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Journal

Sex Roles: A Journal of Research, 63(11)

ISSN

1573-2762

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Publication Date

2010-12-01

DOI

10.1007/s11199-010-9856-5

Peer reviewed

Latina and European American Girls' Experiences with Academic Sexism and their Self-Concepts in Mathematics and Science During Adolescence

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Published online: 11 August 2010

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Abstract The study investigated Latina and European American adolescent girls' ($N=345$, $M=15.2$ years, range=13 to 18) experiences with academic sexism in mathematics and science (M/S) and their M/S perceived competence and M/S value (liking and importance). M/S academic sexism was based on girls' reported experiences hearing sexist comments about girls' abilities in math and science. Older European American adolescents, and both younger and older Latina adolescents, who experienced several instances of academic sexism felt less competent in M/S than girls who experienced less sexism (controlling for M/S grades). In addition, among older girls (regardless of ethnicity), those who experienced several instances of academic sexism valued M/S less than girls who experienced less sexism.

Keywords Academic achievement · Academic self-concept · Discrimination · Sexism · Ethnic differences

Introduction

Researchers, policymakers, and parents are concerned with girls' and women's under-representation in the fields of science, technology, engineering, and mathematics (STEM). These fields are associated with high-paying and

high-prestige occupations. Accordingly, it is important to understand the factors that facilitate or impede girls' motivation and achievement in STEM so that society can achieve greater gender equality (Bussey and Bandura 1999; Halpern et al. 2007). Furthermore, encouraging the potential talents of all members of society in STEM is considered essential for continued economic growth (Zakaria 2008). With these concerns in mind, the present study examined factors related to adolescent girls' achievement and self-concepts regarding math and science. Specifically, the current study surveyed Latina and European American adolescent girls to examine the possible relation of academic sexism to perceived competence and value of math and science in these two U. S. ethnic groups.

Gender Differences in STEM Achievement and Self-Concepts

Historically, girls have underperformed relative to boys in science, technology, engineering, and mathematics. However, within only a few decades, the gender gap has closed in some of these fields in some countries. Girls in the U.S. now do as well as boys in math grades and on math standardized tests (e.g., Else-Quest et al. 2010; Hyde et al. 2008). Also, among the bachelor's degrees awarded in 2005, women attained 45% of those in mathematics and 62% of those in life sciences (National Science Foundation, 2008). In contrast, women continue to be underrepresented in the physical sciences and technology-related fields at all levels beyond high school. In 2005, women accounted for less than one-quarter of the bachelor's degrees in physics (22%), computer science (22%), and engineering (20%). At the doctoral level, women attained parity with men in the life sciences (49%). However, fewer women than men were awarded doctoral degrees in mathematics (27%), physics

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(15%), computer science (20%), and engineering (18%). Note, however, that even among those areas where large gender disparities in achievement exist, the magnitude of the difference has dramatically narrowed within the last few decades. For example, among the bachelor's degrees awarded in 1970, women accounted for less than 1% in engineering (Freeman 2004). These statistics highlight the capacity for rapid social change leading to greater gender equality. They also point to academic areas in STEM where gender imbalances remain.

Despite the narrowing of some gender gaps in STEM achievement, there are persistent gender differences in academic attitudes about STEM domains. Specifically, boys have both higher perceived competencies in math and science, as well as greater interest in math and science coursework and occupations (e.g., Eccles et al. 1999; Evans et al. 2002; Watt 2004; Weinburgh 1995; Whitley 1997). As postulated in Eccles' expectancy-value theory and supported by research (e.g., Eccles 1994), students who expect to do well in a domain (i.e., have high perceived competence in the domain), and who value doing well in that domain (i.e., have high intrinsic interest in and think it is important to do well in the domain), will show better performance and achievement in that domain. Thus, to understand gender differences in math and science achievement, it is important to understand gender differences in perceived competence and valuing of math and science. Indeed, research has shown that gender differences in perceived competence and valuing predict later differences in STEM achievement and occupational choices (Bandura et al. 2001; Dweck 2007; Eccles 2007; Eccles and Wigfield 2002).

Scientists generally agree that multiple factors contribute to gender differences in academic achievement and later occupational choices (e.g., see Ceci and Williams 2007). The dramatic changes that have occurred in women's achievement during the last few decades underscore the impact of social forces. Although some researchers suggest that sex-related biological factors may partly account for some of the variation in STEM achievement, they simultaneously acknowledge that social factors have a major impact and could potentially override some biological predispositions (e.g., Berenbaum and Resnick 2007; Hines 2007; for an excellent review of global social forces, see Else-Quest et al. 2010). The focus of this paper is on the social influences on adolescent girls' STEM-related self-concepts and achievement.

Social Influences on Academic Self-Concepts and Achievement

There is a robust theoretical and empirical body of research that highlights the role of social influences on academic attitudes (i.e., perceived competence and valuing) and achievement. As historically articulated by symbolic inter-

actionist theories (Cooley 1902; Mead 1934), individuals create their self-concept largely by internalizing others' beliefs about themselves. As it applies to academics, for example, one important contributor to students' perceived academic competence is others' beliefs about their academic competence (e.g., Harter 1990). Studies have shown that parents' (Frome and Eccles 1998) and teachers' (Wigfield and Harold 1992) beliefs about students' competence affect those students' own perceived competence, even when controlling for their actual achievement. Further research indicates that, regardless of others' actual beliefs, students' *perceptions* of others' beliefs about their math/science competence and valuing predict their own perceived competence and valuing regarding math and science (Bouchey and Harter 2005). Thus, as if gazing into a looking glass (Cooley 1902), students' reflected appraisals about what they think other people consider their competencies and what other people think they should value can affect their own self-appraisals of competence and values (Bouchey and Harter 2005). In turn, and in further support of expectancy-value theory (Eccles 1994), students' perceived competence in math and science predicted their eventual grades in math and science (Bouchey and Harter 2005).

Based on this theoretical and empirical work, it seems likely therefore that the well-documented differences between boys' and girls' math and science achievement may be due, in part, to girls' perceptions of others' beliefs about their math and science competence and valuing. In other words, girls who perceive others to hold negative beliefs or biases about girls' math and science competence may reflect those appraisals in their own (reduced) perceived competence and valuing of math and science, and in turn their lower future performance in math and science. Therefore, we hypothesized that girls' perceptions of academic sexism in math and science would be negatively associated with their own perceived competence in and valuing of math and science, while controlling for their previous performance in math and science.

Perceptions of Bias and Academic Self-Concepts

Three different areas of research support our hypothesis that perceptions of academic sexism negatively affect girls' perceived competence in and valuing of math and science. First, Leaper and Brown (2008) documented that adolescent girls do indeed perceive academic sexism. Specifically, over half of middle school and high school girls reported hearing sexist comments about their abilities in science, computers, or mathematics. Girls indicated they most often heard these comments from male peers, followed by teachers and female peers. These findings are striking given that many girls may have underreported the incidence of sexist events (Crosby 1984; Foster and Matheson 1999; Taylor et al. 1990).

Second, experimental work in social psychology, particularly work on stereotype threat, has repeatedly linked negative gender stereotypes about women's math abilities to their more negative academic attitudes and performance in math. Specifically, if women are in some way reminded of their stigmatized status (as "poor math achievers"), their concern about fulfilling the negative stereotype interferes with their current performance and is associated with their distancing themselves from the domain (as a way to maintain their overall self-esteem). For example, when women are reminded about gender stereotypes in math, they tend to underperform on math tasks (Spencer et al. 1999), hold lower expectations for their own performance regardless of prior performance (Stangor et al. 1998), are less motivated to achieve (Davies et al. 2002), and are more likely to adopt achievement goals that undermine achievement motivation and performance (Smith 2006). By simply making gender rather than ethnicity salient, women tend to evaluate their own math ability more poorly; that is, they engage in a form of self-stereotyping (Sinclair et al. 2006). Even the suggestion that an evaluator may engage in sexism is associated with women performing worse on a standardized logic test (Adams et al. 2006). Taken together, this work clearly indicates that reminders about negative math stereotypes (in the form of academic sexism) might lead to lower perceived competence and valuing of math and science.

Third, research on perceptions of racial/ethnic discrimination indicates that adolescents' perceptions of bias can indeed affect academic outcomes. Specifically, African Americans adolescents' perception of teacher discrimination on racial grounds predicted both lower perceived general academic competence and lower valuing of school, which in turn predicted lower general academic achievement (Eccles et al. 2006; Wong et al. 2003). Further, among Mexican American adolescents, students who perceived high levels of teacher bias based on ethnicity were more likely to drop out of high school (Wayman 2002) and felt a reduced sense of belonging at school, which in turn was associated with reduced academic performance (Faircloth and Hamm 2005). Thus, because the relationship exists with perceptions of racial discrimination, there may be a similar link between academic outcomes and perceptions of gender discrimination.

Moderators of Perceptions of Sexism and Academic Self-Concepts

As with most psychological phenomena, there are likely to be several moderators influencing the association between adolescent girls' perceptions of academic sexism and their academic attitudes. The first moderator of interest in the current study is girls' age. Specifically, the relationship may be stronger among older adolescents than younger adolescents. Interest in math and science declines in many girls

during the course of adolescence (e.g., Fredricks and Eccles 2002; Häussler and Hoffmann 2002; Wigfield et al. 1991). Across the same age period, there are age-related increases in girls' reports of academic sexism (Leaper and Brown 2008) and other forms of gender discrimination (McMaster et al. 2002; Pepler et al. 2006). Although untested, these patterns of reduced math and science interest may be related to girls' increased perceptions of academic sexism. In other words, girls presumably have greater cumulative experiences with academic sexism across adolescence, and it is therefore likely that the association between academic sexism and academic self-concepts would be stronger in later adolescence than early adolescence.

In addition to age, girls' ethnicity may moderate the association between perceptions of academic sexism and academic self-concepts. Accordingly, the present study includes samples of both Latina girls and European American girls. As explicated in feminist standpoint theory, ethnicity and race intersect with gender in complicated ways (Basow and Rubin 1999; Stewart and McDermott 2004). One consequence of the interaction between ethnicity and gender is that some girls belong to multiple devalued social groups. Specifically, Latina girls belong to two groups (i.e., their ethnic and gender group) that are associated with negative stereotypes regarding math and science competence.

This double-minority status may lead girls in minority ethnic groups to be more sensitive to all forms of discrimination—both ethnic discrimination and gender discrimination—than girls in the majority ethnic group (i.e., European American girls). Thus, ethnic-minority girls, because of their sensitizing experiences with ethnic discrimination, may be more likely than European American girls to recognize sexism (see Kane 2000) and may be more vulnerable to the effects of such sexism. Indeed, previous research has shown that Latina women are more vulnerable to gender-based stereotype threat effects than European American women (Gonzales et al. 2002). Thus, the lower status of their ethnicity seems to make Latina women more sensitive to gender stereotypes than women in high status ethnic groups. It seems likely, therefore, that Latina girls may be more sensitive to academic sexism than European American girls, and subsequently may show a stronger negative association between perceptions of sexism and academic self-concepts. Studying these possible influences has added importance because Latina and other ethnic-minority women are underrepresented in STEM fields even more than European American women (National Sciences Foundation, 2008).

The Current Study

The current study examined the relationships between perceived academic sexism and adolescent girls' perceived competence and valuing of math and science. The study

sampled Latina and European American girls ranging in age from 13 to 18. We had three sets of hypotheses. First, we hypothesized that adolescent girls' perceptions of sexism in math and science would be associated with (a) lower perceived competence in math and science as well as (b) lower valuing of math and science. We expected these patterns to occur even after controlling for girls' grades in math and science. In other words, we predicted girls' perceptions of others' appraisals of their math and science abilities would be predictive of their own perceived competence and valuing of math and science beyond their own self-reported performance. Second, we predicted that the association between academic sexism and academic self-concepts (i.e., perceived competence and value) would be moderated by girls' age. Specifically, we predicted that older adolescent girls (ages 16 to 18) would show more of an association between sexism and academic self-concepts than younger adolescent girls (ages 13 to 15). Third, we predicted that girls' ethnic-minority status would moderate the effects. Because of their double-minority status, Latina girls were hypothesized to be more likely than European American girls to be sensitive to discrimination and therefore show more of an association between sexism and academic self-concepts. As girls' academic attitudes have been shown to be associated with parental education (Silverberg et al. 1996), we also examined parental education as a potential covariate.

Method

Participants

The sample is comprised of 345 girls between 13 and 18 years ($M=15.3$, $SD=1.4$) recruited from middle, junior high, and high school classrooms; school-related programs; and summer camps in northern California (26%) and southern California (73%). Preliminary analyses found no differences due to site. The sample consisted of 253 Latina and 92 European American girls. According to the participants' reports of their mothers' highest education level, 65% had no higher than a high school diploma, 24% had either attended some college or graduated with a bachelor's degree, and 11% had attended graduate school or attained a graduate degree. According to their reports of their fathers' highest education level, 63% had no higher than a high school diploma, 24% had attended some college or attained a bachelor's degree, and 13% had attended some graduate school or attained an advanced degree.

Procedure

Participants completed several survey measures in their classroom or similar settings. Consent from the participants

and one of their parents was obtained in advance. The study was described as a survey on "What it means to be a girl." The survey included questions about participants' (a) demographic background such as age, ethnicity, and mother's and father's highest level of education, (b) self-concepts and grades about math and science, and (c) perceptions of academic sexism. Measures were ordered such that items about academics were given first, followed by the more emotionally laden items related to sexism. In general, girls did not indicate difficulty reading or completing the survey.

Measures

Parents' Education

Parents' education level was used as an index of socioeconomic status (e.g., see Ex and Janssens 1998). Participants separately indicated their mother's and father's highest level of education as either: 1=*Elementary school*, 2=*Some high school*, 3=*High school graduate*, 4=*Some college*, 5=*Bachelor's degree*, 6=*Some graduate school*, or 7=*Graduate degree (master's, doctorate, medical, law, etc.)*. In two-parent families, the rankings for mothers and fathers were averaged.

Math and Science Perceived Competence

Participants' perceived competence in math and science was derived from the Ability Perception subscale of Children's Self- and Task Perception Questionnaire (Eccles and Wigfield 1995). To assess perceived competence, participants were asked, "How good are you at math [science]?" They responded using a three-point scale (1=*Not good at all*, 2=*Somewhat good*, 3=*Very good*). They were also asked, "Compared to the rest of your class, how good are you at math [science]?" They responded using a three-point scale (1=*One of the worst in the class*, 2=*In the middle of the class*, 3=*One of the best in the class*). The sum of the 4 items relating to math/science perceived competence was calculated. Scores could range from 4 to 12, with higher scores indicating greater perceived competence. The internal consistency for these four items was acceptable ($\alpha=.75$).

Math and Science Value

Participants' valuing of math and science was derived from the Task Value subscale of Children's Self- and Task Perception Questionnaire (Eccles and Wigfield 1995). Participants were asked, "How much do you like doing math [science]?" They responded using a three-point scale (1=*Not at all*, 2=*Somewhat*, 3=*Very much*). They were also asked, "How important is it to be good at math [science]?" They responded using a three-point scale (1=

Not at all important, 2=*Somewhat important*, 3=*Very much important*). The sum of the 4 items relating to math/science valuing was calculated. Scores could range from 4 to 12, with higher scores indicating greater valuing. The internal consistency for these four items ($\alpha=.65$) was within an acceptable range.

Self-reported Grades in Math and Science

Participants were asked to circle their grade in different academic subjects (ranging from “A+” to “Below C-”). Scores could thus range from 1 to 10, with higher numbers indicating higher grades. In their meta-analysis, Kuncel, Crede, and Thomas (2005) indicated average correlations between self-reported grades and school records were .84 for math and .82 for science. The authors highlighted some factors that moderated the accuracy of self-reported grades; they also noted that “it should be kept in mind that self-reported grades generally predict outcomes to a similar extent as actual grades” (p. 76). Math and science grades were correlated with one another ($r=.52$, $p < .001$); the two scores were averaged and the mean grade was used in the subsequent analyses.

Perceptions of Academic Sexism

Although there exist measures that tap women’s perceptions of sexist events (e.g., Klonoff and Landrine 1995), no previously published measures assess girls’ experiences with sexism in the domain of academics. Thus, we used a new measure to assess the specific type of academic sexism that was the focus of the current study. Unlike other measures, this measure does not include a specific time frame for perceptions (e.g., perceptions of sexism within the past year). This change was made due to the young age of the sample (as young as 13), as the younger sample may be less sensitive to specific time frames and may have fewer overall experiences with sexism.

Participants were asked about their experiences with academic sexism. The following description was presented:

Some people think that girls are not as good as boys in certain areas. They may make *sexist statements* that “put-down” girls (or women) in their abilities. One area where this might occur is *math, science, or computers*. Some girls think these things have happened to them. Other girls don’t think these things have happened to them. We want to know about your own experience. Have you ever noticed any of the following persons make a *discouraging statement* or express a negative view to you about your abilities in either *math, science, or computers* because you are female? (original emphasis)

Participants subsequently rated the following people using a four-point scale (1=*No*, 2=*Yes—once or twice*, 3=*Yes—a few times*, 4=*Yes—several times*): teachers/coaches,

mother, father, close female friends, close male friends, other family members, neighbors, other girls, and other boys. A sum score was created, with scores ranging from 9 (indicating *no* perceptions of sexism from any source) to 36 (indicating *several* instances of sexism from every source). Strong internal consistency was obtained on these nine items ($\alpha=.89$).

Results

Overview

First, preliminary analyses examined the mean ethnic group and age differences across the variables and the overall rates of perceived academic sexism. Next, to test the three hypotheses, a multivariate analysis of covariance was conducted on girls’ (1) perceived competence in math and science and (2) valuing of math and science, with self-reported grades in math and science as the covariate. Following significant multivariate tests, univariate tests were examined. LSD post hoc tests were used following significant univariate tests.

The first hypothesis was that adolescent girls’ perceptions of sexism in math and science would be associated with lower perceived competence in and valuing of math and science, even when controlling for their grades in math and science. The second hypothesis was that the association between perceived academic sexism and academic self-concepts would be moderated by girls’ age; thus, it was predicted that there would be an interaction between academic sexism and age in which the associations would be stronger among older than younger girls. The third hypothesis was that the association between perceived academic sexism and academic attitudes would be moderated by girls’ ethnicity; thus, it was predicted that there would be an interaction between academic sexism and ethnicity in which the associations would be stronger among Latina than European American girls.

Preliminary Analyses and Mean Group Differences

Analyses first examined whether there were ethnic group and age differences across the descriptive variables using a multivariate analysis of variance. A (age group: younger [ages 13–15], older [ages 16–18]) X 2 (ethnicity: Latina, European American) multivariate analysis of variance was conducted. Presented in Table 1 are means and standard deviations of all variables, separated by ethnicity and age. Both the ethnicity and age multivariate tests were significant, $F(5, 338)=81.84$, $p < .001$, $\eta^2=.55$ and $F(5, 338)=3.26$, $p < .01$, $\eta^2=.05$, respectively. There were no ethnicity by age interactions. Results indicated that there

Table 1 Means and standard deviations across ethnic and age groups

Variable	<i>M (SD)</i> Latina		<i>M (SD)</i> European American	
	Younger (<i>n</i> =119)	Older (<i>n</i> =134)	Younger (<i>n</i> =65)	Older (<i>n</i> =27)
Parent education	2.52 (1.16)	2.28 (1.16)	5.31 (1.22)	4.69 (.90)
Perceived academic sexism	11.59 (4.20)	12.15 (5.09)	11.66 (4.52)	11.93 (5.02)
Grades	5.58 (2.59)	4.36 (2.37)	8.17 (1.77)	7.78 (1.95)
Perceived competence	8.27 (1.67)	7.54 (1.97)	10.35 (1.51)	9.96 (1.91)
Valuing	8.89 (1.63)	8.69 (1.91)	9.96 (1.63)	9.74 (2.31)

Parent education scores ranged from 1 to 7, with 2.52 indicating between some high school and a high school graduate and 5.31 indicating college graduate. Age indicates years and ranges from 13 to 18. Perceived academic sexism scores ranged from 9 to 36, with higher numbers indicating more perceptions of sexism. Grades ranged from 1 to 10, with 5.58 indicating a B- and 8.17 indicating an A-. Perceived competence and valuing scores range from 4 to 12, with higher numbers indicating more competence and valuing

was a significant ethnic group difference in parent education, $F(1, 342)=291.11$, $p<.001$, $\eta^2=.46$, with parents of European American girls having higher educational levels than Latina girls' parents. There was an ethnic group difference in math/science grades, $F(1, 342)=98.31$, $p<.001$, $\eta^2=.22$. European American girls had higher self-reported grades in math and science than Latina girls. There was also an ethnic group difference in math/science perceived competence, $F(1, 342)=92.91$, $p<.001$, $\eta^2=.21$, and math/science valuing, $F(1, 342)=20.21$, $p<.001$, $\eta^2=.06$. European American girls had more perceived competence and valuing of math and science than Latina girls. There were no ethnic group differences in perceptions of academic sexism ($F<.05$). There were also three small age group differences. Results indicated that there was a significant age group difference in parent education, $F(1, 342)=8.09$, $p<.01$, $\eta^2=.02$, with parents of younger girls having higher educational levels than older girls' parents. There were age group differences in math/science grades, $F(1, 342)=7.03$, $p<.01$, $\eta^2=.02$, and math/science perceived competence, $F(1, 342)=5.73$, $p<.05$, $\eta^2=.02$. Younger girls had higher grades and

more perceived competence in math and science than older girls. There were no age group differences in perceptions of academic sexism ($F<.50$).

The overall rates for perceptions of academic sexism were low ($M=11.76$, $SD=4.56$), with most girls indicating few instances of discouraging comments about abilities. Nonetheless, 52% of girls reported hearing a discouraging statement about their math, science, and computer abilities "at least once or twice" from at least one source. Because the distribution of girls' perceptions of academic sexism was positively skewed, girls were grouped into three categories: (a) those who never perceived academic sexism from any source (sum score of 9; $n=181$), (b) those who perceived a few instances of academic sexism (sum score of 10–12; $n=121$), (c) those who perceived more than a few instances of academic sexism (sum score of 13 or more; $n=95$). To qualify for the last category, girls must have perceived academic sexism "several times" by at least one source, or "once or twice" by at least four sources. The number of girls in each category, by age and ethnicity, are presented in Table 2.

Table 2 Estimated means (standard errors) for perceived competence in math/science by ethnicity, age group, and perceptions of academic sexism, controlling for grades in math/science

Numbers represent estimated means (standard errors), with grades in math/science being controlled at 5.73. The scale ranges from 4 to 12, with higher numbers indicating greater perceived competence in math and science. Different superscripts in the same row indicate significant differences at $p<.05$ level (based on LSD post hoc tests)

Age and ethnicity	Perceptions of academic sexism		
	None	A few times	More than a few times
Younger (ages 13–15)			
Latina, <i>n</i> =119	8.44 (.17) ^a <i>n</i> =54	8.24 (.20) ^b <i>n</i> =36	8.19 (.23) ^b <i>n</i> =29
European American, <i>n</i> =65	8.95 (.24) ^a <i>n</i> =29	8.92 (.28) ^a <i>n</i> =23	9.67 (.34) ^a <i>n</i> =13
Combined, <i>n</i> =184	8.70 (.15) ^a <i>n</i> =83	8.58 (.17) ^a <i>n</i> =59	8.93 (.20) ^a <i>n</i> =42
Older (ages 16–18)			
Latina, <i>n</i> =134	8.34 (.16) ^a <i>n</i> =63	8.63 (.21) ^a <i>n</i> =35	7.79 (.21) ^b <i>n</i> =36
European American, <i>n</i> =27	9.73 (.39) ^a <i>n</i> =11	8.10 (.43) ^b <i>n</i> =9	8.71 (.48) ^b <i>n</i> =7
Combined, <i>n</i> =161	9.04 (.21) ^a <i>n</i> =74	8.37 (.24) ^a <i>n</i> =44	8.25 (.26) ^b <i>n</i> =43
Combined ages			
Latina, <i>n</i> =253	8.39 (.11) ^a <i>n</i> =117	8.44 (.15) ^a <i>n</i> =71	7.99 (.16) ^b <i>n</i> =65
European American, <i>n</i> =92	9.34 (.24) ^a <i>n</i> =40	8.51 (.26) ^a <i>n</i> =32	9.19 (.30) ^a <i>n</i> =20

Overall Multivariate Analyses

A 3 (perceptions of academic sexism: none, few times, more than few times) X 2 (age group: younger [ages 13–15], older [ages 16–18]) X 2 (ethnicity: Latina, European American) multivariate analysis of variance was conducted, with self-reported grades in math/science used as the covariate (an analysis including parental education as a covariate was also conducted, but parental education was never a significant covariate and the results did not differ from those reported; thus, the analyses without parental education are presented here). The two dependent variables were perceived competence in math/science (see Table 2) and valuing of math/science (see Table 3). The multivariate main effect of the covariate, self-reported grades, was significant, $F(2, 354)=153.10, p<.001, \eta^2=.46$. The multivariate main effect of ethnicity was significant, $F(2, 354)=10.26, p<.001, \eta^2=.06$. As predicted by the second hypotheses, the multivariate two-way interaction between perceptions of academic sexism and age was significant, $F(4, 710)=2.43, p<.05, \eta^2=.02$. As predicted by the third hypotheses, the multivariate two-way interaction between perceptions of academic sexism and ethnicity was significant, $F(4, 710)=2.04, p<.05, \eta^2=.02$. Finally, the multivariate three-way interaction between perceptions of academic sexism, age, and ethnicity was significant, $F(4, 710)=2.48, p<.05, \eta^2=.02$. Once the significant effects were established at the multivariate level, the significant univariate tests were examined by dependent variable. LSD post hoc tests were used throughout. They are described in the following sections.

Perceived Competence in Math and Science

The covariate, self-reported grades, was significantly related to perceived competence in math/science, $F(1, 355)=29.52, p<.001, \eta^2=.45$. Higher self-reported grades in math and science are associated with greater perceived competence in math and science.

Controlling for self-reported grades, there was a significant main effect for ethnicity, $F(1, 355)=15.15, p<.001, \eta^2=.04$. Specifically, regardless of grades, European American girls perceived themselves to be more competent in math and science than Latina girls. See Table 2 for estimated marginal means and standard errors.

Controlling for self-reported grades, there was a significant two-way interaction between perceived academic sexism and age, $F(2, 355)=3.15, p<.05, \eta^2=.02$. As predicted in the second hypothesis, analyses of simple effects indicated that older girls who perceived more than a few instances of academic sexism felt less competent in math and science than older girls with fewer perceptions of academic sexism, controlling for grades in math/science. (There were no differences between girls who perceived academic sexism only a few times and girls who perceived no academic sexism.) Academic sexism was not associated with differences in perceived competence among younger girls.

There was also a significant two-way interaction (controlling for self-reported grades) between perceived academic sexism and ethnicity, $F(2, 355)=4.04, p<.05, \eta^2=.02$. As predicted in the third hypothesis, analyses of simple effects indicated that Latina girls who perceived more than a few

Table 3 Estimated means (standard errors) for valuing of math/science by ethnicity, age group, and perceptions of academic sexism, controlling for grades in math/science

Age and ethnicity	Perceptions of academic sexism		
	None	A few times	More than a few times
Younger (ages 13–15)			
Latina	8.81 (.21)	9.35 (.25)	9.02 (.28)
European American	8.79 (.30)	8.98 (.34)	9.63 (.43)
Combined	8.80 (.19) ^a	9.16 (.21) ^a	9.32 (.25) ^a
Older (ages 16–18)			
Latina	9.36 (.19)	9.30 (.26)	8.87 (.27)
European American	9.53 (.48)	8.80 (.53)	8.28 (.60)
Combined	9.44 (.26) ^a	9.05 (.29) ^{ab}	8.58 (.32) ^b
Combined ages			
Latina	9.08 (.14)	9.33 (.18)	8.94 (.19)
European American	9.16 (.29)	8.89 (.32)	8.96 (.37)

Numbers represent estimated means (standard errors), with grades in math/science being controlled at 5.73. The scale ranges from 4 to 12, with higher numbers indicating more liking and perceived importance of doing well in math and science. Different superscripts in the same row indicate significant differences at $p<.05$ level (based on LSD post hoc tests)

instances of academic sexism felt less competent in math and science than Latina girls with fewer perceptions of academic sexism, controlling for grades in math/science. (There were no differences between girls who perceived academic sexism only a few times and girls who perceived no academic sexism.) Academic sexism was not associated with differences in perceived competence among European American girls.

Both two-way interactions were qualified, however, by the significant three-way interaction between perceived academic sexism, age, and ethnicity, $F(2, 355)=3.98$, $p<.05$, $\eta^2=.02$. As can be seen in Table 2, regardless of age group, Latina girls who perceived more than a few instances of academic sexism felt less competent in math and science (even when controlling for self-reported grades) than Latina girls who perceived no academic sexism. Among European American girls, however, age was an important moderator. Among European American girls, older girls who perceived at least a few instances of academic sexism felt less competent in math and science than older girls who perceived no academic sexism. There were no differences in perceived competence in math/science based on perceptions of academic sexism among younger European American girls.

Valuing Math and Science

The covariate of self-reported grades was significantly related to valuing math/science, $F(1, 355)=107.97$, $p<.001$, $\eta^2=.23$. Higher self-reported grades in math and science are associated with greater valuing of math and science.

Controlling for self-reported grades, there was a significant two-way interaction between perceived academic sexism and age, $F(2, 355)=3.80$, $p<.05$, $\eta^2=.02$. As predicted by the second hypothesis, analyses of simple effects indicated that older girls who perceived more than a few instances of academic sexism valued math and science less than older girls who perceived no academic sexism, controlling for grades in math/science. (Girls who perceived academic sexism only a few times did not differ from either group.) Academic sexism was not associated with differences in valuing of math and science among younger girls.

Ethnicity did not moderate the relationship between girls' perceptions of academic sexism and valuing of math and science. That is, there were no significant main or interaction effects with ethnicity.

Discussion

We found that, depending on girls' age and ethnicity, reported experiences with academic sexism—that is, hearing

discouraging comments about girls' abilities in math, science, or computers—are negatively associated with girls' academic self-concepts. Perceptions of academic sexism were not related to academic self-concepts for all girls uniformly. Instead, the relationship between perceptions of academic sexism and academic self-concepts differed based on the ethnicity and age of the girl, as well as the dependent variable being assessed.

Specifically, as predicted, perceptions of academic sexism were more strongly linked with lower perceived math and science competence among Latina girls (existing for Latina girls regardless of age) than European American girls (existing only for the oldest girls). This suggests that Latina girls may be slightly more susceptible to academic sexism than European American girls. Consistent with this finding, previous research on stereotype threat found that Latina women were more sensitive to gender-based stereotype threat than European American women (Gonzales et al. 2002). Latina girls' double-minority status—in which both their gender and ethnicity are academically devalued—may make them particularly vulnerable to negative group-based treatment. This effect was present regardless of age group. Thus, hearing discouraging comments about girls' abilities in math, science, or computers was associated with lower perceived competence in math and science for *both* younger and older Latina adolescents.

In contrast, for European American girls, perceptions of academic sexism were related to lower perceived competence only if the girls were in later adolescence. There are two possible, albeit not mutually exclusive, explanations for this finding. First, older adolescents, because of their enhanced ability to understand socially constructed viewpoints (Selman 1989), may better understand the implications of academic sexism. Second, experiencing sexism may have a cumulative impact across the years of adolescence, with its effect being most apparent toward the end of adolescence. Thus, European American girls, who are not already sensitized to negative group-based treatment (as are their Latina peers), may need the additional cognitive capacities and experiential impact to be influenced by academic sexism.

The specific type of academic beliefs being assessed was also important. The association between perceptions of academic sexism and valuing of math and science was only apparent for older adolescents, and the association was not further moderated by girls' ethnicity. This suggests that the value girls place on math and science (i.e., their intrinsic interest in and perceived importance of doing well in those domains) is less sensitive to negative comments than their perceived competence in those domains. For older adolescents of both ethnic groups, however, increased perceptions of academic sexism are related to less valuing of math and science. This differs somewhat from research on ethnic

discrimination, which shows negative effects of bias on valuing of academics even in early adolescence (Wong et al. 2003). Regardless, the current finding is important and suggests that, as girls enter late adolescence, their interest in math and science may be negatively affected by negative comments about their math and science abilities. This has implications for the types of math and science courses girls may choose to take, and may lead girls to take the minimum required math and science courses to graduate and to opt out of advanced level courses.

Consistent with prior research (see Eccles and Wigfield 2002), perceived competence and valuing of math and science were predicted by girls' grades in math and science. Further, as shown previously (e.g., Grigg et al. 2007), Latina adolescents performed more poorly and showed more negative math and science self-concepts overall than did their European American peers. The explanations for this well-documented achievement gap are diverse and appropriately complex, and thus well beyond the scope of this paper (for a description of some of the varied socio-cultural and economic forces at play behind the achievement gap, see Flores 2007; Massey et al. 2006). However, it is important to point out that the stronger link between academic sexism and perceived competence in math and science for Latina girls than European Americans controlled for differences in self-reported grades. Thus, the findings in the current paper are not simply an extension of the achievement gap literature, but suggest that there is an enhanced vulnerability to negative group-based feedback that affects Latina girls more than their European American peers. The implications of this finding are that researchers and educators, when trying to better understand the ethnic achievement gap, should look not only at issues related to ethnic discrepancies, but gender discrepancies as well.

In closing, we acknowledge some of the limitations of our study and suggest directions for future research. First, and most importantly, all associations between variables reflect only correlations and no causality can be inferred. Indeed, there is likely to be a bidirectional influence. For example, the girls who perceive academic sexism may show lower perceived competence in math and science. Feeling less competent, they may become more sensitive to future negative comments about their abilities. Future research should employ experimental designs to examine whether priming girls to think about sexist comments (versus other negative, but gender-neutral comments) is causally associated with decreases in academic attitudes. In addition, longitudinal designs can also be used to infer possible causal influences of sexism on academic outcomes by controlling for earlier academic self-concepts and achievement.

Our reliance on adolescent girls' self-reported experiences with academic sexism is another limitation. Based on previous research, it is likely that many of the girls in our sample

underestimated incidences of sexism (Crosby 1984; Foster and Matheson 1999; Taylor et al. 1990). The denial of discrimination is more likely when evaluating one's own experiences as opposed to others' experiences (Crosby 1984; Taylor et al. 1990). In future research, we propose having girls assess both personal experiences of discrimination as well as perceptions of their peers' experiences. In addition, experimental designs can be used to assess factors related to girls' sensitivity to sexism (e.g., Stangor et al. 1999).

Future research should also examine the role of course choice in girls' perceptions of academic sexism. Girls in more advanced math and science courses may be more outnumbered than girls in more basic math and science courses, and thus may have differential experiences. Although the rates of perceiving academic sexism were not higher among older compared to younger girls, the nature of the comments may differ and the effects may be more powerful in self-selected rather than required courses. Future research should also more clearly examine ethnic group differences in coping with discrimination. The ethnic group differences in the current study are small, open to multiple interpretations, and need to be replicated in future studies with additional dependent variables.

Finally, the current study examined perceptions of sexism collapsed across math, science, and computers. These domains are becoming increasingly unique, however, in their gender compositions. For example, women are now well represented in life sciences, but remain highly outnumbered in computer science. Future research should explore girls' perceptions of sexism across specific academic domains.

Taken together, the findings from this study suggest that the gender-based negative comments perceived by adolescent girls regarding their math and science abilities are infrequent but important. By the time Latina girls reach early adolescence, these comments predict whether they feel competent in math and science (regardless of their own performance), and by late adolescence, whether they are interested in math and science. For European American girls, by the time they reach late adolescence, they too feel less competent and show lower interest in math and science. Thus, when sexist comments are salient (even if infrequent) in their lives, adolescent girls may begin to feel less confident in their abilities and value math and science less than they would otherwise (see Eccles et al. 1999; Halpern et al. 2007; Hyde and Kling 2001). As teachers and parents are often in positions to make such comments, they need to be particularly aware of their influence on girls' academic self-concepts and motivation. Girls (as well as boys) who are encouraged and given opportunities in mathematics and science will be most likely to succeed, and our society will benefit from their talents.

Acknowledgement The research was supported by grants to the first author from the University of California Los Angeles Center for the Study of Women, and by a grant to the second author from the University of California Santa Cruz Academic Senate and Social Sciences Division. The authors are grateful to the girls in Atlanta, Los Angeles, and Santa Cruz for their participation. Also, the authors thank Melanie Ayres and Carly Friedman for their helpful suggestions during survey construction; Agnieszka Spatzier for data coordination; and Bren Michelle Chasse and Nicole Nunez for data entry.

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