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Maternal Judgments of Child Numeracy and Reading Ability Predict Gains in Academic Achievement and Interest

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Abstract

In a representative longitudinal sample of 2602 Australian children (52% boys; 2% Indigenous; 13% language other than English background; 22% of Mothers born overseas; and 65% Urban) and their mothers (first surveyed in 2003), this paper examined if maternal judgments of numeracy and reading ability varied by child demographics and influenced achievement and interest gains. We linked survey data to administrative data of national standardized tests in Year 3, 5, and 7 and found that maternal judgments followed gender stereotype patterns, favoring girls in reading and boys in numeracy. Maternal judgements were more positive for children from non-English speaking backgrounds. Maternal judgments predicted gains in children's achievement (consistently) and academic interest (generally) including during the transition to high school.

Keywords: Maternal judgments; achievement; longitudinal analysis; data linkage

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Do mothers' judgments about their child's academic performance influence later academic outcomes? Do they do so when controlling for children's actual performance? Mothers' judgments about their child's ability are powerful because of the many pathways through which they may suppress or incite motivation and achievement in their child. For example, parents tell their children what they think their strengths and weaknesses are and, as this feedback affects the child's self-perceptions, they suffer or thrive because of it (Pesu et al., 2016). Although research has considered the role of parents' judgments in predicting academic outcomes like achievement and motivation (Frome & Eccles, 1998; Heyder et al., 2017; Simpkins et al., 2012), there has been little research that isolate within-person variance with longitudinal data that can provide greater strength to causal claims (see Orth et al., 2020) about how maternal judgments may kindle motivation and improve academic achievement.

Maternal judgments of child performance and objective child performance

Most of the early literature on this topic in education comes from Miller and colleagues (Delgado-hachey & Miller, 1993; Miller & Davis, 1992; Miller, Manhal, & Mee, 1991). These researchers showed that mothers' judgments were strongly related to their child's objectively measured ability ($r \approx .50$)—though others has found weaker correlations ($r \approx .30$; Sonnenschein, Stapleton, & Metzger, 2013). The discrepancy between mothers' judgments of their child and the child's objectively measured ability could stem from several sources. First, mothers may lack access to normative information. This is particularly the case where there is a growing trend for teachers to limit the use of normative assessments for young children (Lohbeck & Möller, 2017). Second, mothers may make judgments that are influenced by a variety of heuristics. For

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example, Van Zanden et al. (2017) showed that parents engage in heuristics where parents judge their child's ability in one domain not just on their ability in that domain but their ability in other domains. Finally, mothers may skew their judgement either as a form of self-enhancement (Gebauer et al., 2013) or as a means of motivating their child.

Do maternal judgments vary by child demographics?

Mothers' judgments about their child's academic performance are related to, but differ from, the child's objective performance. The amount and direction of this discrepancy may depend on the child/family characteristics and demographics.

The stereotypes that mothers hold about their child likely affect maternal judgments of their child's academic ability. Parents' gender stereotype beliefs can influence children from a very young age by, for example, the way that parents police the play of their children (McFadden et al., 2020; Robnett et al., 2018). Parents' stereotypical beliefs have implications that extend beyond infancy with evidence suggesting they influence children's achievement and later attainment by encouraging academic pursuits that are consistent with stereotypical gender roles (McFadden et al., 2020; Muenks et al., 2020; Pinquart & Ebeling, 2019; Robnett et al., 2018). The influence of parents' gender schemas may be more influential in childhood and adolescence than in infancy (Leaper, 2013).

The expectancy-value theory of Eccles (1985, 1994) emphasizes the systematic influence of child gender on maternal judgments. Eccles' model focuses on the role of gender stereotypes in influencing parents' judgments. These stereotypes can, for example, lead girls to think they are worse at math than they are and boys to think they are better than they are (Parker et al., 2018a; Heyder et al., 2017). This is consistent with research showing that parents tend to hold the gender stereotypes that boys are better at math and girls are better at reading (Räty et al., 2002;

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Räty & Kasanen, 2007; Räty, Snellman, & Vainikainen, 1999). Although a child's gender swayed parental judgments, parents' own gender did not (Räty et al., 2002).

Although most of the focus in this area has been on gender, Eccles' expectancy-value model encourages us to consider the child's cultural milieu more broadly. Beyond gender, there is less consistent research. After gender, socioeconomic status is the most studied influence of parental judgments. For example, some research shows that SES is positively related to parental expectations (Neuenschwander et al., 2007; Sonnenschein et al., 2013). Other research shows no such association (Delgado-gachey & Miller, 1993). In the current research, we consider the influence of socioeconomic status, rural status, and ethnic background on maternal judgments. Given recent research on the way in which social categories intersect with gender (see for example Parker et al., 2020), we also consider if these factors interact with gender in predicting parental judgments. For example, some research shows that parents from ethnic minority backgrounds hold more traditional gender stereotypes about their children (McFadden et al., 2020).

Do maternal judgments influence academic outcomes?

What impact does maternal judgments have on academic outcomes? Few would argue that strongly negative maternal judgements are beneficial. But should mothers err on the side of positive judgments? Bandura (1986) has suggested that optimism may promote motivation and effort and thus enhance positive outcomes. Pesu et al.'s (2016) research also suggests that maternal judgments may directly stimulate child motivation (Pesu et al., 2016). In addition, research by Jussim and Eccles (1992) has shown that the expectations of important others can explain gains in academic achievement.

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There are several potential mechanisms that explain the link between parental beliefs—like maternal judgements—and academic achievement. First, parental beliefs may influence the investment parents make in their child’s education. For example, research has shown that parental judgements are associated with the likelihood that a parent will hire a tutor for their child (Kinsler & Pavan, 2020). Second, parental beliefs may influence the amount (Kinsler & Pavan, 2020) and manner in which parents directly support their child’s education (Gunderson et al., 2012). For example, there is evidence that stronger parental stereotypical gender beliefs around math lead to more intrusive and detrimental homework support (Gunderson et al., 2012). Third, parental beliefs influence their child’s motivation and self-belief (Pesu et al., 2016; Tiedemann, 2000) and via that influence their academic achievement (Gunderson et al., 2012; Simpkins et al., 2012). Fourth and finally, Murayama et al. (2016) has argued that excessively positive parental judgments can be damaging because they can lead to over-involvement, controlling behavior, and excessive pressure.

Although we were unable to assess the first two mechanism, we do address the third mechanism by assessing if parental judgements influence academic achievement via the child’s intrinsic interest; a critical motivation variable (Ryan & Deci, 2017). The fourth mechanism we consider by exploring if there was a polynomial relationship between parental expectations and their influence on academic achievement (holding objective achievement constant). If extremely positive judgements are detrimental, we should see a pronounced inverted U shape relationship between judgements and achievement (and interest) with the turning point—where judgements change from a positive to a negative influence—occurring at more extreme positive levels (holding objective achievement constant).

Current Study

Our research tests the influence of maternal judgments on academic outcomes. We hypothesize that:

- Maternal judgments will be higher for boys than girls in numeracy, controlling for children's objective numeracy performance (H1a).
- Maternal judgments will be higher for girls than boys in reading, controlling for children's objective reading performance (H1b).
- Maternal judgments will positively predict learning gains in numeracy and reading (H2).
- Maternal judgments will positively predict increased interest in numeracy and reading (H3).
- The effect of maternal judgements on numeracy and reading gains will be mediated by gains in numeracy and reading interest (H4).
- Maternal judgements that are overly positive (controlling for prior academic achievement) will have a weaker influence on later academic achievement as indicated by a significant quadratic relationship between judgements and achievement (H5).

Hypotheses H2-H5 were tested using a random-intercept cross-lagged panel models (hereafter RI-CLPM) that focused solely on within-person variance (Orth et al., 2020). Although there has been longitudinal research on the influence of parental expectations on academic outcomes (Simpkins et al., 2012), such research has important limitations that restrict their ability to advance causal claims. In particular, there is a growing recognition that longitudinal data can best address causal questions about psychological mechanisms by focusing on within-person variance (Alison, 2009; Gelman et al., 2020; Orth et al., 2020). Models that focus on within-person variance allow for each participant to act as their own control and thus provide insight

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into causal questions like, “if a parent’s expectations are more positive than usual does their child experience an increase in academic achievement or intrinsic interest?” (Orth et al., 2020). H4 and H5 were suggested by anonymous reviewers and should be considered exploratory. Depending on results, further exploratory analysis was also considered and clearly marked as exploratory.

Method

Participants

Data from mothers and their children came from the K-Cohort of the Longitudinal Study of Australian Children (LSAC). LSAC is a government-run study of a representative sample of Australian children between ages four and five in 2004, which has followed these participants every two years since (AIFS, 2015). We analyzed data from a sample of 2602 children and their mothers with data collected when children were aged 8-9 years old. We included only children in Year 3 who were eligible to complete the National Assessment Program—Literacy And Numeracy (NAPLAN) test (see below). Within our sample, 52% of participants were boys, 2% were Indigenous, 65% lived in an urban location, and 13% grew up in a household where a language other than English was spoken. Because of the early age of the participants, only five percent of children were born overseas, however 22% of the mothers were born overseas with the most common countries being the United Kingdom (5.4%), New Zealand (2.3%), China (1.4%), and India (1.1%). We excluded 62 child/parent dyads where the responding parent was the father due to the small sample size. As a sensitivity analysis, we re-ran all models including these excluded observations. The results were similar and typically differed only at the second or third decimal place. Access to the data can be requested [here](#).

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Measures

Maternal numeracy and reading judgement. When children were in Year 3, 5 and 7, mothers were asked: “Compared to other children in their class, how well do you think <<study child>> is progressing in {math/reading}? (If a child is in a combined class, compare with children in the same year)”. Mothers were given a five-point response scale with poles of ‘Much worse’ and ‘Much better’.

Numeracy and reading ability. Numeracy and reading achievement were taken from administrative records from the NAPLAN tests. The NAPLAN tests are given to all eligible children in the country in Years 3 (age \approx 8), 5 (age \approx 10), 7 (age \approx 12), and 9 (age \approx 14). We had access to data from these tests for Years 3 to 7. The tests are scaled so that they are comparable across Years, allowing for the analysis of learning gains. They have an overall mean of 500 and a standard deviation of 100. Given that maternal judgments were relative to the child’s local environment, we used administrative records to normalize a child’s score by the average school grade’s score in the school they were enrolled in (i.e., child NAPLAN score - school grade average NAPLAN score).

Underlying cognitive ability. No measure of IQ was taken prior to school in the LSAC data. As such, we used underlying verbal ability from the Peabody Picture Vocabulary test (Dunn & Dunn, 2007) which was given to participants at age 4 (i.e., at or just before school commencement) as a proxy for cognitive ability.

Liking of math/literacy. To measure this, children were asked in Years 3 to 7, “Do you like {math and number work/reading and writing} at school?” with a response scale of ‘no’, ‘sometimes’, and ‘yes’. This scale was treated as ordinal in all analysis.

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Demographics. We used the Socioeconomic Position (SEP) index constructed by the LSAC survey organizers (Baker, Siphthorp, & Edwards, 2017). The SEP index included mother reported standardized weekly income, years of education, and occupational prestige derived from the Australian Standard Classification of Occupations—the prestige score is similar to the international socioeconomic index (Ganzeboom, De Graaf, & Treiman, 1992). The SEP has a mean of zero and a standard deviation of one.

Other demographics were the mother-reported gender of the child, the language spoken at home (coded as 1 for LOTE and zero otherwise), rural status (coded as 1 for rural and zero for urban), and Indigenous status (coded as 1 for non-Indigenous and zero for Indigenous).

Analysis

LSAC uses a complex survey design with postcodes as the primary sampling unit. In addition, we used school Year data in this analysis. Seventy-three percent of the sample shared a school with at least one other participant. To correct for this complex design and school nesting, we used cluster robust standard errors via the Survey package in R (Lumley, 2004) or the complex survey options in Mplus. Missing data were small (generally under 4%). The variable with the largest missing data was Year 7 numeracy (13.4%). To account for missing data, we used multiple imputation using a bootstrapped expectation maximization procedure to estimate 10 plausible values sets (Honaker, King, & Blackwell, 2011). All analyses used combined attrition and sample weights provided by the survey organizers for the Year 3 sample.

When mothers' judgement and children's liking of math/literacy were outcome variables, we used proportional odds logistic regression and reported results in log-odds (except for the within-person models; see below). For numeracy/reading achievement, results are reported as

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standardized betas. Dichotomous predictors were coded as 0-1 while all other predictors were z-scored.

Models. Models for hypotheses H1 and H2 were estimated as proportional odds logistic regression models. Models for hypotheses H3-H5 were estimated using models isolating only within-person variance. These models were estimated using Random Intercept–Cross-lagged Panel Models with estimates across lags constrained to be equivalent as per Hamaker et al. (2015). H4 was estimated within these RI-CLPMs using the MODEL INDIRECT command in Mplus which calculates estimates of uncertainty via the delta method. H5 was also tested within the RI-CLPM framework using a LMS latent interaction to form the quadratic effect of judgements on academic achievement (Klein & Moosbrugger, 2000).

Sensitivity analysis and assumption checking. There were several assumptions or design decisions that we made in the construction of our models. These included a) only correcting standard errors for school nesting, and b) assuming proportional odds for ordinal response variables. We assessed the likely impact of these decisions via a series of Bayesian sensitivity analyses reported [here](#). Sensitivity to our choices was modelled using the leave-one-out information criteria (LOOIC; and associated standard error). We assumed that if the delta LOOIC that compared models were only a few times larger than the associated standard error, then our results were reasonably robust to our modeling decisions (Bürkner & Vuorre, 2019). Results supported the use of simpler models (i.e., cluster robust standard errors and proportional odds). Full details of the analysis can be found [here](#).

<Table 1 about here>

Results

Judgments are Moderately Related to Academic Performance

We found that the correlation between the child's Year normalized numeracy score (child's score–school-year average score) and mothers' judgement of their child's numeracy ability, was strong in Year 3: $r = .49$ [.45, .52], Year 5: $r = .49$ [.45, .53], and Year 7: $r = .52$ [.48, .53] as were their assessments of their child's reading ability in Year 3: $r = .56$ [.53, .60], Year 5: $r = .48$ [.44, .52], and Year 7: $r = .43$ [.39, .47]. The distribution of achievement and maternal judgments are presented in Table 1 and Figures 1 and 2.

<Figure 1 & 2 about here>

H1: Maternal Judgments Differ by Some Demographics

We then tested a series of models aiming to explore if demographics may explain maternal judgments. Tables 2a and 2b show that the child's Year normalized ability was the single biggest predictor of maternal judgement of their child's ability in both numeracy and reading. Controlling for child academic performance, we found little evidence that maternal judgments were related to SES or rural/urban status in elementary school (Year 3 and 5). But in Year 7 more advantaged parents rated their children more positively in both reading and math. Likewise, urban parents judged their children more positively in reading compared to rural parents.

<Table 2a & 2b about here>

Mothers of girls judged more positively than mothers of boys in reading in Year 3 and 7 (and only just non-significantly in Year 5). The opposite was true of numeracy in elementary but not secondary school. That is, mothers judged boys more positively than equally performing

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girls. Mothers from non-English speaking backgrounds routinely judged their children more positively than English speaking mothers in reading. There was little difference between mothers from English and non-English speaking backgrounds in math.

We also considered if gender may influence maternal judgments differently for different levels of other demographic variables. We found no significant interactions for maternal judgments in Year 5 and only one each in Year 3 for math judgments and Year 7 for reading judgments. Both of these models involved rural/urban status and were refit, incorporating only the gender by rural/urban status interaction. The results suggested that mothers of urban girls judged them as significantly worse at math than boys (OR = 0.66 [0.53, 0.78]) but mothers of rural girls judged them similarly to mothers of rural boys (OR = 1.00 [0.72, 1.27]). Maternal reading judgments of Year 7 girls and boys showed the opposite pattern. Urban mothers did not judge their girls more positively than their boys (OR = 1.24 [0.95, 1.47]), while rural mothers judged girls significantly more positively than boys (OR = 1.81 [1.30, 2.32]). All interaction parameters and the full models for the significant interaction models can be found in [supplementary materials](#).

H2-H3: Maternal Judgments Stimulate Positive Gains in Academic Outcomes

We next examined if maternal judgement predicted later outcomes. We first report results from models focused only on within-person variance modelled via RI-CLPMs. All results here are reported in standardized betas and are reported in Figures 3a and 3b. Positive deviations from typical maternal judgments predicted gains in numeracy interest, and numeracy and reading achievement, but did not predict gains in reading interest. Although not a central focus of this paper, these models also allowed us to determine if maternal judgments were predicted by prior interest and achievement. We found that positive deviations from typical levels of reading

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achievement predicted increases in maternal judgments in reading (but not interest). Positive deviations in numeracy achievement and interest predicted increases in maternal judgments. Effect sizes for significant effects in the RI-CLPMs were in the range of $\beta = .08-.15$.

<Figure 3a & 3b about here>

Exploratory Analysis: Gender is not a Moderator. Given that gender was such a consistent predictor of maternal judgements—and the focus in this field on gender differences—we explored if the results from the RI-CLPMs were moderated by gender. This exploratory analysis was conducted via a multigroup model with moderation assessed by considering if regression parameters for boys and girls significantly differed. Significant differences were assessed using the delta method in MODEL CONSTRAINT in Mplus. We found no evidence of significant differences on any of the regression estimates in the RI-CLPMs (see [supplementary materials](#)). This indicates that any longitudinal relationships between maternal judgements, child academic interest, and academic achievement differences by gender were likely to be very small.


H4 (Exploratory Hypothesis): Interest is not a Significant Mediator between Judgements and Achievement

We next considered if children's academic interest mediated the influence of parental judgements on academic achievement. We specified the mediation path within the RI-CLPM where Year 5 academic interest mediated the link between Year 3 maternal judgements and Year 7 achievement. Although a very conservative means of estimating mediation, this approach took the best advantage of the causal inference potential of the RI-CLPMs. This mediation path was not significant for reading ($\beta = .002$ 95% CI [-.002, .006]) or for math ($\beta = .008$ 95% CI [-.001, .017]). Very small, but significant indirect effects were present via Year 5 achievement for

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reading ($\beta = .027$ 95% CI [.010, .043]) and Year 5 maternal judgements for math ($\beta = .019$ 95% CI [.003, .035]). All other indirect effects were not significant (see [supplementary materials](#)).

H5 (Exploratory Hypothesis): Extreme Positive Maternal Judgements May Negatively Impact Children

We next explored if extremely positive maternal judgements (controlling for prior achievement) had a weaker or even negative influence on academic achievement and interest. To estimate this quadratic relationship within an RI-CLPM we needed to use a latent interaction. This complex model did not converge when we tried to estimate quadratic effects for both time lags. Thus, we were only able to estimate one quadratic effect at a time. There were four quadratic estimates (two-time lags each for reading and math). Of these four, only one was significant; the relationship between maternal reading judgements at Year 3 predicting change in reading achievement from Year 3 to Year 5 ($\beta = -.057$ 95% CI [-.107, -.007]). Conditional means (setting Year 3 interest and achievement at the mean) indicated that judgements have a positive influence on achievement until .70 of a standard deviation above the mean for Year 3 judgements where the influence of judgements turned negative:  (see Figure 4 for detailed conditional means; see [supplementary materials](#) for all polynomial estimates).

<Figure 4 about here>

Discussion

Maternal judgments influence children's academic careers and life course (Eccles, 1983; Simpkins et al., 2012). Pesu et al. (2016) have argued that parents' judgments affect children directly—by influencing their self-beliefs—and indirectly—by influencing the choices parents make for their child (see also Gunderson et al., 2012; Kinsler & Pavan, 2020). Parental beliefs may also affect how and how much parents assist their child in their schoolwork and the sorts of

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investment decisions they make with respect to their child's education. We set out to determine how maternal judgement are related to child demographics and if maternal judgments predicted gains in academic achievement and interest in numeracy and reading. We found that beyond underlying achievement and academic ability, gender was the most consistent predictor and that gender predicted maternal judgements in stereotypical directions. We also observed that gender differences varied by geography and that children from LOTE homes tended to have maternal judgments that were more positive in reading. Consistent with Neuenschwander et al. (2007) SES was positively associated with maternal judgments; but only in Year 7.

Our within-person RI-CLPM models showed that children who experienced higher maternal judgments than usual experienced a subsequent increase in academic achievement and interest; with the exception of reading interest. This finding indicated that interventions focused on maternal judgments may have positive effects. Readers should be aware that although RI-CLPM analyses in developmental psychology are relatively new, and thus there is little guidance on what effects sizes should be considered big or small. Nevertheless, we consider the effects to be modest. However, such effects can accumulate over time and thus, over the course of a child's school career, lead to significant change.

Our analysis further found little evidence that gender moderated the relationship between judgements and academic interest or academic achievement. This was despite notable evidence of gender stereotype patterns in maternal judgements. The lack of evidence for gender moderation suggests that, while gender might influence the means of maternal judgements, it does not influence the processes by which maternal judgements influence academic interest and achievement. Despite research and theory suggesting that parental judgements influence achievement via their effect on children's self-beliefs and motivation (Gunderson et al., 2012;

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Simpkins et al., 2012), we found little evidence of this. This may be due to previous research using cross-sectional data or not disentangling within- and between-person variance when using longitudinal data. Alternatively, it may suggest other mechanisms like parental investment in education and amount and type of homework involvement are critical in translating parental judgements into children's academic achievement (Kinsler & Pavan, 2020; Gunderson et al., 2012).

Maternal judgments and child achievement

Consistent with Miller and colleagues' (1991, 1992, 1993) work, we found that our measure of maternal judgments correlated with objective achievement measures at around the .4-.6 level. Interestingly, this association was similar to Miller's findings despite our question asking mothers to assess progress rather than performance. Both Miller's and our findings suggest that maternal judgments are tied to objective performance, although not perfectly. As noted in the introduction, there are several reasons why this might be the case. Mothers may not have access to sufficient information on their child's performance. For example, it is increasingly common for teachers in elementary school not to use normative feedback (Lohbeck & Möller, 2017). If this were the case, we would expect the correlation between judgments and achievement to increase over time as children undertake more standardized assessments and as teachers in later school years are more willing to give relative feedback. However, there was little evidence of this in our research with the correlation remaining fairly stable from Year 3 (elementary school) to Year 7 (first year of high school).

Mothers may make more positive judgement when engaging in self-enhancement by proxy, particularly when a child's performance is more central to the mother's sense of self. There is some suggestion in the literature that this may be more likely in people from more

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communal cultures (Gebauer et al., 2013). The majority of recent LOTE background children in Australia have parents that come from more communal cultures, and indeed we saw that mothers from LOTE backgrounds did judge their children more positively. However, this was only clearly the case in relation to reading. It may be more likely that mothers from LOTE backgrounds have a different frame-of-reference that accounts for their child's native language not being English.

Finally, it may be that mother's use their judgments as a motivational tool for their children; either because they believe harsher judgments are a way to push their child to try harder or they believe that more positive judgments may help their child to believe in themselves.

Gender stereotypes

A child's gender influences mothers' judgments in stereotypical directions. Girls were rated by mothers as better at reading and worse at math than equally able boys. The effect size in these cases were practically significant. For example, the chances of a girl of average numeracy ability—and at the mode or mean of all other variables in the model—being rated by her mother as much better than average was .25, .25, and .27 in Year 3, 5, and 7 respectively. For equally able boys, the same probability were .31, .28, and .25 respectively (noting the non-significant difference in Year 7). In contrast, girls of average reading ability had a .50, .44, and .38 probability of being rated much better than average in Year 3, 5, and 7 respectively. Equally able boys only had probabilities of .44, .40, and .30 respectively (noting the non-significant difference in Year 5).

Our findings are consistent with a body of research that shows that mothers distort their judgments of their child in gender stereotyped directions (e.g., Eccles et al., 1990; Lummis, Max & Stevenson, 1990; Rätty et al., 1999, 2002, 2007; Tiedemann, 2000). These findings should spur

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concern given that we found that maternal judgments have meaningful influences on learning and increased interest in numeracy and reading. We also found evidence of significant mediation associations of gender on achievement via maternal judgments in longitudinal models in reading. These effects were, however, small. Yet small effects may have practical implications if: a) they are accumulated over time (which appeared to be the case in our results), and/or b) the small signal we observed is indicative of a legacy of early experiences in development (Fraley et al., 2013).

Consistent with calls for research to focus on the intersection of various social categories with gender (Else-Quest & Hyde, 2016), we also explored the interactions between gender, rural status, LOTE, and SES in predicting optimism bias. Of the 24 interactions we considered, only two were significant. Both were related to the interaction between gender and geography, and both suggested that rural mother's judgments were more stereotypical. This is consistent with research by Elder and Conger (2000) which showed that rural families, particularly farming families, are more likely to hold traditional gender stereotypical positions. However, we suggest that readers place little stock in this finding given that we would expect two interactions out of 24 to be significant by chance alone and because we did not have *a priori* hypotheses related to these interactions.

Maternal judgement and academic gains

Bandura (1986) has suggested that being more positive than objective data may warrant can enhance children's interest in academic pursuits (see also Neuenschwander et al., 2007). Providing a nuanced perspective, Murayama et al. (2016) showed that high parental expectations can lead to poorer outcomes, particularly when they lead to controlling parenting that undermines children's intrinsic motivation. There was small and inconsistent evidence (1 out of

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8 significant effects) that extreme positive maternal judgements—that is, judgements that are highly discrepant from their child’s objective ability—may be neutral or even negative at extremely high levels. The one significant quadratic effect that we found was consistent with the concerns noted by Murayama et al. (2016). Namely, that conditioned on Year 3 achievement, Year 3 maternal judgements that are $>.7$ SD above their normal levels lead to a decline in achievement. Due to limitations in our ability to model these non-linear effects and, given that these non-linear effects often require considerably more power than simple linear effects to detect, further research with bigger samples should concentrate specifically on this issue.

Generally, however, we found only positive associations of maternal judgments. This included positive effects of maternal judgements on a critical intrinsic motivation construct: academic interest. Indeed, interest and maternal judgements were mutually reinforcing. Evidence from our between-person models suggested that a comparison of equally able children who had either more positive or more negative maternal judgments led to practically significant differences in these children’s rank order position on achievement two years later. This included the transition from elementary school to high school. Further, these children also differed in how interesting they found numeracy and reading two years later relative to their peers. Our evidence suggested that an increase in maternal judgments could lead to increases in a child’s achievement (in both numeracy and reading) and interest (at least for numeracy); and vice-versa (i.e., maternal judgements, interest, and achievement were reciprocally related).

Our findings suggest that interventions that encourage mothers to increase the positivity of their judgments may have meaningful outcomes. Further, the results suggest that a parental strategy that relies on more positive judgments may better motivate a child than more negative judgments would. What our research did not test, but is almost certainly important, is how

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parents form those judgments and how they are communicated to children. As Murayama et al.'s (2016) research shows, if judgments are communicated in a more controlling manner, even when positive, children's academic outcomes may suffer. Further, it is unclear if maternal judgments that are considerably more positive than their child's performance justify still lead to positive outcomes. The distribution of maternal judgments and child achievement illustrated in Figures 1 and 2 suggests that such cases are likely rare.

In our research, the significant associations controlled for all between person variance specifically focusing on within person variance such that each student acted as their own control. This significantly strengthens the claims to causal inference we can make (see Allison, 2009). Thus, these results provide a reasonably strong case for the argument that mothers who believe in their child are not Pollyannaish. Rather, there appear to be real benefits to positive maternal judgments beyond what might be expected based on objective metrics of success alone.

Limitations

By using longitudinal data and government administration records of children's academic achievement, we gain many interpretive advantages. Yet we cannot rule out omitted variable bias. Despite our focus on within-person models, there is still a risk of omitted time-varying covariates. We suggest that readers make cautious assessments of what our results imply about the causal mechanisms under investigation. We also caution that this research is conducted in Australia and the Australian school system differs from other countries in important ways (see Parker et al., 2019 for a review). Thus, although we believe the processes we are investigating are universal, we cannot determine what moderating role the school system may play. Previous

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research has shown that school system differences between countries moderate the degree to which children's self-beliefs are biased (Parker et al., 2018b, 2021). It is possible that similar moderators are present for maternal judgement in countries that have very different educational systems.

It is also worth noting that the maternal judgement questions we used asked how children were *progressing* relative to their classmates, rather than asking mothers to evaluate how well they thought their child was *doing* relative to their classmates. We found that the association between objective achievement and the maternal judgement question that focused on progression was approximately the same size, and sometimes larger, as that reported in previous research focused on how well children were doing (Delgado-hachey & Miller, 1993; Miller & Davis, 1992; Miller, Manhal, & Mee, 1991). Nevertheless, readers should be aware of this distinction and what implications this has for interpreting the influence of maternal judgments on important outcomes. In addition, readers should be aware that the maternal judgements we considered do not represent the entirety of parental beliefs that can impact a child's academic achievement. For example, parent's growth mindsets, perceptions of their child's effort, and even parents' own academic anxieties can influence children's academic progress (Gunderson et al., 2012; Tiedemann, 2000).

Finally, we have focused our research on mothers. Paternal judgments may differ in important ways from maternal judgments. There were a small proportion of fathers in LSAC and our sensitivity analysis suggested that their inclusion made almost no difference to the results. Yet, as there were only 62 fathers, we did not have sufficient power to detect any unique paternal associations.

Conclusion

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We found that mothers' academic judgments of their child were moderately to strongly, but not perfectly, related to their child's scores on objective achievement tests. We also found that judgments varied in gender stereotypical directions, being less positive about girls' numeracy and more positive about their reading compared to equally able boys. In addition, we found that mothers from LOTE backgrounds had significantly more positive judgments than non-LOTE mothers when assessing their child on reading but not on numeracy. Finally, we found that maternal judgments positively predicted learning gains and gains in liking of math—including across the elementary to secondary school transition. Further, these results were generally consistent across between- and within-person models suggesting that maternal judgments were not only useful for comparing children but also represented potentially useful intervention targets. Put simply, our results suggest mothers who judge their child's academic performance more positively probably don't hurt and may even promote better outcomes for children. Our findings suggest that interventions that encourage mothers to increase the positivity of their judgments may have meaningful outcomes.

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Tables and Figures

Table 1
Maternal Judgements of Child's Academic Achievement

Domain	School Year	Maternal Judgement	Mean	-95% CI	+95% CI	SD	Average %	Above Avg. %	Below Avg. %
Numeracy	3	much worse	-0.80	-0.98	-0.62	0.44	1.4%	0.0%	2.9%
Numeracy	3	worse	-0.56	-0.64	-0.47	0.57	7.9%	2.5%	13.7%
Numeracy	3	average	-0.16	-0.20	-0.11	0.58	35.6%	24.6%	47.5%
Numeracy	3	better	0.09	0.04	0.14	0.59	26.5%	29.2%	23.7%
Numeracy	3	much better	0.50	0.45	0.55	0.64	28.6%	43.7%	12.2%
Reading	3	much worse	-1.04	-1.28	-0.79	0.77	1.9%	0.2%	4.4%
Reading	3	worse	-0.69	-0.77	-0.61	0.61	10.5%	2.0%	22.7%
Reading	3	average	-0.14	-0.19	-0.09	0.64	27.0%	19.3%	37.9%
Reading	3	better	0.21	0.15	0.27	0.67	23.5%	26.3%	19.4%
Reading	3	much better	0.60	0.55	0.65	0.70	37.1%	52.1%	15.6%
Numeracy	5	much worse	-0.87	-1.04	-0.69	0.47	2.3%	0.2%	4.5%
Numeracy	5	worse	-0.51	-0.60	-0.42	0.61	8.9%	3.4%	14.8%
Numeracy	5	average	-0.16	-0.20	-0.11	0.59	34.4%	24.0%	45.5%
Numeracy	5	better	0.16	0.11	0.21	0.61	26.3%	29.8%	22.5%
Numeracy	5	much better	0.49	0.43	0.55	0.69	28.2%	42.6%	12.7%
Reading	5	much worse	-0.94	-1.15	-0.73	0.77	2.4%	0.3%	4.8%
Reading	5	worse	-0.57	-0.68	-0.45	0.66	8.0%	2.7%	14.1%
Reading	5	average	-0.20	-0.25	-0.15	0.62	27.2%	18.2%	37.7%
Reading	5	better	0.14	0.08	0.20	0.72	26.6%	28.9%	23.9%
Reading	5	much better	0.47	0.42	0.52	0.70	35.9%	50.0%	19.5%

continued.

MATERNAL JUDGMENTS

Table 1
Maternal Judgements of Child's Academic Achievement

Domain	School Year	Maternal Judgement	Mean	-95% CI	+95% CI	SD	Average %	Above Avg. %	Below Avg. %
Numeracy	7	much worse	-0.77	-0.97	-0.57	0.56	3.5%	0.6%	6.1%
Numeracy	7	worse	-0.54	-0.61	-0.46	0.49	11.1%	2.5%	19.2%
Numeracy	7	average	-0.19	-0.24	-0.14	0.57	31.9%	22.1%	41.0%
Numeracy	7	better	0.10	0.04	0.15	0.58	26.8%	30.9%	23.0%
Numeracy	7	much better	0.50	0.45	0.56	0.64	26.7%	44.0%	10.6%
Reading	7	much worse	-0.63	-0.81	-0.45	0.57	3.0%	0.6%	6.2%
Reading	7	worse	-0.45	-0.54	-0.36	0.59	9.6%	3.6%	17.7%
Reading	7	average	-0.06	-0.10	-0.01	0.58	35.0%	28.4%	43.9%
Reading	7	better	0.28	0.23	0.33	0.62	28.0%	34.2%	19.6%
Reading	7	much better	0.47	0.41	0.53	0.66	24.4%	33.1%	12.6%

Notes. Avg. = Average.

MATERNAL JUDGMENTS

Table 2a
Predictors of Maternal Judgements in Reading

Predictor	Year 3			Year 5			Year 7		
	Odd Ratio	-95% CI	+95% CI	Odd Ratio	-95% CI	+95% CI	Odd Ratio	-95% CI	+95% CI
Much Worse Worse	0.00	0.00	0.01	0.02	0.01	0.04	0.03	0.01	0.06
Worse Average	0.04	0.03	0.06	0.10	0.07	0.15	0.16	0.10	0.26
Average Better	0.31	0.23	0.41	0.67	0.45	1.01	1.37	0.85	2.20
Better Much Better	1.08	0.81	1.44	2.53	1.72	3.71	5.81	3.78	8.93
z-Achievement	3.46	3.07	3.89	2.70	2.42	3.00	2.34	2.12	2.59
z-Cognitive Ability	1.19	1.08	1.30	1.11	0.98	1.25	1.11	0.99	1.23
z-SES	0.95	0.87	1.03	0.93	0.85	1.02	1.18	1.07	1.30
Urban	1.00	0.83	1.19	0.96	0.79	1.17	1.21	1.02	1.44
Girl	1.31	1.11	1.55	1.18	0.98	1.42	1.37	1.14	1.63
non-Indigenous	0.44	0.19	1.04	1.12	0.54	2.33	1.12	0.56	2.25
LOTE	1.78	1.37	2.32	1.53	1.16	2.01	1.75	1.30	2.35

Notes. z- indicates that the variables have been z-scored. Bold text indicates that the 95% confidence interval for that parameter does not cross one. LOTE = child growing up in a household where a language other than English is spoken.

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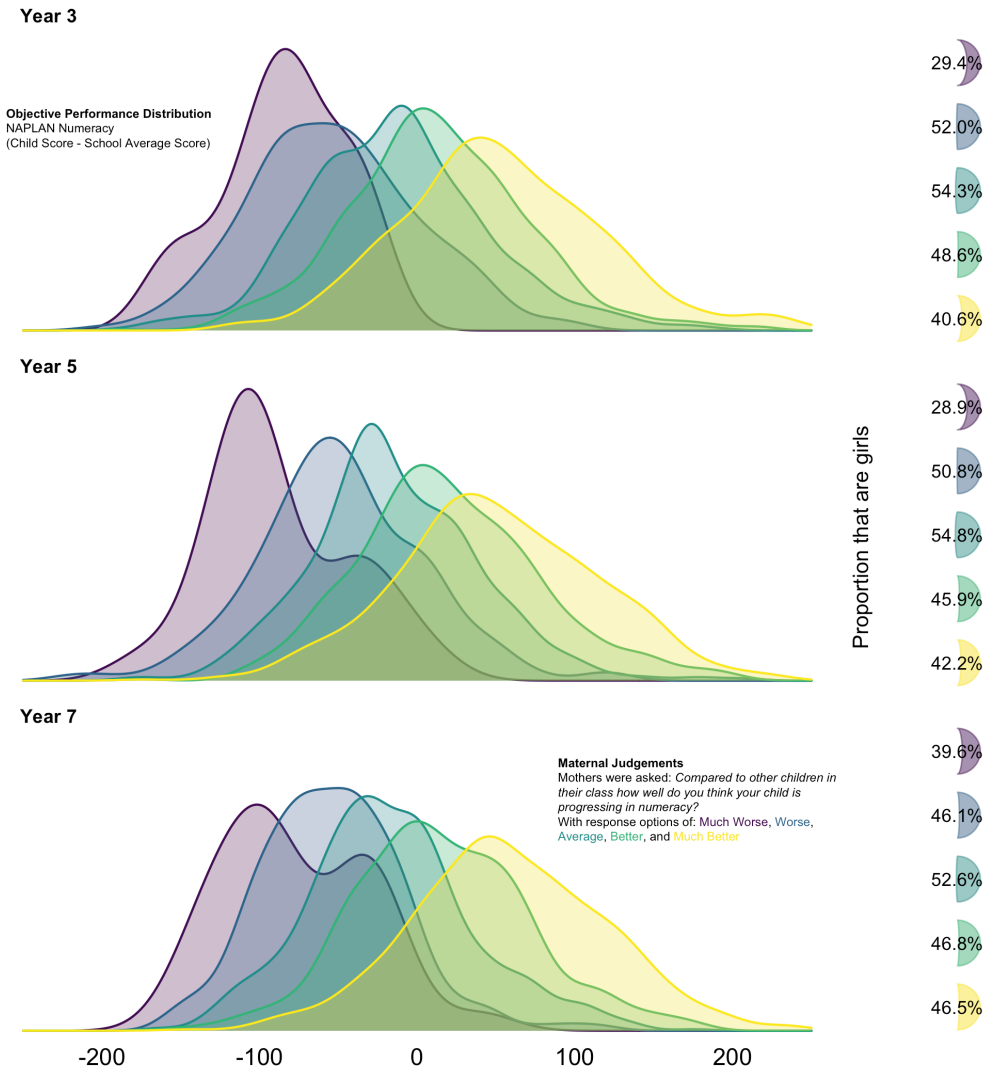
Table 2b
Predictors of Maternal Judgements in Numeracy

Predictor	Year 3			Year 5			Year 7		
	Odds Ratio	-95% CI	+95% CI	Odds Ratio	-95% CI	+95% CI	Odds Ratio	-95% CI	+95% CI
Much Worse Worse	0.01	0.00	0.01	0.01	0.01	0.03	0.02	0.01	0.04
Worse Average	0.05	0.04	0.07	0.08	0.05	0.13	0.13	0.09	0.20
Average Better	0.60	0.49	0.73	0.75	0.45	1.25	0.98	0.68	1.42
Better Much Better	2.36	1.95	2.87	2.90	1.70	4.93	4.27	3.03	6.02
z-Achievement	2.82	2.54	3.14	2.83	2.52	3.18	3.30	2.93	3.71
z-Cognitive Ability	1.14	1.04	1.25	1.10	1.00	1.20	1.01	0.93	1.11
z-SES	1.06	0.98	1.15	1.05	0.93	1.18	1.13	1.03	1.23
Urban	1.14	0.96	1.36	0.91	0.77	1.09	1.00	0.84	1.19
Girl	0.76	0.65	0.90	0.82	0.69	0.98	1.11	0.93	1.32
non-Indigenous	0.85	0.44	1.65	1.12	0.55	2.27	1.18	0.66	2.11
LOTE	1.14	0.87	1.48	1.15	0.88	1.50	1.22	0.87	1.70

Notes. z- indicates that the variables have been z-scored. Bold text indicates that the 95% confidence interval for that parameter does not cross one. LOTE = child growing up in a household where a language other than English is spoken.

MATERNAL JUDGMENTS

Figure 1. Numeracy maternal judgements.



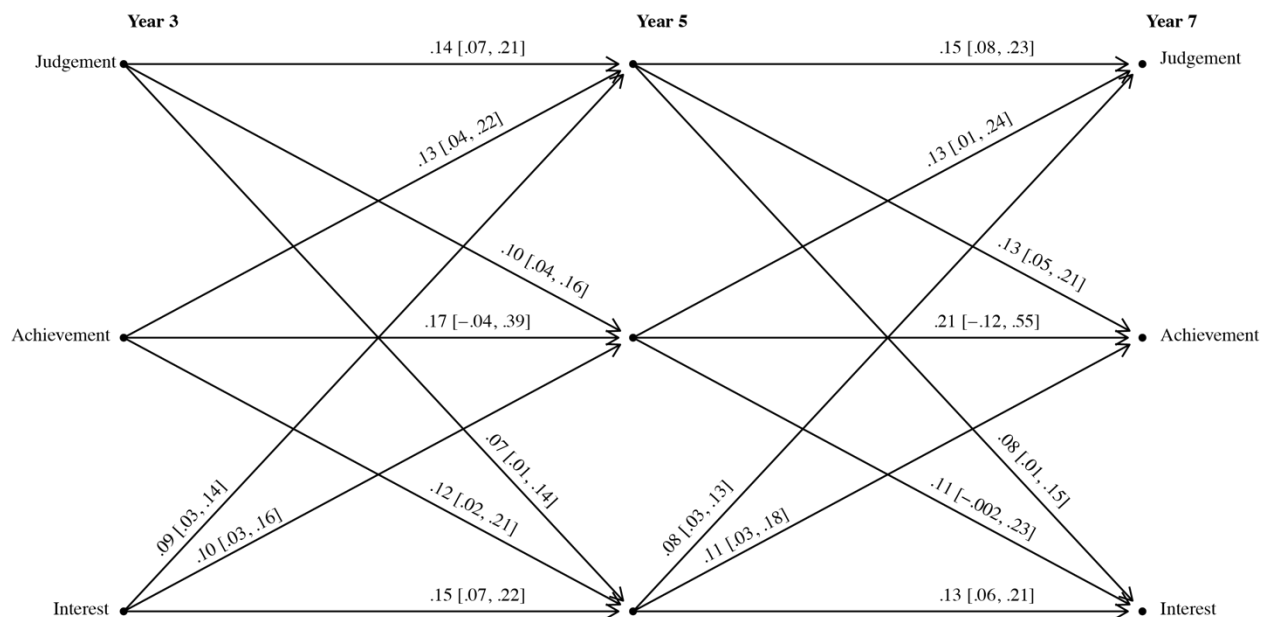
MATERNAL JUDGMENTS

Figure 2. Reading maternal judgements.



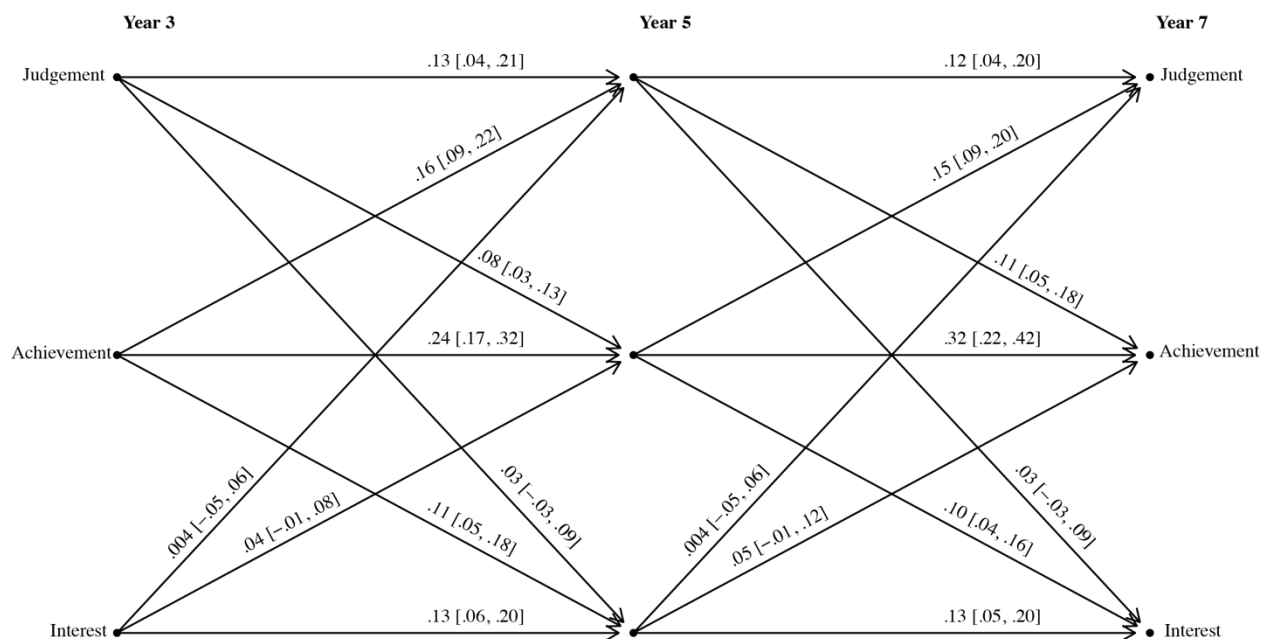
MATERNAL JUDGMENTS

Figure 3a. Simplified path model for reading domain.



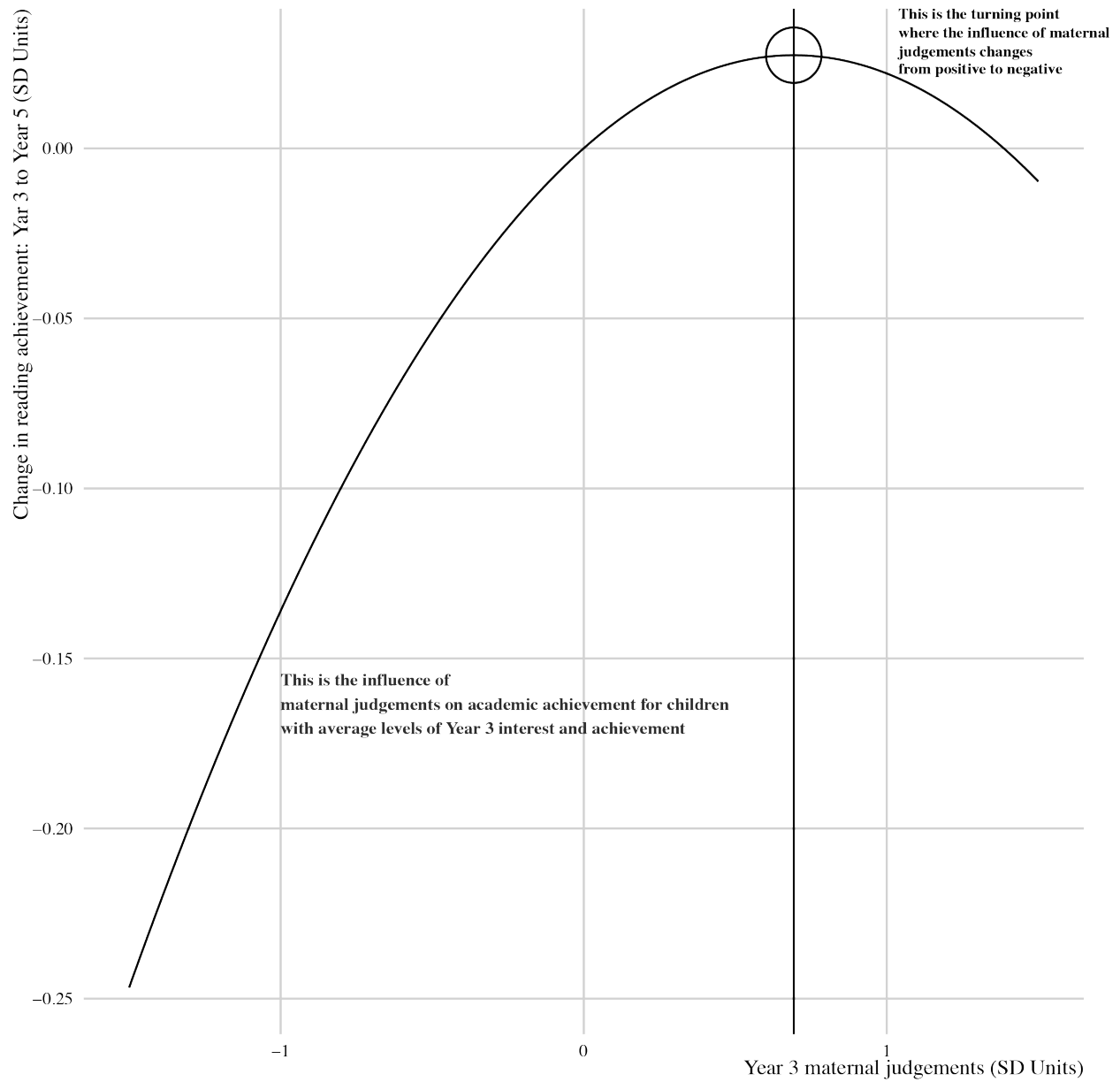
Notes. Only the regression paths are presented here. Estimates are standardized beta with 95% confidence intervals

Figure 3b. Simplified path model for numeracy domain.



Notes. Only the regression paths are presented here. Estimates are standardized beta with 95% confidence intervals

Figure 4. Conditional means of change in reading achievement from Year 3 to Year 5



Notes. This represents the quadratic influence of Year 3 maternal judgements on changes in reading achievement from Year 3 to Year 5. This curve is evaluated at mean levels of Year 3 achievement and Year 3 academic interest. Thus, values further from zero represent more judgements that are more discrepant from objective achievement.