Gender differences in mathematical performance? Is it always like this?

Violeta Pina[1], Javier Fenollar-Cortés[2], Mahia Saracostti[3] and Diana Martella[4]

1 Universidad de Murcia (Spain), 2 Universidad de Loyola Andalucía (Spain), 3 Universidad de la Frontera (Chile), 4 Universidad Autónoma de Chile (Chile)

Correspondence should be addressed to Violeta Pina
violetapina@ugr.es

Introduction

Gender differences in mathematics have been shown in several international studies such as PISA, TIMSS or TERCE (2015)[1]. If boys outperform girls in math or vice versa, the age at which these differences appear or the tasks in which they are observed varies from country to country. Spanish-speaking countries are positioned among those with the greatest gender gap, in favor of boys. According to the last TIMSS report, Spain is the third OECD country with the biggest difference between boys and girls. Chile is the country with one of the highest gender differences according to the PISA report. This study aims to evaluate mathematical gender differences prior the breach onset (at the middle of the primary education), intending to prevent it.

Method

A sample of primary school children, comprised of 533 students from second and third grades were tested. Our final sample in Spain included 327 children aged between 7 years, 6 months and 9 years, 5 months. 167 were in second grade (44,9% male), 160 were in third grade (55,6% male). In Chile, 236 children aged between 7 years, 1 month and 9 years, 0 months were tested. 91 were in second grade (54,9 % male), and 145 were in third grade (56,6 % male).

Measures

Mathematical fluency: Mathematical facts were assessed across 47 items of simple addition and subtraction operations (e.g., “4 +2 = _").
Calculation: 45 items of increasing difficulty to evaluate complex calculations. Participants compared the equivalence between two operations where a missing number or symbol, or both must be placed (e.g., "3 + _ = 5 + 1").

These tests were based on math fluency and calculation of the Woodcock-Johnson III (WJ-III) Achievement (ACH) battery (Woodcock, McGrew, &Mather, 2001, 2007)[1].

Magnitude comparison: For this stage, Nosworthy et al. (2013)[2] task was used. The symbolic part, participants were asked to compare the pairs of numbers (ranging from one to nine); and the non-symbolic part , participants had to indicate the side with the largest magnitude

Results

Table 1. Sociodemographic and performance data

	Samples			
	Spanish Second grade	Third grade	Chilean Second grade	Third grade
N	167	160	91	145
Gender (% male)	44.9	55.6	54.9	56.6
Math Fluency	12.1(4.44)	18.2(5.92)	-	11.8(5.31)
Calculation	6.94(3.51)	11.7(4.24)	-	8.47(4.22)
ComparisonMagnitude				
Symbolic	31.1(9.36)	39.4(8.07)	30.6(10.6)	37.9(10.5
Non-symbolic	26.7(8.57)	32.4(6.46)	31.3(13.2)	35.7(11.3)

Table 2. Number of male and female students in the extreme scores by countries

	Spanish sample						Chilean sample					
	Second grade			Third grade			Second grade			Third grade		
Percentile	Male	Female	χ^2	Male	Female	χ^2	Male	Female	χ^2	Male	Female	χ^2
Math Fluency												
5th	7	7	0.13^{ns}	11	7	0.25^{ns}	-	-	-	7	4	0.13^{ns}
10th	9	13	0.21^{ns}	11	7	0.25^{ns}	-	-	-	11	8	0.00^{ns}
90th	13	11	0.86^{ns}	13	5	2.26	-	-	-	7	7	0.48^{ns}
95th	8	1	**7.24****	10	1	**5.96***	-	-	-	3	4	0.76^{ns}
Calculation												
5th	5	5	0.09^{ns}	4	5	0.48^{ns}	-	-	-	6	4	0.01^{ns}
10th	9	11	0.00^{ns}	10	8	0.00^{ns}	-	-	-	6	4	0.01^{ns}
90th	13	8	2.63^{ns}	15	5	**3.48**^{r}	-	-	-	10	11	1.25^{ns}
95th	6	4	0.91^{ns}	9	2	**3.28**^{r}	-	-	-	3	4	0.76^{ns}
Symbolic												
5th	6	6	0.11^{ns}	9	2	**3.28**^{r}	6	5	0.00^{ns}	6	4	0.00^{ns}
10th	9	10	0.03^{ns}	12	5	1.73^{ns}	6	5	0.00^{ns}	9	6	0.00^{ns}
90th	13	16	0.01^{ns}	11	7	0.25^{ns}	12	9	0.05^{ns}	7	6	0.19^{ns}
95th	13	16	0.01^{ns}	6	5	0.01^{ns}	4	4	0.09^{ns}	7	4	0.09^{ns}
Non-symbolic												
5th	9	12	0.07^{ns}	6	3	0.47^{ns}	4	1	1.34^{ns}	5	2	0.44^{ns}
10th	8	12	0.07^{ns}	11	9	0.00^{ns}	13	5	2.71^{ns}	8	6	0.04^{ns}
90th	8	11	0.10^{ns}	14	9	0.30^{ns}	6	8	0.98^{ns}	7	6	0.19^{ns}
95th	5	4	0.39^{ns}	5	4	0.00^{ns}	3	2	0.06^{ns}	5	3	0.03^{ns}

$^{r}p< .1$, $*p< .05$, $**p< .01$

Discussion

The only significant difference in average performance between genders was found in Chile. For the third grade, boys performed above girls in mathematical fluency. Our study detects differences in Chile at younger ages than other international studies such as TERCE. However, these are detected in very basic areas of mathematics that are not usually evaluated in international studies. In Spain we did not find gender differences in average performance. But on percentiles, we found a gender gap for the mathematical fluency task: for both, second and third grades, boys have a superior representation in the highest percentile than girls. Interestingly, in third grade, a marginally significant difference was also seen in the highest percentile of calculus favoring boys. This result agrees with the previous literature[3,4]. In summary, one grade after a gender gap appears in arithmetic facts, a gender difference is also shown in more complex calculus, though marginally.

Gender differences do not exist in the most basic tasks on the highest percentiles, but a marginally significant difference in the pc 5 of symbolic comparison does. When difficulties arise in such basic skills, it may be related to dyscalculia disorder. These findings have important implications regarding interventions for gender differences in math performance, as they point out fluency skills that could be trained in order for girls to catch up with boys in mathematical ability[4].

Selected References

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