

# Gender, Parental Beliefs and Children's Mathematics Performance: Insights from the Longitudinal Study of Australian Children

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With reports of declining participation in mathematics related careers and low female participation rates, the issue of gender differences in mathematics remains relevant. This study seeks to examine the relationship between: children's sex, parents' beliefs regarding their children's education, and, the children's mathematics performance. Through a secondary analysis of data from the Longitudinal Study of Australian Children (LSAC), responses from 2927 children aged 8 to 9 years old, show that parental perceptions of their children's mathematics achievement and their expectations for their children are closely associated with the children's mathematics performance in NAPLAN.

In terms of the number of graduates in Science, Technology, Engineering and Mathematics (STEM) related disciplines, Australia is lagging behind its trading competitors (Chubb, Findlay, Du, Burmester, & Kusa, 2012). This skills shortage is exacerbated by a consistent gender bias in these disciplines favouring males (Australian Education, Employment & Workplace Relations References Committee, 2012). Despite the considerable work done by researchers and policy-makers alike over the past decade to address this bias, males appear to have a slight advantage in mathematics. Since its inception in 2008, results in Australia's National Assessment Plan - Literacy and Numeracy (NAPLAN) have shown a small bias favouring males in mathematics, even from Year 3 when children first sit the test and this bias appears to have increased during the intervening years (Hill, 2011). Related to this trend is the finding that a significant proportion of Australian adults believe males are better at mathematics than females, especially those younger than 40 who are more likely to be parents of children currently at school (Leder & Forgasz, 2011). These findings raise the possibility that parental expectations for their children could be contributing to the reported gender bias in mathematics that favours males. Accordingly this paper revisits research related to parental expectations and explores the influence that parents have on their children's mathematics achievement.

## Background

Parents' expectations for their children are known to be associated with their children's academic attainments and predictive of later career choices. In a meta-synthesis of parental involvement meta-analyses, Wilder (2013) reported that of all parental involvement measures, it was parents' expectations regarding their children's educational attainments that most closely correlated with those attainments. In relation to career choice decisions, Bleeker and Jacobs (2004) found that mothers' career expectancies for their teenage children predicted their child's later career expectancies and ultimately their child's choice of a science rather than a non-science related career. More recently, Jacobs, Chhin, and Bleeker (2006) reported that mothers' early expectations for the types of jobs, whether gender traditional, gender neutral or gender non-traditional, predicted their daughters' but

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not their sons' later participation in these jobs. Interestingly, fathers' expectations were predictive for both sons and daughters.

The underlying mechanism through which parental expectations influence subsequent behaviours in children has been a focus of study for some time. Parents' expectations for their children's mathematical attainment are thought to emerge from three sources: their beliefs about their own mathematical ability and aspirations; their knowledge of the child, including their perceptions of the child's mathematical ability; and feedback from the child's school, which is thought to correct earlier expectations (Seginer, 1982). These expectations are then transmitted to children through a socialisation process, where parents convey messages regarding their beliefs about the child's abilities, the difficulty of mathematical tasks, and the importance of these tasks (Eccles-Parsons, Adler, & Kaczala, 1982).

In regards to this socialisation process, Gunderson and colleagues have argued that parents' mathematics anxiety and the way they praise their children may also impact on their children's performance in mathematics. Beilock, Gunderson, Ramirez, and Levine (2010), for example, reported that girls performed worse than boys in Year 1 and 2 classes taught by teachers with high levels of mathematics anxiety and argued that this mechanism could manifest itself in parent/child interactions with mathematics. In addition Gunderson et al. (2013), reported that parents tend to praise sons and daughters differently. In a longitudinal study of 53 young children, boys received more process praise (e.g., "that's a good job") from their parents than girls when observed at ages 14, 26 and then 38 months. Moreover, they reported a positive association between the amount of process praise received by the child in their early years and the child's later tendency to adopt an incremental rather than entity view of intelligence (Dweck & Leggett, 1988), where the former is associated with mastery rather than avoidance learning behaviours. This albeit small study provides promising insights into how parental expectations could shape parental behaviours that ultimately influence children's later performance in mathematics.

Given the above research, and earlier cited claims that perceptions regarding gender equity in mathematics are changing in Australia, it is an opportune time to revisit the relationship between parents' beliefs regarding their children's educational attainment, their expectations for their children, and the children's actual achievement in the early primary years. With this in mind the study addresses the following research questions: What are Australian parents' beliefs regarding their children's mathematics performance, how are these related to their expectations for the child and his or her mathematics achievement, and how are these relations influenced by the child's sex?

## Method

The study is based on a secondary analysis of data obtained from LSAC (Sanson et al., 2002). LSAC is informed by an ecological theoretical model of child development (Bronfenbrenner, 1977) that aligns with the focus of this study, namely the influence of parent/child interactions on mathematics achievement. LSAC utilises a cross-sequential design to follow two cohorts of children: a Birth (B) cohort of approximately 5000 children aged between 6 and 12 months of age; and a Kindergarten (K) cohort of approximately 5000 children aged between 4 years 6 months and 5 years. Moreover, it uses a stratified-cluster design that provides a large representative sample of the Australian population of children. Due to the availability of NAPLAN data, this study is restricted to data obtained

from the K-cohort of LSAC. Further details of the student sample, instruments used, and analyses undertaken are discussed below.

### *Student sample*

Of the 4983 children first recruited into the K-cohort, 4331 remained in Wave 3 during 2008. Of this sample, 51.1% of children were male and 7.3% were reported by their parents as having a disability. This study focuses on the 2927 children from the sample for whom NAPLAN data were available. NAPLAN data were unavailable, in most cases, because the responding parent had failed to give permission for its use. Of the children in the reduced sample used in the study, 52.4% were male, 6.4% were reported to have a disability, and they came from families with a mean socio-economic position<sup>1</sup> (SEP) 0.05 standard deviations higher than children from the entire sample. In other words, the sample upon which this study is based contains slightly more males, slightly fewer children with disabilities, and slightly wealthier families than the designed LSAC sample.

### *Instruments*

The items discussed in this study come from an interview with the primary parent, in most cases (96%) the mother that occurred during 2008 and 2009. Parents were asked, "Looking ahead, how far do you think the study child will go with his/her education?" Responses ranged from 1 (*Leave school before finishing secondary school*) to 5 (*Obtain post-graduate qualifications at a university (e.g. Master degree or Doctoral degree)*). Parents were also asked, "Compared to other children in their class how well do you think study child is progressing in maths?" Responses ranged from 1 (*Much better*) through to 5 (*Much worse*).

Children's NAPLAN numeracy scores were used as the outcome measure and for this sample ranged from 180 to 666 ( $M = 415$ ,  $SD = 75$ ). Most (94%) of these children did their Year 3 NAPLAN test in 2008, and probably in most cases before their parents were interviewed. A small minority (6%) did their Year 3 NAPLAN test in 2009 and in most cases after their parents were interviewed.

### *Data analysis*

Univariate analyses of data were undertaken in this study to determine frequencies and group means where appropriate. Chi-square tests of association were used to assess bivariate relationships and simple linear regression was used to investigate multivariate relationships. Regression models used in these analyses were fitted using the R-package "Survey" (Lumley, 2012).

## Results

### *Univariate and bivariate analyses*

Mean NAPLAN numeracy scores for males ( $M = 417.2$ ,  $SD = 77.9$ ) were, on average, higher than those of females ( $M = 412.5$ ,  $SD = 70.6$ ). Moreover, means for both sexes were

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<sup>1</sup> The SEP is index developed by Blakemore, Strazdins, and Gibbings (2009)

higher than corresponding population means<sup>2</sup> ( $\mu_{male} = 400.6$ ,  $\mu_{female} = 393.1$ ) suggesting that the numeracy achievement for these students was slightly greater than that of the population. The difference between male and female means in this sample ( $\Delta M = 4.7$ ), however, was slightly lower than that for the population ( $\Delta \mu = 7.5$ ).

Parents had positive perceptions regarding their child's mathematics achievement with more than half (57%) believing their child was better or much better than others in the class and about a third (34%) believing their child was about the same (see Figure 1). These perceptions were also associated with the child's gender ( $\chi^2 = 47.3$ ,  $p = 0.00$ ) in that parents of boys were more likely to perceive their child to be much better at maths than parents of girls. Overall, 941 (62%) parents of boys believed their son was better or much better than others in mathematics, whereas only 711 (51%) parents of girls shared this view.

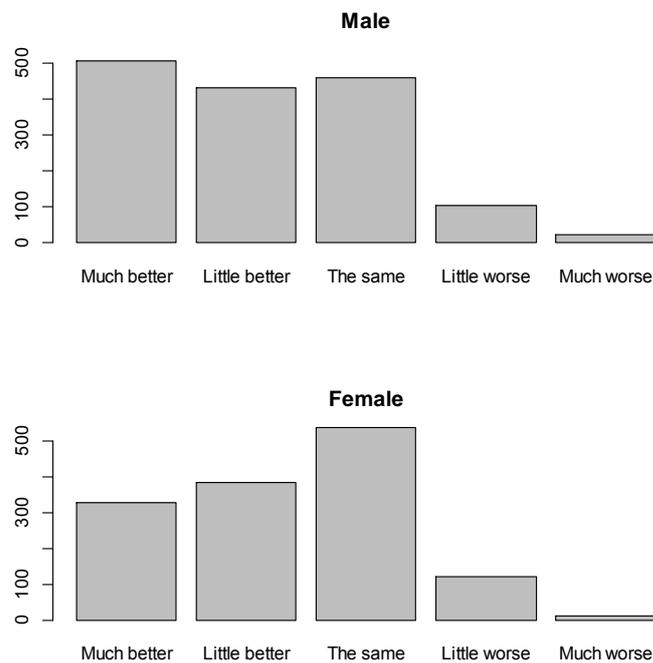


Figure 1. Parental perceptions of their child's mathematics ability by child's gender.

Parents also had high expectations of their children with more than two thirds (68%) expecting their child to gain tertiary or post-tertiary qualifications and almost one fifth (18%) expecting their child to gain trade qualifications. These expectations were associated with their child's gender ( $\chi^2 = 129$ ,  $p = 0.00$ ) in that parents tended to have lower and different educational expectations for their sons than for their daughters (see Figure 2). More specifically, 37 parents of boys felt their child would leave school early, whereas only 9 parents of girls had this expectation. Similarly, 371 (25%) parents of boys felt their son would gain a trade, whereas only 141 (10%) parents of girls shared this expectation. On the other hand, 919 (67%) parents of girls expected their daughter to complete a tertiary degree, with only 768 (51%) parents of boys sharing this expectation.

<sup>2</sup> See Australian Curriculum Assessment and Reporting Authority (2008)

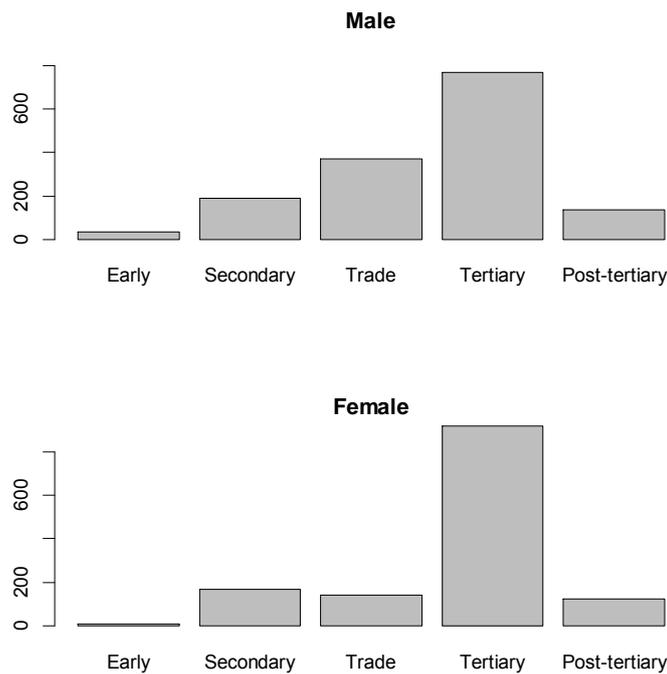


Figure 2. Parental expectations of their child by child's gender.

Parental expectations were also strongly associated with their perceptions of their child's achievement ( $\chi^2 = 315.2, p = 0.00$ ). Parents who expected their child to obtain tertiary or post-tertiary expectations were also more likely to perceive their child was better or much better in mathematics than their peers.

### *Multivariate analyses*

When NAPLAN numeracy scores were regressed onto parental perceptions and gender, only the former variable was statistically significant (at the 5% level). This linear model explained 23% of the variance in NAPLAN numeracy scores. Predicted means for each category of parental response by gender are shown in Table 1 which also records the number of children in each category.

Table 1

*Predicted Mean NAPLAN Numeracy Scores by Parental Perception and Child's Gender*

	Parental perception of child's relative mathematics achievement				
	Much better	Little better	The same	Little worse	Much worse
Male	466 (n=508)	428 (n=433)	393 (n=459)	344 (n=102)	326 (n=23)
Female	455 (n=327)	427 (n=384)	401 (n=537)	358 (n=122)	313 (n=11)
Difference	11*	1	-8	-14	13

\* Significant at 5%

As is seen, there were 508 boys whose parents thought they were much better than others in mathematics. Given the overall proportion of males in the group, this is 70 more than expected if there were no association with gender. Moreover these boys, on average, were predicted to score 11 more points on NAPLAN numeracy than the 327 girls in this category. On the other hand, the 102 boys whose parents believed they were a little worse than their peers were predicted to score, on average, 14 points lower than the 122 girls in this category, though the latter difference is not statistically significant.

When parental expectations for their child's educational attainment and gender were regressed onto NAPLAN numeracy scores, both predictor variables were significant (at the 5% level). This model explained only 15% of the variance in NAPLAN numeracy scores, somewhat less than that explained by parental perceptions of current mathematics ability. The difference between predicted male means and female means, however, increased as parents' expectations increased (see Table 2). As is seen from the table, the 768 boys whose parents expected a tertiary qualification were predicted to score, on average, 19 points higher on NAPLAN numeracy than the 919 girls in this category. The sex of the primary parent and the year that the child did the NAPLAN test were tested in both regression models, but neither factor was a significant predictor.

Table 2:

*Mean NAPLAN Numeracy Scores by Parental Expectation and Child's Gender*

	Early	Secondary	Trade	Tertiary	PG
Male	358 (n=37)	377 (n=192)	382 (n=371)	444 (n=768)	466 (n=136)
Female	361 (n=9)	374 (n=170)	376 (n=141)	425 (n=919)	445 (n=125)
Difference	-3	3	6	19**	21**

## Discussion

The results of the study show that parents of Australian Year 3 children, in general, have positive perceptions of their children's mathematics achievement and high expectations for these children. Less than one tenth of the parents (9%) believed that their child was worse or much worse than other children, though perhaps in this interview situation they were less inclined to acknowledge negative perceptions. Similarly a significant majority expected their son or daughter to gain a tertiary or post-tertiary qualification.

Parental perceptions of their children's mathematics achievement were strongly associated with their expectations for their children. Given that the former are likely to contribute to the latter (Seginer, 1982) this is not surprising. Moreover, these perceptions explained more variance in NAPLAN numeracy scores than the expectations, suggesting they may have been guided by recent mathematics achievement, including information conveyed to the parents on the NAPLAN results of their child.

There was a significant association between parental perceptions of their children's mathematics achievement and the children's sex. On the surface it would appear that parents of boys tended to have more positive perceptions about their son's mathematics achievements than parents of girls, with more boys than girls deemed to be much better

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\*\* Significant at 1%

than others in mathematics. These perceptions, however, appeared to be well-founded with boys in this category scoring, on average, 11 points more than girls.

Parental expectations regarding their children's educational attainments were strongly associated with the children's sex. These parents tended to have lower educational expectations for their boys than for their girls. For example, parents of boys were more likely to expect their sons to leave school early or to gain a trade than parents of girls. Young boys are more likely than girls to have speech and language difficulties (Harrison & McLeod, 2010), which may influence parental expectations regarding the gaining of tertiary qualifications. Further, boys at this age may themselves identify with gender-traditional occupations, such as those associated with trades, and this identification could influence parental expectations. Significantly, though, male children in those categories associated with high expectations reported higher mean NAPLAN numeracy scores than their female counterparts. In terms of effect sizes, boys whose parents expected them to gain degrees scored 0.25 standard deviations higher on the NAPLAN numeracy test than similar girls, a much greater gender effect than the 0.1 obtained from corresponding population data (ACARA, 2008). As noted by Penner and Paret (2008), it appears that gender differences in mathematics appear in the tails of the ability distribution.

## Conclusion

In this study a secondary analysis of data from LSAC has highlighted the important influence that parental expectations have on children's mathematics achievement and the gendered perceptions that parents have regarding this achievement. The results of the study suggest that parents, who were mostly mothers, tended to perceive sons as being better at mathematics than daughters yet they tended to have non-academic long-term expectations for these boys. Considerably more boys than girls were perceived as being much better than their peers in mathematics, and considerably more girls than boys were expected to gain a degree. Given the cross-sectional nature of the study, however, it is difficult to claim causative relationships. It is possible that teacher feedback about their children's achievement in class and even in the NAPLAN tests, for example, have shaped some parental expectations. These, in turn, may have contributed to children's achievement using the mechanisms reported earlier.

Studies such as this are limited in the sense that there is no control over the questions that are used. Nevertheless the analysis of this large representative sample has highlighted the need for further research focusing on parental involvement in their children's mathematics education and in particular the influence of gender. The results of the study suggest that even in Year 3, boys whose parents expect them to gain tertiary qualifications are performing better in mathematics than girls with the same expectations. An investigation of this relationship in later years is warranted.

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