Gender Differences in Mathematics Attainment in Chile

Diferencias de género en rendimiento matemático en Chile

Diferenças de gênero no rendimento matemático no Chile

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Abstract

The study of gender differences in academic attainment has been the focus of international research for the last 40 years. In this context, it is still unknown how gender differences relate to socioeconomic status (SES), and whether girls from less privileged backgrounds or from less privileged schools have even less opportunities to succeed in mathematics. Utilizing data from Chile (a country in the region that has consistently reported male advantage in mathematics) and a multilevel modelling framework for its analysis, this article describes how gender differences are distributed in the population, exploring how they may change at different levels of the SES distribution. Results suggest that boys consistently outperform girls in both early and late primary school, and that girls progress less between these years. In addition, a significant interaction with SES shows that this gap is larger for students with lower SES, with school SES effects being highly dependent on family SES effects. Finally, the political relevance of these differences and further areas of study are discussed.

Keywords

gender and mathematics; gender gap; gender and socioeconomic status; Chile

Resumen

El estudio de las diferencias de género en el rendimiento académico en matemáticas ha sido foco de investigación internacional en los últimos 40 años. En este contexto se desconoce cómo las diferencias de género se relacionan con el nivel socioeconómico (NSE), y si acaso las mujeres de contextos o escuelas menos privilegiadas tienen incluso menos oportunidades para aprender matemáticas. Este artículo describe cómo las diferencias de género se distribuyen en la población, explorando cómo éstas pueden cambiar en distintos niveles de la distribución de NSE. Para esto utiliza datos de Chile (un país en la región que ha reportado consistentemente ventaja masculina en el área de matemáticas) y modelos multinivel para su análisis. Los resultados muestran que los niños tienen un rendimiento consistentemente mejor que las niñas a principios y a finales de su educación básica, y que las niñas tienen un progreso menor entre estos años. Adicionalmente, una interacción significativa con NSE sugiere que la brecha es mayor en estudiantes de menor NSE y que el efecto del NSE de la escuela depende altamente del NSE de la familia del estudiante. Para finalizar se discute la relevancia política de estas diferencias y de otras áreas de estudio..

Palabras clave

género y matemáticas; diferencia de género; género y nivel socioeconómico; Chile

Resumo

O estudo das diferenças de gênero no rendimento académico em matemáticas tem sido foco de pesquisa internacional nos últimos 40 anos. Neste contexto, desconhece-se como as diferenças de gênero estão relacionadas com o nível socioeconómico (NSE) e se as mulheres de contextos ou escolas menos privilegiadas têm menores oportunidades para apreender matemáticas. Este artigo descreve como as diferenças de gênero são distribuídas na população, explorando como estas podem mudar em diferentes níveis da distribuição de NSE. Para isso são utilizados dados de Chile (um país na região que reporta consistentemente uma vantagem masculina na área de matemáticas) e modelos multinível para sua análise. Os resultados evidenciam que os meninos apresentam um rendimento consistentemente melhor do que as meninas no princípio e no final da educação básica, e que as meninas evidenciam um progresso menor nesses anos. Adicionalmente, uma interação significativa com NSE sugere que a brecha é maior em estudantes de menor NSE e que o efeito do NSE da escola depende altamente do NSE da família do estudante. Finalmente, a relevância política de estas diferenças e de outras áreas de estudo é discutida.

Palavras-chave

gênero e matemáticas; diferença de gênero; gênero e nível socioeconómico; Chile

Background Literature

The state of the gender problem in attainment in mathematics

The study of gender differences in academic and mathematical attainment has been focus of intensive international research for the last 40 years. In the 1970s, Maccoby and Jacklin reviewed more than 1600 studies, concluding that boys achieved better than girls in mathematics, while girls outperformed boys in reading and writing (Maccoby & Jacklin, 1974). Since then, many studies have replicated these findings, by reporting that girls are better at literacy but not numeracy (e.g., Hyde, Fennema, & Lamon, 1990; OCDE, 2015).

These findings have led some researchers to suggest that differences in mathematics could be of a great importance beyond educational attainment. During the 1970s and 1980s, female disadvantage in education was viewed as one of the reasons behind gender inequalities in adulthood, especially in relation to the labour market (e.g., England & Browne, 1992). It was proposed that mathematics worked as a "critical filter", controlling access to many areas of advanced studies, which were linked to status and power in society (Sells, 1978). Recently, the same debate has re-emerged in the Latin American context, with a study from the World Bank suggesting that lower scores in mathematics university admission tests could partially explain the gender gap in wages (Ñopo, 2012).

Even though there is robust evidence suggesting a decreased gender difference in mathematics attainment in first world countries (Hyde, Lindberg, Lynn, Ellis & Williams, 2008), international comparative studies have reported a large variation in these differences among countries (Else-Quest, Hyde, & Linn, 2010). In Latin America, the Latin American Laboratory for Assessment of the Quality of Education (LLECE), coordinated byUNESCO, has reported that boys outperform girls in mathematics in most countries (LLECE, 2000, 2008). The same conclusion has been reached by national studies in the region, with consistent male advantages at the end of primary and secondary school in Argentina (Cervini & Dari, 2009), Brazil (Gaviria, Martínez-Arias & Castro 2004), Mexico (Gonzalez-Jimenez, 2003), Colombia (ICFES, 2013) and Peru (Ministerio de Educación del Perú, 2015). Other studies have reported similar differences at primary level in Brazil (Alves Macedo, 2004) Nicaragua (Navarrete, López, & Laguna, 2008) and Mexico (Blanco, et al., 2007).

In Chile, the national standardized test of mathematical attainment has also reported consistent male advantages over the last 10 years (Ministerio de Educación de Chile, 2005). This situation has been confirmed by international studies, reporting a male advantage in the Trends in

International Mathematics and Science Study (TIMSS) (Mullis, Martin, Foy, & Arora, 2012) and the Programme for International Student Assessment (PISA) (OECD, 2013). In primary school, these differences are small or even non-existent, becoming bigger as students move forward in the school system (Ministerio de Educación de Chile, 2005).

A limitation of Chilean and most Latin American studies is that they have not considered how the progression of students is affected by the multilevel structure of the educational system (e.g., Cornejo & Redondo, 2007; see Cervini & Dari, 2009 for a progression analysis in Argentina). Modelling progress in a multilevel context is relevant for two main reasons. First, it allows the modelling of individual trajectories during schooling, controlling gap estimations by individual differences. And second, following the control of these individual variables, modelling progress allows the estimation of the relative contribution of schools (and school variables) in progress. The inclusion of a longitudinal design in the National Assessment of Educational Quality (SIMCE) since 2004 has recently made this possible: The SIMCE now allows us to model individual progression between early and late primary school (between 9–10 and 13–14 years old) and between early primary and secondary school (between 9–10 and 15–16 years old).

Gender and socioeconomic status (SES) influences in mathematical attainment

Although general differences between boys and girls have been widely studied, several authors have argued that more attention should be paid to the biggest within-gender differences (Leder, 1992), particularly between ethnicity and social class groups (e.g., Archer, 1996; Grant & Sleeter, 1986; Lubienski, 2008). This call is also supported by several qualitative studies, which have shown how students' gender *identities*, attitudes and attainment vary in relation to ethnicity (e.g., Martin, 2012) and social class identities (e.g., Willis, 1977). For example, Willis (1977) showed the existence of a "laddish" culture among working class boys, where opposition and resistance to authority (and school) led these students to school failure and future working class jobs. More recently, some studies have suggested that this *laddish* behaviour is not restricted to boys, but that working class girls also support this resisting culture (Jackson, 2006). Following this logic, several studies have supported the notion that gender differences are ethnic- and culture-specific (which has also been supported by international comparison studies, e.g. Else-Quest, et al., 2010) and that they are strongly related to social categories (i.e., ethnicity and social class).

Although there is strong support in the literature for the study of *interactions effects* between gender and other social categories, surprisingly, this is still a relatively neglected area of research. For example, Grant and

Sleeter (1986) reviewed 71 papers from four leading journals between 1973 and 1983 and reported little integration between variables such as gender, social class and ethnicity. Twenty years later, Connolly (2006) found a similar situation.

In Latin America, evidence available regarding the relationship between gender differences in mathematical attainment and SES is even more limited. This is surprising, considering that gender differences are consistently reported and that economic and cultural differences are the biggest factors contributing to attainment differences in the region (Treviño et al., 2010). Only studies that compare mean differences for boys and girls between different socioeconomic groups (i.e. different types of schools and schools from different socioeconomic backgrounds) were found (e.g., in Chile, Ministerio de Educación de Chile, 2005; in Colombia ICFES, 2013). For example, in Chile an analysis of mean differences between different types of schools reported that gender differences were smaller in private institutions—that is, schools that cater to the highest socio economic population in the country (Agencia de Calidad, 2013a). However, these studies have not explored the relative contribution of the schools and families' SES to gender gap distribution in educational attainment. Understanding this relationship is particularly relevant in Latin America and Chile, considering the large educational gap that exists between students from different socioeconomic backgrounds (e.g., in Latin America, Duarte, Bos & Moreno, 2010; in Chile, Torche, 2005), an SES effect that has been described as particularly strong at the school level (e.g., in Latin America, Duarte, Bos & Moreno, 2010; in Chile, Mizala, Romaguera & Urquiola, 2007). This problem acquires even more relevance considering the highly-stratified Chilean educational system, where schools have become *socioeconomic niches* for student populations that are highly similar in terms of their SES (Mizala & Torche, 2012). Following this, it is not known if smaller gender differences in private institutions are related to characteristics from these schools (e.g., higher access to educational resources) or to the socioeconomic outlook of their students. As a consequence, educational differences could be systematically reproduced, and therefore a possible interaction between gender and SES could imply a greater disadvantage for underperforming populations.

In sum, the study of gender differences in mathematics attainment requires an integrated analysis that should include how these differences change during the school trajectory and how they differ between school contexts. There has been a strong call for studies to explore gender differences within other social categories (such as social class), as this area is highly absent in the Latin American context. In order to accomplish this goal, a multilevel approach will be used to estimate differences controlled by the clustered organization of data. More specifically, the questions that this study attempts to answer are: 1) How big are the differences in mathematics attainment between boys and girls and how do they progress/change during primary school? 2) Is there a relationship between these differences and SES of the family of the children? 3) Are gender differences distributed heterogeneously across different types of schools (private vs. subsidized)?

Methodology

Data and variables

The following analysis was based on data gathered from the Mathematics SIMCE, which is provided by the Chilean Ministry of Education. The SIMCE is a series of standardised tests used to measure attainment according to the Chilean curriculum. This test has been applied since 1988, increasing legitimacy (Meckes & Carrasco, 2010) and stakes (particularly at the school level) (Agencia de Calidad, 2014). Since 2004, students started sitting at least two SIMCE applications during their school history (year 4 and year 8 or 10), which has allowed the use of this instrument in exploring progress at the individual level.

This analysis considered a cohort of students that was assessed in year 4 (2005) and year 8 (2009), capturing the gender gap in both middle (year 4, at 9–10 years of age) and at end of primary school (year 8, at 13–14 years of age). In addition, it was also possible to explore individual progress between year 4 and year 8, looking at whether the gender gap narrowed or widened over primary school.

Contextual variables were obtained from information provided by the Ministry, including parent questionnaires. For a detailed description of each variable see Table 1.

Table 1. Variable Descriptions

Variable	Description
Outcome	Year 4 / Year 8 Standardized Maths SIMCE scores (Mean= 0; SD=1)
Individual Level Variables	
Prior Attainment	Year 4 maths standardized score used as control Progression model (Mean= 0; SD=1)
Gender	Binary: 1 for female pupils

Variable	Description
Family Socioeconomic Status (SES)	Factor analysis (principal component analysis) of mother's max education, father's max education and family income (as reported by parents), standardized to have a mean of zero and a standard deviation of unity
School Level variables	
Type of school	Categories according to administration and funds: public (public funds and public administration); private subsidized (public funds and private administration); private (private funds and private administration)
Urban / Rural	According to location

Source: Own elaboration

Analysis

Methodological rationale

A multilevel modelling analysis (MLM) was used in this study. This approach considers the nested structure of data (individual, classroom and school levels), by including the variation of higher hierarchies (for reviews on this method, see Hox, 2010; Snijder & Bosker, 1999). It allows the modelling of variability independently at the different levels and interactions between them, assessing the relative contribution of, for example, individual characteristics and school characteristics, and finding how these different sources of variability interact in their effects on the outcome variable (e.g., Snijder & Bosker, 1999). In this particular case, previous literature regarding Chilean data has confirmed that a significant amount of variance in students' attainment is actually explained at the school level (Manzi, Strasser, San Martin & Contreras, 2008; Mizala, et al., 2007). Based on these findings, it has also been suggested that including intermediate (classroom) and higher (local authorities) levels provides better parameter estimations (Troncoso, Pampaka & Olsen, 2015). As mentioned before, most Chilean reports directly concerned with gender differences have not addressed these issues.

Analytical strategy

A common analytical strategy often used in MLM is to compare models with increasing complexities (e.g., Snijder & Bosker, 1999). In this case, gender was assessed independently and in interaction with variables at the individual level (SES of the family and previous attainment) and with variables at the school level (type of school, location of the school, SES of the school and previous attainment at the school level) (see Table 1). Three different outcome variables were modelled independently: year 4 attainment, year 8 attainment and progress (year 8 scores controlled by year 4 scores). For each of these variables, data was analysed in four steps, addressing each research question of this study:

1. *Empty models and gender models:* independent contribution of gender in different outcome variables (year 4, year 8, and progress).
2. *Family* SES *model:* effect of gender controlled by SES and interaction effect of gender and SES.
3. *School systematic effects models:* systematic differential effects of gender in schools of different administration. Considering the strong relationship between school SES and family status (Manzi, et al., 2008), and the highly-stratified population that attends public, private subsidized, and private schools (Torche, 2005), models were tested in two steps. First, the independent contribution of school administration was tested independently and then controlled by family SES.

Different models were compared using the likelihood-ratio test and the percentage of variance explained by models was defined as the proportional reduction in mean square prediction error at level 1 in comparison with a corresponding model.[1] The significance of individual variables was assessed using the Wald test. For categorical variables of more than one level (i.e., type of school) the Wald multivariate test was used, tested against a chi-square distribution (as suggested by Snijder and Bosker, 1999). Significance of individual categories is only reported (and interpreted) if this test was significant.

1 Proportional reduction of unexplained variance at level 1—as compared to a previous model—allows to estimate the contribution of predictors in explaining variance at level 1 (estimated as suggested by Snijder and Boskert, 1999)

Results

Empty models and models of gender

In relation to question 1 (i.e., *How big are the differences in mathematics attainment between boys and girls and how they change during primary school?*), this study showed that girls were outperformed by boys in the three outcome variables, with an increase in differences between early and late primary school. Boys were also found to make more progress than girls during primary school (and mean differences were bigger in year 8 than in year 4) (see Table 2).

Table 2. Gender Effect in Mathematical Attainment. Negative Scores Represent Male Advantage

	Year 4 Maths Attainment	Year 8 Maths Attainment	Progress
	Gender Coeff (S.E)	Gender Coeff (S.E)	Gender Coeff (S.E)
1 level model (individual)	-0.028 (0.007)	-0.174 (0.005)	-0.091 (0.003)
3 levels model (individual – classroom–school)	-0.064 (0.006)	-0.206 (0.004)	-0.117 (0.003)
r^2 3 levels model (compared with Null)	0.10%	0.42%	0.22%
chi-square 3 levels model (compared with Null)	$x^2_{(1)}$= 468.06***	$x^2_{(1)}$= 2768.79***	$x^2_{(1)}$= 1331.88***

$p < 0.05$ *; $p < 0.01$ **; $p < 0.001$***
Source: Own elaboration

By comparing all empty models and models of gender differences, it was confirmed that a main effect of gender remained significant for attainment in year 4, year 8, and for progress, however the size of this difference varied. For the three outcome variables, mean gender differences were smaller before controlling by schools and classrooms fixed effects (i.e. uncontrolled model 1 level). This difference suggests that part of the average boys' over attainment could be explained at the school and classroom level.

In addition, differences increased as students advanced in their primary education. Differences in year 8 were nearly three times bigger than differences in year 4, with the standard deviation increasing from 6% to 21%. This was also depicted in the progress models, where girls were expected to increase their scores by around 12% of a standard deviation less than their male counterparts. Finally, overall gender explained only a small portion of the variance in attainment (between 0.10 and 0.42 percent).

Family socioeconomic status models

In terms of the relationship between gender and SES (i.e. research question 2: *Is there a relationship between gender differences and* SES *of the children?*) this study showed that gender attainment gap was relatively stable (across low and high SES) in year 4. In contrast, in year 8 as family SES increased, female disadvantage decreased. In Progress, this relationship was mediated by the effect of previous attainment, with differences being bigger for girls from lower SES and lower previous attainment (see Table 3 for details).

Table 3. Individual Level Models, Gender Controlled by Family SES

	Year 4 Maths Attainment	Year 8 Maths Attainment	Progress
Intercept	-0.007 (0.005)	0.002 (0.007)	0.095 (0.005)
Year 4 (Previous Attainment)			0.605 (0.002)***
Female	-0.076 (0.004)***	-0.197 (0.004)***	-0.119 (0.003)***
Family SES	0.292 (0.003)***	0.170 (0.003)***	0.073 (0.003)***
Female * Family SES	-0.002 (0.004)	0.013 (0.004)**	0.000 (0.003)
Female * Year 4			0.012 (0.003)***
Family SES * Year 4			0.015 (0.002)***
Female * Year 4 * Family SES			0.011 (0.003)***
r^2 (compared with Null)	16.1%	11.8%	4.7%
chi-square (compared with Null)	$x^2_{(3)}$= 10872.9***	$x^2_{(3)}$= 6894.3***	$x^2_{(6)}$= 2581.5***

p < 0.05 *; p < 0.01 **; p < 0.001***
Source: Own elaboration

Family SES was found significant in all models, with this effect being bigger than the effect of gender in year 4 but decreasing its size by year 8. In general, the effects of family SES in students' attainment decreased in about 40% during primary education (between year 4 and year 8, from 0.29 to 0.17 of a standard deviation), but its joint effect with gender grew. Following this, while the effect of gender and SES were independent during year 4, in year 8 the effect of SES was bigger for girls than for boys (girls R^2 = 0.513; boys R^2= 0.481)[2]. This can be observed in Figure 1 for mathematics attainment in year 8.

2 These are the R2 of the variables family SES on the predicted scores. In the raw scores these values are 0.166–0.184 and 0.185–0.161, respectively.

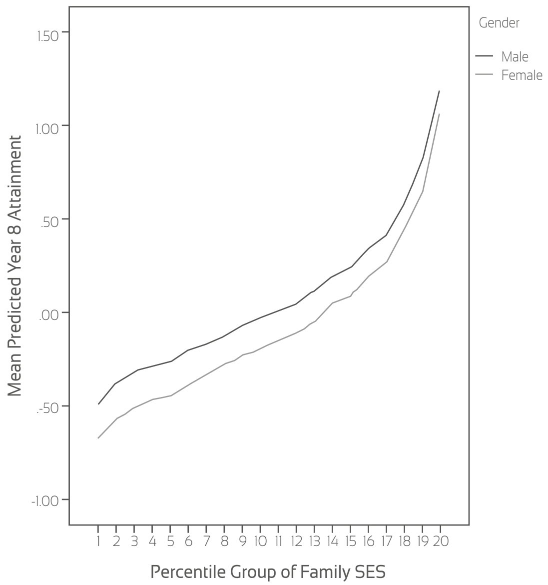

Figure 1. Year 8 Predicted Mathematical Scores by Family SES. Cohort 2009. Total Mean
Source: Own elaboration

The graph suggests that gender differences were relatively stable in different points of the family SES distribution, but became smaller at the upper tail of the distribution. This translates to mean that girls from the higher 10% of SES were performing only slightly lower than boys, while girls in the rest of the SES distribution had much lower predicted scores than boys from the same SES.

The somehow simple interaction effect of gender and SES became more complex when focusing on progress between year 4 and year 8. First, the main effect of previous attainment was highly significant, with an increase of 1 standard deviation in previous attainment adding more than half a standard deviation in year 8 attainment. Second, the effect of previous attainment was not independent from family SES or gender. As indicated by the positive coefficient of the interaction between year 4 attainment and SES, the negative effect of socioeconomic background becomes bigger with increasing previous attainment. Finally, the effect of previous attainment was bigger for girls. In combination, a summative effect of previous attainment and family SES was observed (see Figure 2).

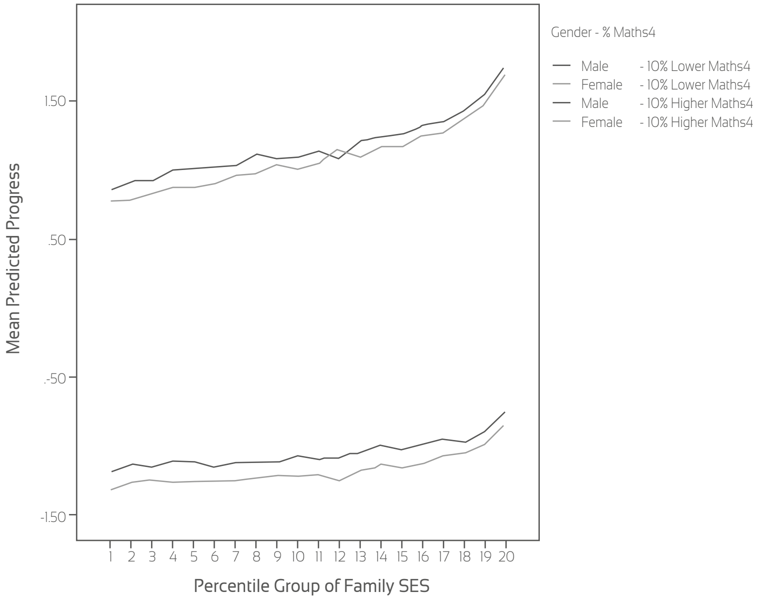

Figure 2. Predicted Progress in Mathematics Scores by Family SES. Mean for 10% Higher and Lower Scores in Previous Attainment (Year 4)
Source: Own elaboration

The graphs show how the effect of SES was stronger for students of higher previous attainment (namely 10% highest scores in year 4), for boys and girls, and how gender differences were bigger for students with lower previous attainment. This latter gender effect was slightly smaller for girls of higher family SES. Putting it in other words, girls that came from less privileged backgrounds and that were performing at a lower level during early primary (year 4) were predicted to make the least progress (relative to boys) when reaching year 8.

School level variables

Regarding research question number 3 (i.e. *Are gender differences distributed heterogeneously across different type of schools [different administrations]?*) this study showed that differences in the distribution of the gender gap between schools from different administrations were strongly influenced by the socioeconomic characteristics of their population (see Table 4).

Table 4. Effect of Type of School on Gender Differences, With and Without Family SES Control. Model for Urban Schools

	Year 4 Maths Attainment		Year 8 Maths Attainment		Progress	
	No-SES Control	Family SES Control	No-SES Control	Family SES Control	No-SES Control	Family SES Control
Intercept	0.072 (0.01)***	0.042 (0.01)***	0.13 (0.01)***	0.118 (0.01)***	0.159 (0.01)***	0.15 (0.01)***
Year 4 (Previous Attainment)					0.606 (0.00)***	0.602 (0.00)***
Female	-0.09 (0.01)***	-0.087 (0.01)***	-0.219 (0.01)***	-0.216 (0.01)***	-0.132 (0.01)***	-0.133 (0.01)***
Family SES		0.273 (0.00)***		0.149 (0.00)***		0.056 (0.00)***
Female * Family SES		0.003 (0.01)		0.018 (0.01)***		0.004 (0.00)
Female * Year 4					0.014 (0.00)***	0.013 (0.00)***
Family SES * Year 4						0.012 (0.00)***
Female * Year 4 * Family SES						0.009 (0.00)**
Public	-0.216 (0.01)***	-0.1 (0.01)***	-0.377 (0.02)***	-0.308 (0.01)***	-0.22 (0.01)***	-0.194 (0.01)***
Private	0.784 (0.03)***	0.277 (0.02)***	0.875 (0.03)***	0.616 (0.03)***	0.459 (0.02)***	0.35 (0.02)***
Female * Type (joint chi-square)	x^2= 6.15*	x^2= 1.27	x^2= 16.8***	x^2= 9.55**	x^2= 20.8***	x^2= 18.2***
Female * Public	-0.008 (0.01)	-0.001 (0.01)	0.011 (0.01)	0.023 (0.01)*	0.029 (0.01)***	0.03 (0.01)***
Female * Private	0.036 (0.02)*	0.022 (0.02)	0.067 (0.02)***	0.031 (0.02)	0.034 (0.01)**	0.014 (0.02)
r2 (compared with Individual Model No-family SES)	9%	17%	13%	17%	7%	8%
chi-square (compared with Individual Model No-family SES)	$x^2_{(6)}$= 1986.6***	$x^2_{(8)}$= 10809.2***	$x^2_{(8)}$= 2239.0***	$x^2_{(8)}$= 5560.3***	$x^2_{(6)}$= 1476.6***	$x^2_{(8)}$= 2221.3***

$p < 0.05$ *; $p < 0.01$ **; $p < 0.001$***
Source: Own elaboration

Comparisons of the gender gap in schools from different administrations showed that private schools presented smaller gaps than public and private subsidized institutions, but these differences disappeared after controlling by the socioeconomic status of students' families. Interestingly, girls progressed more between year 4 and year 8 in public than in private subsidized and private schools (see Table 4 and Figure 3).

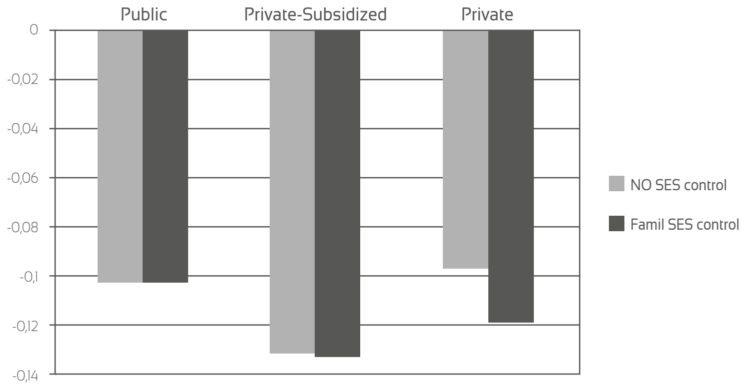

Figure 3. Gender Differences in Progress Between School Types, With and Without Family SES Control
Source: Own elaboration

Figure 3 shows the size of the differences between boys and girls in progress made between year 4 and year 8. It shows that, in all types of schools, girls made less progress than boys, but in public schools this difference was smaller than in private schools. Private schools (those that cater to the wealthiest population in the country) showed a smaller gap than private subsidized schools, but this difference was accounted for by the difference in socioeconomic status of their students: when including family SES in the equation, this difference disappeared.

Conclusion (summary of results)

In sum, the analysis revealed a consistent gender effect in mathematics attainment in year 4 and year 8, with boys making more progress than girls. Regarding the size of differences, these results suggest that, although gender is one of the strong coefficients in all the models explored, it accounts for only 1% of the variance in attainment. In addition, the differences between boys and girls reached a maximum of 20% of a standard deviation. This gap was smaller when modelling progress, where girls progressed one tenth of a standard deviation less than boys. This effect was about a quarter of the difference between students from more and less privileged background (family SES) in year 8, and is nowhere comparable with the effect of previous attainment, where students with lower year 4 scores can fall more than 2 standard deviations behind students with higher initial scores.

In relation to the effect of family SES on students' attainment, this study showed that the effect tended to decrease during primary education (between year 4 and year 8), but increased in its differential effect for girls and boys. Following this, while the effects of gender and family SES were independent during year 4, there was a significant interaction in year 8. At this point, differences between boys and girls became smaller as family

SES increased, with fewer differences in the higher levels of SES (in some cases differences even disappeared). The interaction between gender and family SES on progress showed that girls from less privileged backgrounds and who performed at a lower level during year 4 were predicted to make the least progress when reaching year 8.

The analysis of the systematic effect of different types of schools suggested that, while the effect of family SES decreased during primary school years, the effects of the schools' variables (i.e., type of school, linked with SES) increased. The size of the interaction effects between this variable and gender was small, but allowed the identification that private schools did better for girls only when family SES was not accounted for, and that private subsidized schools increased female disadvantage for average family SES students (this for year 8 and for progress scores). Public schools narrowed the gap in progress when compared with private institutions.

Discussion

This paper explored in detail the state of gender differences in mathematics attainment in Chile. Several reports in this country have raised concerns about the pervasive nature of male advantages, but no previous studies had explored this in detail and with suitable methodological tools. As stated by Lubienski (2008): "detailed analyses of gaps can help researchers and practitioners more effectively target their efforts towards equity, illuminating which groups to target and what aspects of instruction to address" (p. 353).

Overall, this study supports evidence of the persistence of gender differences in academic attainment of Chilean students in mathematics. Importantly, it also shows that differences were small throughout the distribution of SES, becoming even smaller between those from more privileged backgrounds. In the United States and Australia, some researchers have described similar patterns of interaction (Lamb, 1996; Teese et al. 1995), suggesting that the higher SES status of middle class girls—and their corresponding educational opportunities—offsets the negative impact of gender.

In the Chilean context, the scarce previous evidence on gender had suggested that girls' underachievement was stable and an important matter of concern (e.g. Agencia de Calidad, 2013a. 2013b, 2013c). In fact, gender differences are now being considered one of the relevant criteria for obtaining (and assessing) higher quality of education, according to new Chilean educational policy. Recently, the Ministry of Education has promoted a policy that provides a system for assessing and ranking schools, trying to include non-academic criteria (what they call "other evidence of quality"). Showing evidence of gender equity in terms of attainment is one of the variables suggested (Agencia de Calidad, 2014). Although differences in language (which is commonly known to favour girls in Chile) (Ministerio de Educación de Chile, 2005) are also considered in this new policy, most of the preliminary studies that the agency in charge of this process has published are related to girls' disadvantages in mathematics (Agencia de Calidad, 2013a. 2013b, 2013c). This policy issue suggests that girls' failing mathematics is a powerful discourse in the Chilean educational system.

A question raised by these data is whether the actual size of the differences really justifies a public discourse that positions girls as failing (see a discussion of these social positioning for example in Hodgetts, 2008); in other words, whether such discourse reinforces existing cultural stereotypes, instead of reflecting the real dimension of the problem. A couple of recent studies show that stereotypes of mathematics being a male domain are present even in early stages of the Chilean school career (del Rio & Strasser, 2013), when differences in attainment are non-existent—or, as shown by this study, they are smaller. Following a similar logic, another study shows that Chilean teachers expect (and evaluate) lower results from girls (Mizala, Martinez & Martinez, 2015). The obvious question here is whether the existing discourses on differences in attainment are further contributing to reproduce these realities, by influencing individual expectations and beliefs. As has been highly explored theoretically, public debates made available in the media and in everyday social interactions can form what has been called *big discourses* (Gee, 2005), that can impact identities (Gee, 2000). Differences in mathematics attainment and girls' relationships with this subject as problematic can be understood in this way.

Finally, although a focus on academic differences can be problematic and reproductive of social discourses of women failing in mathematics, constant monitoring of these differences is still needed. For example, international evidence has suggested that differences in attainment can be related with differences in course and career selection after compulsory (Crisp et al., 2009; Wang, 2013). As reported by the Chilean Ministry of Education (Ministerio de Educación de Chile, 2011), and as discussed in the series *Comunidad de Mujer* (Comunidad Mujer, 2014), in Chile there is still a great concern regarding highly stereotypical marked selection of careers. Women tend to choose careers related to caring roles (e.g. teaching, nursing) and service, while men tend to choose problem solving and *making* careers (e.g. engineering, technology, industry), including careers in science, technology, engineering and mathematics (STEM). These differences in career choice have been related by some authors to inequality in wages that are still observed in the Latin-American context (Ñopo, 2012). Considering this, monitoring and exploring how differences in attainment could relate to these issues is an area of research that is urgently needed in the Chilean context.

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