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Exploring international gender differences in mathematics self-concept

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Abstract

This study provides an international perspective on mathematics by examnnng mathematics self-concept, achievement, and the desire to enter a career involving mathematics among eighth graders in 49 countries. Using data from the Trends in International Mathematics and Science Study, this study shows that self-concept in mathematics is more closely related to the desire to enter a career using mathematics than achievement is. Further, while gender differences in mathematics self-concept are smaller in more egalitarian countries, both girls and boys have lower mathematics self-concepts and less interest in mathematics careers in these countries. These findings reveal a policy paradox: policies aimed at training the next generation of STEM professionals often highlight the need to close the gender gap, but countries with smaller gender gaps have fewer boys and girls interested in mathematics-intensive careers. We conclude by highlighting the importance of disentangling instrumental and expressive aspects of gender inequality in STEM fields.

Keywords

gender inequality; mathematics self-concept; international education; mathematics achievement; STEM; eighth graders

INTRODUCTION

In spite of the fact that women are excelling in fields such as medicine, law, and literature, women remain underrepresented in science, technology, engineering, and mathematics (STEM) fields (Burrelli, 2008; U.S Department of Labor, 2005). This is particularly noteworthy given that women are now doing considerably better than men in terms of high school and college graduation (Buchmann, Diprete & McDaniel 2008; Schofer & Meyer 2005). One factor why women remain underrepresented in STEM fields highlighted by previous research is a lack of self-concept in mathematics (Fox, Sonnert, & Nikiforova, 2011).

Self-concept captures a person's 'perception of himself, and these perceptions are thought to influence the ways in which he acts, and his acts in turn influence the

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> ways in which he acts, and his acts in turn influence the ways in which he perceives himself. (Shavelson, Hubner, & Stanton, 1976, p. 411)

Students base their mathematics self-concept largely on their experiences and history of achievement, and this self-concept is a crucial component in pursuing a career in a STEM field, as students with low levels of self-concept do not believe that they will perform well in this area (Usher, 2009; Pajares & Miller; 1994, Louis & Mistele, 2012; Bong & Skaalvik, 2003).

Although research has highlighted the important role self-concept plays in encouraging women to pursue and excel in mathematics (Hackett, 1985; Pajares & Miller, 1994; Luzzo, Hasper, Albert, Bibby & Martinelli, 1999), mathematics self-concept is often overlooked in cross-national studies of gender differences, which more often focuses on gender differences in achievement (e.g. Baker & Jones, 1993; Felson & Trudeau, 1991; Penner, 2008). Studies of international gender differences in achievement highlight the role that country level factors play in shaping gender inequality in STEM fields, showing for example, that gender differences in mathematics and science achievement is smaller in more gender egalitarian countries (e.g., Guiso, Monte, Sapienza, & Zingales, 2008; Penner and CadwalladerOlsker, 2012; Riegle-Crumb, 2005). By contrast, research examining the underrepresentation of women in STEM majors suggests that country-level gender egalitarianism is more closely associated with whether women get degrees than whether they are getting degrees in STEM fields, and suggests that forms of gender egalitarianism that stress self-expression might actually lead women to be more underrepresented in STEM fields (Charles & Bradley, 2002; 2009). As such, it is unclear how the overall level of gender egalitarianism in a country might shape gender differences in mathematics self-concept. This study thus draws on data from 49 countries to examine the mathematics self-concept levels of eighth grade girls and boys, comparing not only how gender differences in mathematics self-concept vary across countries and is shaped by the larger gender egalitatrianism of the country, but also how mathematics self-concept and achievement are related to interest in pursing a career involving mathematics.

We believe that this is important, because while the gender differences in content knowledge represented by gender differences in achievement may play a key role in creating gender inequality in STEM representation, in order to persist in the STEM pipeline, students need to have not just content knowledge, but also mathematics self-concept (cf. Ceci & Williams, 2009). A high aptitude in mathematics is unlikely to translate into a STEM degree without high levels of mathematics self-concept, as self-concept provides the belief that one can succed in STEM. While previous research has found that mathematics self-concept increases as achievement increases (Hackett, 1985; Louis & Mistele, 2012; Peters, 2013; Usher, 2009; Wang, Osterlind, & Bergin, 2012), given the important role of mathematics self-concept in shaping students' career interests (Luzzo et al., 1999; Pajares & Miller, 1994), it is important for international research to examine gender differences in mathematics self-concept directly.

In particular, we argue that it is important to examine self-concept directly given research showing that boys believe that they are more mathematically competent than girls even when they have the same level of mathematics achievement (Correll 2001). Correll suggests that cultural beliefs and expectations lead men to believe that they are better in mathematics even when they are not, which results in them pursuing mathematical careers at higher rates than women (Corell, 2001; 2004). While Correll examines only students in the United States, some international research also suggests that mathematics self-concept may be more important for understanding the gender differences in representation in STEM fields, as they find no significant gender difference in achievement, but that boys have higher mathematics self-concept than girls (Louis and Mistele 2012; Peters 2012).

Our study builds on this work by examining how students perceive their own mathematical skills through a self-assessment in 49 countries. Studying multiple countries provides a boarder perspective on gender differences in mathematics self-concept, and allows us to link gender differences in this domain to the gender egalitarianism of the country more broadly. We begin by examining the how mathematics self-concept and achievement are related to gender differences in career interests, showing that mathematics self-concept is more closely linked to career interests than achievement. We then provide information about gender differences in mathematics self-concept in the various countries, and examine the degree to which mathematics self-concept tracks with achievement for girls and boys in the 49 countries we examine. We conclude by examining the importance of broader country level gender inequality, examining the degree to which GEM scores track with gender differences in self-concept and interest in a career involving math.

DATA AND METHODS

Data

To address these questions, we use data on eighth grade students from the 2007 Trends in International Mathematics and Study (TIMSS). Eighth grade represents a key stage for understanding the emergence of gender differences in STEM fields, as previous research has highlighted the importance of adolescence (e.g. Riegle-Crumb, Moore & Ramos-Wada, 2010). TIMSS is a well-established long-running survey that collects nationally representative survey data on fourth and eighth grade students across a range of countries. Importantly for our purposes, TIMSS not only includes a mathematics test, which examine students' knowledge, application, and reasoning in four content areas (number, algebra, geometry, and data and probability), but also asks students questions about their mathematics self-concept and the degree to which they view math as important to their future career (Mullis et al., 2005). We examine TIMSS data from 49 countries: Armenia, Australia, Bahrain, Bosnia and Herzegovina, Botswana, Bulgaria, Chinese Taipei, Colombia, Cyprus, Czech Republic, Egypt, Arab Rep., El Salvador, Georgia, Ghana, Hong Kong, SAR, Hungary, Indonesia, Iran, Islamic Rep., Israel, Italy, Japan, Jordan, Korea, Rep., Kuwait, Lebanon, Lithuania, Malaysia, Malta, Mongolia, Morocco, Norway, Oman, Palestine, Qatar, Romania, Russian Federation, Saudi Arabia, Scotland, Serbia, Singapore, Slovenia, Sweden, Syrian Arab Republic, Thailand, Tunisia, Turkey, Ukraine, United Kingdom, and the United States.

Although ideally we would follow students from eighth grade through adulthood and directly link the gender differences in mathematics self-concept observed in adolescence to the underrepresentation of women in STEM fields (cf. Legewie and DiPrete, 2011), there are no large scale international datasets that permit such longitudinal analyses. Thus, we instead link mathematics self-concept and achievement to students' assessments of their future work. While this somewhat limits the conclusions that we are able to draw, given the cumulative nature of the science pipeline, we believe that these early differences are important, as cumulative advantage processes (DiPrete & Eirich 2006) suggest that even in the absence of other inequalities, these initial differences will be magnified over time.

Following previous international research interested in overall levels of gender quality in a society (Fuwa, 2004; Penner, 2008) we use the United Nations Development Programme's Gender Empowerment Measure (2007) to capture the overall level of gender egalitarianism of a country. The Gender Empowerment Measure (GEM) combines factors such as the percentage of seats in parliament held by women, female legislators, senior officials and managers, female professional and technical workers, ratio of estimated female to male and rank value earned income.

Dependent Variables

Self-concept: To measure self-concept, we use factor analysis to combine students' responses to three questions. Students were asked to rate how much they agreed with the statements: "I usually do well in math," "I enjoy learning math," and "I like math," using a four point likert scale ranging from "Disagree a lot" to "Agree a lot." In doing so, we draw on many of the same questions as previous studies using the TIMSS data to examine self-concept, including Wang, Osterlind, and Bergin (2012) and Louis and Mistele (2012). However, as we use a more limited set of indicators, so as to more closely mirror the items used by Correll (2001)[1].

Career involving math: In addition to rating their mathematics self-concept, students were also asked the degree to which they agreed with the statement "I need to do well in math to get the job that I want." Given the prominence of mathematics in STEM careers (Steele, 2009), and as just over half of the respondents agreed a lot with this statement, we recoded this variable into a dummy variable indicating whether respondents agreed a lot with this statement. We use this item to indicate whether students were interested in careers involving mathematics. While we would have preferred to examine a measure directly examining whether students were interested in STEM careers, this measure allows us to examine the degree to which there are differences in attitudes towards math-related jobs more broadly, as well as the degree to which students are not interested in STEM careers.

Independent Variables

Gender: A dummy variable indicating whether the respondent was a girl or not.

[1]Correll used three items: mathematics is one of my best subjects, I have always done well in mathematics, and I get good marks in mathematics. Wang et al. (2012) used four items: I usually do well in mathematics, mathematics is more difficult for me than for many of my classmates (reverse coded), mathematics is not one of my strengths (reverse coded), and I learn things quickly in mathematics. Louis & Mistele (2012) used eight items, including the items used by Wang et al. (2012) as well as the additional items: I would like to take more mathematics in school, I enjoy learning mathematics, mathematics is boring, and I like mathematics.

GEM: Our key measure of national context is the GEM score of the country. GEM scores range from 0 to 1, and larger values correspond to higher levels of gender equality. The countries in our sample ranged from Saudi Arabia (.25) to Sweden and Norway (.91), and the median score was .52 (Botswana). In our figures depicting the results from models examining how gender differences in mathematics self-concept and career interest vary by GEM score, we report predicted values countries with GEM scores at the 10^{th} and 90^{th} percentiles (corresponding to Turkey's .3 and United Kingdom's .78).

Per capita GNI: In order to ensure that the effects of GEM in our cross-national comparison are not being driven by differences in economic development, all cross-national models include a control for per capita Gross National Income (GNI). We use countries' 2007 GNI as reported by the World Bank. GNI represents the total value of goods and services within a country, combined with income from other countries.

Test Scores: To examine the importance of mathematics achievement, both in predicting mathematics self-concept, as well as relative to mathematics self-concept in predicting interest in a career involving mathematics, we use data from the TIMSS mathematics assessment. This assessment examines students' knowledge (35%), application (40%), and reasoning (25%) in the content areas of number (30%), algebra (30%), geometry (20%), and data and probability (20%). Test scores were constructed to range internationally from 0 to 1000, with a mean of 500 and standard deviation of 100.

Methods

We report analyses from Ordinary Least Squares (OLS) regression models. We take two analytical approaches. In the first, we estimate the same model separately for each of the 49 countries that we examine. Thus, in examining 1) the degree to which mathematics self-concept and mathematics achievement are linked to interest in a career involving mathematics; 2) international variation in gender differences in mathematics self-concept; and 3) the degree to which mathematics achievement predicts mathematics self-concept differently for girls and boys; we estimate separate models for each of the 49 countries. These models account for survey weights and use cluster robust standard errors to account for clustering on schools. Our second approach pools students across countries, and estimates one model for all respondents across the 34 countries for which GEM scores were available.[2] Here we first examine how gender differences in mathematics self-concept are linked to country-level gender equality, and then examine how gender differences in interest in mathematics careers are linked to country-level gender equality. To insure that the results are not driven by sample size differences between countries, we use both weights that sum to the sample size for that country, as well as weights that sum to 500 for each of the countries (thus providing each country with equal weight in the regression). As we find no substantive differences between these two weighting schemes, we report only the results from the weights summing to the sample size for the country. These models use cluster robust standard errors to account for clustering at the country level.

[2]GEM scores were not available for Algeria, Armenia, Bahrain, Bosnia and Herzegovina, Cyprus, Ghana, Hong Kong, SAR, Indonesia, Jordan, Kuwait, Lebanon, Palestine, Scotland, Serbia, Syrian Arab Republic, and Tunisia.

RESULTS

We began by examining the degree to which interest in a career involving math is more closely related to self-concept or achievement. Table 1 presents results from country-specific regressions predicting whether respondents thought that mathematics would be important in their job using respondents' mathematics self-concept and achievement. We find that in all countries, self-concept is strongly predictive of interest in a career involving mathematics, such that students with higher levels of mathematics self-concept are more likely to report interest in jobs involving math. By contrast, while mathematics achievement is also linked with interest in a career involving math in the majority of countries we examine, surprisingly we find that once we take into account mathematics self-concept, the relationship between mathematics achievement and interest in a mathematics-related job is actually negatively related to math-related career interest.[3] While the lack of international longitudinal data prevent us from linking mathematics self-concept directly to taking a STEM career, these results underscore the importance mathematics self-concept, and are suggestive that gender differences in STEM representation are driven more by mathematics self-concept than achievement.

Having established the relative importance of mathematics self-concept, we next examine differences in self-concept levels of girls and boys within each of the 49 countries in our data. The first two columns of Table 2 report the boys and girls levels of self-concept for each country, providing an indication of how the girls and boys in one country compare to the girls and boys in other countries. We see, for example, that girls and boys in the United States have substantially lower levels of mathematics self-concept than girls and boys in Sweden. While these cross-country comparisons are interesting and potentially very informative, it is difficult to entirely rule out the possibility that they could be driven factors such as differences in translation. By contrast, when we compare the gender differences across countries, these issues are less problematic, as any differences arising from factors like the translation would have to differentially affect girls and boys. Thus, in the third column we report the difference between girls and boys average mathematics self-concept scores for each country. Here we see substantial variation, and in four countries girls have significantly higher levels of mathematics self-concept than boys, while in 21 countries boys have higher levels of mathematics self-concept than girls. These results suggest that while boys have higher average levels of self-concept in most countries, there is considerable variation in the degree to which this holds. The final column in Table 2 provides information on GEM scores, to provide a comparison countries' average gender differences in mathematics concept and GEM scores.

Table 3 builds on the previous tables by examining the degree to which the mathematics self-concept is a function of achievement in different countries (cf. Louis and Mistele, 2012; Peters, 2012). In particular, we are interested in whether the relationship between mathematics self-concept and mathematics achievement varies by gender. That is, does the

[3]Coefficients for mathematics achievement were negative and significant in 26 of the 49 countries we examine, while only 8 of the countries had significant positive coefficients. Note that in models that do not control for mathematics self-concept, but just examine the bivariate relationship between mathematics achievement and mathematics-related career interest, we see that mathematics achievement and mathematics-related career interest are positively correlated.

mathematics self-concept of girls and boys increase similarly as they increase in their mathematics achievement; this is particularly interesting insofar as mathematics self-concept provides insight into students' self-assessments of their mathematics ability (cf. Correll 2001).

As in the Tables 1 and 2, we again present results from models estimated separately for each country. The first two columns report the main effects of being a girl and mathematics achievement, and the third column reports the interaction of being a girl and mathematics achievement. This interaction effect provides information about whether mathematics achievement translates into bigger, smaller, or similar increases in mathematics concept for girls and boys. For example, if we increased both a girl and a boy's math score by 100 points, would they have similar increases in mathematics self-concept, or would one or the other gain more. Negative interaction effects suggest that girls gain less mathematics self-concept than boys from increases in mathematics achievement, while positive interaction effects suggest girls benefit more than boys.

Overall, we see that only seven of the countries have statistically significant interaction effects, suggesting that in most countries the relationship between mathematics self-concept and mathematics achievement is similar for girls and boys. Of the seven countries where there are statistically significant interaction effects, we find that in six of the countries girls' self-concept increases more as their achievement increases, suggesting that gender differences in mathematics self-concept are smaller among high achievers than they are among low achievers. By contrast, in Chinese Taipei), we find that boys' mathematics self-concept increases with achievement more than girls', suggesting that there are larger gender differences in self-concept among high achievers.

Taken together, Tables 1, 2, and 3 suggest that mathematics self-concept plays an important role in shaping career interests, that girls have lower levels of mathematics self-concept in the majority of countries examined, and while in most countries there are no gender differences in the relationship between mathematics self-concept and achievement, in a substantial minority girls' mathematics self-concept is more responsive to mathematics achievement than boys'. We next turn to examining how gender differences in mathematics self-concept might vary as a function of the level of gender equality that exists in the larger national context. Figure 1 reports predicted levels of mathematics self-concept for girls and boys in countries with high and low levels of gender equality. We see that in countries with low levels of overall gender egalitarianism (defined here as the GEM score for the 10th percentile country in our sample), girls and boys have similar levels of mathematics self-concept (p=.13). Interestingly, as the gender egalitarianism of the country rises, the average mathematics self-concept score decreases for both girls and boys at a similar rate (p=.94), so that there are no gender differences in mathematics self-concept in high GEM countries (defined here as the GEM score for the 90th percentile country in our sample) either (p=.23). While the gender differences do not vary as a function GEM, we do see that the overall level on mathematics self-concept does vary with GEM, so that both girls and boys in high GEM countries have lower levels of mathematics concept than their counterparts in low GEM countries (p<.00).

Figure 2 examines whether a similar pattern emerges when we examine how gender differences in career interests are shaped by the gender egalitarianism of the overall national context. The findings largely parallel the results shown in Figure 1. As with mathematics concept, the slopes for both girls and boys are sharply negative, suggesting that in gender egalitarian countries both girls and boys are less interested in careers involving mathematics. However, while in low GEM countries we again find that no gender differences (p=.61), we do find a statistically significant gender difference in high GEM countries (p<.05), such that girls in high GEM countries are less interested in mathematics careers than boys. Thus, while for mathematics self-concept (Figure 1) there were no gender differences in either gender egalitarian or inegalitarian contexts, where careers are involved (Figure 2) we find a gender gap in egalitarian settings that we do not see in inegalitarian contexts. Both Figures 1 and 2 are clear, however, that both girls and boys are less mathematically inclined in gender egalitarian countries.

CONCLUSION

This study provides an international perspective on gender differences in mathematics self-concept. We begin by presenting findings underscoring the potential importance of mathematics self-concept for understanding the underrepresentation of women in STEM careers. We show that in all 49 countries that we examine students with high levels of mathematics self-concept are more likely to express interest in a career involving mathematics even when mathematics achievement has been controlled for, but that net of mathematics self-concept, mathematics achievement has, if anything, a negative effect on mathematics-related career interests. We then document the gender differences in mathematics self-concept that exist in different countries, highlighting that eighth grade girls have significantly lower levels of mathematics self-concept than eighth grade boys in the majority of the countries that we examine. While in a number countries differences in mathematics self-concept vary by achievement, so that there are smaller gender differences in mathematics self-concept among high achievers, in the majority of countries examined, the relationship between mathematics achievement and mathematics self-concept does not vary by gender. Finally, we show both girls and boys are less mathematically-inclined in gender egalitarian countries.

In providing an international perspective on these issues, this study provides new insight into not only the importance of gender differences of mathematics self-concept, but also the variety of patterns that gender differences take around the world. These patterns are perhaps not surprising given the different cultural stereotypes surrounding the image and qualities of a scientist that exist around the world. Western societies, for example, typically present few images of women as scientists, so that when people in these countries think of scientists, they picture a man in a white lab coat (Eccles, 1989; Etzkowitz, Kemelgor, & Uzzi, 2000; Zengin-Arslan, 2001). The construction of gender roles makes it hard for women to enter STEM fields because it is seen as masculine. By contrast, many formerly Communist countries have historically placed a high degree of emphasis on gender equity, and have higher levels of women in science than in many other countries (Etzkowitz, Kemelgor, & Uzzi, 2000). Differences in broader cultural stereotypes might also help explain why it is that in Turkey women are more underrepresented among veterinarians than engineers

(Zengin-Arslan, 2001), while in the United States veterinary medicine is thought of as relatively feminized (Lincoln, 2010).

To systematically examine how variation in the national context might affect gender differences in mathematics, we conducted analyses linking the broader country-level egalitarianism and gender differences in mathematics and career interests (Figures 1 and 2). A priori, one might expect gender differences in mathematics self-concept to be smaller in countries with higher overall level of gender egalitarianism. This is particularly reasonable, given previous work showing that gender differences in mathematics achievement are smaller in countries that are more gender egalitarian in other domains (e.g. Reigle-Crumb 2005), and research linking mathematics achievement and self-concept (e.g. Pajares & Miller, 1994). Surprisingly, however, we find no evidence for this. In fact, if anything, our results suggest that gender differences in interest in a career involving mathematics only emerge in gender egalitarian countries. Perhaps more importantly, Figures 1 and 2 show that both mathematics self-concept and interest in a mathematics career are lower for both girls and boys in egalitarian contexts. These results hold regardless of whether we control for per capita GNI (as in Figures 1 and 2) or not, suggesting that the results are not being driven by differences in countries levels of development.

While this finding is perhaps unexpected, we suggest that it is in line with arguments about how national contexts shape gender differences in STEM that focus on the role that self-expression plays in recreating gender inequality (Charles & Bradley, 2009). This research suggests that gender egalitarian contexts can encourage girls and boys to express societally approved gender ideals as part of their gender performance. Education in these contexts thus serves not only an instrumental function, but also an expressive function, so that students' educational choices are thought to reflect important aspects of who they are. From this perspective, educational aspirations can be seen as not simply reflecting the world of possibilities that girls believe are open to them, but also become an arena in which girls perform the gendered identities that they have internalized. Thus, while girls in gender egalitarian contexts may have more opportunities to pursue STEM fields, they may also decide that it is more feminine to be interested in other fields of study, and choose these other fields that they believe more closely match the image that they are seeking to realize. That is, while egalitarian contexts may remove many of the constraints facing women in STEM fields, to the degree that constraints become internalized as preferences (cf. Correll 2004), these egalitarian contexts may serve to magnify these differences. Boys and girls are also encouraged to express their (gendered) identity through their choice of majors.

To the degree that gender egalitarian contexts encourage both girls and boys to express themselves freely, and provide more opportunities for them to do so, gender egalitarian contexts can actually lead to higher levels of gender inequality. Perhaps even more importantly from a policy perspective, it can lead to lower levels of mathematics self-concept and career interest for both girls and boys. Thus, contexts valuing self-expression may actually provide a rationale to pursue non-STEM fields not just for girls, but also for boys. While higher levels of overall gender egalitarianism are obviously desirable for other reasons, this study suggests that simply creating gender egalitarian contexts is unlikely to sufficiently address gender inequality in STEM representation, and may actually have iatrogenic consequences. This is particularly the case where policies are focusing on increasing STEM participation, as we see that STEM participation drops for both girls and boys in egalitarian contexts. Future research should examine whether local contexts operate similarly, to see how gender egalitarianism, norms around self-expression, and STEM participation play out at the school and classroom level.

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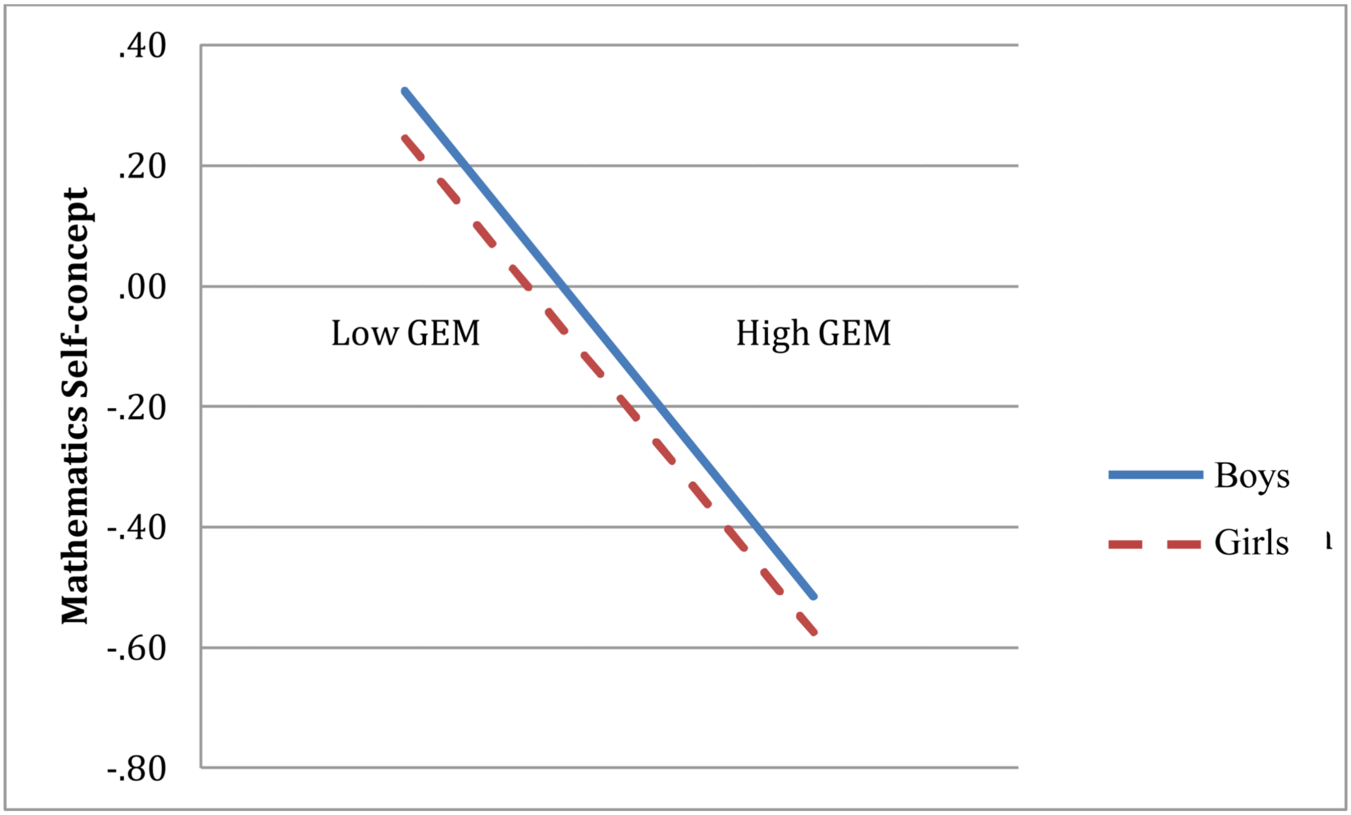

Figure 1.
Gender Differences in Self-concept as a function of GEM, net of GNI
Note: Result from model estimating GEM's effect on self-concept by gender, controlling for GNI. Self-concept is a factor of the three statements: "I usually do well in mathematics," "I enjoy learning mathematics," and "I like mathematics." Low GEM is defined as the 10th percentile of the given GEM value ranks, while high GEM is defined as the 90th percentile.

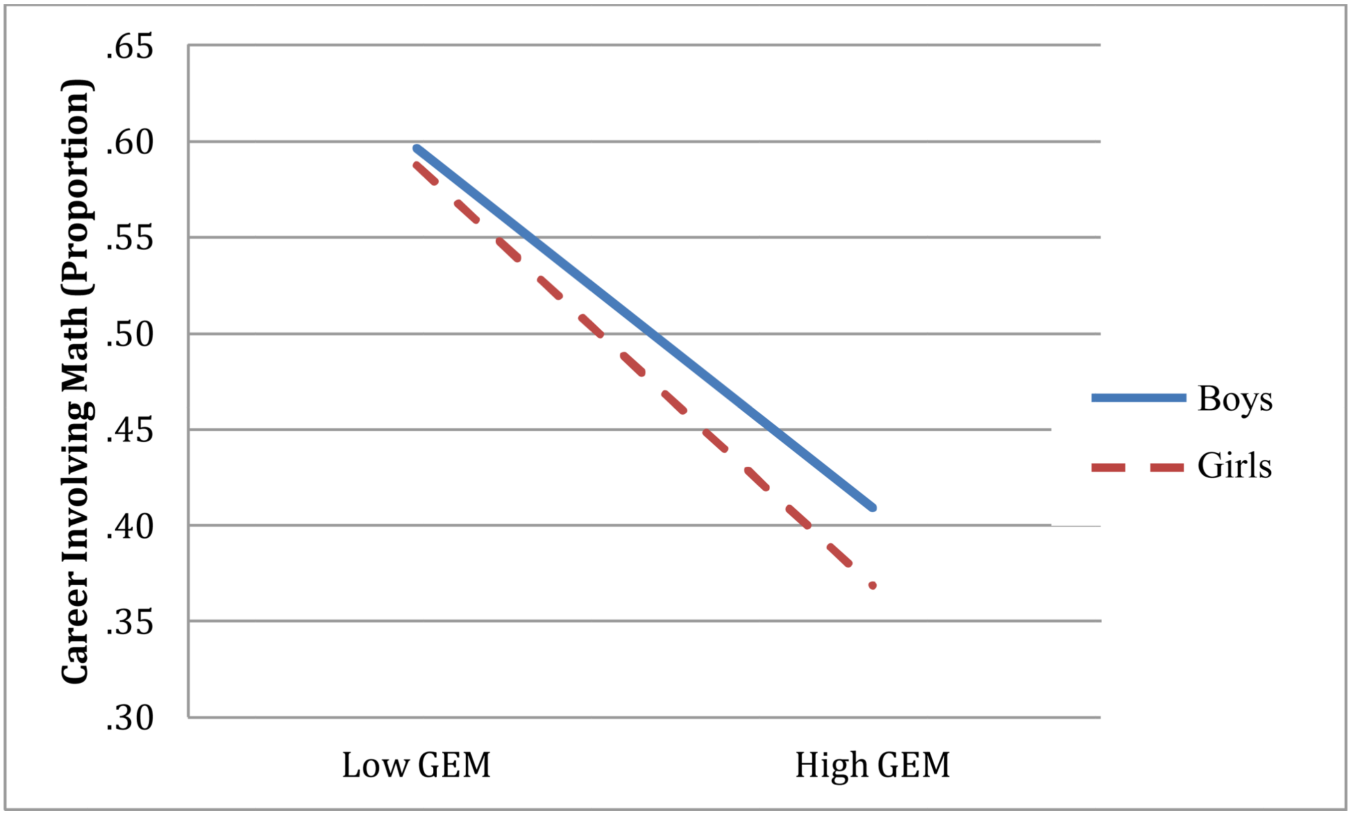

Figure 2.
Gender Differences in Career Involving Math as a function of GEM, net of GNI
Note: Result from model estimating GEM's effect on career preference in STEM by gender, controlling for GNI. Career preference is the likelihood of strongly agreeing that math will be important in your career. Low GEM is defined as the 10th percentile of the given GEM value ranks, while high GEM is defined as the 90th percentile.

Table 1

Career involving Math Jobs as a Function of Self-concept and Achievement, by Country

Country Name	Self-concept	Achievement
Armenia	0.094***	−0.012
Australia	0.100***	−0.037**
Bahrain	0.068***	−0.042***
Bosnia and Herzegovina	0.055***	−0.094***
Botswana	0.049***	0.070***
Bulgaria	0.088***	−0.062***
Chinese Taipei	0.052***	−0.011
Colombia	0.066***	−0.040**
Cyprus	0.099***	−0.042***
Czech Republic	0.080***	−0.097***
Egypt, Arab Rep.	0.101***	0.016
El Salvador	0.070***	−0.127***
Georgia	0.091***	−0.037*
Ghana	0.093***	0.034*
Hong Kong, SAR	0.080***	0.005
Hungary	0.086***	−0.084***
Indonesia	0.109***	0.003
Iran, Islamic Rep.	0.102***	0
Israel	0.080***	−0.003
Italy	0.098***	−0.055***
Japan	0.041***	0.001
Jordan	0.078***	−0.003
Korea, Rep.	0.060***	0.052***
Kuwait	0.093***	0.025*
Lebanon	0.097***	0.021
Lithuania	0.070***	−0.030*
Malaysia	0.116***	−0.031
Malta	0.081***	−0.066***
Mongolia	0.082***	−0.048***
Morocco	0.086***	−0.016
Norway	0.102***	0.027*
Oman	0.093***	−0.089***
Palestine	0.072***	0.024*

Country Name	Self-concept	Achievement
Qatar	0.113***	0.015*
Romania	0.080***	−0.106***
Russian Federation	0.097***	−0.082****
Saudi Arabia	0.101***	−0.029*
Scotland	0.090***	−0.029*
Serbia	0.070***	−0.093***
Singapore	0.100***	−0.089***
Slovenia	0.066***	−0.060***
Sweden	0.088***	−0.062***
Syrian Arab Republic	0.084***	−0.017
Thailand	0.099***	0.045***
Tunisia	0.089***	−0.007
Turkey	0.071***	0.014
Ukraine	0.087***	−0.038***
United Kingdom	0.090***	−0.054***
United States	0.087***	−0.072***

* $p < .05$;

** $p < .005$;

*** $p < .0005$

Note: Results from models estimating interest in career involving math by self-concept and achievement, separately for each country and clustered by school.

Table 2

Comparing Boy and Girl's Self-concept, by Country

Country	Boy's Self-concept	Girl's Self-concept	Difference	GEM Value
Armenia	−0.032	0.017	0.049	
Australia	−0.246	−0.525	−0.279 ***	0.85
Bahrain	0.491	0.497	0.006	
Bosnia and Herzegovina	−0.859	−0.752	0.108	
Botswana	0.636	0.602	−0.034	0.52
Bulgaria	−0.295	−0.297	−0.003	0.61
Chinese Taipei	−0.599	−1.104	−0.505 ***	0.53
Colombia	0.643	0.511	−0.132 *	0.50
Cyprus	−0.259	−0.182	0.078	
Czech Republic	−0.846	−0.818	0.028	0.63
Egypt, Arab Rep.	1.043	0.926	−0.117 *	0.26
El Salvador	0.610	0.456	−0.153 **	0.53
Georgia	0.195	−0.012	−0.207 *	0.41
Ghana	0.896	0.695	−0.200 ***	
Hong Kong, SAR	−0.300	−0.658	−0.358 ***	
Hungary	−0.709	−0.773	−0.064	0.57
Indonesia	0.597	0.514	−0.083 *	
Iran, Islamic Rep.	0.443	0.644	0.201	0.35
Israel	−0.030	−0.007	0.023	0.66
Italy	−0.583	−0.715	−0.132 *	0.69
Japan	−1.062	−1.354	−0.292 ***	0.56
Jordan	0.759	0.760	0.002	
Korea, Rep.	−0.848	−1.104	−0.256 ***	0.51
Kuwait	0.587	0.363	−0.224 ***	
Lebanon	0.626	0.371	−0.254 ***	
Lithuania	−0.519	−0.514	0.005	0.67
Malaysia	−0.027	0.062	0.089 *	0.50
Malta	−0.381	−0.540	−0.159	0.51
Mongolia	0.551	0.493	−0.058	0.43
Morocco	1.123	1.027	−0.096 *	0.33
Norway	0.904	1.018	0.114 *	0.91
Oman	−0.279	−0.305	−0.026	0.39
Palestine	0.481	0.355	−0.126	
Qatar	0.621	0.284	−0.336 **	0.37
Romania	−0.481	−0.290	0.191 **	0.50

Country	Boy's Self-concept	Girl's Self-concept	Difference	GEM Value
Russian Federation	−0.366	−0.109	0.258 ***	0.49
Saudi Arabia	0.536	0.334	−0.202 *	0.25
Scotland	−0.215	−0.319	−0.104 *	
Serbia	−1.014	−0.844	0.169	
Singapore	0.074	0.027	−0.047	0.76
Slovenia	−0.941	−0.928	0.014	0.61
Sweden	−0.268	−0.406	−0.138 ***	0.91
Syrian Arab Republic	0.843	0.725	−0.118 *	
Thailand	0.161	0.136	−0.026	0.47
Tunisia	0.766	0.737	−0.029	
Turkey	0.555	0.561	0.006	0.30
Ukraine	−0.345	−0.128	0.218 ***	0.46
United Kingdom	0.013	−0.373	−0.386 ***	0.78
United States	−0.100	−0.175	−0.075	0.76

* $p < .05$;

** $p < .005$;

*** $p < .0005$

Note: Results from models estimating self-concept differences between boys and girls, separately by each country and clustered by school. GEM value is listed for given countries.

Table 3

Self-concept and the effect of Math Score, by Gender

Country	Girl	Math Score	Girl × Math Score
Armenia	0.395	0.329***	−0.069
Australia	−0.812	0.569***	0.13
Bahrain	−1.174***	0.318***	0.262***
Bosnia and Herzegovina	−0.607	0.555***	0.156*
Botswana	0.15	0.362***	−0.063
Bulgaria	−0.424	0.318***	0.082
Chinese Taipei	0.046	0.821***	−0.094*
Colombia	−0.774*	0.037	0.177*
Cyprus	−0.858**	0.651***	0.167**
Czech Republic	0.188	0.718***	−0.035
Egypt, Arab Rep.	0.118	0.174***	−0.064
El Salvador	0.166	0.215***	−0.083
Georgia	−0.58	0.395***	0.094
Ghana	−0.042	0.275***	−0.035
Hong Kong, SAR	−0.541	0.517***	0.021
Hungary	0.163	0.741***	−0.039
Indonesia	−0.145	−0.139***	0.017
Iran, Islamic Rep.	−0.464	0.494***	0.113
Israel	−0.068	0.215***	0.021
Italy	−0.193	0.675***	0.023
Japan	−0.07	0.701***	−0.034
Jordan	−0.214	0.329***	0.038
Korea, Rep.	−0.241	0.821***	0.004
Kuwait	−0.402	0.306***	0.031
Lebanon	−0.397	0.521***	0.045
Lithuania	−0.201	0.722***	0.03
Malaysia	−0.098	0.493***	0.029
Malta	−1.187	0.500***	0.211
Mongolia	0.101	0.291***	−0.031
Morocco	−0.725	0.155**	0.170**
Norway	−0.012	0.256***	−0.001
Oman	−0.704*	0.798***	0.140*
Palestine	−0.659	0.378***	0.106

Country	Girl	Math Score	Girl × Math Score
Qatar	−0.431	0.312 ***	0
Romania	−0.221	0.397 ***	0.074
Russian Federation	0.054	0.571 ***	0.036
Saudi Arabia	−0.554	0.277 ***	0.079
Scotland	0.131	0.401 ***	−0.046
Serbia	−0.307	0.744 ***	0.087
Singapore	−0.254	0.599 ***	0.018
Slovenia	0.039	0.532 ***	0
Sweden	−1.045	0.601 ***	0.177 **
Syrian Arab Republic	−0.139	0.342 ***	0.02
Thailand	0.212	0.218 ***	−0.064
Tunisia	0.185	0.608 ***	−0.019
Turkey	0.038	0.395 ***	−0.006
Ukraine	−0.036	0.436 ***	0.051
United Kingdom	−0.84	0.370 ***	0.092
United States	−0.064	0.568 ***	0.002

* p <.05;

** p <.005;

*** p <.0005

Note: Results from model estimating math score's effect on self-concept by gender, separately for each country and clustered by countries' schools.