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The interest gap: how gender stereotype endorsement about abilities predicts differences in academic interests

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Abstract

This study used a novel approach to examine the link between gender ability stereotype endorsement and academic interests by examining not only stereotypes people hold *within* the domains of mathematics and language arts, but also *between* them. Grade 6 and 8 students (285 males, 363 females) reported their degree of stereotype endorsement and interest in these two academic domains. Results of path analyses revealed that stereotype endorsement within and between domains accounted for gender differences in interest. In language arts, endorsing a stereotype that females are more competent than males predicted subsequent interest in the domain and accounted for the greater language arts interest among females. In mathematics, however, the perception that males are more competent in mathematics relative to language arts was linked to students' interest in this domain and accounted for the interest gap between genders. These results suggest that students' interests relate to endorsed stereotypes that are either driven by a perceived gender superiority *within* one domain—when females are viewed as more competent than males in language arts—or a gender superiority *between* two domains—when males are viewed as more competent in mathematics relative to language arts. Considering not only stereotypes favoring a gender within one domain, but also between domains, provides a more accurate portrait of students' actual stereotypes and can be useful to better understanding how the interest gap emerges.

Keywords Gender ability stereotypes · Achievement motivation · Gender differences · Interest

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1 Introduction

Historically, there has been a salient achievement gap between genders. Males and females have tended to perform relatively better in mathematics and language arts, respectively (Eccles 1987; Hyde et al. 1990). Within the past few decades, however, this achievement gap has been closing in mathematics, but has largely remained for language arts (Else-Quest et al. 2010; OECD 2014). Meanwhile, there is still a gender difference in interest—an *interest gap*—in both academic domains that aligns with traditional gender ability stereotypes (Marsh et al. 2005). How can these two findings be reconciled, and by what process does this interest gap emerge? Considering the social and economic importance of promoting interest in mathematics and language arts for both genders, understanding how interests emerge in these two academic domains is critical.

In the present study, we took a novel approach to this issue by examining how gender stereotype endorsement about abilities, both within and between domains, predicts academic interests. Because traditional stereotypes favoring females in language arts persist today (Rowley et al. 2007), endorsing the stereotype that females have greater ability in language arts should predict greater interest for females. By contrast, more recent social and educational efforts to promote females in mathematics (Pillow 2002; Weaver-Hightower 2003; Weiner 1994) has equalized perceptions of ability between genders in the domain. Therefore, ability stereotype endorsement in mathematics relative to language arts should predict greater interest for males.

2 Theoretical background

As a result of many efforts to promote the idea that females are as competent as males in mathematics, elementary and high school female students now tend to achieve as well as or even better than males in the discipline (Hedges and Nowell 1995; Hyde et al. 1990; Hyde and Mertz 2009; Plante et al. 2013a; Voyer and Voyer 2014). Females, however, continue to report lower self-concept and expectations for success than males in mathematics (for meta-analyses, see Else-Quest et al. 2010; Huang 2013). These persistent gender differences in students' attitudes and motivation might explain why females continue to be less interested in educational paths related to this domain despite their ability. In most western countries, male students are awarded more degrees in fields related to mathematics (OECD 2014). Similarly, in Canada, male students earn nearly 60 percent of college degrees in mathematics and statistics (OECD 2014).

By contrast, the gender difference in preferences and performance favoring females in language arts domains remains (Plante et al. 2013a; Voyer and Voyer 2014). For instance, females outperform males in reading by one year of school (OECD 2015) and they compose 65% of college students specializing in humanities, arts, and literature (OECD 2014). Such gender imbalance in educational

choices has important social implications as it contributes to the skewed representation of males and females in some domains. Thus, language arts fields may not benefit adequately from the contributions of males, and mathematics-related fields may also not benefit as much from the contributions of females.

2.1 Interest, motivational processes, and the role of gender stereotypes

Researchers have sought to identify the reasons for males' and females' differing career decisions or preferences for specific domains. Especially relevant is the concept of individual interest (Durik et al. 2017; Hidi and Renninger 2006; Schiefele 2009), the predisposition to reengage in particular content and activities that are personally valued and generally experienced positively (see O'Keefe and Harackiewicz 2017; O'Keefe et al. 2017; Renninger and Hidi 2016). Educational and occupational choices have been found to be importantly shaped by the value students place on a topic or task (see Eccles 1987, 2005; Plante et al. 2013b) as well as by their individual interest (Eccles and Wigfield 2002; Nagy et al. 2006). Within the academic context, individual interests are typically domain-specific (e.g., Hidi and Renninger 2006; Krapp 1999; Schiefele 1991). For example, a student might be interested in mathematics, but not interested in literature. Therefore, many investigations conducted on interest adopt a domain-specific approach (Frenzel et al. 2010).

Studies conducted in the domains of mathematics and language arts find that males typically report greater levels of interest in mathematics than females (e.g., Fredricks and Eccles 2002; Frenzel et al. 2010; Marsh et al. 2005), whereas females are generally more interested in language arts than males (e.g., Graham et al. 2008). These interest gaps in mathematics and language arts seem to appear quite early in the academic path as it has been observed as young as grade 1 students (Cvencek, Meltzoff and Greenwald 2011). Such gender differences in students' interests are often interpreted as a result of gender stereotypes, which are socially shared beliefs that certain qualities can be assigned to individuals based on their sex (Lips 2005). Stereotypical views about males and females are held by children as young as 3 years old (Hewstone et al. 2002), and by 6 to 7-years of age, students start reporting stereotypes about gendered abilities (Bian et al. 2017; Cvencek et al. 2011). Such stereotypes, however, tend to become less rigid at the end of childhood (Martin and Ruble 2010). Regarding individual interest, it was often argued that gender stereotypes about males' and females' abilities, suggesting that females lack mathematical ability and that males are verbally less competent than females, could produce gender differences in students' interests (Denissen et al. 2007; Marsh et al. 2005). Accordingly, males' and females' preferences might be shaped by their stereotypes about the domains in which they supposedly excel.

2.2 Considering gender ability stereotypes within *and* between academic domains

Research on ability gender stereotypes typically examines whether a perceived superiority of one gender over the other within a domain (*within-domain stereotypes*;

e.g., stereotypes suggesting that males are more competent than females in mathematics; stereotypes suggesting that females are more competent than males in language arts) relate to students' motivation or achievement outcomes in the domain. Such an approach, commonly used in motivation research, has shown that measures of motivation in mathematics predicted both the number and the difficulty of the math courses selected in subsequent years (Simpkins et al. 2006; Watt 2005). Conversely, Durik et al. (2006) showed that the task values—which include intrinsic value, attainment value, utility value, and perceived cost of a specific task—attached to reading predicts the number of English courses students take in high school and their aspirations for careers involving high literacy skills.

Although within-domain stereotypes may adequately capture how the belief that females have better abilities in language arts than males predict subsequent interest and account for the interest gap in this domain, such stereotypes seem less relevant in mathematics. Indeed, while stereotypes favoring females over males in language arts are widespread and salient (Plante et al. 2009; Rowley et al. 2007), the magnitude and direction of stereotypes in mathematics is less clear. Although research using implicit measures of gender stereotypes typically find traditional stereotypes advantaging males in mathematics (e.g., Flore and Wicherts 2015; Nosek and Smyth 2011; Steffens et al. 2010), explicit measures show a less straightforward portrait. Despite a few studies showing that students still explicitly endorse traditional gender stereotypes advantaging males in mathematics (Cvencek et al. 2011), most others show that students no longer view mathematics as a domain better suited to males than females (e.g., Blanton et al. 2002; Forgasz et al. 1999; Galdi et al. 2014; Passolunghi et al. 2014). Furthermore, surveys suggest that stereotypes in mathematics may have reversed. In France (Martinot and Désert 2007), the United States (Rowley et al. 2007), and Canada (Plante et al. 2009), elementary and high school students perceive females to have better mathematical abilities than males.

Despite this growing trend of research suggesting that students no longer explicitly endorse stereotypes alleging that males are more competent than females in mathematics, they might still believe that males are more competent in mathematics than language arts, a conception that might explain the interest gap favoring males in mathematics. Indeed, consistent with recent efforts to promote interest in mathematics among females (Pillow 2002; Weaver-Hightower 2003), students are being socialized in a less gendered manner in mathematics than they are in the language arts. Meanwhile, despite the widespread message that females are equally capable in mathematics, social agents, such as parents, continue to encourage their daughters to consider traditional careers that do not require mathematics, thus reinforcing the notion that mathematics is less of a female domain than others (Thoman et al. 2013). Therefore, students can learn conflicting messages suggesting that, although females are as competent as males in mathematics, they should still pursue gendered occupations.

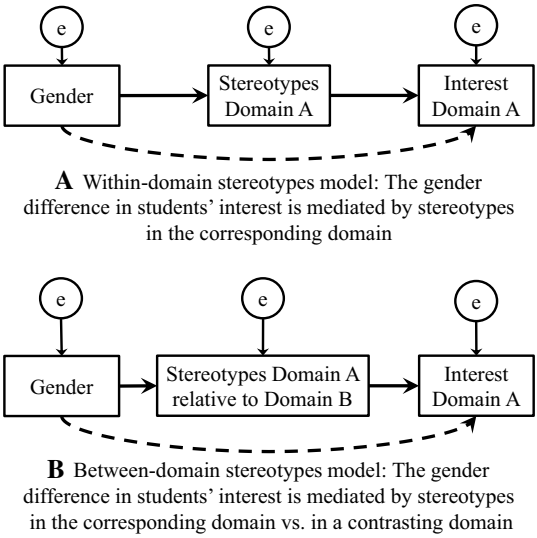
These observations suggest that the gender stereotypes are constructed differently for language arts and mathematics. Therefore, it is important to examine how the different ways in which students hold stereotypes might shape their interests, particularly for mathematics. To this end, instead of only examining within-domain stereotypes, we also consider *between-domain stereotypes*; that is, the perceived

superiority of a gender in one domain relative to another domain, which could be particularly useful in understanding the interest gap in mathematics. A similar approach (e.g., Chow and Salmera-Aron, 2011) was used in research, which showed that prioritizing mathematics and science relative to other school subjects predicts students' educational and occupational aspirations related to physical and information technology (Chow et al. 2012). In the present study, this between-domain approach predicts that endorsement of stereotypes favoring one's own gender in one domain (e.g., mathematics) relative to the other domain (e.g., language arts), is associated with interest in the corresponding domain (e.g., mathematics) and accounts for the interest gap between male and female students.

In summary, we argue that it is important to consider how students construct ability stereotypes—not only separately within the domains of mathematics and language arts, but also by comparing between the two domains—to shape their academic interests. Within-domain stereotypes should be most relevant in explaining the interest gap favoring females in language arts because of the historical relation between traditional gender stereotype endorsement and academic interests. By contrast, in mathematics, even if students do not endorse the stereotype that males are more competent, they might still believe that mathematics is better suited to males as compared to language arts. In other words, the interest gap in mathematics would not stem from students' endorsement of ability stereotypes favoring males (i.e., within-domain stereotypes), but instead from their stereotype that males are more competent in mathematics relative to language arts (i.e., between-domain stereotypes). Given that the links between ability stereotypes and interests are not straightforward across the domains, our nuanced analytical approach may help explain their relation.

3 The present study

The goal of this study was to evaluate how ability stereotypes account for the gender differences observed in students' interest in the domains of mathematics and language arts. To do so, we tested two models for each domain in order to evaluate whether gender differences in interest result from (a) the endorsement of gender ability stereotypes in the corresponding domain (i.e., within-domain stereotypes model), and (b) the endorsement of gender ability stereotypes in the corresponding domain in comparison to stereotype endorsement in the other domain (i.e., between-domain stereotypes model). In addition, to rule out the possibility that the relations between students' stereotypes and interests are due to their prior abilities in a given domain, all tested models included prior grades as a covariate. Theoretical models are presented in Fig. 1a, b. Considering that a growing trend among recent surveys shows that students no longer hold stereotypes advantaging males in mathematics (Martinot and Désert 2007; Plante et al. 2009), we predicted that the between-domain model would explain the interest gap in mathematics. Although males may not necessarily be viewed as more competent than females in mathematics, we expected that interest in the domain would be related to ability stereotypes favoring males' relative to language arts. By contrast, because of the historically consistent



A Within-domain stereotypes model: The gender difference in students' interest is mediated by stereotypes in the corresponding domain

B Between-domain stereotypes model: The gender difference in students' interest is mediated by stereotypes in the corresponding domain vs. in a contrasting domain

Fig. 1 The role of ability stereotypes to explain gender differences in interest according to the within-domain stereotypes model (**a**) and the between-domain stereotypes model (**b**)

stereotypes clearly favoring females in language arts (Plante et al. 2010; Rowley et al. 2007), we predicted that within-domain stereotypes model would explain the interest gap between genders in the language arts domains. If students agree that females are more competent than males in language arts, then their within-domain stereotypes should mediate the relation between gender and academic interest.

4 Method

4.1 Participants

Data were drawn from a large-scale study designed to examine multiple hypotheses regarding gender, motivation, and achievement. Contrary to prior work based on the same data set (see Plante et al. 2013a, b), the current investigation was designed to evaluate the role of ability stereotypes in predicting academic interests. Therefore, students were selected if key measures were available for both mathematics and language arts. The sample comprised 648 grade 6 (11–12 years old) and 8 (13–14 years old) French-speaking students (285 males, 363 females) from 14 public schools, predominantly located in low-socioeconomic areas populated primarily by Canadians of French Caucasian ancestry, in rural and suburban areas around Montreal (Quebec, Canada). According to the school system in the province of Quebec, grade 6 students were completing their last year in elementary school, whereas grade 8 students were in their second year of high school. After selecting two school boards that represented both the rural and urban areas of Quebec who agreed to take part in the study, all school principals were contacted and all agreed to present the project to their teachers. All grade 6 and grade 8 teachers in each school agreed to ask for their students' participation to the study via an information letter that was sent

to the parents. Seventy-six percent of students both assented and obtained parental consent.

4.2 Procedure

Students completed two 20- to 30-min in-class surveys; one related to mathematics and the other related to language arts. Each survey included various psychological assessments, the critical ones for the present study being students' ability stereotype endorsement and interest in mathematics and language arts. To avoid rater fatigue, the surveys were administered over two sessions with an interval of 2 weeks. All questions were read aloud by a trained research assistant to ensure that students understood the constructs being assessed. Survey order was also counterbalanced; half the students (randomly selected) received the mathematics survey first and the other half received the language arts survey first.

4.3 Measures

4.3.1 Interest

The measure was based on prior research on interest (Hulleman et al. 2008) and consisted of two scales validated among French-speaking Canadian students evaluating mathematics and language arts interest, respectively (see Vezeau et al. 1998). Both scales consisted of three items assessing mathematics and language arts interest: "I really like mathematics/language arts," "I am happy when it's time to do mathematics/language arts," and "Mathematics/language arts is a school domain that I really like." For each item of these two scales, participants indicated their response on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Each scale had high internal consistency ($\alpha_{\text{mathematics}} = .89$; $\alpha_{\text{language arts}} = .89$).

4.3.2 Gender ability stereotypes

In the domains of mathematics and language arts, gender ability stereotypes were each assessed with two 16-item scales previously validated among French-speaking Canadians (Plante 2010), which included subscales for Male Domain ($\alpha_{\text{mathematics}} = .88$; $\alpha_{\text{language arts}} = .85$; e.g., "Math-related/Language-related careers are better suited to males than females") and Female Domain ($\alpha_{\text{mathematics}} = .82$; $\alpha_{\text{language arts}} = .82$; e.g., "Females have more natural mathematical/language arts ability than males do"). For each item, participants indicated their response on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

From these two scales, two distinct gender ability stereotype indicators were derived: within-domain stereotypes and between-domain stereotypes. Students' stereotypes within each domain (i.e., mathematics and language arts) were computed by calculating the difference between the Male Domain and Female Domain scales. Subtracting the scores obtained for each scale reveals the tendency to endorse stereotypes more pronounced in favor of males or females (see Plante 2010 for further

details). To ensure coherence between males' and females' stereotype endorsement scores and to ease interpretation of the path analysis results, differences were calculated for males [Male Domain–Female Domain] and females [Female Domain–Male Domain]. Thus, a positive score indicated that students viewed their own gender as superior within one domain, whereas a negative score indicated the opposite.

Students' between-domain stereotype endorsement was calculated by subtracting the scores of the Male Domain and Female Domain scales between the domains of mathematics and language arts to indicate whether they believed that one gender was superior in one domain compared to the other. To ensure coherence between males' and females' between-domain stereotype scores, scores were computed so that a positive score indicated that students viewed their own gender as superior in the corresponding domain, whereas a negative score indicated the opposite. Therefore, in the domain of mathematics, differences were calculated for males [Male $\text{Domain}_{\text{mathematics}}$–Male $\text{Domain}_{\text{language arts}}$] and females [Female $\text{Domain}_{\text{mathematics}}$–Female $\text{Domain}_{\text{language arts}}$]. In language arts, differences were calculated for males [Male $\text{Domain}_{\text{language arts}}$–Male $\text{Domain}_{\text{mathematics}}$] and females [Female $\text{Domain}_{\text{language arts}}$–Female $\text{Domain}_{\text{mathematics}}$].

4.3.3 Prior school performance in mathematics and language arts

Participating schools provided students' grades in mathematics and French from the beginning of the school year (i.e., approximately 6 months prior to the study). Since the grading scale for sixth graders ranged from 1 to 4, whereas grades for eighth graders were percentage scores, grades in mathematics and French were converted into *z*-scores to ensure consistency in scoring.

5 Results

Does gender ability stereotype endorsement within a domain and between domains account for the gender differences in students' mathematics and language arts interest? To address this question, we used path analyses with Amos statistical software package (Arbuckle 2006) to evaluate the empirical validity of the two hypothesized models, the within-domain stereotypes model and the between-domain stereotypes model (see Fig. 1a, b), separately for mathematics and language arts. In order to better capture the specific contribution of stereotypes on interest despite students' initial school performance, students' prior grades were included as a covariate in all analyses. Given that students' ability gender stereotypes might be influenced by their own ability in a given domain, the inclusion of prior grades as a covariate allowed an examination of whether the relation between stereotype endorsement and interest existed above and beyond their individual ability. Before presenting results for the path analyses, we first examined the mean group differences for ability stereotypes and interest. Descriptive statistics and mean group differences for all variables are reported in Table 1 for mathematics and in Table 2 for language arts, separately for male and female students.

Table 1 Mean group differences in mathematics stereotypes and interest within-domain or between-domain as a function of gender

	M	*SD*
Males		
Within-Domain ability stereotypes in mathematics	.27	1.42
Between-Domain ability stereotypes in mathematics	.54	1.16
Interest in mathematics	3.01	1.24
Females		
Within-Domain ability stereotypes in mathematics	.78	.98
Between-Domain ability stereotypes in mathematics	− .34	.99
Interest in mathematics	2.78	1.22

For within-domain ability stereotypes, scores indicate the degree to which students perceived that their own gender was more able than the other in mathematics. For between-domain ability stereotypes, scores indicate the degree to which students believed that their own gender was more able in mathematics than in language arts. Therefore positive scores indicate stereotypes favoring students' own gender in mathematics, whereas negative scores indicate the opposite

Table 2 Mean group differences in language arts interest and stereotypes within-domain or between-domain as a function of gender

	M	*SD*
Males		
Within-Domain ability stereotypes in language arts	− .88	1.10
Between-Domain ability stereotypes in language arts	− .54	1.16
Interest in language arts	2.03	.93
Females		
Within-Domain ability stereotypes in language arts	1.43	.93
Between-Domain ability stereotypes in language arts	.34	.99
Interest in language arts	2.73	1.05

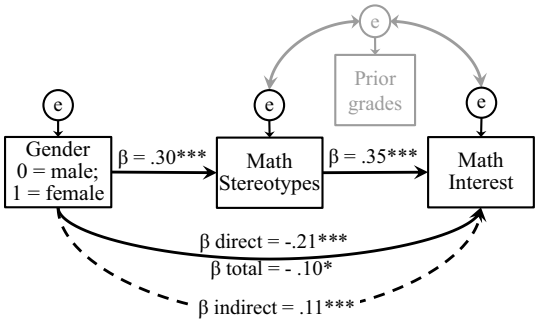
For within-domain ability stereotypes, scores indicate the degree to which students perceived that their own gender was more able than the other in language arts. For between-domain ability stereotypes, scores indicate the degree to which students believed that their own gender was more able in language arts than in mathematics. Therefore positive scores indicate stereotypes favoring students' own gender in language arts, whereas negative scores indicate the opposite

Mean group differences show that males were more interested in mathematics than females. Conversely, females were more interested in language arts than males. In addition, males and females endorsed within-domain stereotypes favoring their own gender in mathematics, whereas both genders reported that language arts was a domain better suited to females than males. In the domain of language arts, students' between-domain stereotypes were consistent with their within-domain stereotypes: both genders reported that female students were more able in language arts than in mathematics thus reflecting traditional stereotypes in this academic domain. In mathematics, between-domain stereotypes suggested that both genders agreed that mathematics was more of a male domain than language arts. Therefore, these

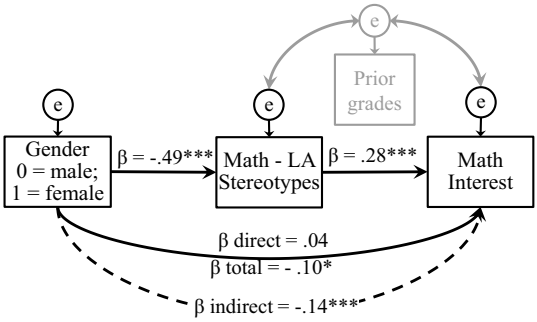
between-domain stereotypes seem to have captured remnants of traditional stereotypes, despite that females reported stereotypes favoring females compared to males in this domain.

We then examined the validity of the two hypothesized models, presented in Fig. 1a, b. Figure 2 illustrates the results in mathematics for the within-domain stereotypes model (A) and the between-domain stereotypes model (B), whereas Fig. 3 displays the results in language arts for the within-domain stereotypes model (A) and the between-domain stereotypes model (B), with standardized coefficients. Results for each model are explained separately for each academic domain in the next section.

Several preliminary analyses were conducted to test the appropriateness of our analytical method. First, before performing the path analyses, intraclass correlations for interest in mathematics and language arts were examined to test for possible school-level effects. Results yielded values of $\rho = .12$ and $\rho = .05$, respectively, suggesting that a non-hierarchical approach is justified (Maas and Hox 2005; Raykov 2011). Moreover, results of the path analyses controlling for students' schools (dummy coded) provided similar results and all in the same direction. Furthermore, all models were tested without prior grades as a covariate, which yielded nearly identical results, all in the same direction. Therefore, we present non-hierarchical analyses with the prior grade covariate included in our main analyses below.

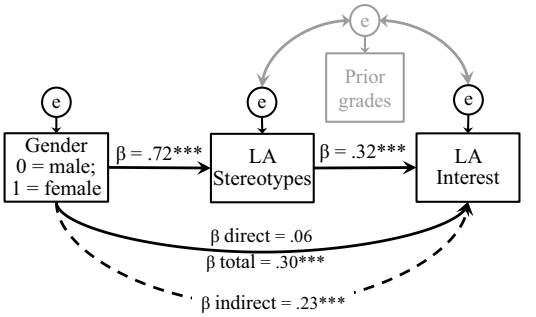


A Results of the within-domain stereotypes model in mathematics

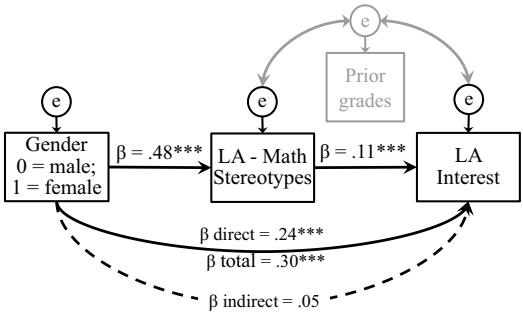


B Results of the between-domain stereotypes model in mathematics

Fig. 2 Results in mathematics for the within-domain stereotypes model (**a**) and the between-domain stereotypes model (**b**)



A Results of the within-domain stereotypes model in language arts



B Results of the between-domain stereotypes model in language arts

Fig. 3 Results in language arts for the within-domain stereotypes model (**A**) and the between-domain stereotypes model (**B**)

Detailed results of our preliminary analyses can be obtained upon request. Furthermore, a post hoc calculation showed that the current analyses were extremely powerful with values of 0.99 or 1.00.

5.1 Results in mathematics for the within-domain stereotypes model

Results revealed the expected effect that, overall, males were more interested in mathematics, as shown by the significant total effect ($\beta_{total} = -.10$, $p = .049$). Stereotype endorsement also significantly mediated the relation between gender and interest in mathematics, as shown by the indirect link between gender and interest ($\beta_{indirect} = .11$, $p < .001$). Finally, results showed that there was a significant direct link between gender and interest ($\beta_{direct} = -.21$, $p < .001$). This latter result indicated that, even after taking into account students' ability stereotypes, males remained more interested in mathematics than females. Overall, results of this model suggested that, for mathematics, stereotypes in the corresponding domain only partly accounted for gender differences in interest levels. In addition, the multiple squared correlation indicated that 17% of the variance in students' interest was explained by the tested model, as reflected by the R^2 statistic. Results are displayed in Fig. 2a.

5.2 Results in mathematics for the between-domain stereotypes model

On the whole, results suggested that students' construals of their own gender's abilities in mathematics relative to language arts (i.e., between-domain stereotypes) fully mediated the relation between gender and mathematics interest. As reported above, results demonstrated that males were overall more interested in mathematics than females ($\beta_{total} = -.10$, $p = .049$). Moreover, the standardized indirect link between gender and interest (i.e., mediated by students' between-domain stereotypes) indicated that females were less likely than males to endorse stereotypes depicting themselves as more competent in mathematics relative to language arts. In turn, these between-domain stereotypes predicted higher levels of mathematics interest ($\beta_{indirect} = -.14$, $p < .001$). Most interestingly, after accounting for students' between-domain stereotypes, the direct relation between gender and mathematics interest became non-significant ($\beta_{direct} = .04$, $p = .521$), suggesting that students' between-domain stereotypes fully mediated the relation between gender and mathematics interest. On the whole, 8% of the variance in students' interest was explained by the tested model, as reflected by the R^2 statistic. Results are presented in Fig. 2b.

5.3 Results in language arts for the within-domain stereotypes model

As expected, females were overall more interested in language arts than males ($\beta_{total} = .30$, $p = .001$). The significant indirect relation between gender and interest revealed that language arts stereotypes significantly accounted for gender differences in language arts interest ($\beta_{indirect} = .23$, $p < .001$). Moreover, the direct link between gender and interest—controlling for ability stereotype endorsement—was not significant ($\beta_{direct} = .06$, $p = .148$). In summary, the results suggest that language arts ability stereotypes fully mediated the link between gender and language arts interest, leading to an interest gap in this domain. Examination of the R^2 statistic revealed that 13% of the variance in students' language arts interest was explained by the tested model. Results are presented in Fig. 3a.

5.4 Results in language arts for the between-domain model

As reported above, the total effect of gender on interest indicated that females were overall more interested in language arts than males ($\beta_{total} = .30$, $p = .001$). In addition, the indirect link between gender and interest (i.e., mediated by students' between-domain stereotypes) indicated that stereotypes did not significantly account for the gender difference in language arts interest ($\beta_{indirect} = .05$, $p = .150$). As expected, after accounting for students' between-domain stereotypes, the gender difference in language arts interest remained significant, as suggested by the significant direct link between gender and interest ($\beta_{direct} = .24$, $p = .001$). These results suggest that students' between-domain stereotype endorsements in language arts do not significantly account for the interest gap between genders in this

domain. In addition, 10% of the variance in students' interest was explained by the tested model, as reflected by the R^2 statistic. Results are presented in Fig. 3b.

6 Discussion

To better understand the reasons underlying gender differences in students' interest in mathematics and language arts, we examined the role of gender ability stereotypes in the two domains. To this end, we tested two contrasting hypotheses stating that endorsement within a specific domain, on the one hand, or between domains, on the other, predicts interest in mathematics and language arts. Moreover, given that we controlled for students' prior school performance, our results highlight the unique contribution of male and female students' stereotype endorsement in the mathematics and language arts interest gap. Overall, our results suggest that ability stereotype endorsement significantly explains gender differences in both mathematics and language arts interest. Importantly, we found that the ways in which stereotype endorsement explains these gender differences in interest varies by domain.

6.1 How does ability stereotype endorsement predict the interest gap between genders?

Extending prior work showing that the endorsement of stereotypes favoring one gender in a particular domain (i.e., within-subject stereotypes) shapes students' expectancy-value beliefs (Bonnot and Croizet 2007; Plante et al. 2013a), our study suggests that the ways by which stereotypes produce interest gaps differs for language arts and mathematics. In language arts, results showed that the within-domain stereotypes model was the most relevant to explain gender differences in interest. Endorsing stereotypes that females are more competent in language arts significantly predicted relatively higher interest among females in the domain and explained the interest gap. By contrast, the between-domain stereotypes model did not explain the interest gap for language arts.

In mathematics, both models were useful in understanding the difference between male and female students' interest, although the between-domain stereotype model was most explanatory. The results of the within-domain stereotypes model showed that the endorsement of stereotypes favoring students' own gender in mathematics predicted males' and females' interest in mathematics accordingly. Within-domain stereotype endorsement in mathematics, however, only partly accounted for gender differences in mathematics interest. By contrast, the between-domain stereotypes model showed that it was not students' endorsed stereotypes in mathematics that accounted for the interest gap in mathematics, but rather the relative difference in stereotype endorsement strength in mathematics and in language arts. These results suggest that males' greater interest in mathematics might be rooted not so much in the belief that they are more competent than females in mathematics, but that males are more competent in mathematics relative to language arts. Consequently, students consider mathematics to be more of a 'male' domain as compared to language arts.

As discussed above, this apparent inconsistency between students' within-domain and between-domain stereotype endorsement might reflect changes in gender socialization processes. On one hand, relatively recent initiatives encourage female students to believe they are as mathematically capable as males (Halpern et al. 2007). On the other hand, compared to men, females continue to receive social messages suggesting that it is important for them to make occupational sacrifices for the family and to pursue nurturing careers (Eccles 2007). Coupled with the little attention given to females' language arts achievement—possibly because researchers have been more concerned with females' underachievement in mathematics than with their 'overachievement' in verbal domains (Plante 2009; Plante et al. 2010)—this might explain why students can simultaneously believe that males and females have equal abilities in mathematics (i.e., within-domain stereotypes) but that, compared to mathematics, language arts is better suited to females (i.e., between-domain stereotypes). Such a conception, captured by the between-domain stereotypes model, was particularly useful in understanding why male students reported more interest in mathematics than female students.

6.2 Implications, limitations, and future directions

These findings have important implications for the interest literature, as well as for educational practices to reduce interest gaps. From a theoretical perspective, our study provides empirical evidence for the nuanced role of gender ability stereotypes in shaping interests. Extending prior work showing that implicit stereotypes predict attitudes and behavior (e.g., Flore and Wicherts 2015; Nosek and Smyth 2011; Steffens et al. 2010), our study revealed that, despite efforts to reduce stereotypes in school settings, students, to some degree, still explicitly endorse traditional gender ability stereotypes. Most importantly, these explicit conceptions predict students' academic interests. Furthermore, because our investigation used two analytical approaches, we were able to explain how ability stereotype endorsement relates to males' and females' interest differently in mathematics and language arts. Our findings also contribute to understanding why gender disparities persist in fields related to mathematics and language arts.

Our results suggest that interventions aimed at changing gender stereotypes in mathematics and language arts could be designed differently for each domain. The fact that within-domain stereotypes were particularly useful in explaining students' interest in language arts suggests that reducing the perception that verbal domains are better suited to females than males might increase males' interest in language arts. By contrast, given that between-domain stereotypes best explained the mathematics interest gap, promoting gender equality across domains, instead of exclusively in mathematics, might be most beneficial to reduce stereotypes and, therefore, the interest gap in mathematics.

The present study has a few limitations that should be addressed in future research. Despite the use of path analyses, the correlational nature of the data does not permit causal inferences. Thus, further research is needed in order to demonstrate whether and how stereotype endorsement—manipulated experimentally, using

a stereotype threat manipulation for example (see Pennington et al. 2016 for a recent review on the topic)—shape males' and females' interest and produce an interest gap. Importantly, however, in controlling for initial levels of performance, our study demonstrated that ability stereotypes predicted the interest gap above and beyond individual differences in prior achievement. A second limitation concerns the generalizability of our results. Given that the study was conducted predominantly in low-socioeconomic areas, it is possible that students held different stereotypes than do students from more privileged areas (Lips 2005; Schneider 2004) and differed in achievement (e.g., Sirin 2005). That said, the relations between stereotypes and the motivational variables we observed have also been found in samples from various socioeconomic backgrounds (e.g., Martinot and Désert 2007), suggesting that similar results would be obtained with students from more privileged areas. Nevertheless, additional studies conducted in locations with greater socioeconomic diversity would be useful in understanding the generalizability of our results. Additionally, given the potential developmental changes in stereotype awareness and endorsement (Martin and Ruble 2010), the generalizability of the findings to students of various age groups should be empirically examined in future research. For instance, the rigidity of younger students' conceptions about gender differences might strengthen the relation between ability gender stereotypes and interest. Finally, our use of self-reported measures, especially those assessing gender ability stereotypes, could be associated with biases such as social desirability (Schneider 2004), given the widespread message promoting gender equality in schools. Therefore, despite that the gender stereotype measure used in the current study showed good predictive validity as it relates to achievement outcomes (Plante et al. 2013a, b), studies using implicit measures of gender ability stereotypes (Flore and Wicherts 2015; Nosek and Smyth 2011) would be useful in confirming our findings.

7 Conclusion

The current investigation showed that ability stereotypes explained the interest gap between genders in different ways for different domains. Our findings help explain why males and females continue to be overrepresented in fields related to mathematics and language arts, respectively, despite the fact that females generally perform better in mathematics (see Hyde and Mertz 2009 for a meta-analysis). Therefore, promoting gender equality within and across academic domains might contribute to closing the interest gap in disciplines stereotypically viewed as male or female domains.

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Compliance with ethical standards

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

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