



Gender achievement gaps: the role of social costs to trying hard in high school

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Abstract

In American high schools female students put greater effort into school and outperform boys on indicators of academic success. Using data from the High School Longitudinal Study of 2009, we found female students' greater academic effort and achievement was partly explained by different social incentives to trying hard in school experienced by male and female students. Males were 1.75 times as likely to report they would be unpopular for trying hard in school and 1.50 times as likely to report they would be made fun of for trying hard in school. Social costs to trying hard in school were directly associated with less rigorous mathematics course-taking and indirectly associated with lower GPA in STEM courses through lower academic effort.

Keywords Gender · Peer relations · Masculinity · Oppositional culture · Popularity · Achievement

1 Introduction

In most Western, industrialized countries female students outperform male students on indicators of academic success (Buchmann et al. 2008). In 1981, American women surpassed males in attaining bachelor's degrees, and continue to outpace males in more recent years. Female students in American high schools also outperform male students in course grades and enroll in more advanced courses. Female

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students' greater school effort explains a substantial portion of the female advantage in educational performance (Downey and Vogt Yuan 2005).

The primary contribution of this study is to investigate the social costs to academic effort faced by male and female high school students and the implications of these social costs for the female advantage in academic effort and performance. Prior ethnographic and experimental research suggests male and female students experience different social costs to trying hard in school (Heyder and Kessels 2017; Jackson 2002, 2003; Jackson and Dempster 2009; Morris 2012). However, scholars have not been able to quantify how much more widespread social costs to academic effort are among male students than female students. In the current study we address this gap by comparing student reports of the social costs to trying hard in school in a nationally representative sample of American 9th grade students. In addition, we investigate whether differential social costs to trying hard in school among male and female students explain why female students try harder in school and have higher achievement than male students.

1.1 Gender achievement gaps

Female students outperform male students in a range of indicators of academic performance. For instance, female students earn higher grades than male students (for a meta-analysis see Voyer and Voyer 2014). The female advantage in grades is particularly pronounced for languages and seems to increase with students' age. But also in science and math, female students earn higher grades than male students. Further, the gender gap in students' grades tends to be more pronounced in North American samples than in samples from other countries. One might argue the gender gap in grades in favor of female students is due to competence differences, as measured by standardized achievement tests. However, several studies have shown female students earn higher grades than male students even if they show equal competence (Duckworth and Seligman 2006 for various subjects; Kenney-Benson et al. 2006 for math). Thus, female students' higher grades cannot be (fully) explained by higher competencies.

Further, female students' higher GPA is not due to enrolling in easier classes; in fact, girls earned more credits than boys in high school overall, as well as in math and science (U.S. Department of Education 2011, 2012; You and Sharkey 2012). For instance, female students are now more likely than male students to complete pre-calculus and algebra II and are equally likely to complete calculus and statistics (National Science Board 2012, 2014). In high school science, girls are still over-represented in advanced biology and underrepresented in physics, but these gender differences have decreased substantially (Xie et al. 2015).

It is an interesting fact that the female advantage in academic outcomes was found not only for languages but also for math and science. Whereas female students in general are thought of as having higher verbal competencies than male students (e.g., Retelsdorf et al. 2015; Steffens et al. 2010) common stereotypic beliefs ascribe higher math or science talent, ability, and interest to male than female students (e.g., Blažev et al. 2017; Holder and Kessels 2017; Hyde et al. 1990; Nosek et al. 2009).

Thus, current math-male or science-male stereotypes do not accurately reflect gender differences in academic achievement: female students earn higher grades than male students and enroll in similarly demanding or even more demanding courses not only in the verbal domain but also in math and science.

1.2 Effort and the female advantage

What explains female students' higher grades and enrollment in more demanding courses? One important factor contributing to female students' higher achievement is the greater effort female students put into school compared to male students. For instance, female students report they work harder in school (Lam et al. 2012), show more homework effort (Trautwein et al. 2006), and place more personal value on working hard than male students (Kessels and Heyder 2017; McCrea et al. 2008). This gender gap in academic effort explains why female students tend to earn higher grades or higher teacher ratings than equally competent male students (DiPrete and Jennings 2012; Downey and Vogt Yuan 2005; Lam et al. 2012). Thus, controlling for academic effort substantially reduces the gender gap in academic achievement.

Effort has been considered a normative parameter of the school environment (Matteucci 2007) and seems to affect students' achievement in different ways. First, exerting more effort improves the learning process, as demonstrated by the significant relationship between effort and achievement test scores (DiPrete and Jennings 2012). Second, teachers reward effort with better grades. Students showing a lot of effort earn higher grades than equally performing students who show low effort (e.g., Brookhart 1993; McMillan 2001; Randall and Engelhard 2010). Further, experimental studies from the field of psychology have shown displaying effort also influences teachers' perception of students' performance as such. This means students showing high effort were perceived as showing higher achievement than students showing low effort, even if students' achievement and effort were unrelated (Kaiser et al. 2013).

So far, research has focused on the role of effort for gender differences in grades. Since grades are a positive predictor of course enrollment (e.g., Watt et al. 2006), it is plausible gender differences in effort not only contribute to gender differences in grades but also in course enrollment.

1.3 Social costs of academic effort

Education scholars do not fully understand why male students put forth less effort in school than female students. The gender disparity in effort may reflect different social incentives male and female students experience for trying hard in school. Peer influence through these types of social incentives is greatest around 8th or 9th grade when students are less secure in their self-identity and more sensitive to the opinions of others (Brown et al. 1986; Kinney 1993; Steinberg 1996). Small-scale ethnographic studies have found adolescent social norms are not very supportive of academic effort, but this is particularly the case for males. In this paper we compare male and female students' reports of the social costs to trying hard in school in a

nationally-representative sample of American 9th grade students. We assess whether gender differences in social incentives explain any of the female advantage in academic effort and achievement.

Fitting in with one's peers and doing well academically are two primary goals among high school students. These two goals are often more in competition than reinforcing one another. In the economics literature this is referred to as a two-audience signaling quandary where, "signals that beget labor-market success are signals that induce peer rejection" (Fryer and Torelli 2010, p. 381). The most popular students, the "leading crowd", set the norms for the broader student body (Coleman 2006). Popularity tends to be a reward for athleticism, trendy clothes, and attractiveness. In contrast, the students who strive hardest for academic success are many times socially isolated or teased as nerds/geeks (Kinney 1993; Tyson 2011).

Studies have found many students actively limit their academic effort out of concern for the opinions of their peers. In a study of California and Wisconsin, Steinberg (1996) found one in six high school students reported playing down their achievement because of what their peers might think. Overall, the prevailing norm regarding academic effort among high school students seems to be working just hard enough to get by Morris (2012) and Tyson (2011). Students have esteem for those who do well in school, but only as long as it looks like the student isn't trying too hard and isn't "all about school" (Heyder and Kessels 2017; Jackson 2002; Morris 2012). Being successful in school without having to try hard gives the impression the person is simply naturally gifted or smart.

Adolescent social norms that undermine academic effort are particularly pronounced for male students. It has been argued (Mickelson 1989) the student role, that is, being diligent, attentive and hard-working, is more compatible with female gender norms than male gender norms. According to gender role socialization theory, female students are socialized to be "good" students, i.e. being good at school and working hard and diligently at it (Legewie and DiPrete 2012; Mickelson 1989). The male gender role, on the other hand, is generally less compatible with the student role, requiring, for instance, some resistance to authorities and school rules.

These claims have been supported by qualitative studies with male adolescents and college students in the sociological literature (Jackson 2002, 2003; Jackson and Dempster 2009). The studies found low effort signals intelligence and masculinity and increases male students' popularity among peers. Thus, male students working hard for school are at-risk of facing social sanctions for not fulfilling male gender norms. Jackson and Dempster (2009) argued the larger social benefits of showing low academic effort for male than female students are the motivating factors in boys' lower academic effort even though it undermines their academic achievement. Indeed, Morris (2012) observed a process where male adolescents seek affirmation from their peers by making a show of clowning around or being inattentive in class. Morris (2012) referred to this performative element of disengagement signaling as "contrived carelessness."

The tension between the student role and male gender norms were further supported by quantitative experimental research from the field of psychology. In two vignette studies with adolescents and teachers (Heyder and Kessels 2017), fictitious students showing low effort were considered as masculine and unfeminine. However,

showing low effort was found to increase the popularity ascribed to male and female target students to a similar extent (Heyder and Kessels 2017). The authors explained the lack of a gender-specific effect of effort on the perceived popularity by the decision to vary target students' gender as a between subjects factor.

Students' perceptions of their personal social costs to trying hard in school are a critical component of education decision-making. It is perceived social costs that factor into students' weighing of the costs and benefits of academic effort. The expectancy-value model of achievement motivation, a prominent psychological model for explaining academic choices and achievement (e.g., Eccles and Wigfield 2002; Wigfield and Eccles 2000), traces back academic choices on students' success expectations and students' values and costs attached to the domain or learning activity. Similarly, researchers from sociology and economics commonly view educational decisions through a rational-choice lens, where the investment of time, energy, and finances in education are based upon a cost-benefit calculation (Becker 1993, Breen and Goldthorpe 1997; Breen and Jonsson 2005). For high school students the decision to enroll in the most challenging courses or to spend a considerable amount of time studying can have associated social costs of less time for other activities like hanging out with friends or direct negative peer reactions (Bishop 2006; Wigfield and Eccles 2000). Thus, social costs attached to effort should not only predict academic effort and achievement but also academic choices.

So far, research on gender-specific social costs attached to academic effort either studied the outer perception of (fictitious) target students (Heyder and Kessels 2017) or relied on qualitative interviews with mostly male students (e.g., Jackson 2003). Thus, *quantitative* research is lacking regarding studying the social costs to academic effort that female and male students *perceive for themselves*. Are the anticipated social costs to trying hard in school different for male and female students? The most obvious way to answer this question is to ask students directly: if you try hard in school will you experience negative social consequences, such as harassment and unpopularity? Comparing the responses of male and female students can provide a sense of the social norms to which students may feel compelled to conform. In the current study we compare male and female students' reports on the costs of trying hard in school using a nationally-representative sample of American 9th grade students. In addition, we investigate the implications of gender differences in the social costs to trying hard in school for the female advantage in academic effort, course grades, and course enrollment.

1.4 Hypotheses

With a large, representative sample, our analyses aim to assess the following three hypotheses:

1. Male students experience greater social costs to trying hard in school than female students.
2. Gender-specific social costs partly explain gender differences in academic effort.

3. Gender-specific social costs partly explain gender differences in academic achievement.

2 Method

2.1 Sample

Data for the study comes from the High School Longitudinal Study of 2009 (HSLs: 09) that focuses on students' educational trajectories in math and science. The HSLs: 09 was collected by the National Center for Education Statistics and consists of a nationally-representative sample of approximately 22,000 students who were enrolled in 9th grade in the United States in fall 2009. The sampling strategy consisted of a multi-stage design where 944 schools were selected for participation, then students were selected within schools (approximately 23 students per school). The first wave of data collection occurred in fall 2009 when students were in 9th grade. Follow-up waves of data collection were conducted in spring 2011 when most students were in the 11th grade.

For this study, we analyzed data from 21,992 students. In the base year questionnaire students were asked to report their gender. Gender was also measured via parent questionnaire and school-provided student roster. If the students' gender was inconsistent across any of these three sources then gender was coded based upon manual review of the students' first name. Approximately half of the sample were female (49.52%). Students' average age at the first wave was 14.87 years (standard deviation = 0.61).

2.2 Measures

Since the HSLs: 09 focused on educational trajectories in math and science, it assessed the social costs, effort, and academic outcomes with respect to math and science.

2.2.1 Social costs

Social costs to trying hard in math and science were measured in terms of both harassment and popularity. In the baseline student survey students were asked, "if I try hard in my math and science classes people will make fun of me" and "if I try hard in my math and science classes I won't be popular." Each question provided four response categories ranging from strongly agree to strongly disagree. The analyses used a composite measure of social costs that equally weighted the unpopular and harassment variables ($\alpha = .82$). The composite measure of social costs was standardized to have a mean of zero and a standard deviation of one.

2.2.2 Academic effort

Academic effort was captured on the 11th grade student questionnaire. Students were asked how often they did the following things in their math and science classes: paid attention to the teacher, turned in assignments on time, kept trying on difficult assignments, did as little work as possible to get by. There were five response categories ranging from 1 = never, to 5 = always. The responses were recoded so higher values indicated greater effort. The composite student effort variable equally weighted students' responses to separate questions on their mathematics and science courses and was standardized to have a mean of zero and a standard deviation of one.

2.2.3 Academic outcomes

We assessed how social costs attached to trying hard in school were associated with students' academic outcomes, namely mathematics course-taking and GPA in STEM-related classes. Transcripts for each student were collected directly from the high school and were used to capture students' mathematics course enrollment and STEM GPA. Mathematics course-taking captured the most advanced mathematics course in which the student enrolled by the end of 12th grade. The measure was an ordinal indicator that reflected thirteen categories of mathematics courses including: no math, basic math, other math, pre-algebra, algebra I, geometry, algebra II, trigonometry, other advanced math, probability and statistics, other AP/IB math, precalculus, calculus, and AP/IB calculus. The hierarchy of the mathematics course-taking pipeline was created by the National Center for Education Statistics, which collected the HSLs: 09 data.

STEM GPA measured students' performance in all science, technology, engineering, and mathematics related courses in 10th, 11th, and 12th grades. STEM GPA was measured on a 1–4 point scale and averages grades across all classes. Higher scores indicated higher achievement. In deciding what grade levels to include in the measure of STEM GPA there was a tradeoff. Predicting STEM GPA in 10th to 12th grades had the benefit of providing a more holistic and unbiased picture of students' performance in STEM courses throughout high school than predicting STEM GPA in 11th and 12th grade.¹ However, using this variable had the shortcoming that one predictor variable, academic effort, was only measured in 11th grade. Since previous research has found academic effort to be highly correlated within students over time (e.g., Lazarides and Raufelder (2017) found a latent correlation of 0.79 between academic effort at the beginning of 8th grade and end of 9th grade), we ultimately decided to use STEM GPA in 10th to 12th grades.

¹ Many students were able to opt out of mathematics or science courses in 11th and/or 12th grades. Students who were missing STEM GPA information for 11th and 12th grades were disproportionately male, had low GPA in 8th grade, and reported higher social sanctions in 9th grade. Therefore, excluding these students from the analysis would have biased the estimates of the inter-relationships between gender, social sanctions, and academic performance.

2.3 Analytic approach

We used path analysis in STATA 15 to assess the inter-relationships between gender, social costs, effort in school, and academic achievement. Separate models were estimated that used mathematics course-taking (Model 1) and STEM GPA (Model 2) as achievement outcomes. Gender and social costs to trying hard in school were measured in the fall of 9th grade. We were interested in assessing whether male or female students reported greater social costs to trying hard in school and how these reports of social costs were related to later academic performance. We therefore controlled for earlier academic achievement (mathematics and science GPA in 8th grade; mathematics course-taking in 9th grade) so our models were assessing how social costs were related to change in academic performance. Finally, both models used sampling weights and standard errors corrected for the clustered sampling design where students were nested within schools. For handling missing values, we applied the maximum likelihood with missing values (MLMV) estimation procedure in Stata. This full information estimation technique incorporates as much information as possible from observations with missing values (StataCorp 2017).

3 Results

3.1 Descriptive statistics and gender differences

Table 1 displays descriptive statistics for the variables included in the analyses, broken apart by gender. Importantly, female students reported fewer social costs to trying hard in school. Combining the strongly agree and agree categories, 12% of male students reported they would be made fun of if they tried hard in their math and science classes compared to 8% of female students ($p < .001$). Male students were also 1.75 times as likely to report they will be unpopular for trying hard in their math and science courses (14%) than female students (8%) ($p < .001$). Looking at the composite measure of social costs that equally weights the unpopular and make fun components, the difference between male and female students was approximately 15% of a standard deviation ($p < .001$). Thus, Hypothesis 1 was supported by the data, female students report substantially fewer social costs to trying hard in school than male students.

Students reporting high social costs were further characterized by low effort and GPA in STEM-related classes in 10th to 12th grades and less rigorous mathematics course-taking. Table 2 provides a bivariate correlation matrix showing the inter-relationships among the covariates used in the models. Social costs were inversely correlated with each of the three academic outcomes of effort, STEM GPA, and mathematics course-taking. Additionally, our data corroborates the female advantage in academic effort and achievement. Female students reported greater effort in school and also had higher GPA and enrolled in more rigorous mathematics courses than male students (see Tables 1, 2).

Table 1 Descriptive statistics of covariates by gender

	All	Female	Male
N	21,992	10,890	11,102
Make fun			
Strongly agree	0.03	0.02	0.04***
Agree	0.07	0.06	0.08**
Disagree	0.55	0.57	0.54*
Strongly disagree	0.34	0.35	0.34
Unpopular			
Strongly agree	0.03	0.02	0.04***
Agree	0.08	0.06	0.10***
Disagree	0.58	0.59	0.58
Strongly disagree	0.31	0.33	0.28***
Social costs	0.01 (1.01)	-0.07 (0.94)	0.08*** (1.06)
Effort	-0.04 (1.03)	0.05 (0.98)	-0.14*** (1.07)
STEM GPA	2.34 (0.91)	2.47 (0.88)	2.20*** (0.92)
Highest math course	7.79 (3.16)	8.03 (3.06)	7.55*** (3.24)

Statistical significance indicates statistically significant difference between male and female students. Standard deviations in parentheses

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

Table 2 Pairwise bivariate correlation matrix of covariates

	Female	Social costs	Effort	STEM GPA	Highest math course
Female	1				
Social costs	-0.07*** (20,693)	1			
Effort	0.10*** (13,861)	-0.10*** (12,307)	1		
STEM GPA	0.15*** (20,241)	-0.07*** (17,875)	0.37*** (12,791)	1	
Highest math course	0.06*** (21,865)	-0.09*** (19,294)	0.23*** (13,223)	0.65*** (21,786)	1

Sample size reported in parentheses

*** $p < .001$

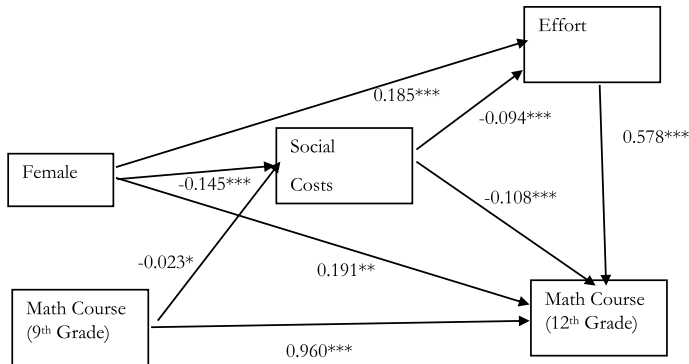


Fig. 1 Path model explaining gender differences in highest math course-taking (model 1). Note: * $p < .05$, ** $p < .01$, *** $p < .001$

3.2 Social costs and mathematics course-taking

Figure 1 displays the results of a path analysis investigating the inter-relationships between gender, social costs, and mathematics course-taking (Model 1). All the relationships between gender, social costs, and mathematics course-taking (as well as indirect and direct effects) reached statistical significance ($\alpha = .05$). First, we were interested in gender differences in our target variables. Female students experienced significantly less social costs to trying hard in school than male students ($B = -0.145$, $SE = 0.019$, $p < .001$), reported higher levels of academic effort ($B = 0.185$, $SE = 0.029$, $p < .001$), and more advanced math course-taking ($B = 0.191$, $SE = 0.060$, $p = .01$). Social costs were directly associated with less advanced mathematics course-taking ($B = -0.108$, $SE = 0.027$, $p < .001$) and less academic effort ($B = -0.094$, $SE = 0.017$, $p < .001$). Academic effort had a strong, positive association with advanced math course-taking ($B = 0.578$, $SE = 0.041$, $p < .001$).

Table 3 reports the direct, indirect, and total effects from the relationships of Model 1. Our second hypothesis concerned whether gender-specific social costs explained any of the gender differences in academic effort. We found social costs explained a modest portion of gender differences in academic effort. Approximately 7% ($0.014/0.198 = 0.07$) of the total relationship between gender and effort (0.198) was mediated through social costs (0.014).

Our third hypothesis concerned whether gender-specific social costs explained any of the gender differences in academic achievement. We found a modest portion of the gender differences in mathematics course-taking were explained by social costs. The total effect of female on mathematics course-taking was 0.321. The path female \rightarrow social costs \rightarrow course-taking ($-0.145 * -0.108 = 0.016$) and the path female \rightarrow social costs \rightarrow effort \rightarrow course-taking ($-0.145 * -0.094 * 0.578 = 0.008$) combined to explain approximately 7% of the total relationship between female and course-taking ($0.024/0.321 = .07$).

Table 3 Direct, indirect, and total effects for model 1

	Direct effects	Indirect effects	Total effects
Social costs			
Female	-0.145*** (0.019)		-0.145*** (0.019)
Math course (9th)	-0.023**** (0.008)		-0.023*** (0.008)
Effort			
Social costs	-0.094*** (0.017)		-0.094*** (0.017)
Female	0.185*** (0.029)	0.014*** (0.003)	0.198*** (0.029)
Math course (9th)		0.002* (0.001)	0.002* (0.001)
Highest math course (12th)			
Social costs	-0.108*** (0.027)	-0.054*** (0.010)	-0.162*** (0.027)
Effort	0.578*** (0.041)		0.578*** (0.041)
Female	0.191** (0.060)***	0.130*** (0.019)	0.321*** (0.060)
Math course (9th)	0.960 (0.031)	0.004* (0.002)	0.964*** (0.031)

N=21,992. Unstandardized effects with standard errors in parentheses

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

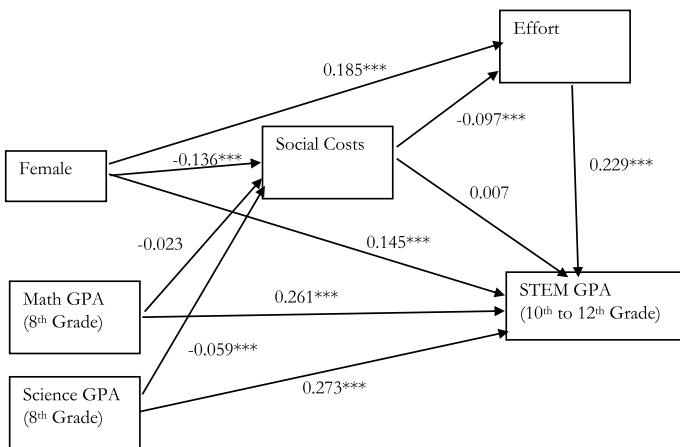


Fig. 2 Path model explaining gender differences in STEM GPA (model 2).

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4 Direct, indirect, and total effects for model 2

	Direct effects	Indirect effects	Total effects
Social costs			
Female	-0.136*** (0.019)		-0.136*** (0.019)
Science grade (8th)	-0.059*** (0.018)		-0.059*** (0.018)
Math grade (8th)	-0.023 (0.015)		-0.023 (0.015)
Effort			
Social costs	-0.097*** (0.017)		-0.097*** (0.017)
Female	0.185*** (0.028)	0.013*** (0.003)	0.198*** (0.029)
Science grade (8th)		0.006* (0.002)	0.006* (0.002)
Math grade (8th)		0.002 (0.001)	0.002 (0.001)
STEM GPA (10th to 12th grade)			
Social costs	0.007 (0.008)	-0.022*** (0.004)	-0.015 (0.008)
Effort	0.229*** (0.012)		0.229*** (0.012)
Female	0.145*** (0.023)	0.044*** (0.007)	0.189*** (0.024)
Science grade (8th)	0.273*** (0.012)	0.001 (0.001)	0.273*** (0.012)
Math grade (8th)	0.261*** (0.012)	0.000 (0.000)	0.261*** (0.012)

N=21,992. Unstandardized effects with standard errors in parentheses

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

3.3 Social costs and STEM GPA

Figure 2 displays the results of a path analysis investigating the inter-relationships between gender, social costs, and STEM GPA (Model 2). Model 2 was identical to Model 1 except for the achievement indicators, which were science grades (8th grade), math grades (8th grade), and STEM GPA (10th to 12th grade). Female students earned significantly higher STEM GPA than male students (total effect=0.189). Social costs were significantly associated with less academic effort ($B = -0.097$, $SE = 0.017$, $p < .001$). Less effort was significantly related to a lower STEM GPA ($B = 0.229$, $SE = 0.012$, $p < .001$). In contrast with Model 1, social costs were not directly associated with STEM GPA ($B = 0.007$, $SE = 0.008$, $p = .342$). The

effects of social costs and effort on GPA were also descriptively smaller than on course selection (see Model 1).

The results of Model 2 are summarized in Table 4, breaking apart the relationships into direct, indirect, and total effects. Concerning our third hypothesis, virtually none of the gender difference in STEM GPA was explained by social costs. The path female \rightarrow social costs \rightarrow effort \rightarrow STEM GPA ($-0.136 * -0.097 * 0.229 = 0.003$) explained only 1.6% of the total relationship between female and course-taking.

3.4 Intersection of gender with race-ethnicity and social class

In supplementary models (presented in Table 5 of “Appendix”), we investigated whether social costs to trying hard in school are shaped by the intersection of gender with race-ethnicity and social class. The social costs to trying hard in school are thought to be greater among black and Latinx adolescents, a phenomenon known as the burden of “acting white” (Fordham and Ogbu 1986; Fryer and Torelli 2010; Ogbu 2003; Portes and Zhou 1993); however, these claims have faced mounting criticism (Ainsworth-Darnell and Downey 1998; Harris 2006; Tyson 2011). While male students experience greater social costs to trying hard in school, these experiences may be particularly pronounced for black and Latinx male students. We assessed this possibility by including interaction terms for black * female and Latinx * female in predicting social costs. In Model 1 of Table 5, none of the race-gender interactions were statistically significant, which indicated female students experienced fewer social costs to trying hard in school than male students and this male–female difference was not significantly greater or smaller for black, Latinx, or white students.

Additionally, in Model 2 of Table 5 we introduce an interaction term for socioeconomic status² * female because students’ conceptions of masculinity are also assumed to be shaped by their socioeconomic status (see Legewie and DiPrete 2012). The coefficient for the interaction term between socioeconomic status and female was not statistically significant indicating the relationship between gender and social costs to trying hard in school did not differ across the spectrum of socioeconomic status.

4 Discussion

In order to better understand what mechanisms lead to the differential academic success of male and female students, we studied the inter-relationships between gender, social costs to trying hard in school, and student achievement in a large, nationally-representative sample of American 9th grade students. Our study contributes to the literature on gender gaps in academic achievement through three key findings.

² Our measure of socioeconomic status is a composite that equally weights mother’s education, father’s education, mother’s occupational prestige, father’s occupational prestige, and family income.

First, female students experienced fewer social costs to academic effort than male students. Male students were 1.75 times as likely as female students (14% vs 8%) to report they would be unpopular for trying hard in high school and 1.50 times as likely (12% vs 8%) to report they would be harassed for trying hard in school. On the composite measure of social costs the difference between male and female students constituted 14–15% of a standard deviation. Our findings supported prior results from qualitative interview studies (e.g., Jackson 2002, 2003) that suggested male and female students experience different social costs to trying hard in school, but previous studies were unable to quantify how much more widespread social costs to academic effort are among male students compared to female students.

Second, differential social costs to trying hard in school contributed to gender differences in academic effort. We estimated that approximately 7% of the gender disparity in effort was explained by social costs attached to trying hard in school. The ideal among adolescents is to excel in school without appearing to try very hard (Heyder and Kessels 2017; Jackson 2002; Morris 2012). Doing well in school without effort sends the signal that one is simply smart or naturally gifted. Students value and reward achievement that appears effortless, so students who perceive high pressure to put low effort in school have no social incentive to show low performance. The belief among students that academic success comes from innate, fixed abilities rather than hard work can lead to a host of problems (Blackwell et al. 2007; Degol et al. 2018). Recently, for example, Leslie et al. (2015) found academic disciplines in which the belief that success comes from innate abilities are less open to women and under-represented minorities.

Third, whether social costs explained gender differences in academic achievement, seemed to depend on the outcome: they did more so in course-taking than GPA. Social costs were not directly related to GPA, but rather indirectly through effort. Thus, the present study deepens our understanding of how gender-specific social costs might contribute to gender differences in academic achievement. The stronger relationship of social costs with course-taking than grades is in line with the finding that costs and values are often stronger predictors of choices than of performance (e.g., Eccles and Wigfield 2002). Also, since students' choices seem more open to influence by peers than GPA, choices might provide a better opportunity for self-presentation, for instance as "careless" (Morris 2012). This better opportunity for self-presentation in combination with the lack of costs attached to achievement (Jackson 2003) might be one explanation for the different patterns revealed in this study.

These findings are of particular interest given the HSLs: 09 focus on mathematics and science, two domains that are typically considered as masculine (e.g., Hand et al. 2017, Steffens et al. 2010). Since the HSLs: 09 does not include social costs to academic effort in other domains we can only rely on prior research and theories in order to hypothesize whether and how the domain might have affected our findings. One could reason that the stereotype that males have higher (innate) talent for math than females (e.g., Steffens et al. 2010) might put additional pressure on boys to hide their effort in order to appear talented in math. This might lead to higher social costs attached to effort in math than languages for male students. However, based on psychological identity theories, one might expect larger social costs to male students

for domains stereotyped as feminine like art or languages or school in general than math, because engaging in feminine domains should conform even less with the male gender role than engaging in masculine domains (Kessels et al. 2014). Since the HSLs: 09 does not include social costs to academic effort in other domains, taking an intra-individual perspective and comparing gender differences in social costs attached to effort across domains remains as promising task for future research.

Regarding the size and direction of the gender gap in STEM achievement found here and in other research (e.g., U.S. Department of Education 2011, 2012; Voyer and Voyer 2014), it is interesting that stereotypes regarding female disadvantage in mathematics and science remain, even as female students have overtaken male students in GPA in these subjects. From a sociological perspective the endurance of these stereotypes might be understood as cultural lag, that cultural meanings are slow to adjust in the face of changing circumstances (Macdonis 2017), or as contention in women's pursuit of equality in male dominated fields.

What are the implications of this study for educators and administrators? As academic effort pays off in higher grades and more advance course enrollment, we identify a need to recognize and change students' understandings of gender norms that create a situation where boys experience greater social costs to trying hard in school than female students. There is substantial room for improvement even in academic subjects that are typically considered male domains. Bishop et al. (2004) note, "the quickest way to change a school's peer norms is to persuade the leaders of the popular crowds, that such change is desirable" (p. 240). Increased educational competition between schools may raise the visibility and status of the highest achieving students (Bishop et al. 2004; Tyson 2011). In addition, "no pass, no play" policies for athletic teams can create incentive for higher academic achievement among the leading crowd. The focus on competition and athletics in both these policies may disproportionately nudge male students toward norms that support greater academic engagement.

When promoting academic effort, however, it is important to consider evidence suggesting that there might be students showing too much commitment to school. In a recent study, Herrmann et al. (2019) showed that female students have a higher risk of developing symptoms of school burnout, which was amongst others explained by their self-worth depending more on academic success compared with male students. Thus, interventions aiming at changing male students' peer norms in order to increase their effort should reflect that there might be situations when high school commitment and high academic effort can have negative side-effects on students' well-being.

4.1 Limitations and future research directions

A limitation of this study is our analytic strategy does not allow us to establish a causal relationship between social costs to trying hard in school and later academic achievement. There may be omitted factors that are correlated with both students' perceptions of social costs to trying hard in school and their later course-taking and GPA. For instance, 9th graders with low academic achievement may have a

psychological incentive to report greater social costs to trying hard in school than their high-achieving peers. Perceiving high social costs to trying hard in school may be a student's way to internally rationalize their own low performance by telling oneself that trying harder in school is not worth it because it would lead to unpopularity and harassment anyway. Similarly, underreporting the amount of effort might protect students' self-worth, as in this case, their low achievement might be attributed to a lack of effort but not lack of ability (Covington and Omelich 1979a, b). In our analyses we address this concern by controlling for prior indicators of achievement (9th grade course-taking and 8th grade GPA), however there is likely additional unobserved heterogeneity in students' skills.

Further research is needed to identify whether the relationship between social costs to trying hard in school and later academic achievement is observed in models that more thoroughly control for omitted variable bias. Ideally, data would be available that measures both students' reports of social costs to trying hard in school and academic achievement at several occasions throughout middle and high school. A student fixed effects modeling approach would allow us to assess how changes in perceived social costs are associated with changes in achievement, while controlling for all differences between students that are stable over time. Taking a longitudinal approach that focused on students' experiences throughout middle school and high school would also allow us to assess when social costs to trying hard in school first emerge and the influence of these social cost on important educational decisions, such as which math and science courses in which students enroll at the beginning of high school. Such a longitudinal approach may also help overcome an additional limitation that we only had information about students' academic effort in 11th grade. Ideally, we would have had measurements of students' academic effort in 10th, 11th, and 12th grades to match more closely with the measurement of our STEM GPA measure.

Our analyses used data from a nationally representative sample of American 9th grade students. Our findings that male students experience greater social costs to trying hard in school than female students may be generalizable to other Western school systems. Using a range of methodological approaches, researchers from several countries (e.g., Heyder and Kessels 2017 in Germany; Jackson and Dempster 2009 in United Kingdom; Morris 2012 in United States) have found social costs to trying hard in school are higher for male than female students. However, it is unclear whether our findings of the extent to which social costs explain female students' higher academic effort and achievement is generalizable to other contexts. Indeed, a fruitful direction for future research would be to investigate the degree to which social costs to trying hard in school explain female students' higher academic effort and achievement in contexts outside the United States. A final direction for future research would be to study gender-specific social costs attached to academic effort outside Western countries, for instance in Japan and China, where effort is highly valued and perceived as more relevant for students' academic achievement than in the United States (e.g., Holloway 1988; Stevenson et al. 1993).

4.2 Conclusion

To summarize, using nationally representative data from the High School Longitudinal Study of 2009 (HSLs: 09) we found female students experienced fewer social costs to trying hard in school than male students. Males were 1.75 times as likely to report they would be unpopular for trying hard in school and 1.50 times as likely to report they would be made fun of for trying hard in school. Furthermore, social costs were directly associated with less rigorous mathematics course-taking and indirectly associated with lower GPA in STEM courses through lower academic effort. Our findings demonstrate the importance of peer norms in shaping students' behavior and decision-making in school. In particular, we illustrate the role of social costs to trying hard in school for understanding gender differences in students' academic effort and achievement.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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Appendix

See Table 5.

Table 5 Gender Interactions With Race-Ethnicity And Socioeconomic Status

	Model 1	Model 2
Social costs		
Female	-0.134*** (0.022)	-0.146*** (0.019)
Latinx	-0.075 (0.045)	
Latinx * female	-0.005 (0.048)	
Black	-0.115 (0.068)	
Black * female	-0.039 (0.082)	
SES		-0.065** (0.019)
SES * female		0.013 (0.027)
Math course (9th)	-0.028** (0.009)	-0.016* (0.008)
Effort		
Social costs	-0.102*** (0.020)	-0.094*** (0.017)
Female	0.189*** (0.030)	0.184*** (0.029)
Highest math course (12th)		
Social costs	-0.111*** (0.029)	-0.110*** (0.027)
Effort	0.611*** (0.040)	0.576*** (0.041)
Female	0.206** (0.062)	0.191** (0.060)
Math course (9th)	0.939*** (0.032)	0.962*** (0.031)
N	18,001	21,992

Unstandardized effects with standard errors in parentheses. Model 1 includes only black, Latinx, and white (omitted category) students

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

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