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Exploring the Association of Sex and Majoring in Science

One consequence of gender socialization is that different attitudes, behaviors, and aspirations are socially constructed as appropriate for men and women. It is no surprise, then, that arguments about gender socialization are widely used by researchers who study sex differences in those individuals who major in science (Etzkowitz, Kemelgor, & Uzzi, 2000; McIlwee & Robinson, 1992; Valian, 1999). We build on this work and use the conceptual model presented in Figure 1 to explore whether gender socialization and its products, gender roles and gender stereotypes, mediate the relationship between sex and majoring in science. H1 and H5 specify the total and residual sex effects respectively. H2, H3, and H4 use theoretical and empirical arguments about gender socialization to identify three sets of factors that may link sex to majoring in science and thus help account for the gender gap in science.

Hypotheses
1. There is a negative relationship between being female and the likelihood of being a science major.
2. Being female reduces the likelihood of being a science major because social constructions of women and science associated with traditional gender roles contribute to the underrepresentation of women in science by identifying a male breadwinner and a female homemaker and by sustaining the social construction of science as a male field (Etzkowitz et al., 2000; Rolin, 2001; Rosser & Zieseniss, 2000; Schiebinger, 1999; Tonso, 1999; Valian, 1999).
3. Being female reduces the likelihood of being a science major because it is associated with lower levels of high school science and mathematics preparation, which is necessary for pursuing science in university (Betz, 1997; Leslie, McClure, & Oaxaca, 1998; Sax, 1994; Yauch, 1999).
4. Being female reduces the likelihood of being a science major because it is associated with lower levels of mathematics self-efficacy, less interest in science and less encouragement to pursue science in university. Mathematics self-efficacy, interest in science, and encouragement to pursue science are all positively associated with majoring in science (Betz, 1997;

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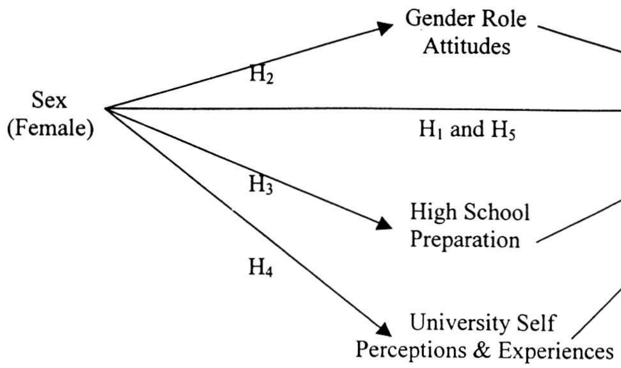

Figure 1. Conceptual model of being a science major.

Lee, 1998; Leslie et al., 1998; Rayman & Brett, 1993; Seymour & Hewitt, 1997; Sonnert & Holton, 1996; Zeldin & Pajares, 2000).

5. There is a negative relationship between being female and the likelihood of being a science major over and above the effects of gender role attitudes, high school preparation, and university self-perceptions and experiences.

Method

To test these hypotheses we use data from a sample of 121 science majors and 160 social science majors at a commuter university in a large city in western Canada. Sixty-six percent of participants were women; 34% were men. Their average age was 24 years (*SD*=.27). Questionnaires were anonymous and confidential. Most questions were closed-ended, with participants checking off or circling the responses that described them. Table 1 describes the variables used in the analysis. We use logistic regression to analyze our data because the outcome variable, major, is a dichotomous unranked variable with values of 1 (science major) and 0 (social science major).

Results

Model 1 of Table 2 shows that the total effect of sex on the likelihood of being a science major is negative and statistically significant. As H1 predicted, women are significantly less likely to be science majors. Adding gender role attitudes in Model 2 shows that both variables have significant positive associations with the likelihood of being a science major. Students who reject the breadwinner ideology and believe that when it comes to having a family and career, women can "have it all" are more likely to be science majors than are students with more traditional work-family attitudes. Students who reject traditional perceptions of science as masculine, believing instead that society encourages women to pursue science, are also likely to be science majors. But because the addition of gender role attitudes does not reduce the coefficient associated with sex, neither factor mediates the effect of sex on this outcome. H2 is not supported.

The results are different for our second set of variables. With adjustment for high school preparation in mathematics and science in Model 3, the coefficient for sex is reduced by 44% from Model 2 (.879–.490/.879=.443) and rendered

Table 1
Description of Variables[a]

Variable	*Description*
Major (science)	Dummy variable, coded 1 if science major (biological sciences, chemistry, computer science, geology and geophysics, mathematics and statistics, physics and astronomy).
Sex (female)	Dummy variable, coded 1 if female.
Nontraditional gender role attitudes	
"Having it all"	Belief that a family and a top-level science career are compatible for women. Coded 1-5; 1 is strongly disagree, 5 is strongly agree.
Perception of science	Belief that society encourages women to pursue science. Coded 1-5; 1 is strongly disagree, 5 is strongly agree.
High school	
Mathematics preparation	Dummy variable, coded 1 if student took an advanced mathematics course in high school.[b]
Science preparation	Number of high school chemistry, biology, and physics courses, range is 3-9.
University	
Mathematics self-efficacy	Self-perceived mathematics ability. Coded 1-5: 1 is bottom 10%, 5 is top 10%.
Interest in science	Level of interest in science. Coded 1-5: 1 is bottom 10%, 5 is top 10%.
Encouragement to major in science	Sum of encouragement to pursue science from fathers; mothers; peers; high school teachers, counselors, university professors, or graduate teaching assistants; and mentors. Coded 1 if received support, range is 1-5.

[a]All measures are based on self-reports.
[b]Based on research demonstrating the predictive value of elective mathematics courses (Chipman & Wilson, 1985; Farmer, Wardrop, Anderson, & Risinger, 1995).

nonsignificant. Almost half of the apparent sex effect was due to the high school preparation of students: a finding that supports H3.

Adding the final set of variables in Model 4 shows that interest in science and encouragement to major in science have significant positive associations with the likelihood of being a science major. Students who report higher levels of interest in science and students who received more encouragement to pursue undergraduate majors in science are more likely to be science majors than students who report lower levels of interest and encouragement. Contrary to H4, however, the effect of sex on the likelihood of being a science major is not mediated by either of these factors. In fact the coefficient associated with sex increases slightly.

Discussion

Two things are clear from our results. First, H5 is not supported. Sex does not have an effect on the likelihood of being a science major over and above the estimated effects of gender role attitudes, high school preparation, and university self-perceptions and experiences. Second, although fewer traditional work-

Table 2
Logistic Regression Results Predicting the Likelihood of Being a Science Major (N=253)

	Model 1	Model 2	Model 3	Model 4
Sex (female)	−.882***	−.879***	−.490	−.604
Nontraditional gender role attitudes				
"Having it all"		.205*	.284**	.454**
Perceptions of science		.369**	.321*	.423*
High school				
Mathematics preparation			1.243***	1.037**
Science preparation			.312***	.241**
University				
Mathematics self-efficacy				.274
Interest in science				1.375***
Encouragement to major in science				.436**
Constant	.337	−1.047*	−4.239***	−11.362***
−2 Log likelihood	336.260	326.300	278.875	201.188
Goodness of fit	252.999	251.126	263.832	204.806
Improvement in chi-square (df)	10.664(1)***	9.960(2)***	47.425(2)***	77.687(3)***

*p<.05; **p<.01; ***p<.001.

family attitudes, fewer traditional perceptions of science, greater interest in science, and more encouragement to pursue an undergraduate major in science all increase the likelihood of being a science major, none of these factors mediates the effects of sex on the likelihood of being a science major. Only high school preparation in mathematics and science mediates this relationship.

Our finding that high school preparation in mathematics and science accounts for over 40% of the effect of sex on majoring in science carries important implications for interventions designed to reduce the gender gap in science. Although a "multitude of interventions" (Sonnert & Holton, 1995) is needed, policies targeting factors that link sex to majoring in science may prove especially efficacious. Educators should intervene early, promoting curriculum reforms and classroom practices that increase the number of mathematics and science courses young women take in high school.

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