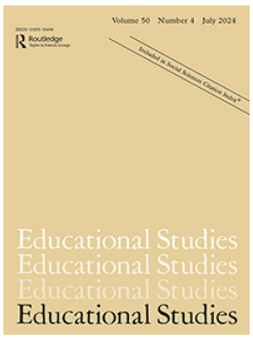

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Gender gaps in the evaluation of academic abilities and their role in shaping study CHOICES

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ABSTRACT

This study examines gender gaps in ability grouping based on students' appraisals of their math and Spanish language abilities. The role of these ability groupings in predicting students' university studies was also analyzed. 796 secondary students participated (mean age=16 years, S.D=.81). The self-criterion residual method resulted in three groups: over-estimators, realistic, and under-estimators. The classification analysis with linear regressions show that female students fell into the under-estimator math group, whereas male students into the under-estimator Spanish group. However, female students were more likely to belong to the over-estimator Spanish group, whereas male students to the over-estimator math group. In addition, the logistic regressions suggested that students who over-estimated their math ability were more likely to pursue STEM studies, whereas students who underestimated their math ability more likely opted for studies related to humanities and social sciences. The practical implications with regards to study choices and gender-role assumptions are discussed.

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Accuracy; gender; performance; self-concept of ability; study choices

Introduction

In most Western countries women continue to be underrepresented in some STEM (science, technology, engineering, and mathematics) disciplines (MEFP 2020; UNESCO 2018). In Spain during the academic course 2018–2019 women represented 12,9% in the studies of computer science, 28,5% in the studies belonging to the field of engineering, industry and construction, 49,1% in the studies of science. However, women were highly represented in the STEM studies oriented to life-sciences (71,4% of the students enrolled in health and social services). In addition,77,7% in the studies of education, 60,8% in the studies of arts and humanities, 61,9% in the studies of social sciences, journalism, and documentation, and 53,5% in the studies with the field of business, administration, and law.

Several studies have traditionally associated women's lack of interest in STEM careers with their lower self-concept of maths abilities (e.g. Bandura et al. 2001; Sainz and Eccles 2012; Wang and Degol 2016). Nonetheless, despite the rich empirical research tackling gender differences in the pursuit of STEM studies, it is still unclear which motivational factors encourage women to pursue careers such as medicine or biology and discourage

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them from enrolling in STEM fields such as engineering or computer science (Ceci and Williams 2010; Wang and Degol 2016).

Women have traditionally been stereotyped as being bad at maths, whilst in contrast, it is generally assumed that men are good at maths (Eccles 2009). Women's awareness of this stereotype has major negative implications for several motivation indicators. For instance, women have a lower self-concept of STEM ability (Sainz and Eccles 2012) and a lack of aspirations in STEM majors (Cadaret et al. 2017; Wang and Degol 2013). In addition, this stereotype also has an impact on female students' final maths and STEM performance (Guizzo et al. 2019; Spencer, Steele, and Quinn 1999).

Self-assessment of students' academic competence

Students' self-concept of ability has traditionally been taken as a basis to measure their level of competence in different subject areas (Marsh and Hau 2004). Self-confidence, self-efficacy, and self-perception of ability are key notions within motivational theories of choice or behaviour, such as social cognitive theory or the expectancy-value theory of achievement motivation (i.e. Eccles 2009; Lent et al. 2016; Wang and Degol 2013). Self-confidence was conceptualised some years ago as "the belief that one can successfully execute a specific activity, rather than a global trait that accounts for overall performance optimism" (Druckman and Bjork 1994, 174).

Current self-confidence beliefs have been conceptualised by literature as self-concept beliefs, whereas someone's confidence about their future capacities has been conceptualised as self-efficacy (Sheldrake, Mujtaba, and Reiss 2022). On the one hand, self-efficacy makes reference to cognitive judgements of one's capabilities based on one's direct experiences with the task (Bong and Clark 1999). On the other hand, self-perception of ability is heavily influenced by social comparison and incorporates both cognitive and affective responses towards the self (Bong and Clark 1999; Kung 2009). The present study addresses these issues with an analysis of existing biases in the way secondary students evaluate their own maths and Spanish language abilities.

Research drawing on social cognitive career theory has confirmed that high self-efficacy beliefs in STEM shape persistence and interest in STEM (Byars-Winston et al. 2010; Kung 2009; Lent et al. 2016). Research on students' self-perception of ability in STEM subject areas like maths, computer science, and science is prolific (Bench et al. 2015; Kung 2009; Sainz and Eccles 2012). However, little research has been conducted on students' self-concept of ability in domains different from STEM, with the exception of languages (e.g. Archambault, Eccles, and Vida 2010; Gonida and Leondari 2011; Jacobs et al. 2002). These last studies conclude that female students reported a higher self-perception of language ability and higher verbal performance than their male counterparts (Archambault, Eccles, and Vida 2010; Gonida and Leondari 2011; Jacobs et al. 2002). At the same time, there is a dearth of studies in the Spanish context focused on gender differences in students' self-perceptions and calibration of their language ability. The present study therefore aims to fill these research gaps by analysing the existence of gender differences in students' calibration of their maths and Spanish abilities and how this shapes their interest in future academic studies.

Calibration is defined as the degree to which beliefs—e.g. self-concept of ability – reflect an actual situation—e.g. students' performance (Sheldrake, Mujtaba, and Reiss 2014). It can measure the degree of overall accuracy of beliefs or bias, or the direction of the discrepancy (Sheldrake, Mujtaba, and Reiss 2014). Having an accurate self-perception of ability seems to be associated with more realistic academic decisions (Eccles 2009; Sheldrake, Mujtaba, and Reiss 2014, 2022). Nevertheless, although many students are quite realistic in the evaluation of their abilities in different subject areas (their scores are equivalent to their assessment of academic competence), many other students tend to either overestimate (their assessment of competence is above their actual performance) or underestimate (their assessment of competence is below their actual performance) these academic abilities (Bench et al. 2015; Gonida and Leondari 2011; Sainz and Katja 2016; Sheldrake, Mujtaba, and Reiss 2014; Sheldrake 2016).

Interestingly, scholars have obtained complementary results suggesting that students can show various degrees of under-confidence or over-confidence, through expressing lower or higher confidence than expected given their performance (Bouffard and Narciss 2011; Sheldrake 2016). In this regard, several studies have concluded that under-confident students reported lower performance and academic attitudes than other students, despite having similar or higher performance than their school mates (Gonida and Leondari 2011; Narciss et al., 2011; Sheldrake, Mujtaba, and Reiss 2014). Nevertheless, further research has drawn the conclusion that higher performing students were more accurate in their confidence (their actual performance was equivalent to their assessment of academic competence), while lower performing students exhibited greater over-confidence (García et al. 2016). In addition, another study went beyond performance and has demonstrated that students with accurate self-perception of maths ability also reported the highest intentions to study maths-related courses years later, as well the highest maths interest, maths enjoyment, and subject-level self-concept (Sheldrake et alt., 2015).

Motivational effects of students' accuracy in evaluating their academic competence

Students' accuracy in the evaluation of their academic abilities has played a major role in the prediction of several motivational indicators, such as students' interest in science (Sheldrake 2016; Sheldrake, Mujtaba, and Reiss 2014), performance in several subjects (Bouffard et al. 2011) or achievement goal orientations (Gonida and Leondari 2011). Some studies have delved into the relationship between students' classification of their academic competence and their academic aspirations (Bench et al. 2015; Sheldrake 2016; Sheldrake, Mujtaba, and Reiss 2014). Students with accurate maths calibration at age 15 reported the highest intentions to study mathematics at ages 17 and 18 (Sheldrake, Mujtaba, and Reiss 2014), while students who overestimated their maths abilities were more likely to pursue science-related studies (Bench et al. 2015; Sheldrake, Mujtaba, and Reiss 2014; Sheldrake 2016).

In addition, scholars have still not agreed on the benefits and costs associated with positive and negative appraisals of students' competence (Bouffard and Narciss 2011; Sheldrake 2016). Whereas for some scholars having a realistic self-concept or an optimistic view of one's capabilities (that is, evaluating one's abilities above actual

performance) is positive (i.e. Gonida and Leondari 2011), for others having a realistic evaluation of one's abilities (evaluating one's abilities in line with actual performance) is more adaptive in terms of academic motivation, achievement, persistence, and self-regulation (i.e. Bouffard and Narciss 2011; Sheldrake, Mujtaba, and Reiss 2014, 2022). However, there is a consensus among researchers that having a pessimistic view of students' capabilities (that is, evaluating their capabilities below their actual performance) is the least adaptive scenario with regards to academic motivation, achievement, persistence, and self-regulation (Bouffard and Narciss 2011; Sheldrake, Mujtaba, and Reiss 2014; Sainz and Katja 2016). Students with a pessimistic view of their capabilities can be therefore less motivated to surpass their normal performance and overcome difficulties through persistence or other strategies (Sheldrake 2016).

In the present study, we expect to find different groups of students with varying levels of accuracy in their maths and Spanish ability self-concept: over-estimators, realistic, and under-estimators [Hypothesis 1]. Moreover, the gender gap in students' evaluation of their school competence continues to be a timely research topic (Bench et al. 2015; Gonida and Leondari 2011; Marakova et al., 2019; Sainz and Katja 2016) given the prevalence of gender differences between male and female students in academic performance (i.e. PISA findings regarding performance in reading, maths, and science), or study choices (i.e. UNESCO studies showing girls' underrepresentation in STEM fields like engineering, computer science, or physical science, 2021).

Several studies suggest that male students tend to overestimate their school competence (i.e. they rate their level of competence over their actual performance) in subjects such as maths or science (Bench et al. 2015; Guimond and Roussel 2001; Sainz and Eccles 2012), due partly to the fact that male students have traditionally been expected to perform better than female students in these subject areas (Ecclesand Wigfield 2020). However, whereas some research claims that female students seem to be more accurate or realistic than their male counterparts in the evaluation of their own competence in maths and science (Watt 2010), other studies conclude that female students are more likely to evaluate their competence in maths and science below their actual performance (Bench et al. 2015; Gonida and Leondari 2011; Sainz and Katja 2016).

Previous research developed in Spain with a two-year longitudinal sample (Sainz and Katja 2016) identified four groups of students according to their evaluation of maths ability before and after they transited into high school: high-accurate, low-accurate, optimistic, and pessimistic. Male students more likely belonged to the high-accurate or optimistic self-concept maths ability group across time. Likewise, secondary students whose parents had a high level of education more likely belonged to the low-accurate or pessimistic self-concept of maths ability group. In the present study, male students are therefore expected to be more likely than female students to overestimate their maths abilities, whereas female students will be more likely than male students to overestimate their Spanish abilities [Hypothesis 2].

Evaluation of competences and study choices

There is actually a vast literature on this topic, which shows that female students tend to have lower self-concepts in maths and science (Sainz and Eccles 2012; Kung 2009; Sheldrake, Mujtaba, and Reiss 2022). This partially contributes to their reduced aspirations to pursue STEM (Authors 2012; Wang and Degol 2013). However, there is very little empirical research on the motivational factors leading students to choose non-STEM studies (Jacobs et al. 2002). In addition, there is a dearth of studies analysing the connection between the gender gap in students' appraisal of their academic abilities and the existing gender disparities in the pursuit of studies. Recent research has examined the extent to which the evaluation of maths academic competences predict other school outcomes, such as grades, school self-concept beliefs, or life satisfaction (Sheldrake, Mujtaba, and Reiss 2022).

In light of this previous work (Sainz and Eccles 2012; Sainz and Katja 2016; Sainz and Muller 2018), the present study attempts to make a unique contribution to literature since it tackles the way high school students calibrate their maths and Spanish abilities and how this is attached to their future aspirations beyond STEM disciplines. Plenty of research suggests that individuals who have ability profiles reflected by high maths and moderate language ability are far more likely to pursue STEM (i.e. Marsh et al. 2015; Wang, Ye, and Degol 2017). In the current study, students with a pessimistic assessment of their maths abilities are expected not to choose STEM studies, whereas students with realistic and optimistic views of their maths abilities are expected to choose STEM studies (experimental & health studies and architecture & technology) [Hypothesis 3]. In addition, students with a pessimistic view of their Spanish competence will pursue STEM studies, whereas students with more optimistic and realistic views of their Spanish competence will pursue studies related to arts and social sciences [Hypothesis 4].

According to Bench et al'.s study, the observed gender gaps in STEM fields are not necessarily the result of women underestimating their STEM abilities, but rather may be due to men overestimating their STEM abilities (Bench et al. 2015). For this reason, it is crucial to continue investigating the reasons why this happens. Knowing further about the factors influencing female students to pursue humanities or social sciences-related careers will complement our vision on why they are discouraged from pursuing certain STEM fields. It is therefore expected that when controlling for GPAs, students with an optimistic view of their maths competences (especially males) will be more likely to pursue STEM studies, and less likely to pursue arts and social sciences studies [Hypothesis 5]. Furthermore, students with an optimistic view of their Spanish competences (especially females) will be more likely to pursue arts and social sciences and less likely to pursue STEM studies [Hypothesis 6].

Materials and method

Sample

The sample consisted of 796 students (*mean* age = 16 years, *S.D*=.81) enrolled in the 10th grade (the final year of compulsory secondary education). Ten public schools participated. Most of the students (72%) were born in Spain. A total 53.1% were male students and

46.9% were female students, with 27.3% of the students being born outside Spain. While 77% of the participants reported their intention to continue high school, the rest were likely to choose vocational training. In addition, 58.2% and 57.9% of their mothers had intermediate educational level (they had completed post-compulsory secondary education). Similarly, most of the parents (65.3% of the fathers and 66.4% of the mothers) had been born in Spain.

Measures

Self-concept of maths and Spanish ability

Students' self-concept of ability in maths and Spanish was measured with a translated version of Eccles and Harold's (1991) scale (Sainz and Eccles 2012). This scale consists of five items with values ranging between 1 (low level of competence) and 7 (high level of competence). Cronbach's reliability was .88 for maths and .88 for Spanish, respectively. This reflects acceptable internal consistency of the items when they are considered together. Bartlett's test of sphericity was statistically significant for both the maths (x^2 (10) = 1409.486, $p < .001$) and Spanish ($x^2(10) = 1221.500$, $p < .001$) measures. That is, the items are not independent and affirms that they can be aggregated together. Kaiser's measure of sampling adequacy was .85 for maths and .81 for Spanish, respectively. This shows that the items are likely to form one factor, shown by the values being above .50.

Math and Spanish performance

The students' final grades in maths and Spanish were obtained at the end of the course. The scores ranged between 1 (the lowest score) and 10 (the highest score) in maths and Spanish.

Grade Point Average (GPA)

An average score was extracted from all the different subjects (maths, Spanish, physical science, technology, chemistry, and social sciences/history) at the end of the course. The average for female students ($\bar{x} = 6.07$, S = 1.61) was higher than for male students ($\bar{x} = 5.51$, S = 1.76). GPA was significantly different between male and female students, $t(1, 794)$=-4.53.

Types of studies to be pursued in the future

Students were asked about the types of university studies they were planning to enrol on in the near future. This was an open-ended question and the responses were grouped according to the following fields of knowledge recognised by the Spanish Ministry of Education (Sainz and Muller 2018), which resulted in the following four different fields of knowledge: experimental & health sciences; architecture & technology; law & social sciences; and arts & humanities. That is, STEM studies related to architecture & technology (engineering and computer science titles), STEM studies oriented towards experimental & health sciences (medicine, biology, maths, and physical science), and non-STEM studies (degrees within the fields of arts & humanities and law & social sciences).

Finally, for the development of the logistic regressions, the categories associated with career aspirations were collapsed into a dummy variable (Sainz and Muller 2018): STEM studies oriented towards experimental & health sciences (1), versus the rest (0); STEM studies oriented towards architecture & technology (1), versus the rest (0); and non-STEM studies oriented towards arts & social sciences (1), versus the rest (0).

Procedure

The collection of data was carried out by the research team, who contacted with the school principals of the high schools that agreed to take part in a broader study. In every participating school, the research team administered the surveys to complete class levels. A survey was delivered in classroom hours after having obtained the consent of parents and school authorities, during the academic course 2016–2017. Fifty public schools were targeted (most of them at random) to take part in a broader longitudinal study, but only 10 located in the metropolitan areas of Madrid (six) and Barcelona (four) accepted to participate. The schools in the sample tried to represent the diversity of secondary students enrolled in public schools located in the two main metropolitan areas of Spain, with students belonging to families with intermediate socioeconomic backgrounds and cultural backgrounds below 40% of the classroom (Latin American, Eastern Europe, Asian and Northern Africa). After a brief introduction in which the researchers introduced the purpose of the study, the students responded to the questionnaire, which took approximately 35–45 minutes.

Participation was voluntary, with no remuneration or course credits awarded. Students could abandon the study at any time. Both the anonymity of the participants and the confidentiality of the data collected were guaranteed. Information regarding the students' final grades was gathered a few months after the collection of the remaining data. For confidentiality reasons, most of the grades were collected by the research team in the participant schools, where the direct scores were extracted from the official transcript records and introduced into a database. The grades were facilitated by the schools, after having previously identified the participant students with an anonymous code provided to the research team by the schools and students. The research received the approval of the university IRB (Institutional Review Board).

Results

Classification of students' assessment of their math and Spanish competence

In order to classify the students into different accuracy groups, the self-criterion residual (SCR) strategy was adopted (Paulhus and John 1998; Robins and John 1997). This approach is a relative indicator of under-estimation, accuracy, or over-estimation of their abilities. This method was also adopted by Bouffard et al. (2011) and Gonida and Leondari (2011), because it is associated with greater validity than traditional measurements. These last measurements may be subject to social desirability. Applying the self-criterion residual method, self-reports (in our case, self-concept of ability) were regressed on an external criterion (achievement in Spanish and maths) and the standardised residual was used as the index of self-evaluation bias. The use of the two scores seems to be more objective than using only the self-concept of ability score (Gosling et al. 1998).

The classification procedure was applied separately for Spanish and for maths. The self-assessment of maths and Spanish ability variables were constructed using the following procedure:

(1) First, a linear regression model was conducted to examine students' rating of their maths and Spanish abilities, taking self-concept of maths and Spanish ability as dependent variables and the actual grades in these subject areas as independent variables.
(2) Next, the standardised residuals of the model were calculated. That is, the difference between the observed and expected values in students' self-assessment of maths and Spanish ability.
(3) The self-assessment of maths and Spanish ability was constructed departing from standardised residuals. Students were therefore classified into three groups: over-estimators, realistic and under-estimators (see Table 1 for the total group classification by gender).

The realistic students had residuals between −1 and 1, meaning that the difference between their self-concept of ability in maths and Spanish corresponds to their actual subject scores. They represented 63.1% and 67.3% of students' self-assessments in maths and Spanish, respectively. The pessimistic students had residuals below −1 because they rated their self-concept of ability below their actual grades in maths or Spanish. They represented 16.8% and 14.2% of students' self-assessments in maths and Spanish, respectively. Finally, the optimistic students had residuals above 1 because their self-concept of ability in maths and Spanish was higher than their actual scores in the different subject areas. They represented 16.2% and 14.4% of the students, respectively.

In line with Hypothesis 1, students were classified into three groups according to their evaluation of their maths and Spanish abilities: over-estimators, realistic, and under-estimators. A new variable was constructed after computing the difference between the standardised values of self-concept of ability and actual grades in maths and Spanish. As expected (see Table 2), and congruent with Hypothesis 2, male students were more likely to belong to the group of maths over-estimators than to the group of maths under-estimators, whereas female students were more realistic in the self-evaluation of their competence in maths. Similarly, although female students were more optimistic in Spanish, male students were more optimistic in maths. Likewise, and in line with Hypothesis 2, female students were more pessimistic in maths (56%), whereas male students were more pessimistic in Spanish (65.5%).

In addition, possible gender differences with regard to group classification were examined. Chi-square tests indicated significant differences between female students and male students in both Spanish, x^2 (2, 765) = 14.926, $p < .001$; and maths, x^2 (2, 765) = 6.832, $p < .05$. As expected, and in agreement with Hypothesis 2, male students were

Table 1. Means and standard deviations for the general sample and for boys and girls.

		M	SD	M	SD	M	SD	T test
Domain	Variables	Global sample		Boys		Girls		
Math	Performance	5.20	2.00	5.01	1.93	5.42	2.04	−2.79***
	(1–10 Scale)	4.32	1.39	4.41	1.37	4.20	1.40	2.22**
	Self-concept of ability (1–7 Scale)							
Spanish	Performance	5.64	1.94	5.35	1.82	5.98	1.99	−4.57***
	(1–10 Scale)	4.55	1.26	4.33	1.16	4.85	1.29	−6.16***
	Self-concept of ability (1–7 Scale)							

Table 2. Grouping of students' accuracy in the evaluation of Math and Spanish abilities by gender.

	Math			Spanish		
	Males	Females	Total	Males	Females	Total
Under-estimators	59 (14,50%)	75 (20,95%)	134 (16.8%)	74 (18,18%)	39 (10,92%)	113 (14.2%)
Realistic	271 (66.58%)	231 (56.76%)	502 (63.1%)	287 (70.52%)	249 (60.18.5%)	536 (67.3%)
Over-estimators	77 (18.92%)	52 (12.78%)	129 (16.2%)	46 (11.30%)	69 (16.95%)	115 (14.4%)
Total	407	358	765	407	357	764

more optimistic in maths (18.92%), whereas female students were more optimistic in the evaluation of their Spanish competence (16.95%). In Spanish, male students represented the highest percentage of the pessimistic group (18.18%) while female students reached the highest rate among the pessimistic maths group (20.95%). Analysis was conducted under STATA 14.0.

The male students' performance in maths and Spanish was lower than their female counterparts (see Table 2). However, whereas male students reported a higher self-concept of ability in maths, female students reported a higher self-concept of ability in Spanish. These differences were statistically significant.

In addition, the association between self-concept of ability and performance was generally higher in Spanish for both genders than in maths (see Table 3). Similarly, the correlation between self-concept of ability and achievement in Spanish was higher for female students than for male students; this difference was statistically significant ($Z = 2.09$, $p = 0.04$). The correlation between self-concept of ability and achievement in maths was slightly higher for male students than for female students. However, this difference was not statistically significant ($Z = 0.37$, $p = 0.71$). Interestingly, whereas the correlation between self-concept of maths and Spanish abilities was statistically significant for male students, this correlation was not statistically significant for female students. The difference between male students and female students was not statistically significant ($Z = 1.39$, $p = 0.17$). The same was true for the correlation between maths achievement and self-concept of Spanish ability, with male students showing significant correlations and female students insignificant ones. The correlation between maths and Spanish achievement was also slightly higher for female students than for male students. This difference was not statistically significant ($Z = 1.58$, $p = 0.11$). Finally, the correlation between self-concept of maths ability and Spanish achievement is slightly higher for male students than for female students. This difference was not statistically significant ($Z = 1.64$, $p = 0.10$).

Table 3. Correlations between Self-concept of ability and achievement in maths and Spanish by gender.

	1.	2.	3.	4.
1. Math performance	1	**0.66*** **	**0.49*** **	**0.06**
2. Spanish performance	0.72***	1	**0.22*** **	**0.31*** **
3. Self-concept of maths ability	0.51***	0.33***	1	**0.03**
4. Self-concept of Spanish ability	0.21***	0.44***	0.13**	1

Accuracy in students' evaluation of their abilities and future aspirations

The majority of the students (52.5%) intended to pursue non-STEM studies, although 25% of them reported an interest in technological STEM studies and 22.5% planned to take STEM studies not related to technology. As regards the distribution of students' aspirations according to their evaluation of ability grouping (see Table 4), and without controlling for their GPA (Hypothesis 3), among those with a realistic view of maths (63% of the sample) most had an interest in pursuing STEM experimental & health sciences, and arts & social sciences studies. However, among those students who underestimated their maths abilities, the majority were inclined to follow studies in arts & social sciences. Interestingly, those who over-estimated their maths abilities were equally distributed among those interested in pursuing studies across the different fields. In addition, as regards students' aspirations as a result of grouping with regards their evaluation of Spanish ability, most of the students with a realistic view of their Spanish abilities were particularly interested in choosing arts & social sciences studies. Moreover, among the students who overestimated their abilities in Spanish, most of them had aspirations in arts & social sciences; whilst the students who underestimated their Spanish abilities were equally distributed across those attracted to studies within the fields of STEM architecture & technology, and arts & social sciences. Furthermore, students with a realistic view of their maths abilities were interested in arts & social sciences studies.

With respect to differences in students' aspirations as a result of their self-perception of ability groupings in maths and Spanish (see Table 5), among students in both the maths and Spanish under-estimators groups, some gender differences emerged. In line with Hypotheses 3 and 4, there was a higher number of female students in the under-estimators maths group, and a higher number of male students in the under-estimators Spanish group. However, male and female students with an under-estimating view of their maths abilities were more interested in arts & social sciences. Similarly, and in line with predictions, most of the male students among the students in the under-estimators Spanish group were interested in pursuing STEM architecture _& technology studies.

Among the realistic group of students in maths, an equal number of male students were inclined towards STEM architecture & technology, and arts & social sciences, whereas a higher proportion of female students (61%) were inclined towards studies in arts & social sciences. Similarly, among the realistic group of students in Spanish, while most female students aspired to study arts & social sciences, most male students also were willing to study arts & social sciences as well as STEM architecture & technology. In addition, among the group of over-estimators in maths, male students were more likely to

Table 4. Self-perception of ability groupings in maths and Spanish across future aspirations.

	Math			Spanish		
	Under-estimators	Realistic	Over-estimators	Under-estimators	Realistic	Over-estimators
Architecture & Techno	16 (11.9%)	129 (25.7%)	43 (33.6%)	46 (40.7%)	122 (22.8%)	20 (17.4%)
Experimental & Health	14 (10.5%)	118 (23.5%)	41 (32%)	23 (20.3%)	128 (23.9%)	23 (20.0%)
Arts & social Sciences	104 (77.6%)	255 (50.8%)	44 (34.4%)	44 (38.9%)	285 (53.3%)	72 (62.6%)
Total	134	502	128	113	535	115

Table 5. Students' aspirations and ability groupings in maths and Spanish by gender.

	Males	Females	$X^2(2)$	Males	Females	$X^2(2)$
	Math			Spanish		
Under-estimators						
Architect &Technology	13 (22.0%)	3 (4.0%)	16.75***	40 (54.1%)	6 (15.4%)	15.85***
Experiment &Health	1 (1.7%)	13 (17.3%)		12 (16.2%)	11 (28.2%)	
Arts & Social Sciences	45 (76.3%)	59 (78.7%)		22 (29.7%)	22 (56.4%)	
Total	59	75		74	39	
Realistic						
Architecture &Technology	110 (40.6%)	19 (8.2%)	68.60***	108 (37.6%)	14 (5.7%)	77.87***
Experiment &Health	49 (18.1%)	69 (29.9%)		52 (18.1%)	76 (30.7%)	
Arts & Social Sciences	112 (41.3%)	143 (61.9%)		117 (44.3%)	158 (63.7%)	
Total	271	231		287	248	
Over-estimators						
Architecture &Technology	38 (49.4%)	5 (9.8%)	21.52***	13 (28.3%)	7 (10.14%)	7.25**
Experiment &Health	19 (24.7%)	22 (43.1%)		6 (13.0%)	17 (24.6%)	
Arts & Social Sciences	20 (25.9%)	24 (47.1%)		27 (58.7%)	45 (65.2%)	
Total	77	51		46	69	

choose STEM architecture & technology studies, whereas female students were attracted to the fields of arts & social sciences, and STEM experimental & health sciences.

Prediction of students' future aspirations

Logistic regression analyses were conducted to analyse the prediction of STEM architecture & technology studies (see Table 6), controlling for the influence of students' global GPA. Male students (7.14 male students for each girl) were therefore more likely to aspire to these STEM studies. In line with Hypothesis 5, students with a realistic evaluation of their maths abilities were more likely to aspire to STEM architecture & technology studies than those underestimating their maths abilities (2.5 realistic in maths for each under-estimator). Similarly and congruently with Hypothesis 6, students underestimating their Spanish abilities were more inclined to pursue technological STEM studies than the realistic ones (2.30 under-estimators for each realistic). The GPA for all subject areas did not predict the intention to pursue technological STEM studies.

Moreover, gender differences emerged as a result of the accuracy groupings in the evaluation of students' abilities in maths and Spanish (see Figure 1). In line with

Table 6. Logistic regression models for the pursuit of studies.

	Architecture &Technology		Experimental & Health		Arts & Social Sciences	
	B(SE)	OR	B(SE)	OR	B(SE)	OR
Girls	−2.00	0.14***	0.67	1.96***	0.86	2.37***
GPA	0.00	1.00	0.38	1.45***	−0.27	0.76***
Under-estimators Math	−0.89	0.41**	−0.92	0.40**	1.11	3.05***
Over-estimators Math	0.38	1.46	0.79	2.19**	−0.93	0.39***
Under-estimators Spanish	0.79	2.21**	−0.04	0.84	−0.66	0.52**
Over-estimators Spanish	−0.10	0.90	−0.17	0.96	0.21	1.23
Constant	−0.53	0.59	−3.86	0.02***	1.34	3.81***
Pseudo R^2	0.16		0.11		0.12	
N	760		760		760	

Note: ***p<.001; **p<.01; *p<.05.

Hypothesis 5, female students and male students underestimating their maths abilities were less likely to pursue STEM architecture& technology studies. Male students overestimating their maths abilities were more likely to pursue STEM architecture & technology studies. Furthermore and congruently with Hypothesis 6, male students underestimating their Spanish abilities were more likely to pursue architecture & technology studies. Both genders were less likely to pursue these studies if they underestimated their Spanish abilities. However, with regard to their appraisal of maths competence, especially male students were more likely to pursue these studies if they overestimated their maths competence.

In relation to students' intention to pursue STEM experimental & health sciences studies, female students and students with a high GPA were more likely to intent to pursue these studies (see Table 5). In comparison to realistic students, those underestimating their maths abilities were less likely to pursue these studies, whereas in line with Hypothesis 5 students overestimating their maths abilities were more likely to pursue these studies. In addition and contrary to predictions of Hypothesis 6, whether students overestimated or underestimated their Spanish abilities did not predict their intention to pursue these non-technological STEM studies. Moreover, both genders were more likely to pursue these studies if they rated their maths abilities positively (see Figure 2). However, both genders tended to express less interest in pursuing these studies if they rated their Spanish abilities more negatively. In both groups, female students were more likely to intent to pursue STEM

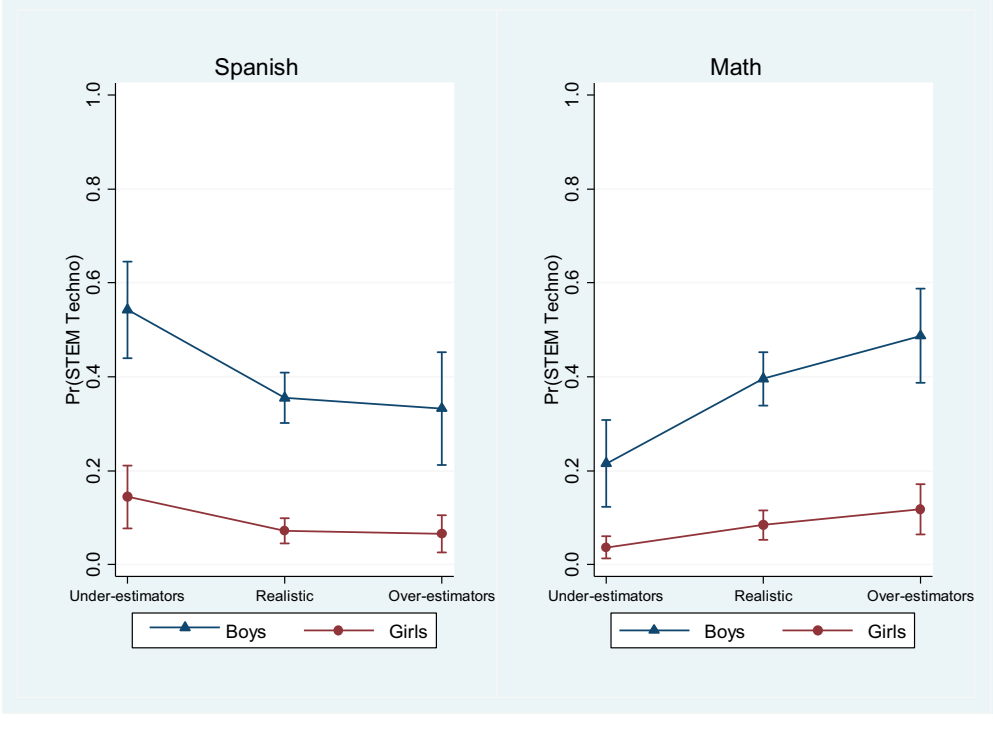

Figure 1. Gender differences among self-concept of maths and Spanish ability groups in the pursuit of STEM architecture and technology studies.

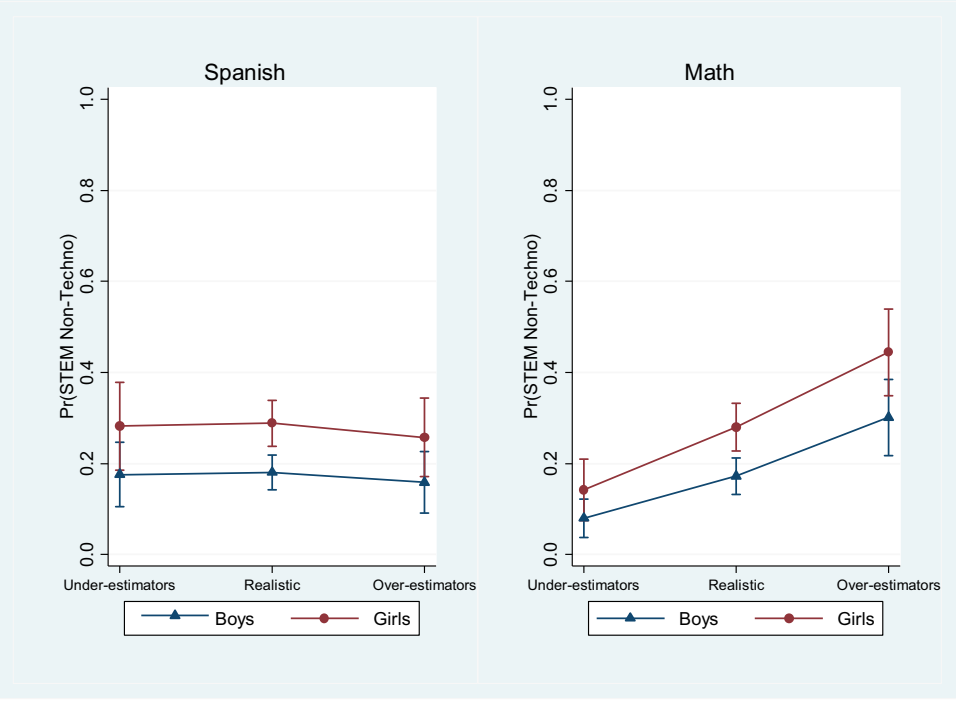

Figure 2. Gender differences among self-concept of maths and Spanish ability groups in the pursuit of STEM experimental and health studies.

experimental & health sciences studies, especially among the group of students who overestimated their maths competence. This last finding confirms predictions of Hypothesis 6.

Finally, female students were more likely than male students to intent to pursue arts & social sciences (see Table 5). In addition, students with a high GPA were less likely to pursue these studies. Similarly and in line with Hypothesis 5, students who underestimated their maths abilities were more likely than those who overestimated their maths abilities to enrol on these studies. In comparison to students who were accurate about their Spanish abilities, students who underestimated these abilities were also less likely to wish to enrol on these studies. This finding corroborates Hypothesis 6. Both genders were more likely to pursue these studies if they overrated their Spanish abilities and undervalued their maths abilities (see Figure 3).

Discussion

The present study aims at analysing gender differences in self-concept of ability accuracy groupings in students' evaluation of their maths and Spanish abilities. The classification of students' appraisal of their maths and Spanish abilities into three categories is one of the assets of the present study.

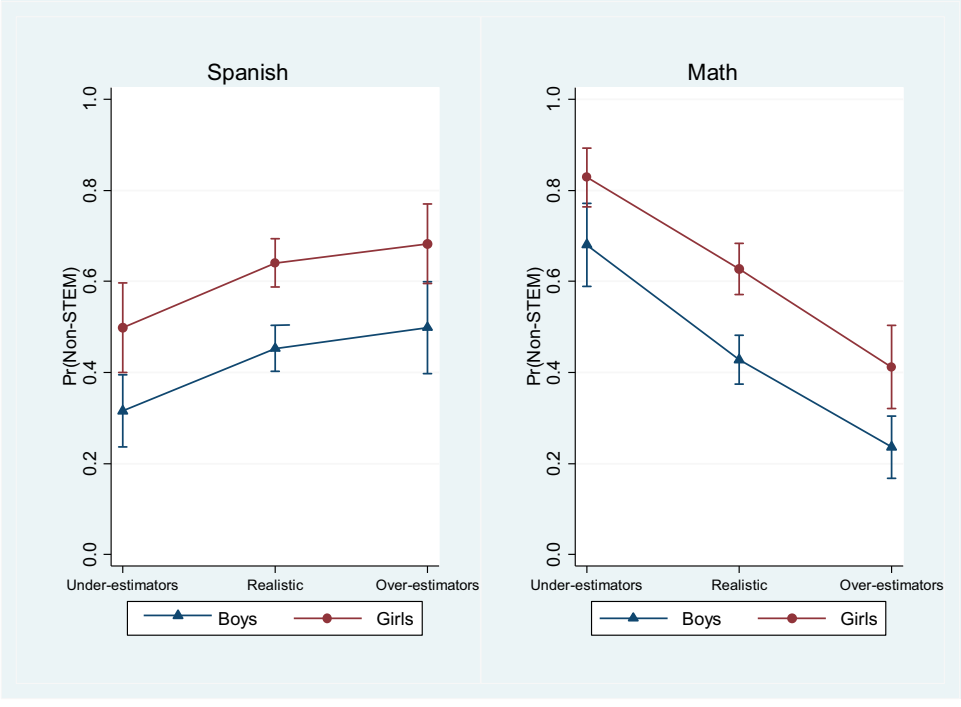

Figure 3. Gender differences among self-concept of maths and Spanish ability groups in the pursuit of arts and social sciences studies.

Classification of students' self-concept of math and Spanish abilities

The classification of students' appraisal of their abilities is aligned with predictions associated with Hypothesis 1. Interestingly, most of the students were classified among those with a realistic view of their maths and Spanish abilities. The rest of the students either belonged to the under-estimators or the over-estimators classification of their maths and English abilities (Gonida and Leondari 2011; Sheldrake, Mujtaba, and Reiss 2014; Sheldrake 2016). On the one hand, these findings confirm that students at this age are mainly realistic in their assessment of their academic abilities (Bouffard and Narciss 2011; Sainz and Eccles 2012). On the other hand, they suggest that schools and families should encourage policies that help those students who do not properly rate their competencies to gain a more accurate evaluation of their capabilities.

In addition, and as regards gender, more male students were classified as realistic in the assessment of both maths and Spanish abilities. This finding does partly confirm predictions of Hypothesis 2 since it was expected that girls were more realistic than their male counterparts in the evaluation of Spanish (a subject area where females are supposed to have a good performance). Furthermore, it is not surprising that in line with predictions of Hypothesis 3, female students were more likely to underestimate their maths abilities than male students while male students were more likely to underestimate their Spanish abilities (Gonida & Leondari, 2011; Sheldrake 2016). In this regard, it is interesting to observe how the group of under-estimators in both maths and Spanish had higher actual performance than they expected in both domains. This finding

contradicts previous research, where students with a low appraisal of their abilities tended to have a low performance (García et al. 2016). Among the group of over-estimators, students with a high self-concept of their ability in maths and Spanish did not necessarily perform well in maths and Spanish. This last finding also informs about the risks for students of making overconfidence judgements of their academic competences.

Students' aspirations and ability groupings

Congruent with Hypothesis 4, students with a negative appraisal of their maths abilities (particularly female students) were less likely to pursue both types of STEM studies (Sheldrake 2016; Sheldrake et al., 2022). However, students with a realistic view of their maths abilities were less likely to pursue technological STEM studies, but also more likely to express their interest in STEM experimental & health sciences. This may be due to the extremely competitive status associated with STEM experimental & health sciences studies, given the high degree of entry requirements to access those (Sainz and Eccles 2012). Additionally and congruent with Hypotheses 5 and 6, male students who overestimated their maths abilities and underestimated their Spanish abilities were more likely to intent to pursue STEM architecture & technology studies.

Interestingly, female students and students with a high GPA were more likely to pursue STEM experimental & health sciences studies. Nevertheless, female students and students with a lower GPA were more likely than male students to pursue arts & social sciences. In comparison to students with a realistic view of maths and in line with predictions of Hypothesis 5, those who overestimated their maths abilities were more interested in STEM studies related to experimental & health sciences. This finding is especially true for females, but not for males. In Spain, medicine and other health-related studies such as nursing, physiotherapy, or veterinary medicine have high entry requirements and are thereby very well considered in terms of the requested high intellectual capacities. Accordingly, many secondary teachers recommend their high-performing students (normally female students) to choose medicine because it is seen as a very prestigious career pathway (Sainz and Muller 2018). However, students perceive that arts and social sciences programs are less prestigious and demanding since they are not associated with high intellectual abilities and high entry requirements.

Similarly and in line with Hypothesis 6, compared to students with a realistic appraisal of their Spanish abilities, students with a pessimistic appraisal of their Spanish abilities were less likely to pursue arts & social sciences.

Significance of the present research

This study contributes to research on the existence of gendered biases in the evaluation of a group of secondary students' abilities in maths and language. It also makes a contribution to research on how self-perception of ability groupings in maths and Spanish shape students' decisions to pursue STEM and non-STEM university studies (Marsh et al. 2015; Wang, Ye, and Degol 2017). This research also contributes to the understanding of why Spanish male students and female students are more or less predisposed to pursue STEM and non-STEM studies (Sainz and Muller 2018). The comparison between the ability groupings in students' assessments of their maths and Spanish

abilities is one of the assets of the present research. In addition, the use of a variable-oriented (not a person-oriented) approach to classify students' self-perceptions of ability groupings is also another contribution of the present research. Finally, this study contributes to the way Spanish secondary students calibrate their maths and language competence and how this calibration shapes their interest in different studies.

Moreover, the present research suggests some ideas for intervention. It points to the need to design school interventions in order to increase male students' and female students' self-appraisals in maths and Spanish. Similarly, interventions addressing students' gendered biases as regards the evaluation of their abilities are also required. Parents, academic advisors, and school teachers should receive further training on how to fight different biases in students' appraisals of their abilities and the possible negative implications on young people's ability to make career decisions free from the influence of gender stereotypes.

Limitations and future research

Limitations of the present study could be associated with the classification of the future studies, given the different entry requirements linked to the diverse disciplines within the various categories analysed herein. Future research should consider latent profile analysis to extract groups and find the best-fitting class solution. In addition, the separate analysis of maths and language is another limitation of this study, since it could mask possible interaction effects of students with different ability levels in both subject areas. Future research should consider an analysis of both disciplines simultaneously.

The conversion of a quantitative variable into a qualitative one and the splitting of participants into the three extracted categories (over-estimators, under-estimators, and realistic) could be another limitation. In addition to it, the sample belongs to a group of ten self-selected secondary schools, with similar student profiles. Therefore, it may not be a representative sample of the Spanish population, hence not allowing extend the obtained conclusions to it. Another limitation to be mentioned could be associated with the use of a descriptive methodology. Other research methodologies (i.e. a quasi-experimental study, or Oaxaca-Blinder decomposition) could be more appropriate to examine gender differences.

Finally, another limitation could be associated with the use of a self-criterion residual approach, since it provides a relative indicator of over-estimation and underestimation. When residuals are obtained from estimations, they do not fulfill the basic requirements of Ordinary Least Squares regression (OLS) estimators (i.e. mean zero, normal distribution, lack of correlation between independent variables and the error, etc.), which may bias the obtained findings.

Given that the observed results might follow from unmeasured factors (i.e. like other motivational factors such as intrinsic value), more research on students' level of accuracy in the evaluation of their ability should incorporate these aspects. Likewise, future research should include an analysis of stereotype perception.

In order to gain further insights on how to design more reliable interventions, future research should also include the perspective of academic advisors and family members. This could help students to make more realistic academic and career-related decisions. Moreover, when computing students' evaluation of their abilities

and in order to prevent from obtaining biased differences future research should control for the effect of factors, such as socio-economic level or student's actual ability.

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References

Archambault, I., J. S. Eccles, and M. N. Vida. 2010. "Ability Self-Concepts and Subjective Value in Literacy: Joint Trajectories from Grades 1 Through 12." *Journal of Educational Psychology* 102 (4): 804–816. doi:10.1037/a0021075.

Bandura, A., C. Barbaranelli, G. V. Caprara, and C. Pastorelli. 2001. "Self-Efficacy Beliefs as Shapers of Children's Aspirations and Career Trajectories." *Child Development* 72 (1): 187–206. doi:10.1111/1467-8624.00273.

Bench, S. W., H. C. Lench, J. Liew, K. Miner, and S. A. Flores. 2015. "Gender Gaps in Overestimation of Math Performance." *Sex Roles* 72 (11–12): 536–546. doi:10.1007/s11199-015-0486-9.

Bong, M., and R. E. Clark. "Comparison Between Self-Concept and Self-Efficacy in Academic Motivation Research." *Educational Psychologist* 34(3): 139–153. 1999. 10.1207/s15326985ep3403_1

Bouffard, T., and S. Narciss. 2011. "Benefits and Risks of Positive Biases in Self-Evaluation of Academic Competence Introduction." *International Journal of Education Research* 50 (4): 205–207. doi:10.1016/j.ijer.2011.08.001.

Bouffard, T., C. Vezeau, M. Roy, and A. Lengelé. 2011. "Stability of Biases in Self-Evaluation and Relations to Well-Being Among Elementary School Children." *International Journal of Educational Research* 50 (4): 221–229. doi:10.1016/j.ijer.2011.08.003.

Byars-Winston, A., Y. Estrada, C. Howard, D. Davis, and J. Zalapa. 2010. "Influence of Social Cognitive and Ethnic Variables on Academic Goals of Underrepresented Students in Science and

Engineering: A Multiple-Groups Analysis." *Journal of Counseling Psychology* 57 (2): 205–218. doi:10.1037/a0018608.

Cadaret, M. C., P. J. Hartung, L. M. Subich, and I. K. Weigold. 2017. "Stereotype Threat as a Barrier to Women Entering Engineering Careers." *Journal of Vocational Behavior* 99: 40–51. doi:10.1016/j.jvb.2016.12.002.

Ceci, S. J., and W. M. Williams. 2010. "Sex Differences in Math Intensive Fields." *Current Directions in Psychological Science* 19 (5): 275–279. doi:10.1177/0963721410383241.

Druckman, D., and R. A. Bjork, Eds. 1994. *Learning, Remembering, Believing: Enhancing Human Performance*. The National Academies Press: Washington, DC. doi:10.17226/2303

Eccles, J. S. 2009. "Who Am I and What Am I Going to Do with My Life? Personal and Collective Identities as Motivators of Action." *Educational Psychologist* 44 (2): 78–89. doi:10.1080/00461520902832368.

Eccles, J. S., and R. D. Harold. 1991. "Gender Differences in Sport Involvement: Applying the Eccles' Expectancy-Value Model." *Journal of Applied Sport Psychology* 3 (1): 7–35. doi:10.1080/10413209108406432.

Eccles, J. S., and A. Wigfield. 2020. "From Expectancy-Value Theory to Situated Expectancy-Value Theory: A Developmental, Social Cognitive, and Sociocultural Perspective on Motivation." *Contemporary Educational Psychology* 61: 101859. doi:10.1016/j.cedpsych.2020.101859.

García, T., C. Rodríguez, P. Gonzalez-Castro, J. A. Gonzalez-Pienda, and M. Torrance. 2016. "Elementary students' Metacognitive Processes and Post-Performance Calibration on Mathematical Problem-Solving Tasks." *Metacognition and Learning* 11 (2): 139–170. doi:10.1007/s11409-015-9139-1.

Gonida, E., and A. Leondari. 2011. "Patterns of Motivation Among Adolescents with Biased and Accurate Self-Efficacy Beliefs." *International Journal of Educational Research* 50 (4): 209–220. doi:10.1016/j.ijer.2011.08.002.

Gonida, E., and A. Leondari. 2011. "Patterns of Motivation Among Adolescents with Biased and Accurate Self-Efficacy Beliefs." *International Journal of Educational Research* 50: 209–220. doi:10/1016/j.ijer.2011.08.002.

Gosling, S., O. P. John, K. H. Craik, and R. W. Robins. 1998. "Do People Know How They Behave? Self-Reported Act Frequencies Compared with On-Line Codings by Observers." *Journal of Personality and Social Psychology* 74 (5): 1337–1349. doi:10.1037/0022-3514.74.5.1337.

Guimond, S., and L. Roussel. 2001. "Bragging About One's School Grades: Gender Stereotyping and students' Perception of Their Abilities in Science, Mathematics and Language." *Social Psychology of Education* 4 (3/4): 275–293. doi:10.1023/A:1011332704215.

Guizzo, F., A. Moè, M. Cadinu, and C. Bertolli. 2019. "The Role of Implicit Gender Spatial Stereotyping in Mental Rotation Performance." *Acta Psychologica* 194: 63–68. doi:10.1016/j.actpsy.2019.01.013.

Jacobs, J. E., S. Lanza, D. W. Osgood, J. S. Eccles, and A. Wigfield. 2002. "Changes in Children's Self-Competence and Values: Gender and Domain Differences Across Grades One Through Twelve." *Child Development* 73 (2): 509–527. doi:10.1111/1467-8624.00421.

Kung, H. Y. 2009. "Perception or Confidence? Self-Concept, Self-Efficacy and Achievement in Mathematics: A Longitudinal Study." *Policy Futures in Education* 7 (4): 387–398. doi:10.2304/pfie.2009.7.4.387.

Lent, R. W., M. J. Miller, P. E. Smith, B. A. Watford, R. H. Lim, and K. Hui. 2016. "Social Cognitive Predictors of Academic Persistence and Performance in Engineering: Applicability Across Gender and Race/Ethnicity." *Journal of Vocational Behavior* 94: 79–88. doi:10.1016/j.jvb.2016.02.012.

Marsh, H. W., A. S. Abduljabbar, P. D. Parker, A. J. S. Morin, F. Abdelfattah, B. Nagengast, J. Möller, and M. M. Abu-Hilal. 2015. "The Internal/External Frame of Reference Model of Self-Concept and Achievement Relations: Age-Cohort and Cross-Cultural Differences." *American Educational Research Journal* 52 (1): 168–202. doi:10.3102/0002831214549453.

Marsh, H. W., and K. T. Hau. 2004. "Explaining Paradoxical Relations Between Academic Self-Concepts and Achievements: Cross-Cultural Generalizability of the Internal/External Frame of Reference Predictions Across 26 Countries." *Journal of Educational Psychology* 96 (1): 56–67. doi:10.1037/0022-0663.96.1.56.

MEFP [Spanish Ministry of Education]. 2020. Equality in Figures. https://www.educacionyfp.gob.es/dam/jcr:914e956e-9241-49c5-b9a6-d99d6eade751/igualdad-en-cifras-2020-online.pdfDate of consult: [22 July 2020]

Narciss, S., H. Koerndle, and M. Dresel. 2011. "Self-Evaluation Accuracy and Satisfaction with Performance:Are There Affective Costs or Benefits of Positive Self-Evaluation Bias?." *International Journal of Educational Research* 50: 230–240. doi:10.1016/j.ijer.2011.08.004.

Paulhus, D. L., and O. P. John. 1998. "Egoistic and Moralistic Biases in Self-Perception: The Interplay of Self-Deceptive Styles with Basic Traits and Motives." *Journal of Personality* 66 (6): 1025–1060. doi:10.1111/1467-6494.00041.

Robins, R. W., and O. P. John. 1997. "The Quest for New Insight. Theory and Research on Accuracy on Self-Perceptions." In *Handbook of Personality Psychology*, edited by R. Hogan, J. Johnson, and S. R. Briggs, 649–679. Cambridge, Massachusetts: Academic Press.

Sainz, M., and J. S. Eccles. 2012. "Self-concept of computer and math ability: Gender implications across time and within ICT studies." *Journal of Vocational Behavior* 80 (2): 486–499. doi:10.1016/j.jvb.2011.08.005.

Sainz, M., and U. Katja. 2016. "Accuracy and bias in Spanish secondary school students' self-concept of ability: The influence of gender and parental educational level." *International Journal of Educational Research* 77: 26–36. doi: 10.1016/j.ijer.2016.02.009.

Sainz, M., and J. Muller. 2018. "Gender and family influences on Spanish students' aspirations and values in stem fields." *International Journal of Science Education* 40 (2): 188–203. doi:10.1080/09500693.2017.1405464.

Sheldrake, R. 2016. "Students' Intentions Towards Studying Science at Upper-Secondary School: The Differential Effects of Under-Confidence and Over-Confidence." *International Journal of Science Education* 38 (8): 1256–1277. doi:10.1080/09500693.2016.1186854.

Sheldrake, R., T. Mujtaba, and M. J. Reiss. 2014. "Calibration of Self-Evaluations of Mathematical Ability for Students in England Aged 13 and 15, and Their Intentions to Study Non-Compulsory Mathematics After Age 16." *International Journal of Educational Research* 64: 49–61. doi:10.1016/j.ijer.2013.10.008.

Sheldrake, R., T. Mujtaba, and M. J. Reiss. 2015. "Students' Intentions to Study Non-Compulsory Mathematics: The Importance of How Good You Think You are." *British Educational Research Journal* 41 (3): 462–488. doi:10.1002/berj.3150.

Sheldrake, R., T. Mujtaba, and M. J. Reiss. 2022. "Implications of Under-Confidence and Over-Confidence in Mathematics at Secondary School." *International Journal of Educational Research* 116: 102085. doi:10.1016/j.ijer.2022.102085.

Spencer, S. J., C. M. Steele, and D. M. Quinn. 1999. "Stereotype Threat and Women's Math Performance." *Journal of Experimental Social Psychology* 35 (1): 4–28. doi:10.1006/jesp.1998.1373.

UNESCO, (2018). Cracking the Code. Female students' and Women's Education in Science, Technology, Engineering and Mathematics (STEM). Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000253479>.56 [Date of consult: 9 July 2020].

UNESCO. 2021. A New Generation of 25 Efforts for Gender Equality in Education. Retrieved from: https://en.unesco.org/gem-report/2020genderreport [Date of consult: 18 October 2022].

Wang, M. T., and J. L. Degol. 2013. "Motivational Pathways to STEM Career Choices: Using Expectancy–Value Perspective to Understand Individual and Gender Differences in STEM Fields." *Developmental Review* 33 (4): 304–340. doi:10.1016/j.dr.2013.08.001.

Wang, M. T., and J. L. Degol. 2016. "School Climate: A Review of the Construct, Measurement, and Impact on Student Outcomes." *Educational Psychology Review* 28 (2): 315–352. doi:10.1007/s10648-015-9319-1.

Wang, M. T., F. Ye, and J. L. Degol. 2017. "Who Chooses STEM Careers? Using a Relative Cognitive Strength and Interest Model to Predict Careers in Science, Technology, Engineering, and Mathematics." *Journal of Youth and Adolescence* 46 (8): 1805–1820. doi:10.1007/s10964-016-0618-8.

Watt, H. M. G. 2010. "Gender and Occupational Choice." In *Handbook of Gender Research in Psychology*, edited by J. C. Chirsler and D. R. McCreary, 379–400. New York: Springer.