SOCIAL SCIENCES

The stereotype that girls lack talent: A worldwide investigation

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Recent research has shown that there exist gender stereotypes that portray men as more brilliant or inherently talented than women. We provide a large-scale multinational investigation of these stereotypes and their relationship with other gender gaps. Using a survey question asked to more than 500,000 students in 72 countries, we build a measure of the stereotypes associating talent with men and show that they are present in almost all studied countries. These stereotypes are stronger among high-achieving students and in more developed or more gender-egalitarian countries. Similar patterns are observed for gender gaps in competitiveness, self-confidence, and willingness to work in an ICT (Information and Communication Technology)–related occupation. Statistical analysis suggests that these three latter gender gaps could be related to stereotypes associating talent with men. We conclude that these stereotypes should be more systematically considered as a possible explanation for the glass ceiling.

INTRODUCTION

Women nowadays outnumber men in higher education in most Western countries, and the percentage of women in the labor market is above 40% in most Organization for Economic Co-operation and Development (OECD) countries. However, a glass ceiling remains, and certain fields of study and work, associated with higher wages, are vastly dominated by men, while within given occupations as well, women remain underrepresented among top executives and top earners (*1*). In Europe, for example, only 23.3% of board members of the largest publicly listed companies and 5.1% of chief executive officers (CEOs) are women (*2*). The existence of a glass ceiling is first an issue of rights and fairness, and also an issue of efficiency, since it can restrict the pool of talents deemed eligible for certain occupations and it leads to reduced diversity (*1*).

Recently, Leslie and coauthors (*3*) have introduced the concept of brilliance and shown that there exists a gender-brilliance stereotype that portrays men as more brilliant than women, and that it is likely to hold women back in careers perceived to require brilliance (*3*–*6*). As noted by Storage *et al.* (*7*), the content of the gender-brilliance stereotype differs along two key dimensions from the content of other gender stereotypes: First, it is general, in the sense that it pertains to a quality that cuts across specific domains of intellectual activity (unlike the gender-science stereotype for instance), and second, it pertains to a particularly high level of intellectual talent [unlike gender stereotypes about competence; see, e.g., (*8*, *9*)]. A number of previous works have evidenced the existence and impact of the gender-brilliance stereotype. In (*10*), parents think that their sons are brighter than their daughters and (*11*) reported that parents in the United States are more than twice as likely to search Google for whether their sons are geniuses than for whether their daughters are. In (*12*), the most common children's drawing of an intelligent person was an adult male, involved in a mental-cognitive activity. In biology, which is not male-stereotyped, male students are seen to excel even when their female classmates actually have higher grades (*13*). In the study of Schmader *et al.* (*14*), letters recommending male and female scientists for jobs were equally likely to refer to the scientists' ability (using words like intelligent or proficient), but letters about men were significantly more likely to include "standout" terms (exceptional, extraordinary, unmatched). The teachers in a study by Bianco *et al.* (*15*) were provided with identical information about a hypothetical male or female student and were significantly more likely to refer the male than the female student to a gifted program. Leslie *et al.* (*3*) show that across the academic spectrum, women are underrepresented in fields where practitioners believe that raw, innate talent is the main requirement for success.

Other scholars, like Stewart-Williams and Halsey (*16*), have come to the conclusion that men suffer from a stereotype of lower ability in educational contexts. According to Hartley and Sutton (*17*), by 4 years of age, girls tend to assume that boys are academically inferior, and by 7, boys assume the same thing. Teachers tend to view their female students as superior at math and reading (*18*). Stewart-Williams and Halsey (*16*) conclude that "It is far from obvious that on balance, stereotypes about academic ability favor boys more than girls."

The studies cited above are usually established in specific contexts or cultures that may not be representative of beliefs or stereotypes regarding boys' and girls' general talent, brilliance, or academic ability in other settings. In this work, we provide a large-scale investigation of a systematic association of raw talent with men more than women. We study on a sample of more than 500,000 students in a total of 72 countries how the association of raw talent with men varies across countries and students with different abilities. We also show how gender norms regarding raw talent relate to and may explain other well-known gender differences regarding competitiveness, self-confidence, and willingness to work in male-dominated occupations that are stereotyped as requiring special abilities. Building on the literature that has shown the importance of gender norms regarding brilliance (*3*, *5*, *6*), our study makes two main contributions: It investigates at the world level how gender norms regarding talent can vary according to the cultural environment, and it helps characterizing the link between these norms and other gender differences in either psychological traits or behaviors.

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Students participating in the 2018 Programme for International Student Assessment (PISA2018) were asked the following question (which was not included in the previous waves of PISA): "When I am failing, I am afraid that I might not have enough talent." Exploiting systematic differences between girls' and boys' answers to this question, and relying on double standards theory (*19*–*21*), we propose a measure of the magnitude of the stereotype associating talent with boys rather than girls. We obtain that there is a strong stereotype that girls lack talent, which is observed in almost all 72 PISA2018 participating countries. While our measure focuses specifically on talent, we argue that it is related to the former literature that has focused on brilliance as both talent and brilliance are usually seen by the general public as attributes that are scarce, likely innate, or at least that cannot be taught. In the discussion, we compare our measure with various gender gaps we obtain from the PISA survey to confirm that we do capture something specific about talent rather than other sociocultural influences.

The stereotype that girls lack talent then exhibits two central patterns. First, it is larger in more developed and more gender-egalitarian countries [in the sense of the Global Gender Gap Index (GGI), see details below]. This type of apparently paradoxical relationship has already been documented for a large range of gender gaps: More gender-egalitarian and wealthier countries also experience higher gender gaps in choice of studies (*22*, *23*), in basic preferences measured through laboratory experiment (*24*), cognitive abilities such as spatial visualization (*25*), self-reported personality traits (*26*), basic human values (*27*), self-esteem (*28*), subjective well-being (*29*), or depression (*30*).

All these relationships at the country level are often referred to as "the gender-equality paradox." We argue that the stereotype that girls lack talent more than boys may explain some of them. For example, believing that they are less talented than boys may hurt girls' self-confidence and lead them to be self-protective and thus to avoid challenging situations and opportunities, and to choose studies and careers where success is not perceived to depend on special abilities. Hence, it may not be surprising that the countries where girls are the most likely to believe they lack talent (compared to boys) are also those where they shy away from prestigious or competitive careers. To confirm these insights, we build from PISA2018 gender gaps in self-confidence and expectations to work in an ICT (Information and Communication Technology)–related occupation. We then show that these gender gaps are also larger in more developed or more gender-egalitarian countries [confirming former analyses; see, e.g., (*22*, *23*, *31*, *32*)], but these relationships can be largely accounted for by the gender gaps in the belief to lack talent: Once we control for the latter in country-level analyses, the relationships largely disappear. A similar exercise is reproduced with gender gaps in competitiveness. We build a nonexperimental measure of these gaps using the information available in PISA2018 and show that gender gaps in competitiveness also verify the gender-equality paradox: They are larger in more developed or more gender-egalitarian countries. Again, this "new" gender-equality paradox can be largely accounted for by the stereotype that girls lack raw talent compared to boys.

The second observed pattern is that the stereotype associating talent primarily with men is larger among higher-ability students. This might not be surprising as talent is likely to be more related to higher-ability students, and it is also consistent with the literature showing that stereotypes about ability are particularly relevant among the most talented (*33*–*36*). This consistency contributes to validate our measure and its similarity with other measures used in past work. More surprising, however, is the fact that the gender gaps in self-confidence, in expectation to work in an ICT-related occupation, or in willingness to compete are also higher for higher-ability students. Again, these latter patterns can be largely accounted for by our measure of the gender-talent stereotype (GTS), reinforcing further the idea that this stereotype can be important to explain many well-known gender differences in behavior, psychological traits, or choices, as well as the widely documented glass ceiling arising, in part, due to these differences.

RESULTS

Our main data source is PISA2018, an every-3-year international assessment of the knowledge and skills of about half a million 15-year-old students in mathematics, reading, and science. PISA2018 takes place in the 37 mostly developed countries belonging to the OECD in 2018 and an additional 39 developing countries (see details in the Supplementary Materials), covering in total students from 80% of the world economy. It not only focuses primarily on reading but also includes several measures of students' attitudes toward competition, their self-confidence, and their expected careers (see the Supplementary Materials).

Gender gaps in attributing failure to a lack of talent

A measure of the gender-talent stereotype (GTS)

Bian *et al.* (*5*) first elicited the existence of the gender-brilliance stereotype among children, showing that 6-year-old girls are less likely than boys to associate "smart" attributes to members of their gender and begin to avoid activities said to be for children who are "really, really smart." More recently, they elicited the gender-brilliance stereotype among both children and adults, using Implicit Association Tests (*7*). They compared the brilliance trait with six distinct other traits (creative, happy, strong, funny, friendly, and beautiful) and found consistent evidence for an implicit gender-brilliance stereotype favoring men ($N = 3618$). For five of six of the comparison traits (even the male trait funny), male was more associated with brilliant and female with the comparison trait. Only a physical trait (strong) showed a stronger association with male than brilliant did.

Measuring the gender-brilliance stereotype, or the related concept of "gender-talent stereotype," like other social norms or stereotypes, is prone to many challenges. Individuals' explicit statements can be biased, e.g., by social desirability. Experimental measures, based, for example, on vignette experiments, might be more reliable, but they are costly to establish in a consistent way on a large scale for several countries. Last, what the implicit measures, based on the Implicit Association Test, capture also remains largely debated [see, e.g., (*37*)], and these measures are also available only for small samples, from specific countries.

To build a measure of the gender-brilliance or gender talent stereotype that is consistent across a large set of countries, we therefore need to depart from existing approaches. We rely on expectations state theory and more precisely on status characteristics theory (*38*–*42*) and double standards theory (*19*–*21*) to provide a measure of the internalized lower entitlement of women to innate talent, which limits as much as possible the problems described above.

According to (*19*), gender constitutes a diffuse status characteristic, and men (as members of the high-status group) are stereotyped as being endowed with (more) talent. They are expected to be talented and to succeed, implying that failure constitutes for them an expectancy disconfirmation and will be more likely attributed, by themselves and others, to external factors such as being unlucky than to internal factors such as a lack of personal talent. By contrast, for women (as members of the low-status group), failure is consistent with expectancies and will be more internally attributed, by themselves and others, to a lack of innate talent.

Consistent with this theory, we assume that girls' internalization of a stereotype of lack of talent will be reflected in their higher association of failure with a fear of lack of talent, and we propose to measure the strength of the *GTS* among a given group of students by the average differences in the attribution of failure to lack of talent between equally-able boys and girls within this group. *GTS* is a valid measure of this stereotype among a given group (i.e., a country) under the assumption that systematic differences between girls and boys with similar measured ability are the product of an internalization of a stereotype of lack of raw talent of girls. Although *GTS* primarily focus on (lack of) talent, it can be considered as conceptually related to the gender-brilliance stereotypes put forward by Leslie and coauthors (*3*) as the two notions refer to attributes that are scarce and likely innate, in the sense that they are not easy to learn or develop by someone who is not endowed with them.

Students in PISA2018 were asked to report the extent to which they agree ("strongly disagree," "disagree," "agree," "strongly agree") with the following statement about themselves: "When I am failing, I am afraid that I might not have enough talent." This question arguably captures the extent to which students are likely to attribute their own failure to their lack of talent. Note that it satisfies the conditions that it pertains to a quality that cuts across specific domains, that cannot be taught, and that is related to a particularly high level of competence. Our measure of the prevalence of *GTS* consists of the gender gap in this item, standardized by country, and controlling for students' performance in math, reading, and science, which are also standardized by country (see details in the Supplementary Materials). Standardizations ensure comparability of *GTS* across groups, making sure, in particular, that differences in *GTS* across countries (or other groups of students) are not influenced by average differences in the share of students attributing failure to a lack of talent. As explained above, *GTS* provides an indirect measure of gender stereotypes regarding talent, as it only captures the strength of their internalization by 15-year-old girls and boys. Also, note that the study of gender gaps in the attribution of failure to a lack of talent is interesting in its own. Therefore, the reader that is not convinced by status characteristics theory or double standard theory and our interpretation of these gender gaps as an indirect measure of gender talent stereotypes may simply read what follows as a cross-national study of gender gaps in attributing failure to a lack of talent.

Strength and cross-country comparison of gender-talent stereotypes

On average, across all students in PISA participating countries, the magnitude of the gender gap in attributing failure to lack of talent (conditional on the standardized math, reading, and science performances) is 0.24 of an SD, and it is as large as 0.32 SD if we restrict the sample to OECD countries (Table 1). For OECD countries, while slightly less than one in two boys (47%) strongly agree or agree that when they fail, it makes them afraid that they might not have enough talent, 61% of girls report so. When controlling for standardized performance, the gender gap in percentage of students attributing their failure to a lack of talent remains as high as 14 percentage points among OECD countries and 7.4 percentage points among non-OECD countries (table S1, column 4).

Table 1. Gender-talent stereotypes by region and for a selected set of countries. The table presents the level of *GTS* for the sample of all 73 PISA2018 countries, for OECD countries, for non-OECD countries, and for a selected set of countries. *GTS* (see Supplementary Appendix for more detail) is defined as the difference between girls and boys in their agreement with PISA item "when I am failing, I am afraid that I lack talent," standardized at the country level (i.e., such that the weighted mean equal to 0 and the weighted SD equal to 1 in each country) and controlling for performance. *GTS* are therefore expressed as a proportion of the SD of the underlying variable. A positive gender gap represents a higher attribution of failure to a lack of talent for girls. ***$P < 0.01$, **$P < 0.05$, and *$P < 0.1$.

	Gender talent stereotypes (*GTS*)
All PISA2018 countries	0.239***
OECD countries	0.320***
Non-OECD countries	0.167***
United States	0.359***
United Kingdom	0.495***
Canada	0.444***
Germany	0.394***
France	0.439***
Finland	0.476***
Denmark	0.575***
Brazil	0.238***
Russia	0.279***

Turning to the results for each country, we observe that in 71 of the 72 countries for which we could compute *GTS*, girls are more likely than boys to attribute their failure to their lack of talent (table S1). Among the 34 OECD countries, the gender gap varies between 0.08 SD for Mexico and 0.58 SD for Denmark, and all countries but Mexico (0.08), Turkey (0.14), Chile (0.17), and Colombia (0.22) have gender gaps above 0.25 SD. Among the 38 non-OECD countries, the gender gaps vary between −0.19 SD for Saudi Arabia and 0.39 SD for Belarus. The average of country-level gender gaps across all countries in the sample is equal to 0.27 SD.

We verify that the gender gaps are robust to alternative constructions of *GTS*: They are, for example, very similar if we do not control for students' performance, or if we simply consider, without any standardization, the gap between the share of girls and boys agreeing that they fear not having enough talent when they fail. We also still observe similar gender gaps if we control for diligence at school. Girls could attribute failure more to lack of talent if they study more and are more diligent. We do not have in PISA2018 individual data about time devoted to homework, but we have data about the importance granted to trying hard at school or about truancy, and controlling for them has little effect on the measure of GTSs (see table S2).

First pattern: A gender-equality paradox for gender-talent stereotypes

Gender gaps in attributing failure to a lack of talent (conditional on students' abilities) are higher in more developed and more gender-egalitarian countries (see Table 2). In particular, an increase of 1 SD of (the logarithm of) gross domestic product (GDP) is associated

Table 2. Relation between *GTS* and countries' measures of development and gender equality. Estimates from country-level linear regressions. The table shows the results of the regressions at the country-level of *GTS* on measures of development (GDP and HDI) and gender equality (GGI). *GTS* are defined by the gender gap in the answers of boys and girls to PISA question about their attribution of failure to lack of talent ("when I am failing, I am afraid that I might lack talent"), controlling for performance. Higher values of our explanatory variables correspond to higher development or higher equality. Definitions and data sources for measures of development and equality are more detailed in Supplementary Appendix A. ***$P < 0.01$, **$P < 0.05$, and *$P < 0.1$.

	Dependent variable is gender talent stereotypes (*GTS*)		
GGI	0.651***		
	(0.0942)		
HDI		0.681***	
		(0.0935)	
Log GDP			0.470***
			(0.109)
Constant	0.00909	0.00133	−0.00686
	(0.0935)	(0.0906)	(0.107)
Observations	67	69	70
R^2	0.423	0.441	0.215

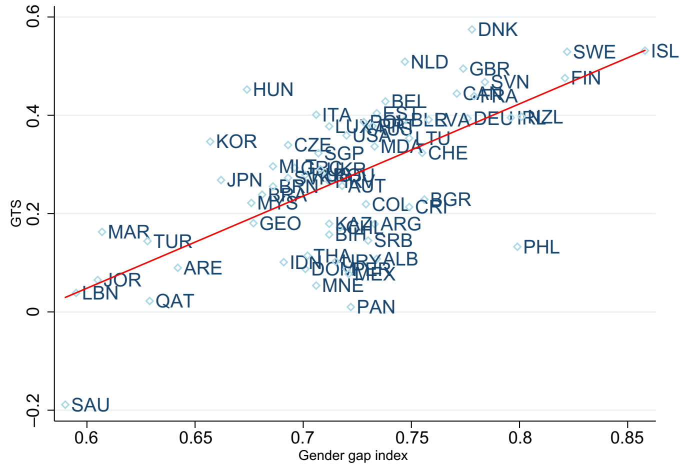

Fig. 1. Country-level relationship between gender equality (*x* axis, measured with the GGI) and gender-talent stereotypes (*GTS*). The figure shows the *GTS* as a function of the GGI. Variables and data sources are described in Supplementary Appendix A. Country codes from ISO3166-1 standard.

with an increase of 0.47 SD of *GTS* ($N = 70$, $r = 0.46$). A stronger positive association is found with the Human Development Index (HDI), which incorporates measures of education and life expectancy on top of economic wealth ($N = 69$, $r = 0.66$). For the GGI, which is a leading composite index used to capture gender equality in the labor market, education, health, or political representation, we obtain that an increase of 1 SD in GGI is associated with an increase of 0.65 SD of *GTS* ($N = 67$ observations, $r = 0.65$; see also Fig. 1).

We also run the student-level counterparts of these country-level analyses on a sample of more than 450,000 students. More specifically, we use linear regression models to explain students' attribution of failure to their lack of talent by their gender and their gender interacted with a measure of countries' development (GDP or HDI; see table S3, A and B) or gender equality (GGI; see table S3C). All models are saturated with country fixed effects and include various sets of controls for students' ability, educational resources, parental background, etc. It appears that differences in students' individual characteristics across countries have no influence on the magnitude of the relationship between countries' development or extent of equality and the gender gap in attributing failure to a lack of talent: The estimated effect of the interaction between gender and GDP, HDI, or GGI barely varies when individual control variables are included.

Second pattern: gender-talent stereotypes are larger among high-ability students

The gender gap in attributing failure to a lack of talent is larger among high-performing students. For example, if we focus on the group of students whose performance is above average in the three subjects (math, reading, and science), then the gender gap (conditional on performance) is equal to 0.32 SD, instead of 0.19 SD for students outside that group. Looking more precisely across the whole ability distribution, we observe that *GTS* defined by deciles of the average performance in math, reading, and science are increasing steadily from the third to the top decile (right of Fig. 2). This increase is largely driven by girls: The fear of lacking talent after failure is slightly increasing with performance for boys, while being much more strongly increasing for girls (left of Fig. 2). These differences between girls and boys are statistically significant at all conventional levels, and they are not driven by the way we standardize students' general performance (table S4). To formalize the graphical insights above, we also run the following regression model

$$\text{Fear of lacking talent}_i = \alpha \text{Girl}_i + \beta \text{General\_ability}_i + \gamma(\text{General\_ability}_i * \text{Girl}_i) + \varepsilon_i \quad (1)$$

which captures how the fear of lacking talent after failure varies with general ability for boys (coefficient β) and for girls (β + γ), assuming that the relationship is linear for both sexes (which is consistent to what is observed on Fig. 2). Table S5 provides estimates of Eq. 1 at the world level and for various regions and all countries in our sample. On the group of all 506,000 students, we observe that a 1 SD increase in general performance increases attribution of failure to lack of talent by 0.11 SD for girls but by 0.03 SD only for boys. This pattern remains valid on both OECD and non-OECD countries, and it also holds and is statistically significant in 50 of the 71 countries in our sample for which we could estimate Eq. 1, showing that the larger gender gap in attributing failure to a lack of talent among top-performing students is a very widespread phenomenon across the world. These findings confirm, on a large scale, former research showing that "the most talented members of stereotyped groups tend to be most affected by signals suggesting that they may lack ability" (*36*) [see also (*33*–*35*)]. They may be related to the "impostor phenomenon" by which high-achieving women can feel intellectually inadequate despite objective proof of their competence and its higher prevalence in fields that value brilliance (*43*).

Gender gaps in competitiveness, self-confidence, or expectation to work in an ICT-related occupation are related to gender-talent stereotypes

Girls are known to be less competitive than boys [e.g., (*44*)], to have lower self-confidence [e.g., (*45*, *46*)], and to choose fields of study

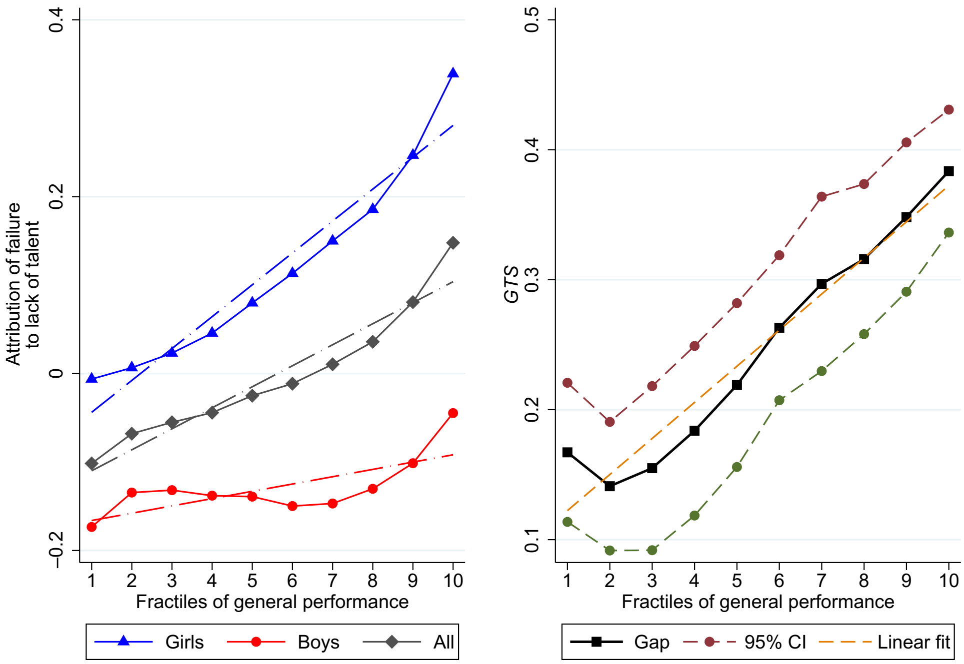

Fig. 2. Girls' and boys' attribution of failure to lack of talent and their difference (*GTS*) as a function of their ability. Analyses based on a sample of 73 countries and more than 500,000 observations. The left figure shows the mean levels of perceived lack of talent for boys (red), for girls (blue), and for all (black) by deciles of general performance. The right figure shows the difference between girls' and boys' level of perceived lack of talent, i.e., gender-talent stereotypes (GTS) in each decile of general performance, as well as the associated 95% confidence intervals (CI). Perceived lack of talent is based on students' answers to PISA item about their attribution of failure to lack of talent and is standardized at the country level. General performance is the unweighted mean of performance in math, reading, and science. It is standardized to have a weighted mean equal to zero and a weighted SD equal to one in each country in the sample. It is then split in deciles. The variables are described in detail in Supplementary Appendix A. Estimates and SEs involving measures of ability are based on plausible values and account for measurement error in these abilities on top of standard sampling error (see details in Supplementary Appendix B).

and careers that are less rewarding, in terms of earnings and chances to access top positions [e.g., (*47*)]. Women born in 1985 chose educational degrees that mapped into degrees and fields with 6% lower average earnings than men and 10% lower 90th percentile earnings (*1*). Regarding female representation in certain male-dominated fields, the trends are actually aggravating: Women's share of U.S. bachelor's degrees in computer science, for instance, declined from 28 to 18% between 2000 and 2015. Competitiveness preferences have been shown to explain partly students' decisions to enroll in a science career (*48*). They may also affect the choice to compete for promotions and the decision to negotiate salary (*49*, *50*). Self-confidence is finally an important determinant of the willingness to enter a negotiation for a salary increase or a promotion. For all these reasons, gender gaps in willingness to compete, self-confidence, and early career choices are among the most frequently advanced possible (supply-side) reasons for gender wage inequality and for the glass ceiling (*47*).

We also have reasons to think that the gender-talent stereotypes may be related to these gender gaps. Believing that they are less talented than boys may hurt girls' self-confidence, it may lead them to be self-protective and thus avoid challenging situations and opportunities. It may also lead them to avoid studies and careers where success is perceived to depend on special intellectual ability, such as careers in math or ICT-related domains.

Because our aim is to document how gender-talent stereotypes can be related to the glass ceiling, and because the three features above are among the main explanations of the glass ceiling, we restrict our attention to them. Our analysis therefore includes two psychological traits (self-confidence and competitiveness) and one behavioral variable (expected career in an ICT-related domain), which we think are likely to be related to gender-talent stereotypes. The latter can of course itself be related to the former. While gender gaps in competitiveness attract a lot of attention in the literature, we are not aware of a worldwide analysis of these gaps. Our analysis of these gaps in more than 70 countries therefore constitutes a small contribution in itself. We start by it and turn to the two other variables in a second step.

Two similar patterns for gender gaps in competitiveness

Our measure of competitiveness is based on explicit statements. Such statements may be more subject to biases than laboratory-based measures or measures based on incentivized choice experiments. However, several recent papers show a strong correlation between incentivized choice experiments and nonincentivized survey measures of competitiveness and that the latter is able to predict career outcomes as well as the former (*51*–*53*). This validates our choice to use explicit statements to provide a worldwide description of gender gaps in competitiveness among 15-year-old students.

To construct our measure of competitiveness, we rely on students' answers to the item "'I enjoy working in situations involving competition with others," given on a four-point Likert scale. We find that girls are less competitive than boys. For OECD countries, the gender gap is on average equal to 0.26 SD without controls, and equal to 0.25 SD when controlling for performance in math, reading, and science. Looking country by country, we find a gender gap at the advantage of boys in all OECD countries. However, there is also substantial variation across countries, and there are countries where the gender gap in competitiveness is not significant, like, e.g., Japan or United Arab Emirates (table S6, column 1).

Gender gaps in competitiveness exhibit the two patterns observed for gender-talent stereotypes. First, there is a gender-equality paradox for gender gaps in competitiveness, which are larger in more developed or more gender-egalitarian countries: A 1 SD increase in countries' GGI, log GDP, or HDI significantly increases the gender gap in competitiveness by 0.4 to 0.6 SD (Table 3, columns 1 to 3). As this is a new finding (to our knowledge), we provide two robustness checks. First, we show that it is entirely robust to using student-level regression analyses that control for students' abilities (table S7, column 2) as well as other students' characteristics (table S7, column 3). Second, we replicate the cross-country analyses using as an alternative measure of the country-level gender gaps in competitiveness the difference between the percentage of males and of females who report finding competition good in the World Value Survey 2017–2020 (see the Supplementary Materials for more details). Table S8 (columns 1 to 3) shows that the relationships between this alternative measure and countries' GGI, (log of) GDP, or HDI are quantitatively smaller but still positive. Hence, the gender-equality paradox regarding gender gaps in competitiveness is not driven by our specific measure of competitiveness taken from PISA.

Second, gender gaps in competitiveness also increase with students' performance, consistent with previous experimental findings for Swiss students (*54*). To show this, we estimate Eq. 1 after replacing the outcome variable by our PISA measure of competitiveness

$$\text{Enjoy competition}_i = \alpha\,\text{Girl}_i + \beta\text{General\_ability}_i + \gamma(\text{General\_ability}_i * \text{Girl}_i) + \varepsilon_i \quad (2)$$

Results indicate that a 1 SD increase in general performance is associated with an increase in competitiveness of 0.13 SD for boys and 0.08 SD for girls, resulting in a steady increase in the gender gap in competitiveness with students' ability (table S9). Looking country by country, we observe that this increase is widespread: It is statistically significant in 53 countries out of the 73 for which we could estimate Eq. 2.

GTSs can account for variations in gender gaps in competitiveness across countries and groups of students

We now turn to the relationship between GTSs and the gender gap in competitiveness. First, we observe at the country-level a large and statistically significant relationship between both variables. This is true when gender gaps in competitiveness are built using PISA2018 (Table 3, column 4) or using the World Value Survey (table S8, column 4). This relationship is still observed at the individual level after controlling for students' individual characteristics: Girls are less likely to enjoy competition relative to boys in countries where gender-talent stereotypes are higher (table S7D).

Since gender gaps in competitiveness and gender gaps in attributing failure to a lack of talent are strongly correlated at the country level, we may wonder whether the "gender-equality" paradox observed for gender gaps in competitiveness may be related to gender-talent stereotypes. To do so, we perform a simple "horse race" in which we attempt to explain gender gaps in competitiveness measured at the country level with both a measure of countries' development or gender equality and our country-level measure of gender-talent stereotypes. The analyses are still performed with simple linear regression models. Table 3 (columns 5 to 7) shows that the magnitude of the relationship between gender gaps in competitiveness and GTSs is barely affected by controlling for the GGI, the log of GDP, or the HDI. The opposite is, however, not true: The magnitude of

Table 3. Relationship between the gender gap in competitiveness, countries' measures of development and gender equality, and gender-talent stereotypes: macrolevel analysis. The table shows the results of the regressions at the country level of the gender gap in competitiveness on a measure of *GTS* and measures of development (GDP and HDI) and gender equality (GGI). *GTS* denotes a country-level measure of talent stereotypes as defined and shown in table S1. The regressions whose results are reported in the first four columns involve only one explanatory variable, whereas those in the last three columns involve both a measure of gender talent stereotype and a variable measuring development or gender equality. Competitiveness is based on students' answers to PISA item about their enjoyment "working in situations involving competition with others," and gender gaps in competitiveness are defined in more detail in Supplementary Appendix A. Definitions and data sources for GDP, HDI, and GGI are more detailed in Supplementary Appendix A. ***$P < 0.01$, **$P < 0.05$, and *$P < 0.1$.

	Dependent variable is gender gap in competitiveness (B-G)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GGI	0.586***				0.262**		
	(0.102)				(0.122)		
Log GDP		0.426***				0.136	
		(0.110)				(0.102)	
HDI			0.597***				0.256**
			(0.0996)				(0.121)
GTS				0.698***	0.520***	0.621***	0.520***
				(0.0853)	(0.114)	(0.0988)	(0.116)
Constant	0.0725	0.0415	0.0456	−0.00580	0.0634	0.0262	0.0391
	(0.102)	(0.109)	(0.0989)	(0.0847)	(0.0903)	(0.0898)	(0.0893)
Observations	69	72	71	76	67	70	69
R^2	0.329	0.176	0.342	0.475	0.509	0.482	0.504

the relationship between gender gaps in competitiveness and GGI, log GDP, or HDI is reduced by more than two once controlled for gender-talent stereotypes, and it becomes not statistically significant for the log of GDP.

When we use the alternative measure of gender gaps in competitiveness constructed using the World Value Survey, the conclusions above are even reinforced since the relationships between this alternative measure and the GGI, the log of GDP, or the HDI entirely disappear once controlled for *GTS* (table S8, columns 5 to 7). Last, we also performed similar horse races at the individual level, controlling for students' characteristics, and found similar results: When gender gaps in competitiveness are related to both gender-talent stereotypes and a measure of countries' development or gender equality, the first relationship is much more robust than the second one (table S10, in which the magnitude of the coefficients can be compared with those obtained in table S7).

We perform a similar horse race for the second pattern, which is the fact that gender gaps in competitiveness increase with students' ability. To this aim, we group students by deciles of general performance (standardized by country) and compute gender gaps in attributing failure to a lack of talent (conditional on ability) in each decile. This measure of gender-talent stereotypes and its interaction with students' gender are then introduced as controls in Eq. 2. Table 4 shows the results. Column 1 just confirms that the gender gap in competitiveness increases with general performance. In contrast, column 2 shows that this is no longer the case once we control for gender talent stereotypes and their interaction with students' gender, which suggests that the increase of the gender gap in competitiveness with students' ability may be attributed to the fact that gender-talent stereotypes are stronger among high-performing students.

We conclude from the analyses above that the patterns observed for gender gaps in competitiveness among 15-year-old students can be related to the similar patterns for GTSs uncovered earlier in the paper. While the analyses we perform should not be interpreted as causal, they suggest a possible link between gender-talent stereotypes and gender gaps in competitiveness. Note that these results are not due to the fact that students who like competition are also students who do not attribute failure to a lack of talent: The correlation at the individual level in PISA2018 between students' competitiveness and their attribution of failure to a lack of talent is actually positive and very small ($r = 0.027$), implying that the large negative correlation between gender gaps (girls minus boys) in these variables cannot simply capture baseline correlations between the variables.

Table 4. Impact of performance on boys' and girls' competitiveness on the whole sample, with and without the mediation of gender talent stereotypes. The table shows the results of the regression on the whole sample of a variable measuring competitiveness on a dummy for female, general performance, and gender interacted with performance in the first specification, adding gender talent stereotypes and their interaction with general performance in the second specification. Competitiveness is based on students' answers to PISA item about their enjoyment "working in situations involving competition with others" and is standardized at the country level. General performance is the unweighted mean of performance in math, reading, and science and is also standardized to have a weighted mean equal to 0 and a weighted SD equal to 1 in each country. *GTS* are measured by the gender gap in perceived lack of talent taken in a reference group that comprises all students of the country that are in the same decile of general performance. All estimates and SEs are based on plausible values for math, reading, and science ability and account for measurement error in these abilities on top of standard sampling error. SEs in parentheses. ***$P < 0.01$, **$P < 0.05$, and *$P < 0.1$

	Dependent variable is students' competitiveness	
	(1)	**(2)**
General performance	0.133***	0.111***
	(0.006)	(0.006)
Girl*General performance	−0.054***	−0.007
	(0.009)	(0.009)
GTSs		0.031***
		(0.003)
Girl*GTSs		−0.066***
		(0.004)
Girl	−0.191***	−0.028**
	(0.006)	(0.012)
Constant	0.093***	0.017
	(0.005)	(0.011)
Observations	527,960	516,466
R^2	0.021***	0.023***

Similar results for gender gaps in self-confidence and career choices

All analyses presented above regarding gender gaps in competitiveness are replicated with gender gaps in self-confidence and gender gaps in expectations to pursue an ICT-related career. We describe below how we measure these gender gaps before turning to the results.

General sense of self-efficacy refers in PISA to individuals' beliefs in their own general ability to engage in activities and perform tasks. PISA2018 includes items about students' self-efficacy, and in particular the two items "when I'm in a difficult situation, I can usually find my way out of it" and "my belief in myself gets me through hard times," that are of particular interest to us since they are related to adverse circumstances (difficult situations). We think that the context of adverse circumstances is likely to be more related to both talent and future choice and have considered as our measure of self-confidence (in the face of difficulty) an index made of the equally weighted average of these two items (see Supplementary Appendix A for more details on this measure). We produce evidence based on this index and have also checked that results are similar for each of the two items considered separately.

Concerning fields of study and careers, PISA2018 asked students what occupation they expect to be working in when they are around 30 years old, which permits to identify the gender gap in students expecting to work in ICT -related occupations. We focus on this field because it is highly gendered, promised to a high growth in the near future, and associated with high earnings, and the gender gap in this field is seen as particularly problematic because it could generate further inequalities.

Gender gaps in self-confidence and willingness to work in an ICT-related occupation are provided for the whole PISA sample and each PISA participating country in table S6. The average gender gap in self-confidence "worldwide" amounts to 10% of an SD (16% among OECD countries). Boys are also about twice more likely than girls to expect working in an ICT-related occupation later on, confirming that ICT-related jobs are highly gendered. Tables S11 and S12 (columns 1 to 3) confirm the existence of a gender-equality paradox for gender gaps in self-confidence and willingness to work in ICT-related occupations. Column 4 of the same tables shows a large cross-country association between gender-talent stereotypes and each of the two gender gaps above. Last, the gender-equality paradox regarding ICT-related occupations entirely disappears (table S12), while the one regarding self-confidence is largely reduced (table S11) once we control for GTSs at the country level.

Tables S13 and S14 study how the gender gaps in self-confidence and willingness to work in ICT-related occupations vary with students' ability. Column 1 shows that these gender gaps are increasing with ability: Compared to their male counterparts with similar ability, high-performing girls exhibit lower self-confidence and they are less willing to work in an ICT-related occupation than low-performing girls. Regarding self-confidence, this pattern entirely disappears once we control for the partial effects of *GTS* and its interaction with gender on self-confidence (table S13, column 2), while this is only partially the case for ICT-related occupations (table S14, column 2). Overall, we conclude that the two additional gender gaps studied in this section follow the two intriguing patterns also observed for gender-talent stereotypes and that our measure for these stereotypes can largely explain the patterns for the other variables.

DISCUSSION

Many of the gender gaps said to be related to the glass ceiling (*47*) are larger in more developed or more gender-egalitarian countries, and they are also larger among high-performing students. The first pattern suggests that the glass ceiling is unlikely to disappear as countries develop or become more gender-egalitarian. The second is worrying as high-performing students are the most likely to be concerned with the glass ceiling. Moreover, for the three gender gaps studied in this paper, we can show that the patterns observed worldwide are related to our measure of gender-talent stereotypes. To better understand why, we now turn back to our measure and try to characterize what it captures exactly, and why it also exhibits a gender-equality paradox.

What do gender-talent stereotypes actually measure?

Our measure of gender-talent stereotypes is related to gender gaps in confidence for activities that are stereotyped as difficult or requiring to be talented. For example, *GTS* are positively correlated across countries with gender gaps in students' feeling to be self-responsible when failing in math ($r = 0.53$, see table S15B). Hence, when our measure of *GTS* is large, girls are more likely, relative to boys, to attribute a failure in math to their own inability rather than to external factors. As math is one of the academic fields most strongly related with brilliance or raw talent (*3*), this result shows that *GTS* are related to gender gaps in self-concept for activities that are stereotyped as requiring talent.

GTS are also associated at the country level with gender gaps in students' belief that they can understand things quickly ($r = 0.45$) or that they are efficient at reading a map ($r = 0.64$). Hence, the stronger *GTS*, the more girls will think (relative to boys) that they cannot be a fast-thinker or perform a task that is usually not taught and stereotyped as masculine. *GTS* are also associated at the country level with gender gaps in students' belief that they will struggle to perform a difficult task. This is actually the case when the considered task is in a domain that is stereotyped as feminine ("understanding difficult texts"; $r = 0.51$; see table S15). *GTS* are therefore positively associated to gender gaps in self-concept in domains that are stereotyped as requiring talent, as well as to gender gaps in attitudes toward tasks that are labeled as requiring talent, no matter the domain in which the tasks take place.

GTS do not relate to gender gaps in self-confidence in all contexts: There is, for example, no significant cross-country correlation between *GTS* and gender gaps in students' confidence that they are good readers ($r = -0.12$). *GTS* is therefore related to gender gaps in students' beliefs that they can perform difficult tasks in reading, but not to general self-confidence in reading. This shows that *GTS* more specifically capture attitudes or self-concepts for activities or tasks that are stereotyped to require talent.

GTS do not capture either a lack of ambition of girls relative to boys. On average, girls expect to be working at around 30 years old in higher-status occupations than boys, even when controlling for performance or when restricting the sample to OECD countries. There is also no significant cross-country correlation between the gender gaps in students' expected occupational status at 30 years old and *GTS* (table S15). Last, *GTS* do not reflect a lower perceived control over succeeding at school as girls agree more than boys with the assertion "if I put enough effort, I can succeed at school" (gender gap of −0.09 SD), and there is no significant cross-country correlation between the corresponding gender gap and *GTS* (table S15). This is in line with the 6- and 7-year-old girls by Bian *et al.*'s (*5*) study who thought that girls get better grades in school than boys. It shows that girls can at the same time internalize a lack of talent, and a higher ability to succeed at school, confirming that the two lines of research that have examined these different stereotypes [Leslie *et al.* (*3*) on the one hand and Stewart-Williams and Halsey (*16*) on the other hand] are not in contradiction with each other. Together, these results illustrate the specificity of *GTS*, which does not deal with plain ability at school but with the lack of a special aptitude, that cannot be taught.

Last, we can show that *GTS* is unlikely to capture a gendered tendency for personal attribution. The question we use to build *GTS* is about attributing failure to the lack of a personal characteristic: talent. One may be concerned that it is not the characteristic per se that matters, but rather gender differences in attributing outcomes to oneself or a personal characteristic, no matter the characteristic that is considered. To show that this is not the case, we proceed in two steps. We first consider an item in PISA2012 about math: "Doing well in math is entirely up to me." For this item, the gender gap (still conditional on ability) is clearly in favor of boys, showing that girls do not systematically attribute outcomes to themselves. A fundamental difference, however, with the item above is that it is about attributing success (rather than failure) to oneself. One could still argue that girls/women will attribute failure more, and success less, to themselves than do boys. To discard this hypothesis, we recall that the gender gap in the item "if I put enough effort, I can succeed at school" is in favor of girls (see above), showing that girls can in some cases attribute success to themselves or a personal characteristic. Together, the comparison of the gender gaps in the items above suggests that there are no systematic gender differences in attributing success or failure to a personal characteristic, and that the tendency to do so for girls and boys depends on the characteristic at stake. When it is about "doing math," girls are less likely than boys to attribute potential success to themselves. However, when it is about "putting effort" to succeed, then they are more likely than boys to consider they can do it.

Why is there a gender-equality paradox regarding gender-talent stereotypes? And what does it imply?

As underlined by, e.g., Ridgeway (*55*), sex categorization is too deeply rooted as a system of relational sense-making for people to tolerate a serious disruption, and the bringing together of men's and women's worlds, the weakening of traditional gender norms, and roles about education and labor force, and politics participation that takes place in wealthier and more gender-equal countries can be associated with the enhancement of new forms of gender differentiation, like gender-talent stereotypes. This general theory is in line with the findings of England (*56*) or Knight and Brinton (*57*) that show that no country has eliminated gender essentialism. For instance, in the United States, with women's progress toward equality in the workforce and in education, the beliefs that women are less intelligent and competent than men have weakened in the past decades (*58*), but "these specific gender beliefs were transformed and there is now more focus on women's lower brilliance" (*3*, *59*, *60*). Broadly consistent with this argument, we find that the more women are present and entitled to be present in education, labor force, or politics, the stronger *GTS* are. *GTS* are positively related at the country level with female mean years of study, the female-to-male ratio in the labor force, the (opposite of the) date of women's suffrage, or the opposite of the percentage of individuals agreeing with traditional values (in the World Value Survey).

A more fundamental reason that may explain why some gender essentialist norms (regarding talent or other domains) are more pronounced in wealthier and more egalitarian countries might be that these countries have also developed more emancipative, individualistic, and progressive values that give a lot of importance to self-realization and self-expression (*61*). These countries tend to "give citizens greater space to fall back on an old, deeply ingrained cultural frame as they try to make sense of themselves and others and organize their choices and behaviors accordingly" (*55*). This could explain that essentialist gender norms can be more easily internalized in these countries, as these norms will give individuals a cultural background on which they can fall back when facing the need to express their social identities. This explanation has been developed extensively by Charles and coauthors [see (*22*, *62*–*64*)] to explain math attitudes and the larger extent of occupational segregation in more developed countries. We argue here that it can also apply to gender stereotypes regarding talent. Consistent with this argument, we find a large cross-country correlation between individualistic values and *GTS* ($r = 0.68$, $N = 69$; see the Supplementary Materials for details).

A related explanation comes from the fact that people in more developed and more individualistic countries have different beliefs regarding human intelligence. According to Rattan *et al.* (*65*), in Western countries, people tend to think that high intelligence is not universal but only granted to some (gifted) individuals, while in India or South Africa, for example, people believe that virtually everyone is born with the potential to become highly intelligent. This implies that in more developed countries, people may be generally more likely to attribute the underperformance to a lack of inherent potential, leaving more space for gender stereotypes regarding lack of talent to develop.

The existence of a gender-equality paradox for gender-talent stereotypes finally has important implications for the lively debate on the origin of the similar paradox regarding the underrepresentation of women in STEM (science, technology, engineering, and mathematics) or math-related fields. Some scholars have explained the latter paradox by the existence of deeply rooted gender differences in preferences that materialize more easily in countries where economic constraints are more limited or in countries where men and women have more similar rights [see, e.g., (*23*)]. Others argue that the paradox could be explained by the emergence of stronger gender norms associating math primarily with men in more developed or more gender-egalitarian countries (*20*, *61*). The fact that *GTS* are larger in more developed countries means that girls in those countries internalize more the fact that they are less talented than boys, which is not consistent with an easier expression of girls' and boys' inner interests or preferences in these countries.

Final comments and policy implications

This paper shows the existence of large and widespread gender gaps in attribution of failure to a lack of talent. These gender gaps are linked to other well-known gender gaps at the country level and across students of different abilities, suggesting that self-selection patterns of girls away from competitive and prestigious careers may also be related to gender norms regarding talent. Considering gender norms regarding talent or related concepts such as brilliance or giftedness is therefore likely to be important to understand the supply-side contribution to the glass ceiling. This is both because these norms are likely to be directly related to the scarcity of women in top positions and because they are related to some of the main factors commonly put forward to explain it.

The evidence provided in the paper suggests, in particular, that exposure to cultural stereotypes about girls' intellectual abilities and talent leads boys and girls to develop attitudes and preferences that they may not have had otherwise. In sending these messages, our culture may needlessly limit the behaviors, preferences, and career options that boys and girls consider. Gender-talent stereotypes may actually also hurt boys. For example, it may lead them to rely too much on talent and quick learning, to underestimate the role of effort over ability in the performance of particular tasks, to despise hard and in-depth study, and to abandon school work in case of failure. Consistent with this hypothesis, we obtain on PISA data that the gender gap in homework, as well as the gender gap in the belief that "Trying hard at school is important," both at the advantage of girls, increase with *GTS*. The gender gap in students' ability to sustain their performance over the course of the PISA test, also at the advantage of girls [see (*66*)], is again positively correlated with *GTS* at the country level, suggesting further that gender-talent stereotypes may hinder boys' ability to engage in a sustained effort.

In terms of policy interventions, trying to suppress the myth of brilliance, raw talent, and creativity might require to convey the idea that talent is built through learning and effort and through trials and errors and that it is not innate and unchangeable (*64*). This consists of instilling a growth mindset [e.g., (*35*)] and viewing success as emerging from these processes rather than as depending on the amount of fixed, inherent ability one was supposedly born with. One small starting point is to be cautious when describing peers, children, or students as creative or brilliant because of the potential for bias in these descriptions. Exposing boys and girls to successful and arguably talented female role models is also likely to be a successful practical solution [see, e.g., (*36*, *67*, *68*)].

MATERIALS AND METHODS

As described above, our main data source is PISA2018 (see the Supplementary Materials). We complete PISA2018 with several country-level measures of socioeconomic development or gender equality. Those measures are taken from various sources described in the Supplementary Materials. We also build a few additional country-level measures of gender gaps in attitudes using PISA2012 (see the Supplementary Materials).

Empirical analyses presented in the paper rely primarily on standard country-level correlations and multivariate linear regressions with a few competing explanatory variables. We also present student-level analyses that control for some observable students' characteristics.

In all procedures that involve PISA students, be it the construction of aggregated statistics used in follow-up analyses or direct statistical procedures, we use PISA sampling weights to get results that are representative of all students in the PISA participating countries.

Last, PISA does not provide a single measure of students' abilities in math, science, or reading but a set of 10 plausible values drawn from students' ability posterior distributions. We systematically use the standard procedures required to obtain correct estimates and SEs when dealing with plausible values (all details are provided in the Supplementary Materials).

SUPPLEMENTARY MATERIALS

Supplementary material for this article is available at https://science.org/doi/10.1126/sciadv.abm3689

REFERENCES AND NOTES

1. M. Bertrand, Coase lecture—The glass ceiling. *Economica* **85**, 205–231 (2018).
2. European Union, "Gender balance on corporate boards. Europe is cracking the glass ceiling," Directorate-General for Justice and Consumers, Fact sheet, July 2016.
3. S.-J. Leslie, A. Cimpian, M. Meyer, E. Freeland, Expectations of brilliance underlie gender distributions across academic disciplines. *Science* **347**, 262–265 (2015).
4. M. Meyer, A. Cimpian, S. J. Leslie, Women are underrepresented in fields where success is believed to require brilliance. *Front. Psychol.* **6**, 235 (2015).
5. L. Bian, S.-J. Leslie, A. Cimpian, Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science* **355**, 389–391 (2017).
6. L. Bian, S. J. Leslie, M. C. Murphy, A. Cimpian, Messages about brilliance undermine women's interest in educational and professional opportunities. *J. Exp. Soc. Psychol.* **76**, 404–420 (2018).
7. D. Storage, T. E. S. Charlesworth, M. R. Banaji, A. Cimpian, Adults and children implicitly associate brilliance with men more than women. *J. Exp. Soc. Psychol*. **90**, 104020 (2020).
8. S. T. Fiske, A. J. C. Cuddy, P. Glick, J. Xu, A model of (often mixed) stereotype content: Competence and warmth respectively follow from perceived status and competition. *J. Pers. Soc. Psychol.* **82**, 878–902 (2002).
9. J. E. Williams, D. L. Best, *Measuring Sex Stereotypes: A Multination Study* (Cross-cultural research and methodology series, Sage Publications Inc., 1990), vol. 6.
10. A. Furnham, E. Reeves, S. Budhani, Parents think their sons are brighter than their daughters: Sex differences in parental self-estimations and estimations of their children's multiple intelligences. *J. Genet. Psychol.* **163**, 24–39 (2002).
11. S. Stephens-Davidowitz, "Google, tell me. Is my son a genius," *New York Times*, 19 January 2014.
12. H. Raty, L. Snellman, Children's images of an intelligent person. *J. Soc. Behav. Pers.* **12**, 773–784 (1997).
13. D. Z. Grunspan, S. L. Eddy, S. E. Brownell, B. L. Wiggins, A. J. Crowe, S. M. Goodreau, Males under-estimate academic performance of their female peers in undergraduate biology classrooms. *PLOS ONE* **11**, e0148405 (2016).
14. T. Schmader, J. Whitehead, V. H. Wysocki, A linguistic comparison of letters of recommendation for male and female chemistry and biochemistry job applicants. *Sex Roles* **57**, 509–514 (2007).
15. M. Bianco, B. Harris, D. Garrison-Wade, N. Leech, Gifted girls: Gender bias in gifted referrals. *Roeper Rev*. **33**, 170–181 (2011).
16. S. Stewart-Williams, L. G. Halsey, Men, women and STEM: Why the differences and what should be done? *Eur. J. Personal.* **35**, 3–39 (2021).
17. B. L. Hartley, R. M. Sutton, A stereotype threat account of boys' academic underachievement. *Child Dev.* **84**, 1716–1733 (2013).
18. J. P. Robinson, S. T. Lubienski, The development of gender achievement gaps in mathematics and reading during elementary and middle School. *Am. Educ. Res. J.* **48**, 268–302 (2011).
19. M. Foschi, Status characteristics, standards, and attributions, in *Sociological Theories in Progress: New Formulations*, J. M. Zelditch Jr., B. Anderson, Eds. (Sage, 1989), vol. 58, pp. 58–72.
20. M. Foschi, Double standards in the evaluation of men and women. *Soc. Psychol. Q.* **59**, 237–254 (1996).
21. M. Foschi, Double standards for competence: Theory and research. *Annu. Rev. Sociol.* **26**, 21–42 (2000).
22. M. Charles, K. Bradley, Indulging our gendered selves? Sex segregation by field of study in 44 countries. *Am. J. Sociol.* **114**, 924–976 (2009).
23. G. Stoet, D. C. Geary, The gender-equality paradox in science, technology, engineering, and mathematics education. *Psychol. Sci.* **29**, 581–593 (2018).
24. A. Falk, J. Hermle, Relationship of gender differences in preferences to economic development and gender equality. *Science* **362**, eaas9899 (2018).
25. R. A. Lippa, M. L. Collaer, M. Peters, Sex differences in mental rotation and line angle judgments are positively associated with gender equality and economic development across 53 nations. *Arch. Sex. Behav.* **39**, 990–997 (2010).
26. E. Mac Giolla, P. J. Kajonius, Sex differences in personality are larger in gender equal countries: Replicating and extending a surprising finding. *Int. J. Psychol.* **54**, 705–711 (2019).
27. S. H. Schwartz, T. Rubel-Lifschitz, Cross-national variation in the size of sex differences in values: Effects of gender equality. *J. Pers. Soc. Psychol.* **97**, 171–185 (2009).
28. M. Zuckerman, C. Li, J. A. Hall, When men and women differ in self-esteem and when they don't: A meta-analysis. *J. Res. Pers.* **64**, 34–51 (2016).
29. M. Zuckerman, C. Li, E. F. Diener, Societal conditions and the gender difference in well-being: Testing a three-stage model. *Personal. Soc. Psychol. Bull.* **43**, 329–336 (2017).
30. R. L. Hopcroft, D. B. Bradley, The sex difference in depression across 29 countries. *Soc. Forces* **85**, 1483–1507 (2007).
31. N. M. Else-Quest, J. S. Hyde, M. C. Linn, Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychol. Bull.* **136**, 103–127 (2010).
32. G. Stoet, D. H. Bailey, A. M. Moore, D. C. Geary, Countries with higher levels of gender equality show larger national sex differences in mathematics anxiety and relatively lower parental mathematics valuation for girls. *PLOS ONE* **11**, e0153857 (2016).
33. K. E. Snyder, J. L. Malin, A. L. Dent, L. Linnenbrink-Garcia, The message matters: The role of implicit beliefs about giftedness and failure experiences in academic self-handicapping. *J. Educ. Psychol.* **106**, 230–241 (2014).
34. J. W. Osborne, C. Walker, Stereotype threat, identification with academics, and withdrawal from school: Why the most successful students of colour might be most likely to withdraw. *Educ. Psychol.* **26**, 563–577 (2006).
35. C. S. Dweck, Beliefs that make smart people dumb, in *Why Smart People Can Be So Stupid*, R. J. Sternberg, Ed. (Yale Univ. Press, 2002), pp. 24–41.
36. J. S. Boston, A. Cimpian, How do we encourage gifted girls to pursue and succeed in science and engineering? *Gift. Child Today* **41**, 196–207 (2018).
37. H. R. Arkes, P. E. Tetlock, TARGET ARTICLE: Attributions of implicit prejudice, or "would Jesse Jackson 'fail' the Implicit Association Test?". *Psychol. Inq.* **15**, 257–278 (2004).
38. J. Berger, B. P. Cohen, M. Zelditch Jr., Status characteristics and social interaction. *Am. Sociol. Rev.* 241–255 (1972).
39. S. J. Correll, Gender and the career choice process: The role of biased self-assessments. *Am. J. Sociol.* **106**, 1691–1730 (2001).
40. S. J. Correll, Constraints into preferences: Gender, status, and emerging career aspirations. *Am. Sociol. Rev.* **69**, 93–113 (2004).
41. C. L. Ridgeway, Social status and group structure, in *Blackwell Handbook of Social Psychology: Group Processes*, M. A. Hogg, R. S. Tindale, Eds. (Blackwell, 2001), pp. 352–375.
42. S. J. Correll, C. L. Ridgeway, Expectation states theory, in *Handbook of Social Psychology* (Springer, 2006), pp. 29–51.
43. M. Muradoglu, Z. Horne, M. D. Hammond, S. J. Leslie, A. Cimpian, Women—particularly underrepresented minority women—and early-career academics feel like impostors in fields that value brilliance. *J. Educ. Psychol.* Advance online publication, (2021).
44. M. Niederle, L. Vesterlund, Gender and competition. *Annu. Rev. Econ.* **3**, 601–630 (2011).
45. K. Deaux, E. Farris, Attributing causes for one's own performance: The effects of sex, norms, and outcome. *J. Res. Pers.* **11**, 59–72 (1977).
46. S. Beyer, Gender differences in the accuracy of self-evaluations of performance. *J. Pers. Soc. Psychol.* **59**, 960–970 (1990).
47. F. D. Blau, L. M. Kahn, The gender wage gap: Extent, trends, and explanations. *J. Econ. Lit.* **55**, 789–865 (2017).
48. T. Buser, M. Niederle, H. Oosterbeek, Gender, competitiveness, and career choices. *Q. J. Econ.* **129**, 1409–1447 (2014).
49. A. Leibbrandt, J. A. List, Do women avoid salary negotiations? Evidence from a large-scale natural field experiment. *Manag. Sci.* **61**, 2016–2024 (2015).
50. M. Dittrich, A. Knabe, K. Leipold, Gender differences in experimental wage negotiations. *Econ. Inq.* **52**, 862–873 (2014).

51. T. Buser, M. Niederle, H. Oosterbeek, Can competitiveness predict education and labor market outcomes? Evidence from incentivized choice and survey measures (No. w28916, National Bureau of Economic Research, 2021).
52. W. Bönte, S. Lombardo, D. Urbig, Economics meets psychology: Experimental and self-reported measures of individual competitiveness. *Personal. Individ. Differ.* **116**, 179–185 (2017).
53. A. Boschini, A. Dreber, E. von Essen, A. Muren, E. Ranehill, Gender, risk preferences and willingness to compete in a random sample of the Swedish population. *J. Behav. Exp. Econ.* **83**, 101467 (2019).
54. T. Buser, N. Peter, S. C. Wolter, Gender, willingness to compete and career choices along the whole ability distribution. IZA Discussion Paper No. 10976 (2017).
55. C. L. Ridgeway, Framed before we know it: How gender shapes social relations. *Gend. Soc.* **23**, 145–160 (2009).
56. P. England, The gender revolution: Uneven and stalled. *Gend. Soc.* **24**, 149–166 (2010).
57. C. R. Knight, M. C. Brinton, One egalitarianism or several? Two decades of gender-role attitude change in Europe. *Am. J. Sociol.* **122**, 1485–1532 (2017).
58. A. H. Eagly, C. Nater, D. I. Miller, M. Kaufmann, S. Sczesny, Gender stereotypes have changed: A cross-temporal meta-analysis of U.S. public opinion polls from 1946 to 2018. *Am. Psychol.* **75**, 301–315 (2020).
59. S. R. Fisk, C. L. Ridgeway, Framing gender, in *Handbook of the Sociology of Gender* (Springer, 2018), pp. 157–171.
60. S. Thébaud, M. Charles, Segregation, stereotypes, and STEM. *Soc. Sci.* **7**, 111 (2018).
61. T. Breda, E. Jouini, C. Napp, G. Thebault, Gender stereotypes can explain the gender-equality paradox. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 31063–31069 (2020).
62. M. Charles, K. Bradley, Equal but separate? A cross-national study of sex segregation in higher education. *Am. Sociol. Rev.* **67**, 573–599 (2002).
63. M. Charles, D. B. Grusky, *Occupational Ghettos: The Worldwide Segregation of Women and Men* (Stanford Univ. Press, 2004), vol. 200.
64. M. Charles, B. Harr, E. Cech, A. Hendley, Who likes math where? Gender differences in eighth-graders' attitudes around the world. *Int. Stud. Sociol. Educ.* **24**, 85–112 (2014).
65. A. Rattan, K. Savani, N. V. R. Naidu, C. S. Dweck, Can everyone become highly intelligent? Cultural differences in and societal consequences of beliefs about the universal potential for intelligence. *J. Pers. Soc. Psychol.* **103**, 787–803 (2012).
66. P. Balart, M. Oosterveen, Females show more sustained performance during test-taking than males. *Nat. Commun.* **10**, 3798 (2019).
67. L. Del Carpio, M. Guadalupe, More women in tech? Evidence from a field experiment addressing social identity. CEPR Discussion Paper No. DP13234 (2018).
68. T. Breda, J. Grenet, M. Monnet, C. Van Effenterre, Do female role models reduce the gender gap in science? Evidence from French high schools. ⟨halshs-01713068v4⟩ (2020).

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