Results indicated that women ( $M = 3.03$ ,  $SD = 0.71$ ) reported greater use of social coping than did men ( $M = 2.71$ ,  $SD = 0.71$ ),  $t(1050) = -6.39$ ,  $p < .001$ . We conducted a series of multiple regression analyses to assess whether social coping was a more important factor in predicting commitment to major, turnover intent, and academic performance among women and men. In choosing control variables, we followed Tabachnick and Fidell’s (2007) suggestion of selecting a small set of theoretically valuable controls that relate to the outcome variable. We included university and race as a first step in each regression equation. Table 2 presents the  $B$  values, standard errors for the  $B$  values, betas,  $R^2$  and change in  $R^2$  for all six regression equations.

TABLE 1

**Means, Standard Deviations, Alpha Reliabilities, and Bivariate Correlations Between Measured Variables**

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. Gender	—	—	—						
2. Race	—	—	-.20**	—					
3. University	—	—	-.17**	.53**	—				
4. Social coping	2.76	0.72	.21**	-.13**	-.16**	(.90)			
5. Commitment	4.82	0.96	.08*	-.03	-.08*	.09**	(.83)		
6. Turnover intent	2.17	1.14	.03	-.15**	-.09**	-.01	-.49**	—	
7. Course grade	6.28	3.46	-.02	.26**	.18**	-.09**	.04	-.22**	—

*Note.* Gender is coded 0 = men, 1 = women; race is coded 0 = minority, 1 = majority (Caucasian); university is coded 0 = University A, 1 = University B; course grade is coded 0 = F to 11 = A; commitment = commitment to major. Alpha reliabilities are reported in parentheses. \* $p < .05$ . \*\* $p < .01$ .

TABLE 2

**Summary of Regression Analysis Results for Predicting  
Commitment, Turnover Intent, and Course Grade**

Variable	Men					Women				
	<i>B</i>	<i>SE B</i>	$\beta$	<i>R</i> <sup>2</sup>	$\Delta R^2$	<i>B</i>	<i>SE B</i>	$\beta$	<i>R</i> <sup>2</sup>	$\Delta R^2$
	Commitment									
Step 1				.03***					.08***	
University	0.20	.12	.08*			0.55	.22	.24*		
Race	0.24	.10	.11*			0.13	.22	.06		
Step 2				.03***	.01*				.13***	.06***
Social Coping	0.13	.06	.08*			0.39	.11	.24**		
	Turnover Intent									
Step 1				.02***					.05**	
University	0.02	.12	.01			-0.39	.22	-.17		
Race	-0.32	.10	-.14**			-0.17	.22	-.07		
Step 2				.02**	.00				.07**	.02*
Social Coping	-0.02	.06	-.01			-0.22	.11	-.14*		
	Course Grade									
Step 1				.06***					.14***	
University	0.46	.41	.05			-0.15	.69	-.02		
Race	1.54	.32	.22***			2.71	.69	.39***		
Step 2				.07***	.01*				.15***	.00
Social Coping	-0.46	.20	-.09*			0.23	.35	.05		

Note. University is coded 0 = University A, 1 = University B; race is coded 0 = minority, 1 = majority (Caucasian); course grade is coded 0 = F to 11 = A; commitment = commitment to major.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Research Question 2 sought to determine if the relationship between social coping and commitment to major would be more positive for women than for men. For men, race ( $\beta = .11, p = .011$ ) and university ( $\beta = .09, p = .044$ ) were significant control variables. Racial majority group members reported higher commitment than did racial minority group members, and participants at University B reported higher commitment than did University A participants. When social coping was added in Step 2, the change in  $R^2$  was significant ( $\Delta R^2 = .01, p = .032$ ), and social coping was a significant predictor of commitment ( $\beta = .08, p = .032$ ); it explained 1% of the variance in commitment. For women, university was a significant control variable ( $\beta = .24, p = .011$ ). Women at University B reported more commitment than did women at University A. For women, the change in  $R^2$  in Step 2 was significant ( $\Delta R^2 = .06, p < .001$ ), and social coping was positively related to commitment ( $\beta = .24, p = .001$ ); it explained 6% of the variance in commitment. As expected, the effect sizes indicated that the positive relationship between social coping and commitment to major was stronger for women than it was for men.

Research Question 3 sought to determine if the relationship between social coping and turnover intent (i.e., intent to turn over from major) would be more negative for women than for men. For men, race was a significant control variable for predicting turnover intent ( $\beta = -.14, p =$

.001). Racial majority group members reported lower turnover intent than racial minority group members. When social coping was added in Step 2, the change in  $R^2$  was nonsignificant ( $\Delta R^2 = .00$ ,  $p = .739$ ), and social coping was not significantly related to turnover intent ( $\beta = -.01$ ,  $p = .739$ ). For women, the change in  $R^2$  was significant ( $\Delta R^2 = .02$ ,  $p = .050$ ), and social coping was negatively related to turnover intent ( $\beta = -.14$ ,  $p = .050$ ). Social coping explained 2% of the variance in turnover intent. As expected, these results indicated that for women, social coping was negatively related to reports of turnover intent, whereas there was no relationship between social coping and turnover intent for men.

Research Question 4 sought to determine if the relationship between social coping and academic course grade would be more positive for women than it would be for men. For both men ( $\beta = .22$ ,  $p < .001$ ) and women ( $\beta = .39$ ,  $p < .001$ ), race was a significant control variable in predicting academic course grade. Racial majority group members reported higher grades than did racial minority group members. For men, when social coping was added in Step 2, the change in  $R^2$  was significant ( $\Delta R^2 = .01$ ,  $p = .020$ ), and social coping was negatively related to academic course grade ( $\beta = -.09$ ,  $p = .020$ ). Social coping explained 1% of the variance in men's academic course grades. For women, the change in  $R^2$  in Step 2 was nonsignificant ( $\Delta R^2 = .00$ ,  $p = .514$ ), and social coping was not significantly related to academic course grade ( $\beta = .05$ ,  $p = .514$ ). Contrary to our expectations, results indicated that social coping had a negative relationship with academic course grade of men but did not relate to academic course grades of women.

## Discussion

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In the present study, we examined coping as a mechanism both for understanding and for addressing the retention issue concerning undergraduates with a STEM major. Toward this end, our findings revealed that undergraduate women reported using social coping more than did undergraduate men. This extends the existing research to explain coping strategies in the unique context of STEM undergraduate education. Another contribution of the present study was the finding that social coping was a better predictor of persistence outcomes (i.e., commitment and turnover intent) for women than for men. Although this was a cross-sectional study and does not allow for causal inference, findings suggest that social coping is more effective for women than for men. The implications of women's inclination toward social coping is of concern when applied to the STEM context if one considers the so-called chilly, male-dominated, impersonal climate that typifies STEM educational programs (Foster et al., 1994; Seymour & Hewitt, 1997; Suresh, 2006). Women may be caught in a bind because the coping strategies they are accustomed to are not supported by the environment.

Contrary to our expectations, social coping was related to grades for men, but not for women. This result parallels N. W. Brown and Cross's (1997) finding that despite having fewer coping resources, women's academic achievement was not affected. Social coping may be more important to persistence outcomes (e.g., commitment, turnover intent) because they more directly reflect attitudes and feelings. The gender disparity concerns persistence rather than performance. Women leaving STEM majors have tended to have higher grades in college than did the men who have left

these majors, but the women reported greater dissatisfaction with their major than men did (Adelman, 1998). For men, the relationship between social coping and course grade was negative. Because social coping is less common for men and is inconsistent with gender role expectations, men may turn to social coping as a last resort. This finding is in line with Carver and Scheier's (1994) research suggesting that, for men, feelings of threat are linked to coping. It is also in line with research (Christie & Shultz, 1998; González-Morales et al., 2006) suggesting that social coping may have a negative impact on men.

### **Implications for School and Career Counselors**

Given the underrepresentation of women in STEM fields, we echo other researchers (e.g., C. Brown, Garavalia, Fritts, & Olson, 2006) in encouraging practitioners to support girls and women in their choice of nontraditional careers. School counselors have an instrumental role in ushering students into nontraditional STEM careers. In many cases, girls and women in STEM curricula may be coming to a counselor as an outreach to cope socially with their major or chosen field. Because school and career counselors are a resource for social coping, it is important for them to be aware of the unique career barriers girls and women in STEM contexts encounter so that these counselors are able to sympathize with the client and offer viable suggestions to overcome barriers. Specifically, it is important for counselors to acknowledge the chilly climate that women in STEM contexts face and realize that these girls and women have fewer resources available to cope (N. W. Brown & Cross, 1997; Suresh, 2006).

In response to the challenges their clients face, counselors should coach them in STEM contexts to be proactive in developing their own resources to draw on for social coping. STEM scholars (DeMichiel, Donohue, & Johnson, n.d.; Margolis & Fisher, 2002) recommended mentoring programs as valuable for increasing the representation of girls and women in STEM fields. To encourage social coping, counselors may implement mentoring programs by pairing high school students with college students in STEM majors. Likewise, high school and college counselors may pair girls and women with professionals from the university or local community who are in STEM fields. At the college level, a counselor might suggest that girls and women who are aspiring to or struggling with STEM curricula make special efforts to form study groups with peers, build relationships with other students, use teaching assistants and professors for support, join STEM-specific girls' and women's organizations, and engage in professional networking. In a recent qualitative study of undergraduate women in STEM majors, Adams, Jensen, Lester, Olson, and Tennant (2006) illustrated how such resources can be accumulated to rely on as needed. Participants reported such tactics as identifying an adviser who was well-versed in the issue of women in STEM contexts, forming study groups with other students, and taking courses with friends. As previous research has shown (Horan, 2002; Veach, Rahe, & Tolles, 2003), coping is a trainable skill; counselors can coach students to help them to have a positive STEM experience.

### **Implications for Policy**

The findings of this study have several implications for educational and institutional policy. School counselors, teachers, and administrators should

work together to ensure that their programs foster collaboration and provide resources for social coping. Middle school and high school counselors can foster social coping by organizing girls' computer, mathematics, and science clubs. DeMichiel et al. (n.d.) suggested inviting a supportive teacher to act as an adviser and organizing trips to local companies, science and technology museums, and sites of engineering projects. Middle school and high school counselors should consider organizing a science day for students to work on STEM-related team projects (DeMichiel et al., n.d.). College counselors can facilitate social coping by inviting and sponsoring STEM-specific women's groups on campus, organizing extracurricular social activities, and creating forums for peer networking. In the classroom, STEM programs should be revised to include collaborative projects. As Williams and Kessler (2003) pointed out, implementing peer programming is one strategy to foster collaboration and to provide resources for social coping. Other STEM research (e.g., Davis, Oborn, Morganson, & Major, 2009) advocated designing entry-level courses that teach coping skills and foster peer relationships to inoculate women and minorities against STEM-related barriers. Counseling is needed at all academic levels (i.e., middle school, high school, and college) to counteract the chilly climate of the STEM environment and increase the representation of girls and women in STEM fields. Counselors and STEM teachers must work together to create a warm and collaborative learning environment that promotes social coping for girls and women. To encourage school counselors, teachers, and administrators to provide social resources, the goal for creating a collaborative program should be communicated among staff, and training and reward systems should emphasize being responsive to student needs. For example, it may be beneficial to offer rewards for supportive teachers and best mentors.

### Limitations and Future Research

Effect sizes in this study were modest. Folkman and Moskowitz (2004) suggested that coping research would benefit from using real-time, nonretrospective measures to achieve larger effect sizes rather than using cross-sectional research designs and inventory measures, as we used in this study. Numerous researchers (e.g., Abelson, 1985) have asserted the practical value of small effect sizes. To the extent that social coping may act as a gender barrier in the STEM environment, the current study has practical value; as the tournament model asserts (Ragins & Sundstrom, 1989), barriers to women's career development occur as small disadvantages that accumulate over time and eventually have an incremental result. Future studies should continue to explore gender differences in coping strategies as a possible means to repair the leaking pipeline that allows women to be drained from STEM educational programs and careers because it appears that this is a fruitful avenue for research.

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