International Journal of
Gender, Science and Technology
http://genderandset.open.ac.uk

Gender, Competitiveness, and Intentions to Pursue STEM fields

Catherine Riegle-Crumb, Menglu Peng, Jenny Buontempo

University of Texas at Austin, USA

ABSTRACT
Building on the insights of gender theorists as well as a small body of emerging quantitative research, the authors examine whether and how students' self-perceptions of competitiveness are related to gendered patterns of future STEM expectations among a sample of U.S. high school students. Results of regression analyses reveal that female students' relatively lower self-perceptions of competitiveness (compared to male students) significantly contribute to their lower expectation of majoring in two historically male-dominated fields, physical science and engineering. Additional results revealed an interaction between gender and competitiveness for expectations to major in computer science, such that while girls' expectations significantly increase with their perceptions of competitiveness, boys' decisions to pursue computer science are unrelated to such perceptions.

KEYWORDS
gender, high school, expectations, competition, STEM

Gender, Competitiveness, and Intentions to Pursue STEM fields

INTRODUCTION

Despite the increasing presence of women in the labor force and the higher rates of female college matriculation that have occurred in recent decades in the United States, females remain substantially under-represented in many STEM (science, technology, engineering, and mathematics) fields, which are typically both high-status and high-earning fields (DiPrete & Buchmann, 2013). As such, scholars from many disciplines have focused on trying to understand the sources behind this continued inequality. The antecedents of women's lower representation in STEM fields in college and beyond reach back to the formative years of adolescence, where young people's interest and preferences for different domains begin to crystallize at the same time that gender identity and gender roles become increasingly salient (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Denner, 2011; Eccles, 2007; Perry & Pauletti, 2011). Specifically, research indicates that adolescent girls indicate much lower expectations of pursuing STEM fields compared to their male peers, and that the gender gap in intended college major that emerges during adolescence is an extremely powerful predictor of the subsequent gender gap in STEM college degrees and occupations (Ceci et al., 2009; Morgan et al., 2013; Xie & Shauman, 2003).

So why do adolescent girls have lower intentions of pursuing STEM fields than their male peers? Scholars examining this issue have long acknowledged the role that gender norms and stereotypes play in this process, as beliefs about the presumed inferior innate mathematical ability of females remain prevalent and work to deter the math-related interest and confidence of girls and young women, as well as influence the expectations and support of their parents, teachers, and peers (Correll, 2001; Dasgupta & Asgari, 2004; Eccles, 1994; Lazarides & Watt, 2017). While much has been learned from research in this area, we also point to its relatively limited focus on gender norms and stereotypes that are domain-based, that is, specifically related to math or science. Instead, we argue that more attention is needed on gender norms or stereotypes that are broader in scope, but yet may have strong implications for STEM outcomes.

Specifically, in this paper, we consider whether gender differences in *self-perceptions of competitiveness* have implications for gender gaps in intentions to pursue STEM fields. Informed by the insights of gender theorists (Ridgeway, 2011), we suggest that widely held, socially-constructed gendered beliefs about competitiveness as a masculine characteristic may deter young women from developing interest and aspirations towards STEM fields, which are commonly perceived as highly competitive domains (Hirshfield, 2015). Thus, to the extent that females perceive themselves as less competitive than males, this may help to explain gender gaps in STEM expectations. Building on a very small empirical body of work in economics (Niederle & Vesterlund, 2010; Reuben et al., 2015), we investigate this issue.

Yet it is also possible that perceptions of competitiveness are an even more important predictor for females' STEM intentions than for males, as gender scholars argue that biased performance expectations often result in females having to work harder to prove themselves as competent in situations where gender is salient (Heilman, 2001; Ridgeway, 2001). As such, it may be that particularly high self-perceptions of competitiveness are necessary for young women to decide to pursue STEM fields. Our study will therefore contribute to the literature on gender inequality in STEM fields by examining whether and how self-perceptions of competitiveness may be more strongly related to young women's future STEM expectations compared to their male peers.

To examine these issues, we utilize quantitative analyses of survey data from students in more than twenty high schools in the U.S. In doing so, our study is informed by an emerging body of literature on gender inequality that moves beyond a treatment of STEM fields in the aggregate, and instead acknowledges that young people hold different views about the individual fields that fall under the broad umbrella of STEM, and that such perceptions are further differentiated according to gender (Appianing & Van Eck, 2015; Cheryan et al., 2016; Watt et al., 2017). Importantly, our data provides an opportunity to examine intentions to pursue college majors in four separate STEM fields, including those that are heavily male-dominated (engineering and computer science), those that are slightly male-dominated (physical sciences), and those that are not male-dominated (biological sciences). Our analyses explore potential variation in patterns across different STEM fields, with the goal of highlighting whether and how gendered expectations of entering certain STEM fields are more strongly associated with students' self-perceptions of competitiveness than others. In sum, our study seeks to contribute new insights to understanding the creation and maintenance of gendered choices in educational and occupational fields.

BACKGROUND

Gender as a Social System

This study is rooted in theories of gender as a multi-level system that is socially constructed (and reinforced) at the macro level of institutions, at the interactional level between individuals in local contexts, and at the level of the individual (Ridgeway & Correll, 2004; Risman, 2004). Societal beliefs about gender are integral in creating and maintaining this system of inequality, encompassing the characteristics thought to distinguish men and women, and correspondingly, expectations of differentiated behavior. These widely held beliefs that categorize individuals according to their gender are embedded in organizations and large social structures, present in social relations and interactions, and often internalized by individuals (Ridgeway, 2001). As such, children grow up within this system, and typically develop perceptions of self and preferences for activities that are consistent with broad gender stereotypes, subsequently (re)creating clearly defined roles and behaviors for each gender, which are then thought to 'naturally' map onto different future roles and activities as adults (Ridgeway & Correll, 2004). Relatedly, role congruence theory articulates that both young women and men will seek out opportunities and locations that are consistent with their culturally assigned gender attributes and attempt to avoid placing themselves in environments that are perceived as gender incompatible (Diekman et al., 2011). Consequently, the educational and occupational choices of young men and women largely reflect societal beliefs about the types of work and activities for which they are each presumed to be differentially and innately suited to perform (Charles & Bradley, 2002).

The Role of Domain-Based Beliefs and Stereotypes

Regarding the particular topic of gender inequality in STEM fields, the extant literature has long implicated the role of gender stereotypes in shaping the educational and occupational expectations and choices of both males and females. Specifically, researchers have focused on measuring the existence and impact of enduring stereotypes about males' presumed higher innate ability in math fields, or related beliefs about the inherent 'maleness' of math-related domains (Eccles & Wang, 2016; Perez-Felkner et al., 2017). While more recent research has concentrated on empirically capturing individuals' endorsement of such stereotypes (either implicitly or explicitly) and examining the subsequent behavioral outcomes of such beliefs (Bonnot & Croizet, 2007; Dasgupta & Asgari, 2004; Gresky et al., 2005; Lane et al., 2012), previous research in this vein more often focused on indirect evidence of the salience of such stereotypes, as found in girls' lower confidence in their math ability despite comparable levels of math performance to that of their male peers (Cech et al., 2011; Correll, 2001; Eccles,1994; Hackett, 1985; Lent et al., 1991; Robnett & Leaper, 2013). Thus, there is a large body of research that argues for the powerful influence of gender-STEM stereotypes on discouraging girls' efficacy and interest in STEM fields, and subsequently contributing to their relatively low likelihood of pursuing STEM fields as an adult.

Considering the Role of Self-Perceptions of Competitiveness

While there is an undeniable logic (and a corresponding body of empirical evidence) supporting research on domain-based stereotypes and the domain-based attitudes of individuals, such a focus is limited in its capacity to explain gendered choices. Indeed, there is comparatively much less research that brings attention towards broader gender schemas and stereotypes that also have implications for patterns of inequality in STEM fields. Specifically, prominent gender stereotypes describe males as more agentic and women as more communal in nature; thus, females are viewed as naturally more caring and committed to the welfare of others, while males are perceived as innately more driven by exerting and maintaining dominance and control (Eagly, 1997; McGuire & Leaper, 2016; Ridgeway, 2001). To date, a few studies have explored the implications of these broader stereotypes for STEM-related outcomes, examining for example, how females' inclination towards more communal goals may contribute to their relative aversion to STEM careers (Diekman et al., 2011; Stout et al., 2016).

In this paper, we chose to focus on one dimension that is commonly referred to under the larger umbrella of men's presumably agentic gendered selves: competitiveness. Gender scholars often cite competitiveness as a stereotypically male attribute, as it sits clearly within a larger picture of men seeking to be dominant and not subservient (Diekman et al., 2010; Ridgeway, 2011). As such, gender stereotypes prescribe that men should be more competitive than women, subsequently encouraging perceptions of the self and related behavior by each gender that appears consistent with this stereotype (Hanek et al., 2016). Therefore, it stands to reason that as they contemplate their future adult roles, adolescent females will be less likely than their male peers to perceive of themselves as competitive, and subsequently feel dis-inclined towards educational and occupational fields that appear to be consistent with this stereotypical masculine attribute.

A small body of mostly experimental research from the field of economics has supplied some evidence that this is the case, finding that females are typically less inclined towards competitive behavior than males, as evidenced, for example, by being less willing or eager to enter competitive academic tournaments (Booth & Nolen, 2012; Kamas & Preston, 2012; Niederle & Vesterlund, 2010). A few studies have examined whether young women's lower levels of competitiveness may contribute to gender differences in educational and occupational choices (Buser et al., 2014). For example, a study of high school students in Finland found that girls' lower relative levels of competitiveness helped to explain gender differences in expectations to pursue prestigious occupations (Kleinjans, 2009); this finding was echoed by a study of college students at a selective university that examined gender differences in expected adult earnings (Reuben et al., 2015).

Building on this very limited empirical research in conjunction with the insights of gender scholars, we argue that widely held, socially-constructed beliefs about competitiveness as a masculine characteristic will encourage adolescent males, and at the same time deter females, from developing interest and aspirations towards STEM fields. Studies reveal public perceptions of STEM fields as elite and high-status (Hershbein & Kearney 2014), and research examining the culture of academic STEM fields indicates the presence of strong competitive norms, where individuals seek to prove themselves as superior to others through intense work and high levels of productivity (Hirshfield, 2010; 2015; Traweek, 1988; Sallee, 2011; Schiebinger, 1999). Relatedly, literature within higher education has pointed towards the competitive atmosphere of STEM college majors, where grading is typically curve-based, and where classroom norms entail a focus on students proving themselves as smart and worthy of belonging, as integral to understanding why females choose to depart such majors (Fox et al., 2011; Seymour & Hewitt, 1997; Strenta et al., 1994*).* This stands in contrast to fields such as the social sciences and humanities, where grading schemes are often characterized as comparatively less stringent, and norms of inclusion are more prevalent (Barnes et al., 2001). Thus, to the extent that adolescents (and those around them that help shape their choices) view STEM fields as competitive domains where not everyone can succeed, those individuals who perceive themselves as more competitive will be more likely to plan to pursue STEM fields. And if girls perceive of themselves as less competitive than their male peers, as gender theories would predict, this likely contributes to the creation of a gender gap in expectations of pursuing STEM fields. Our study will investigate this possibility.

Additionally, we also consider the possibility that self-perceptions of competitiveness might be an even more important factor in shaping girls' decisions to pursue STEM fields than it is for boys. As outlined in expectation states theory, in circumstances when gender is salient, status characteristics create double standards when attributing competence or ability to individuals from a lower status group (Heilman, 2001; Ridgeway, 2001; Ridgeway & Correll, 2004). Put differently, in situations that call to mind masculine stereotypes and normative expectations, females are held to a different and higher standard to demonstrate their worth, while males have comparatively much less to prove.

Indeed gender-biased performance expectations are well-known to occur in STEM fields. Beginning in the early grades of elementary school, research finds evidence of bias in teachers' evaluations of students' math skills, such that girls are only viewed as mathematically proficient as their male peers when they are also perceived as working harder and being more eager to learn (Robinson-Cimpian et al., 2014). As young adults in college and the labor force, women in STEM fields report the burden of having to prove themselves over and over again to be taken seriously and given the same respect as a male peer (Williams et al., 2014). Regarding the link to competitiveness in particular, a recent case study of a STEM graduate program suggested that because female students do not physically embody masculinity in a domain where such is valued, they felt "more pressure to conform to strict norms of competition that are associated with traditional masculinity" compared to their male peers, who in fact did not feel the need to engage in expressly competitive behavior to be viewed as successful (Hirshfield, 2015).

Building on these insights, we suggest that when it comes to contemplating future college majors or occupations, gender is very likely salient in the minds of adolescents. Further, girls are likely aware (either consciously or subconsciously) from previous experiences in and out of classrooms that they will have to work harder to prove themselves in STEM domains than their male peers (Archer et al., 2017; Hughes, 2010; Schuster & Martiny, 2017). Consequently, it may take comparatively stronger perceptions of competitiveness for girls to choose to enter these masculine-stereotyped domains, given the gendered salience of such a choice. Our study will therefore investigate whether self-perceptions of competitiveness may be an even stronger predictor of future STEM expectations for female students than for male students.

Considering Variation within the Category of STEM

Finally, our study contributes to an emerging body of work that moves beyond a broad focus on STEM fields in the aggregate that can obscure important gendered patterns (Stout et al., 2016; Watt et al., 2017). While they share a foundation in mathematical thinking in common, and a process of scientific inquiry, individual fields under the umbrella of STEM possess their own distinct content and culture (Cheryan et al., 2016). Importantly from a gendered perspective, patterns of representation vary substantially across fields. For example, the biological sciences are generally characterized by a gender equitable composition, with recent U.S. cohorts even exhibiting a female advantage (58%) in the percentage of undergraduate degree holders (National Science Board, 2016). Yet women are under-represented among degree-holders in physical science (slightly under forty percent of degree holders). Finally, engineering and computer science stand out due to the dramatic under-representation of women, as less than twenty percent of undergraduate degrees in the U.S. in each of these fields are awarded to women (National Science Board, 2016). Recent studies suggested that these two fields are characterized by a stronger stereotypically masculine culture than other STEM fields, likely leading young girls and women to perceive of these fields as particularly incompatible with their gendered selves, and therefore leading to a low interest in pursuing a degree in these fields (Appianing & Van Eck, 2015; Cheryan et al., 2016; Denner, 2011).

The processes that underlie these different gender patterns are undoubtedly complex and raise many questions. For example, do young people view engineering as competitive because of the perceived challenge of the content and associated norms that accompany the field, or more because the field is male-dominated? Relatedly, do adolescents see biology as a particularly non-competitive field because so many women are already in it, or do young women choose biology because the field itself does not seem so competitive? While it is beyond the scope of the present study to answer the much larger question of the cause and effect relationship between the gender composition of a field and the public perceptions of the field as highly competitive in nature, informed by the insights of gender theorists (e.g Ridgeway & Correll, 2004), we posit that the process is more iterative than linear. Specifically to the extent that competitiveness is and remains strongly stereotyped as a male characteristic, the labeling of fields themselves as competitive will be strongly linked with its gender composition.

The specific contribution of this study then is to consider the vantage point of adolescents as they make decisions about the fields they want to pursue in the future, and to provide new empirical evidence about the extent to which their self-perceptions of competitiveness map onto their gendered expectations to pursue different STEM fields. To the extent that we find a link between this stereotypically male attribute and intentions to pursue male-dominated STEM fields, this speaks to an important way in which such fields are socially constructed as masculine that has heretofore received very little attention in the empirical literature. Further, by considering STEM fields with varying gender compositions, our results will help inform this larger conversation by revealing whether or not perceptions of competitiveness are similarly linked to young men and women's expectations of entering the most heavily male-dominated fields (engineering and computer science) vs. fields that are much less male-dominated (physical sciences).

RESEARCH QUESTIONS

Our study will address two research questions intended to extend the research literature on gender inequality in educational and occupational fields. First, do self-perceptions of competitiveness predict adolescents' expectations to major in different STEM fields, and if so, does this help to explain gender gaps in such expectations? Additionally, are perceptions of competitiveness stronger predictors of intentions to enter some STEM fields for girls than for boys?

METHOD

Participants

We utilize data collected from a sample of more than 600 high school students enrolled in 21 public schools, mostly in the South and Southwest regions of the U.S, in the spring of 2015. The students were enrolled in an interdisciplinary STEM course offered at their schools that was originally developed by faculty and researchers at a university in the Southwest, with support from the National Science Foundation as part of a broad national effort to provide more elective STEM course options to high school students nationwide. Specifically, the course uses project-based instruction to engage students in solving engineering tasks while using computational thinking, as well as more traditional math and science content. Importantly, while our sample of high school students is not representative of students nationwide, it captures a sub-population of students who have some level of interest in STEM. From a gender perspective this is particularly critical, as past research reveals that a majority of girls have decided by early adolescence that they are not interested in pursuing a STEM degree (Tai et al., 2006); thus our sample, while selective, provides the opportunity to examine how self-perceptions of competitiveness may shape the subsequent STEM-related decisions of girls who are still in the STEM pipeline, and thus 'at-risk' of exiting.

The schools in the sample were recruited by the curriculum team that designed the course, and include suburban (n=12), urban (n=6) and rural (n=3) schools. The schools also serve quite diverse populations, with an average percent minority of approximately 55 percent and an average percent economically disadvantaged of approximately 32 percent.

Our final analytic sample includes 633 students; consistent with the actual gendered patterns of enrollment in this elective STEM course, our analytic sample is 33% female and 67% male. Additionally, there is racial/ethnic diversity in our sample; while White students do comprise the largest group (46 percent), there is a substantial representation of Hispanic students (25 percent), Black students (9 percent), Asian students (13 percent), and students who report membership in more than one category (7 percent). Lastly, approximately half of the students (48%) report that their mother has a college degree, and most of the students are in their junior or senior year of high school (about 60 percent).

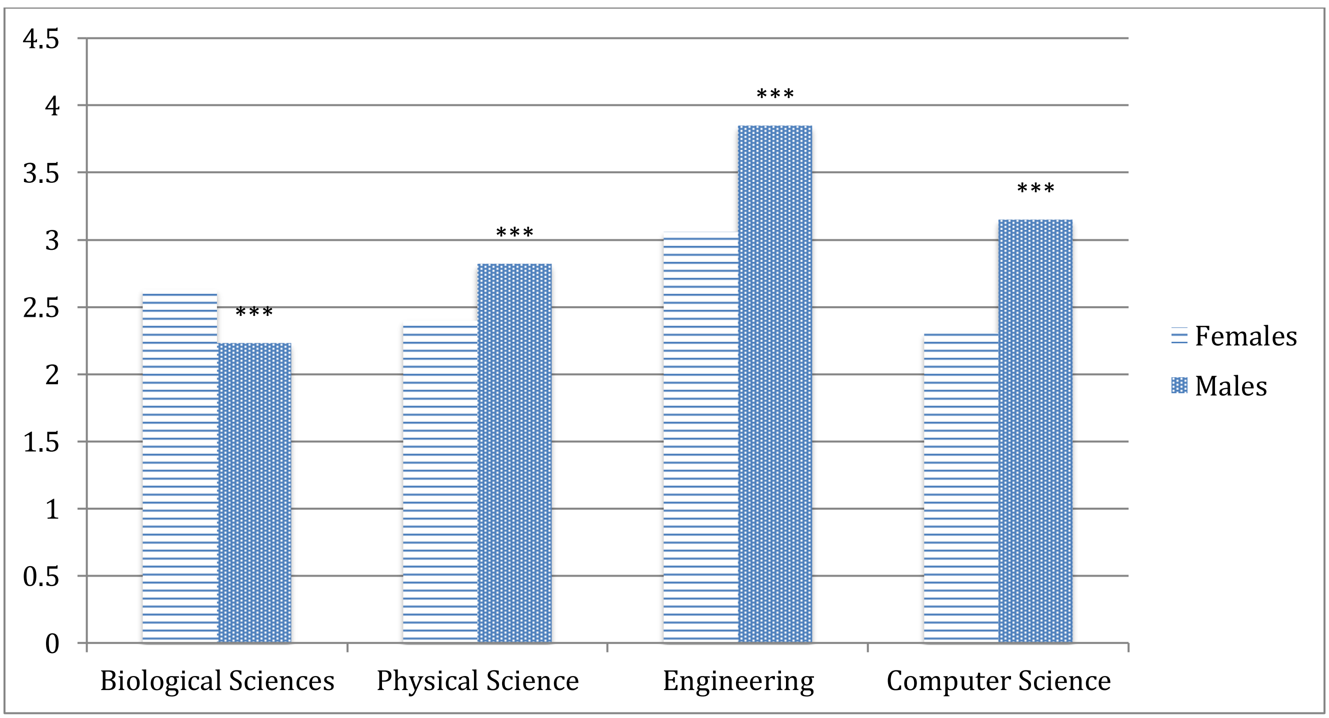
Procedure

Our data comes from student surveys administered online by classroom teachers during class at the end of the school year. The first page of the survey outlined that the intent was to learn about their educational experiences and goals, and that their responses were anonymous and confidential. All students in the class were surveyed, but we include only responses of students with signed parental consent forms (approximately 75% of all students surveyed).

Measures

Our **dependent variables** are students' *expectations of majoring in different STEM fields.* The survey asked students to report the likelihood that they would major in each of the following STEM fields in college: biological science, physical science, engineering, and computer science. Response categories for each of these seven variables were on a Likert scale from 1 (do not at all expect to major in this field) to 5 (very strongly expect to major in this field). Among the four different fields, expectations to major in the biological and physical sciences were positively correlated at about .4, while expectations to major in computer science and engineering were correlated at about .5.

Figure 1 displays the means on each of these outcomes by gender. While our sample is somewhat selective, the gendered patterns observed by field are similar to those evident in nationwide U.S. samples (National Science Board, 2016). Specifically, female students have statistically significantly higher expectations of majoring in the biological sciences. In contrast, male students have statistically significantly higher means than female students for expectations to major in each of the other STEM fields considered, but with a gender gap observed in physical science that is approximately half that observed in both engineering and computer science.



*** p <0.001; Results from two-tailed t-tests

Figure 1: Gendered Expectations of Majoring in Different STEM Fields

Our key **independent variable** is a scale used in previous research to measure students' *perceptions of competitiveness* (Ghaith, 2003). Students were asked a series of eight questions, such as: "I like the challenge of seeing who is best"; "I don't like being second"; and "I am happiest when I am competing with other students." Responses categories ranged from 1 (strongly disagree) to 5 (strongly agree). Students' responses were averaged across all items, and the alpha reliability for the scale is .896. As anticipated (and seen in Table 1), there is a statistically significant gender difference, with boys having a higher average than girls; the gender difference is approximately .4 of a standard deviation.

Table 1: Descriptive Statistics

	All Students	**Females**	**Males**	Significant gender difference
	Mean (or proportion)	Mean (or proportion)	Mean (or proportion)	
Competitiveness	3.56	3.36	3.66	***
	(.79)	(.79)	(.78)	
Race/Ethnicity				*
White	.46	.40	.49	
Hispanic	.25	.26	.24	
Black	.09	.12	.07	
Asian	.13	.15	.12	
Multi-racial	.07	.07	.06	
Grade level	.64	.61	.65	
	(.48)	(.49)	(.48)	
Math confidence	4.15	4.10	4.17	
	(.92)	(.94)	(.92)	
Math grade	.51	.57	.48	*
	(.50)	(.49)	(.50)	
Advanced math course-taking	.66	.65	.67	
	(.47)	(.48)	(.47)	
n	633	207	426	

Standard deviation in parentheses;
*** p <0.001, ** p <0.01, * p <0.05, ~ p <0.1; Results from two-tailed t-tests (and chi-square tests for race/ethnicity)

Our analyses also include several **control variables** to take account of different aspects of students' background. In addition to gender, we include measures of students' *race/ethnicity*, distinguishing between Black, Hispanic, Asian, and multi-racial students compared to White students (the reference group). Analytic models also include a control for students' *grade level*, coded 1 for juniors and seniors and 0 for freshmen and sophomores.

Furthermore, given that prior research has found that disparities on math confidence help to explain females' lower likelihood of entering STEM fields (e.g., Correll, 2001; Watt et al., 2017), additional control variables include students' self-reported *math confidence* (coded on a scale of 1 to 5). This variable is weakly correlated with perceptions of competitiveness (r=.3), and boys' mean was again higher than girls' mean, although this difference did not reach statistical significance. We also control on students' *advanced math course-taking* by including a dichotomous measure of whether or not the student has already taken, or is currently taking, advanced math classes (which includes Pre-calculus, Trigonometry, or Calculus), as well as a measure of students' *math grades*. As most students reported receiving high grades, the latter is coded as 1 if the student reports getting mostly A's in their high school math classes, and coded 0 if they report getting grades that are mostly B's and below. As seen in Table 1, about 66 percent of both male and female students report taking the advanced math classes listed above, while girls are statistically significantly more likely to report getting mostly A's in their math classes (57 percent of girls vs. 48 percent of boys).

Analyses Plan

To investigate our research questions, we utilize multivariate linear regression models with school fixed effects to account for the clustering of students within schools (ICCs across outcomes ranged from .01-.04). Supplementary analyses using ordered logit models yielded highly comparable results (results available upon request); however, for ease of interpretation we display the results of linear regression analyses.

To address our first research question, we include two models predicting each of our four STEM outcomes; the first model includes gender and all control variables, while the second model adds the measure of competitiveness. To assess whether the inclusion of competitiveness significantly reduces the gender gap in STEM expectations, we conducted post-estimation comparisons to test the difference in the gender coefficients between the first and second models (via the 'suest' command in Stata 14). To address our second research question, whether competitiveness is a stronger predictor of STEM expectations for girls than for boys, we created an interaction term between gender and competitiveness.

RESULTS

Beginning with the results from the baseline model predicting expectations of majoring in the biological sciences, net of the control variables in the model, female students have significantly higher expectations of majoring in this field than their male peers (B=.286*). Model 2 adds the variable for self-perceptions of competitiveness; the results reveal that such perceptions are not a statistically significant predictor of expectations of majoring in the biological sciences. Yet the next two sets of models reveal a different story for the physical sciences and engineering.

Beginning with the results for physical science, as seen in model 1, net of controls in the model, females remain significantly less likely to expect to major in physical science than their male peers (B=-.345*). With the addition of self-perceptions of competitiveness in the second model (B=.206*) the gender coefficient appears reduced from the first model (declining to -.291~). Post-hoc tests confirm that this reduction is statistically significant. The next set of models capturing expectations of majoring in engineering reveal a parallel pattern. As seen in the first model, girls are significantly less likely than boys to expect to major in engineering (B= -.519**). In model 2, the gender coefficient is reduced (B= -.467**) with the inclusion of perceptions of competitiveness (B= .198*). Post-hoc tests again confirm that the difference in gender coefficients between model 1 and model 2 is statistically significant.

The last set of models capture expectations of majoring in computer science. Although the gender coefficient in the first model appears slightly reduced in the second model with the inclusion of self-perceptions of competitiveness, this latter variable does not significantly predict the outcome in the full model, and post-hoc tests indicate that there is no statistically significant change in the gender coefficient across the two models.

Stepping back, in response to our first research question, we do find some evidence that students' self-perceptions of competitiveness predict expectations of majoring in some STEM majors, and that this helps to explain the gender gap in such expectations. Specifically, competitiveness significantly predicts intentions to major in both the physical sciences and engineering, but not the biological sciences or computer sciences (and post-hoc tests of coefficients confirm that the coefficients for physical science and engineering are significantly different than the coefficients for the other two outcomes). Further, the inclusion of self-perceptions of competitiveness significantly reduces the gender gap in expectations of majoring in both the physical sciences and engineering.

Although the main focus of this study is whether perceptions of competitiveness help explain gender disparities in intentions to major in STEM fields, we also note the effect of certain control variables in our analyses. First, students' math confidence significantly predicts intentions to major in physical science, engineering, and computer science; and in models predicting physical science and engineering expectations, the magnitude of the effect is comparable to that observed for competitiveness. This suggests that perceptions of competitiveness may be as important in predicting STEM intentions as this domain-based measure that is very commonly discussed in the research literature on gender and STEM fields. Relatedly, math course-taking is also a significant predictor of STEM intentions in all fields except engineering; however exploratory analyses reveal that it does significantly predict engineering intentions when math confidence is not included (as the variables are positively correlated).

Table 2: Examining Gender Gaps in Expectations of Majoring in STEM fields

	Biological Sciences		**Physical Science**		**Engineering**		**Computer Science**	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Competitiveness		0.126		0.206*		0.198*		0.102
		(0.086)		(0.073)		(0.086)		(0.072)
Female	0.286*	0.319*	-0.345*	-0.291~	-0.519**	-0.467**	-0.772***	-0.746***
	(0.119)	(0.122)	(0.153)	(0.147)	(0.151)	(0.152)	(0.127)	(0.131)
Grade Level	-0.133	-0.146	0.059	0.036	-0.143	-0.165	-0.415**	-0.427**
	(0.152)	(0.157)	(0.186)	(0.203)	(0.353)	(0.354)	(0.132)	(0.128)
Math Confidence	0.076	0.059	0.247**	0.220**	0.396***	0.370***	0.294***	0.280***
	(0.074)	(0.073)	(0.070)	(0.069)	(0.045)	(0.045)	(0.054)	(0.060)
Math Grade	0.005	-0.024	0.114	0.066	0.124	0.078	0.067	0.044
	(0.121)	(0.121)	(0.107)	(0.106)	(0.093)	(0.088)	(0.201)	(0.190)
Math Course -Taking	0.227*	0.216*	0.357**	0.340**	0.098	0.081	0.257*	0.249*
	(0.098)	(0.101)	(0.114)	(0.110)	(0.165)	(0.151)	(0.117)	(0.115)
Race/Ethnicity (reference =white)								
Hispanic	0.092	0.081	0.139	0.121	0.178	0.161	0.284~	0.275
	(0.139)	(0.142)	(0.160)	(0.157)	(0.195)	(0.196)	(0.163)	(0.166)
Black	-0.089	-0.118	-0.204	-0.252	0.031	-0.015	0.349	0.325
	(0.222)	(0.211)	(0.238)	(0.252)	(0.195)	(0.199)	(0.232)	(0.232)
Asian	0.218~	0.216~	-0.170	-0.174	-0.100	-0.103	0.306~	0.304~
	(0.124)	(0.125)	(0.128)	(0.131)	(0.129)	(0.143)	(0.159)	(0.161)
Multiracial	0.247	0.226	0.219	0.185	0.327	0.295	0.069	0.052
	(0.197)	(0.190)	(0.159)	(0.148)	(0.229)	(0.234)	(0.155)	(0.160)
Constant	1.796***	1.444**	1.362***	0.785*	2.030***	1.477**	1.821***	1.536***
	(0.291)	(0.424)	(0.285)	(0.351)	(0.250)	(0.430)	(0.199)	(0.287)

N=633; Coefficients are from fixed effects regression models; Robust standard errors in parentheses
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, ~ $p<0.1$; Two tailed test

While we find obvious gender differences in STEM intentions, we find little evidence of racial/ethnic differences. Specifically, Asian students are more likely than their White peers to expect to major in both the biological sciences and computer science, but both effects are marginally significant ($p<.10$). A marginally significant positive effect is also observed for Hispanic students relative to White students for computer science expectations in the baseline model. We note that although our sample is selective, these results are nevertheless consistent with studies using national data to examine STEM intentions across racial/ethnic groups, which tend to find that Black and Hispanic students are equally likely to declare STEM majors as their White peers, while Asian students are generally more likely to enter most STEM fields compared to White students (Xie, Fang, & Shauman, 2015).

Finally, to address our second research question, Table 3 displays the results of separate models for each STEM major where we test the interaction between gender and self-perceptions of competitiveness. Each model includes the same variables as those in model 2 in Table 2. Results reveal a positive and statistically significant interaction only in the model predicting expectations of majoring in computer science. Additionally, the main effect of competitiveness on expectations to major in computer science is near zero and not statistically significant, indicating that self-perceptions of competitiveness is positively associated with plans to major in computer science only for girls.

Predicted values confirm that this is the case; using the margins post-estimation command in Stata, we calculated the predicted level of computer science expectations based on students' level of competitiveness, while holding all other variables in the model to the mean. Beginning with the results for female students and, recalling that expectations to major in computer science are coded on a scale from 1 (not at all likely) to 5 (very likely), as seen in Figure 2, girls who have the lowest self-perceptions of competitiveness have a predicted score of 1.7. As girl's perceived competitiveness increases to the maximum level, their predicted level of computer science expectations increases to 2.8. In contrast, predicted values for male students show a different story. For example, boys with the minimum level of perceived competitiveness have a predicted value of 3.09. As their perceptions of competitiveness increase to the maximum value, however, we see only a very slight and statistically non-significant increase to 3.15. Thus, while girls' expectations to major in computer science clearly increase with their perceptions of competitiveness, boys' expectations of majoring in computer science appear impervious.

Table 3: Interactions of Gender and Self-Perceptions of Competitiveness Predicting Expectations to Major in STEM Fields

	Biological Sciences	**Physical Science**	**Engineer-ing**	**Computer Science**
Female * Competitiveness	0.001	0.161	0.090	0.260**
	(0.159)	(0.154)	(0.108)	(0.088)
Female	0.315	-0.851	-0.781~	-1.652***
	(0.575)	(0.544)	(0.436)	(0.343)
Competitiveness	0.126	0.152	0.168	0.014
	(0.112)	(0.105)	(0.100)	(0.094)
Grade Level	-0.147	0.022	-0.173	-0.449**
	(0.157)	(0.201)	(0.355)	(0.139)
Math Confidence	0.059	0.217**	0.368***	0.276***
	(0.072)	(0.070)	(0.046)	(0.056)
Math Grade	-0.024	0.070	0.081	0.051
	(0.120)	(0.104)	(0.089)	(0.191)
Math Course-Taking	0.216*	0.346**	0.084	0.258*
	(0.103)	(0.109)	(0.151)	(0.118)
Race/Ethnicity (reference=white)				
Hispanic	0.082	0.135	0.169	0.297~
	(0.139)	(0.154)	(0.194)	(0.169)
Black	-0.118	-0.251	-0.014	0.327
	(0.211)	(0.260)	(0.204)	(0.236)
Asian	0.216~	-0.166	-0.099	0.316~
	(0.124)	(0.131)	(0.141)	(0.159)
Multiracial	0.226	0.196	0.301	0.070
	(0.185)	(0.147)	(0.235)	(0.167)
Constant	1.445**	0.995*	1.594**	1.875***
	(0.468)	(0.446)	(0.494)	(0.343)

N=633; Coefficients are from fixed effects regression models; Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, ~ p<0.1; Two tailed test

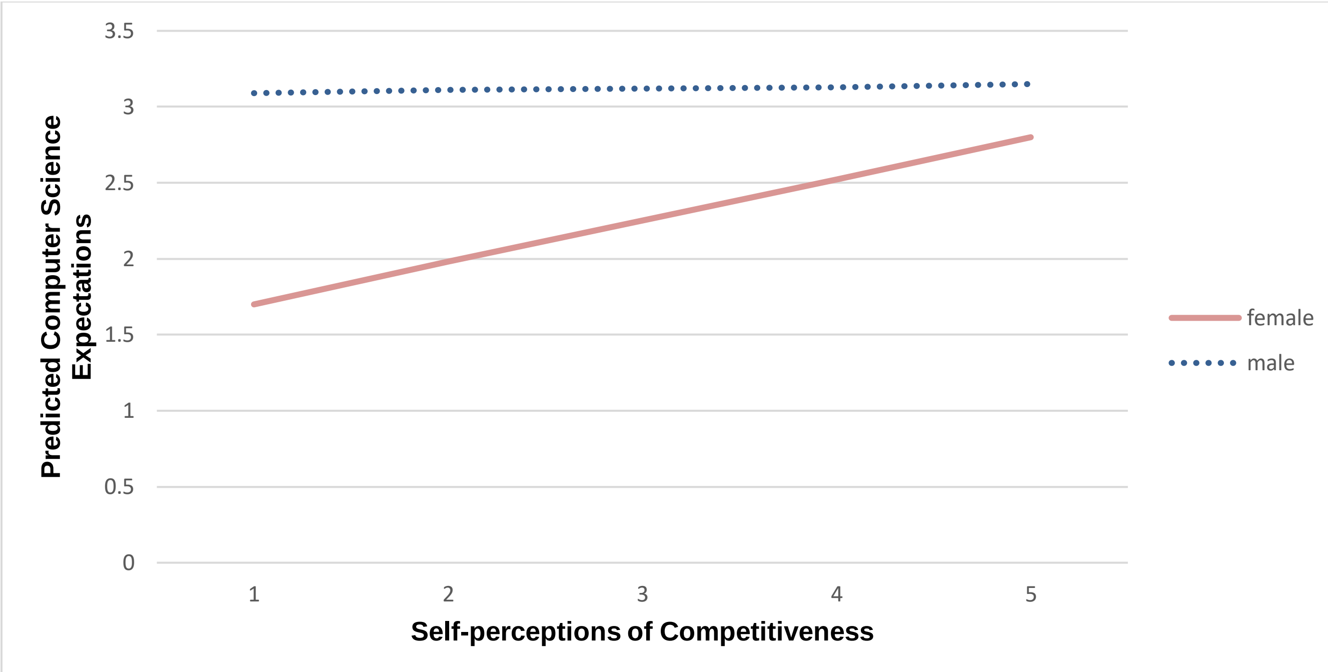


Figure 2: Predicted Computer Science Expectations Based on Self-Perceptions of Competitiveness

DISCUSSION

In an effort to understand persistent gender inequality in STEM fields, scholars have rightly paid attention to the critical role of gender norms and stereotypes in creating and maintaining the under-representation of women in these relatively high-earning and high-status fields. Yet empirical studies in this vein have primarily concentrated on measuring the existence and impact of domain-based beliefs and stereotypes, including research on females' lower levels of math confidence and studies on implicit stereotypes that males are innately better at math (Dasgupta & Asgari, 2004; Correll, 2001; Eccles, 1994; Perez-Felkner et al., 2017). This important body of research has gone a long way to highlighting the social construction of gender differences in experiences and engagement in STEM fields. In this paper, we seek to contribute new knowledge to a not-so-new topic by arguing that more research is needed to explore how socially-constructed gender norms or stereotypes that are broader in scope also have strong implications for inequality in STEM fields. Specifically, building on the insights of gender theorists as well as a small body of emerging quantitative research from economics, we examined whether and how students' perceptions of competitiveness are related to gendered patterns of future STEM expectations. Importantly we considered patterns across four different STEM fields, including those that are strongly male-dominated as well as those that are not.

The results of our data analyses provide new evidence that self-perceptions of competitiveness may indeed play a key role in explaining why young women are less likely than their male peers to decide to enter some STEM fields, despite being well-qualified to do so. Specifically, in response to our first research question, we found that self-perceptions of competitiveness was not a significant predictor of expectations to major in the biological sciences, a STEM postsecondary field that at the national level is comprised of more females than males (a pattern also mirrored in our measure of expectations). Yet female students' relatively lower perceptions of competitiveness (compared to male students) significantly helps to explain their correspondingly lower expectation of majoring in two STEM fields traditionally dominated by men (although to different degrees): physical science and engineering. We note that these results are net of a host of control variables, some of which are strong predictors of students' STEM expectations, such as math self-confidence.

We also found some evidence in support of our second research question, as additional results revealed an interaction between gender and self-perceptions of competitiveness for predicting expectations to major in computer science. As shown in Figure 2, self-perceptions of competitiveness was not a significant predictor of computer science expectations for male students, but was in fact significantly and positively related to female students' expectations of pursuing this field. In making sense of this result, we note that the insights of expectation states theory led us to wonder whether competitiveness might be an even stronger predictor for females' than for males' decisions to enter some STEM fields; yet our results revealed that the interaction between gender and competitiveness was driven by the fact that young men's decisions to pursue computer science appear completely un-related to their self-perceptions of competitiveness. Thus, it is not simply that high school girls' expectations to enter this field are more strongly associated with competitiveness than is the case for boys, but rather that there is no significant association with boys' expectations.

So why might young men's future plans to pursue computer science appear impervious to their perceptions of competitiveness? Perhaps the social framing of computer science as masculine is so strong that for young men, endorsing stereotypically masculine characteristics appears unnecessary or brings no added benefit. Recent stories in the media have chronicled the strong male culture of the field, one that often veers towards outwardly misogynistic and gender discriminatory practices as seen in prominent organizations such as Google and Microsoft, as well as in on-line gaming communities (Isaac, 2016; O'Brien, 2015; Wingfield, 2014). Given such a notable public awareness and conversation regarding the masculinity of computing fields, perhaps adolescent males do not feel any need to prove that they belong there; and correspondingly it is not surprising that female students might view it very differently. Indeed, we note that in terms of gender composition, computer science is as strongly male-dominated as engineering; yet self-perceptions of competitiveness do predict intentions to major in engineering for young men (and women). This suggests that among young men at least, there may be differences in how they view the expectations and culture of these two fields and their likely fit within them, such that they might feel the need to work to prove themselves worthy against others within one field but not the other.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

While our focus on the relation between competitiveness and gendered decisions to pursue STEM fields makes a new contribution to the literature on inequality, we acknowledge several limitations and related areas for new research to consider.

First, we note that our measure of competitiveness is self-reported and therefore captures students' perceptions, unlike, for example, some experimental studies that aim to measure actual competitive behavior (e.g. Hanek et al., 2016). However, much as research on math confidence or self-efficacy finds that female students under-rate their actual mathematical ability (while males tend to over-rate theirs) with resultant implications for choosing to enter some STEM fields (Correll, 2001), we posit that self-perceptions of competitiveness are likely to be as important (if not more important) in shaping young people's choices of what fields to pursue. Relatedly, we suspect that what students define as competitive behavior is itself strongly shaped by gender norms and stereotypes; for example, girls tend to get the highest grades in school, even in math classes (as echoed in our sample as well), and therefore could be viewed as the most successful when competing for grades. We think that future qualitative research could add much to our understanding of these issues by querying young women (and young men) about whether and how they define their academic motivations and behaviors in terms of competitiveness.

Second, regarding data limitations, although longitudinal research has found a strong link between expectations formed in high school and subsequent choices (Xie & Shauman, 2003), our study is cross-sectional in nature and cannot determine whether perceptions of competitiveness will in fact predict ultimate decisions that young people make regarding their choice of major and occupation. Our sample is also quite selective as it includes high school students enrolled in an elective STEM course; gender differences in competitiveness may in fact be greater in a less selective sample and have additional implications for other gendered outcomes, such as decisions to attend highly selective colleges.

Additionally, in exploratory analyses we tested for but did not find any evidence that the association between competitiveness and gendered expectations varied across racial/ethnic groups. As our study is necessarily limited in scope and in size, we suggest that new research in this area should consider intersectionality, as what it means to be competitive and how it is related to future choices may vary according to racial/ethnic background.

Furthermore, while we argue that there is good reason to think that STEM domains are generally viewed as competitive domains due to the rigor of the academic content as well as the (real or perceived) norms and climate of these fields (Barnes et al., 2001; Hirshfield, 2015; Traweek, 1988), we acknowledge that it is beyond the scope of this paper to establish the causal direction of the relationship (e.g., are fields perceived as competitive because more men are in them, or are certain fields male-dominated because men are drawn to the competitive characterization of the fields?).Yet at the same time, we note that our findings reveal some interesting patterns across fields. As mentioned above, despite the fact that computer science shares the common distinction with engineering as being the most male-dominated (National Science Board, 2016), boys' expectations of pursuing computer science were un-related to their perceptions of competitiveness. Further, for both genders, self-perceptions of competitiveness were equally strong predictors of expectations of majoring in engineering (which is generally more than 80% male) and physical science (which is typically about 60% male). This suggests that it might not be just gender composition itself that cues students' views of how competitive they need to feel to fit with a given field. Future studies could explore this by more directly examining how young women and young men perceive different STEM fields in terms of their climate and culture, and could also examine whether and how competitiveness is linked to decisions to enter other less-studied male-dominated fields, such as economics and philosophy (Leslie et al., 2015).

IMPLICATIONS AND CONCLUSION

Our study has implications for the field of higher education. To the extent that some STEM disciplines choose to create a competitive culture, or at the very least, (explicitly or implicitly) contribute to the public perception of such a competitive culture, they may do so to their own detriment. As the U.S. is continuing to face a shortage of workers in many STEM disciplines, the current historical moment requires that we think about how best to recruit more students to these fields, rather than how to weed them out. And while a good amount of pre-requisite skills and knowledge are a logical requirement for entry into such fields, perceptions of an inhospitable culture where students are pitted against one another to prove their relative worth, is likely to deter many talented young women (as well as some men). We therefore concur with others who have charged STEM faculty and administrators in higher education with confronting their own pedagogical and grading practices in this regard (Fox et al., 2011; National Academies of Sciences, Engineering, and Medicine, 2016).

Additionally, the continued gendered disparities in expectations of entering STEM fields speak to the clear need for interventions and programs designed at promoting gender equity to also focus on male students. Too often the emphasis lies on helping girls and young women to change (e.g., become more confident in your ability to navigate a man's world). Yet our findings regarding computer science in particular perhaps hint at a much less-discussed problem. To the extent that boys and young men embrace the notion that certain educational or occupational fields belong to men, they may help to construct an environment that is hostile to the presence of women. Rather than simply coaching female students to embrace a sense of competitiveness to succeed in such an environment, educators can also encourage male students to relinquish their constructed sense of entitlement.

Overall, our study contributes to the larger literature on gender stratification in education and the labor force by shedding light on the continued deterrents to women's equal representation in STEM fields. While progress towards gender equality has occurred in the past few decades, young women remain less likely than young men to consider many STEM fields as potential opportunities for their own futures. We argue that the social construction of competitiveness as a male characteristic and the corresponding construction of some STEM fields as competitive arenas for only the very best, are likely key factors behind the creation and maintenance of gender inequality, and thus require more critical attention.

ACKNOWLEDGEMENTS
This research was supported by grants from the National Science Foundation (HRD-1348819; Catherine Riegle-Crumb, PI; DUE-0831811; Dave Allen, PI). This research was also supported by NICHD grant 5 R24 HD042849, awarded to the Population Research Center at the University of Texas at Austin. Opinions reflect those of the authors and do not necessarily reflect those of the granting agencies.

REFERENCES

Archer, L., Moote, J., Francis, B., DeWitt, J., & Yeomans, L. (2017). The "exceptional" physics girl: A sociological analysis of multimethod data from young women aged 10–16 to explore gendered patterns of post-16 participation. *American Educational Research Journal 54*, 88-126.

Appianing, J., & Van Eck, R. N. (2015). Gender differences in college students' perceptions of technology-related jobs in computer science. *International Journal of Gender, Science and Technology*, *7*(1), 28-56.

Bandura, A., Barbaranelli, C., Caprara, G.V., & Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories*. Child Development*, 72, 187-206.

Barnes, L. L. B., Bull, K. S., Campbell, J., & Perry, K. M. (2001). Effects of academic discipline and teaching goals in predicting beliefs among undergraduate teaching faculty. *Research in Higher Education, 42*, 455-467.

Bonnot, V., & Croizet, J. (2007). Stereotype internalization and women's math performance: The role of interference in working memory. *Journal of Experimental Social Psychology, 43,* 857-866.

Booth, A.L., & Nolen, P. (2012). Gender differences in risk behaviour: Does nurture matter? *The Economic Journal, 122*, F56-F78.

Buser, T., Niederle, M., & Oosterbeek, H. (2014). Gender, competitiveness, and career choices. *The Quarterly Journal of Economics, 129,* 1409-1447.

Ceci, S.J., Williams, W. M. & Barnett, S.M. (2009). Women's underrepresentation in science: sociocultural and biological considerations. *Psychological Bulletin, 135,* 218-261.

Charles, M. & Bradley, K. (2002). Equal but separate? A cross-national study of sex segregation in higher education. *American Sociological Review, 67*, 573-599.

Cheryan, S., Ziegler, S.A., Montoya, A.K., & Jiang, L. (2016). Why are some STEM fields more gender balanced than others? *Psychological Bulletin,143,* 1-35.

Cech, E., Rubineau, B., Silbey, S., & Seron, C. (2011). Professional role confidence and gendered persistence in engineering. *American Sociological Review*, *76,* 641-666.

Correll, S.J. (2001). Gender and the career choice process: the role of biased self-assessments. *American Journal of Sociology, 106*, 1691-1730.

Dasgupta, N., & Asgari, S. (2004). Seeing is believing: Exposure to counterstereotypic women leaders and its effect on the malleability of automatic gender stereotyping. *Journal of Experimental Social Psychology, 40,* 642-658.

Denner, J. (2011). What Predicts Middle School Girls' Interest in Computing? *International Journal of Gender, Science and Technology*, *3*(1) 54-69.

Diekman, A. B., Brown, E.R., Johnston, A.M., & Clark, E.C. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science, 21,* 1051-1057.

Diekman, A.B., Clark, E.K., Johnston, A.M., Brown, E.R., & Steinberg, M. (2011). Malleability in communal goals and beliefs influences attraction to STEM careers: Evidence for a goal congruity perspective. *Journal of Personality and Social Psychology, 101*, 902-918.

DiPrete, T.A., & Buchmann, C. (2013). *The rise of women: The growing gender gap in education and what it means for American schools*. New York: Russell Sage Foundation.

Eagly, A.H. (1997). Sex differences in social behavior: Comparing social role theory and evolutionary psychology. *American Psychologist, 52,* 1380-1383.

Eccles, J. S. (1994). Understanding women's educational and occupational choices. *Psychology of Women Quarterly*, *18,* 585-609.

Eccles, J. S. (2007). Where Are All the Women? Gender Differences in Participation in Physical Science and Engineering. In Ceci, S.J. & Williams, W.M. (Eds.), *Why Aren't More Women in Science? Top Researchers Debate the Evidence* (199-210). Washington, D.C.: American Psychological Association.

Eccles, J.S., & Wang, M. (2016) What motivates females and males to pursue careers in mathematics and science? *International Journal of Behavioral Development*, *40,* 100-106.

Fox, M.F., Sonnert, G., & Nikiforova, I. (2011). Programs for undergraduate women in science and engineering: Issues, problems, and solutions. *Gender & Society, 25,* 589-615.

Gresky, D.M, Ten Eyck, L.L., Lord, C.G., & Intyre, R.B. (2005). Effects of salient multiple identities on women's performance under mathematics stereotype threat. *Sex Roles*, *53,* 703-716.

Ghaith, G. (2003). The relationship between forms of instruction, achievement, and perceptions of classroom climate. *Educational Research, 45*, 83-93.

Hackett, G. (1985). Role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis, *Journal of Counseling Psychology*, *32,* 47-26.

Hanek, K. J., Garcia, S.M., & Tor, A. (2016). Gender and competitive preferences:

The role of competition size. *Journal of Applied Psychology, 101,* 1122-1133.

Hershbein, B., & Kearney, M. (2014). *Major decisions: What graduates earn over their lifetimes.* New York, NY: The Hamilton Project: Brookings Institution Press.

Heilman, M. E. (2001). Description and prescription: How gender stereotypes prevent women's ascent up the organizational ladder. *Journal of Social Issues, 57,* 657-674.

Hirshfield, L. E. (2010). “She Won’t Make Me Feel Dumb”: Identity Threat in a Male-Dominated Discipline. *International Journal of Gender, Science and Technology*, *2*(1), 6-24.

Hirshfield, L. E. (2015). “I just did everything physically possible to get in there”: How men and women chemists enact masculinity differently. *Social Currents, 2*, 324-340.

Hughes, R. M. (2010). Keeping college women in STEM fields. *International Journal of Gender, Science and Technology*, *2*(3), 417-436.

Isaac, M. (2016). Women in Tech Band Together To Track Diversity, After Hours. *New York Times,* 3 May*.* Retrieved from https://www.nytimes.com/2016/05/04/technology/women-in-tech-band-together-to-track-diversity-after-hours.html

Kamas, L., & Preston, A. (2012). The importance of being confident; gender, career choice, and willingness to compete. *Journal of Economic Behavior & Organization, 83*, 82-97.

Kleinjans, K.J. (2009). Do gender differences in preferences for competition matter for occupational expectations? *Journal of Economic Psychology, 30*, 701-710.

Lane, K.,Goh, J.X., & Driver-Linn, E. (2012). Implicit science stereotypes mediate the relationship between gender and academic participation. *Sex Roles*, *66,* 220-234.

Lazarides, R., & Watt, H. M. (2017). Student-perceived mothers’ and fathers’ beliefs, mathematics and english motivations, and career choices. *Journal of Research on Adolescence*. DOI: 10.1111/jora.12317

Leslie, S., Cimpian, J., Meyer, A., & Freeland, E. (2015). Expectations of brilliance underlie gender distributions across academic disciplines. *Science,* 347(6219), 262-265.

Lent, R. W., Lopez, F.G., & Bieschke, K.J. (1991). Mathematics self- efficacy: Sources and relation to science-based career choice, *Journal of Counseling Psychology*, *38,* 424-430.

McGuire, J.E., & Leaper, C. (2017). Competition, coping, and closeness in young hetereosexual adults’ same-gender friendships. *Sex Roles, 74,* 422-435.

Morgan, S.L., Gelbgiser, D., & Weeden, K.A. (2013). Feeding the pipeline: Gender, occupational plans, and college major selection*. Social Science Research, 42,* 989-1005.

National Science Board. 2016. *Science and Engineering Indicators* (2016). Arlington, VA: National Science Foundation.

National Academies of Sciences, Engineering, and Medicine. (2016). *Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic Change to Support Diverse Student Pathways*. Committee on Barriers and Opportunities in Completing 2-Year and 4-Year STEM Degrees. S. Malcom and M. Feder, Editors. Board on Science Education, Division of Behavioral and Social Sciences and Education. Board on Higher Education and the Workforce, Policy and Global Affairs. Washington, DC: The National Academies Press. doi: 10.17226/21739.

Niederle, M., & Vesterlund. L. (2010). Explaining the gender gap in math test scores: The role of competition. *The Journal of Economic Perspectives, 24*, 129-144.

O'Brien, A. (2015). Microsoft sued for gender discrimination. CNN Tech, 16 September. Retrieved from http://money.cnn.com/2015/09/16/technology/microsoft-lawsuit-sex-discrimination/index.html

Perez-Felkner, L., Nix, S., & Thomas, K. (2017). Gendered pathways: How mathematics ability beliefs shape secondary and postsecondary course and degree field choices. *Frontiers in Psychology*, *8*, 1-11.

Perry, D. G., & Pauletti, R. E. (2011). Gender and adolescent development. *Journal of Research on Adolescence*, *21*(1), 61-74.

Reuben, E., Wiswall, M., & Zafar, B. (2015). Preferences and biases in educational choices and labour market expectations: Shrinking the black box of gender. *The Economic Journal*, *127*, 2153-2186.

Ridgeway, C. L. (2011). *Framed by gender: How gender inequality persists in the modern world.* New York: Oxford University Press.

Ridgeway, C. L. (2001). Gender, status, and leadership. *Journal of Social Issues, 57*, 637-655.

Ridgeway, C.L., & Correll, S.J. (2004). Unpacking the gender system a theoretical perspective on gender beliefs and social relations. *Gender & Society, 18,* 510-531.

Risman, B. J. (2004). Gender as a social structure: Theory wrestling with activism. *Gender & Society*, 18, 429-450.

Robinson-Cimpian, J.P., Lubienski, S.T., Ganley, C.M., & Copur-Gencturk, Y. (2014). Teachers' perceptions of students' mathematics proficiency may exacerbate early gender gaps in achievement. *Developmental Psychology, 50,* 1262-1281.

Robnett, R. D., & Leaper, C. (2013). Friendship groups, personal motivation, and gender in relation to high school students' STEM career interest. *Journal of Research on Adolescence*, *23*(4), 652-664.

Schiebinger, L. (1999). *Has feminism changed science?* Cambridge, MA: Harvard University Press.

Schuster, C., & Martiny, S.E. (2017). Not feeling good in STEM: Effects of stereotype activation and anticpated affect on women's career aspirations. *Sex Roles, 76,* 40-55.

Seymour, E., & Hewitt, N.M. (1997). *Talking about leaving: Why undergraduates leave the sciences.* Boulder, CO: Westview Press.

Stout, J.G., Grunberg, V.A., & Ito, T.A. (2016). Gender roles and stereotypes about science careers help explain women and men's science pursuits. *Sex Roles, 75,* 490-499.

Strenta, A.C., Elliott, R., Adair, R., Matier, M., & Scott, J. (1994). Choosing and leaving science in highly selective institutions. *Research in Higher Education*, 35, 513-547.

Tai, R. H., Liu, C.Q., Maltese, A.V., & Fan, X. (2006). Planning early for careers in science. *Science, 312,* 1143–1144.

Traweek, S. (1988). *Beamtimes and lifetimes: The world of high energy physicists*. Cambridge, MA: Harvard University Press.

Watt, H.M., Hyde, J.S., Peterson, J., Morris, Z.A., Rozek, C.S., & Harackiewicz, J.M. (2017). Mathematics- a critical filter for STEM-related career choices? A longitudinal examination among Australian and U.S. adolescents. *Sex Roles 77*: 254-271.

Williams, J., Phillips, K.W., & Hall, E.V. (2014). *Double jeopardy?: gender bias against women of color in science*. Center for WorkLife Law at U.C. Hastings College of Law. Retrieved at http://worklifelaw.org.

Wingfield, N. (2014). Feminist Critics of Video Games Facing Threats in "GamerGate" Campaign. *New York Times,* 15 October. Retrieved from https://www.nytimes.com/2014/10/16/technology/gamergate-women-video-game-threats-anita-sarkeesian.html

Xie, Y., Fang, M., & Shauman, K. (2015). STEM education. *Annual Review of Sociology*, *41*, 331-357.

Xie, Y., & Shauman, K. A. (2003). *Women in science: Career processes and outcomes.* Vol. 26, no. 73.4. Cambridge, MA: Harvard University Press.