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Early Shared Reading, Socioeconomic Status, and Children's Cognitive and School Competencies: Six Years of Longitudinal Evidence

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Abstract

This study explored the longitudinal association between early shared reading and children's later school achievement. We also examined the mediating role of children's academic school readiness and the moderating effect of family socioeconomic status. Data were drawn from the *Longitudinal Study of Australian Children* (*n* = 4,768). Frequency of shared reading and academic school readiness were assessed at the ages of 2–3 and 4–5. School achievement was assessed at age 8–9 via standardized national tests of school literacy and mathematics achievement. Results indicated that early shared reading was associated with children's school achievement directly and indirectly through receptive language and early academic skills. The results also showed that frequency of reading predicts the outcome measures, over and above other home activities such as telling child a story or practicing music. The associations were stronger among low and middle SES groups compared to the high SES group. We conclude that shared reading is uniquely associated to indicators of children's cognitive development such as language and early academic skills as well as children's school achievement. This effect is over and above families' socioeconomic status and other activities that parents do. This may be because books offer unique opportunities to teach children new words and concepts in a systematic way, and this is something that most parents would not be able to do otherwise.

Keywords

shared reading; literacy; longitudinal; reading competency; mathematics; school readiness

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It is widely accepted among educators, educational and developmental psychologists and the general public that reading to children supports the development of children's reading skills. "Shared reading" at home—when an adult reads to his or her child—has been linked with children's superior language skills and reading competencies in the preschool years (Fletcher & Reese, 2005). Individual differences in literacy skills in preschool, kindergarten, and the primary school years are in turn predictive of children's reading skills, academic achievement, and intelligence throughout their school years and beyond (Duncan et al., 2007; Ritchie, Bates, & Plomin, 2015; Scarborough & Dobrich, 1994). Children with better reading skills generally continue to amplify their reading skills, while poor readers tend to lag behind their peers in reading development and face a higher risk of academic failure (Cunningham & Stanovich, 1997; Mol & Bus, 2011).

The research literature relevant to the associations between reading to children and subsequent cognitive development however, is limited in several ways. Firstly, while a large number of studies have investigated the associations between book reading and children's cognitive abilities such as language and reading skills (for a review see Cunningham & Stanovich, 1997; and also Mol & Bus, 2011), most of this research has focused on preschool and kindergarten aged children. However, reading to children begins earlier, before the pre-school years (Van den Berg & Bus, 2014). Only a few studies have explored whether there are long-term associations between reading books to infants and toddlers and children's cognitive development at later times (see for instance Gottfried, Schlackman, Gottfried, & Boutin-Martinez, 2015). Yet, exploring the early factors that are associated to children's cognitive development are of boundless importance given that very recent research shows early differences in children's learning environment can explain why the effects of intervention programs fadeout for some children in experimental conditions compared to the control groups, when children are from similar family and social background (see Bailey, Nguyen, Jenkins, & Domina, 2016). Secondly, almost all of this literature has focused on the associations between book reading and language and literacy learning, ignoring other aspects of children's cognitive skills such as mathematical proficiency. It would be important to know, however, whether book reading is associated only to reading and literacy, or to broader domain general cognitive developmental skills as well. In the current study, we address these limitations by studying the effects of share reading at home among a large sample of two-year-old Australian children. The children were tested at the age of four in relation to receptive language and academic school readiness, and at the age of six in the areas of reading, writing, spelling and grammar, as well as mathematics competencies. Thirdly, while the majority of past studies have tested children from lower socio-economic (SES) status homes, we know of no study that has compared the associations between shared reading and cognitive development among children of varying SES background families. Such an investigation would be particularly significant because of its potential to explain the links between the families' economic resources and children's cognitive development, and would be in response to calls for longitudinal research exploring the effect of environment on cognition and development (Bailey & Littlefield, 2016; Tucker-Drob & Briley, 2014). Thus in the current study we assess three broad hypotheses and address research questions relating to these issues.

1. Hypothesis 1: Early shared reading is associated with long term cognitive competencies

Shared book reading is associated with vocabulary knowledge and literacy achievement

Shared book reading between adults and children has been shown to increase children's knowledge of vocabulary (Fletcher & Reese, 2005; Raikes et al., 2006). It has been suggested that much of children's knowledge of sophisticated words is acquired during incidental learning such as while being read to, rather than any form of structured learning (Cunningham & Stanovich, 1997). A meta-analysis of the literature discussing the effects of shared reading on children's language development from the ages of three to six years showed that eight percent of the variance in language skills relates to preschoolers' exposure to printed material (Bus, van IJzendoorn, & Pellegrini, 1995). This is not surprising since reading story books to children during early childhood, a period of rapid language learning, exposes children to novel vocabulary—the kind of words that are less frequently used in conversations (Raikes et al., 2006)—and general knowledge, as well as concepts not often encountered in day-to-day interactions (Fernald & Marchman, 2012). Further, reading to children typically involves a constellation of supportive behaviors on the part of the caregiver, such as labelling pictures, explaining new words, commenting upon content, and asking questions (Sénéchal, 2006; Tucker-Drob & Harden, 2012), all of which are associated with children's development of reading skills and acquisition of vocabulary and grammar, particularly before the age of three (Mol, Bus, de Jong, & Smeets, 2008). Such associations have been found to hold even after controlling for a range of variables such as the child's nonverbal intelligence, parents' education and parents' level of literacy (Sénéchal, Pagan, Lever, & Ouellette, 2008). It has thus been relatively well established that reading to preschoolers overall enhances children's vocabulary knowledge and language skills.

Early vocabulary knowledge and literacy skills lead to better academic achievement

Academic achievement depends both on children gaining new skills and improving already existing ones (Entwisle & Alexander, 1990). Language adeptness (operationalized by the size and complexity of a child's vocabulary) is known to be an important predictor of children's later mastery of higher-level reading skills (Fletcher & Reese, 2005; Sénéchal & LeFevre, 2002). Preschool children with a greater knowledge of vocabulary show better early reading skills, meaning that they enter school with a better capacity to master reading (Whitehurst et al., 1994). Additionally, other skills such as the ability to use pen and paper appropriately, and familiarity with writing names, letters and numbers are also important predictors of children's later school performance.

A meta-analysis of six longitudinal data sets suggested that children's early literacy skills when they enter school are significant predictors of their later school performance, and the patterns of association hold for both girls and boys equally, as well as for children from different socio-economic backgrounds (Duncan et al., 2007). Sénéchal (2006) investigated the longitudinal relationship between children's home literacy environment during their early years and their later literacy skills (at ages six, seven and ten). Her results indicated that children's early exposure to storybooks is linked to their knowledge of the alphabet at kindergarten and reading fluency at grade four. This pattern is consistent with a more

general pattern pointing to the long-term stability of shared (family) environmental effects on children's development of cognitive skills from the preschool years onward (Tucker-Drob & Briley, 2014).

Early reading skills may lead to better school performance by way of reciprocal associations with the motivation to read. In other words, more skilled readers tend to be more interested in reading, leading them to pursue further reading exposure, which in turn increases reading skills and also reinforces the motivation to read. Such transactional theories of reciprocal causation have received increasing attention in recent years in relation to both motivational factors and reading development specifically (Mol & Bus, 2011), and with respect to motivational factors and cognitive development and academic achievement more generally (Tucker-Drob, in press; Tucker-Drob, Briley, Engelhardt, Mann, & Harden, in press).

Shared reading and other cognitive outcomes, are there links with mathematic as a non-literacy related competency?

While almost all previous research has confirmed the positive effect of shared reading on children's literacy skills, much less is known about whether the benefits of reading books to children are specific to literacy performance, or extend to other academic domains such as mathematics (Williams, Barrett, Welch, Abad, & Broughton, 2015). Despite lack of research, it is reasonable to expect such association.

Some longitudinal research evidence suggests that preschool children with better basic knowledge of words go on to achieve better mathematics scores at school (e.g., Aunola, Leskinen, Lerkkanen, & Nurmi, 2004; Passolunghi, Vercelloni, & Schadee, 2007). For instance, a three-month program in which teachers read two picture books to children per week is shown to have a positive influence on children's understanding of numbers, measurement and geometry (Van den Heuvel-Panhuizen, Elia and Robitzsch, 2016).

Children's mathematical development depends on building connections between mathematical concepts and their related vocabulary. Developmental theories of mathematical learning (Krajewski & Schneider, 2009; Resnick, 1989) propose that children's long term mathematical comprehension is built on the development of an understanding of quantity that, by necessity, requires the ability to compare and draw conclusions and, at the same time, acquire the language needed to express ideas and receive feedback.

The link between linguistic abilities and both reading and mathematical skills may also be related to domain general cognitive abilities such as visual-spatial skills and short-term memory. If this is so, then reading books to children likely enhances children's cognitive skills, leading not only to better literacy outcomes, but also to enhanced mathematical comprehension (Davidse, de Jong, & Bus, 2014). This implies that the links between mathematics and literacy are likely to be bidirectional and complex.

In this study we will explore whether book reading is also associated to children's mathematics achievement, besides literacy related outcomes.

Hypothesis 2: Shared reading uniquely predicts children's cognitive developmental outcomes

By serving as an enriching experience that fosters foundational cognitive skills upon which later learning is scaffolded, shared book reading may have lasting effects on children's cognitive performance and academic achievement during school. Additionally, shared book reading may be associated with downstream cognitive and academic outcomes via more general mechanisms not specifically involving the actual experience of shared reading. For example, families who engage in greater shared reading may also be more likely to have greater socioeconomic resources, to engage in a multifaceted constellation of positive and cognitively stimulating parenting behaviors, to surround their children with peers who are themselves cognitively advanced, and to enroll their children in higher quality preschools and grade schools, all factors that are associated with more advanced cognitive development and school achievement (Bennett, Weigel, & Martin, 2002; Hoff, 2013; Tucker-Drob, 2012). Thus, a supplementary goal of the current study is to test the extent to which shared reading remains associated with later achievement outcomes after controlling for a range of family demographic factors and home activities (such as the number of books parents keep at home and activities such as telling a story to the child). We hypothesize that unique relation between shared reading and later achievement outcomes will remain even after accounting for such covariates.

Hypothesis 3: SES moderates the relationship between shared reading and children's later cognitive competencies

While all families are encouraged to participate in shared reading activities with their children, parents differ in terms of how frequently they read to their children. Parents' level of education and socioeconomic status are correlated with higher rates of reading to children (Bus et al., 1995). This may be a partial explanation for the past findings that parental education and family socioeconomic status are associated with superior skills and academic achievement (e.g. Bennett, Weigel, & Martin, 2002; Hoff, 2013).

Family socioeconomic status is also an indicator of myriad factors outside the home that potentially influence children's cognitive development. Children from lower SES families are less likely to attend preschools and are more likely to attend primary schools with fewer resources, have less supportive peer groups, and overall experience lower schooling achievement (Huston & Bentley, 2010; Tucker-Drob, 2012; Putnam, 2015). For disadvantaged children, stimulating home learning environments can play an important role in cognitive development and academic achievement by compensating for having fewer advantages within the educational system. Home learning environments may, however, be less important for advantaged children who are already more likely to receive high quality cognitive stimulation during the school day (Tucker-Drob, 2012). Based on this rationale, we hypothesized that the association between shared reading and children's cognitive competence may be stronger for children raised in lower socioeconomic background families. While many studies show that shared reading is an important tool in helping less advantaged children to develop reading and literacy skills, to our best knowledge, no study

to date has examined the different effects of these influences among higher and lower SES families. In the current study, we examine whether the effect of shared reading changes based on the families' SES.

Research questions and hypotheses

To recap, this study examines two main hypotheses:

Hypothesis 1- Shared reading has long lasting associations with children's language learning and academic achievement. To test this hypothesis we ask three questions:

1. Does shared reading in toddlerhood predict children's vocabulary and early academic skills in early childhood?
2. Does shared reading during toddlerhood predict children's academic achievement (i.e., literacy and mathematics) during the school period?
3. Do vocabulary and early academic skills statistically mediate the relationship between shared reading and academic achievement?

Hypothesis 2- Shared reading uniquely associates with children's academic achievement even after controlling for other home activities that parents do with their children.

Hypothesis 3 - The family's SES moderates the effects of shared reading on children's later academic achievement. Our research question here is: does early shared reading have a similar influence on children from different SES backgrounds?

Method

Ethics Statement

The data include children, and parents participating in the Longitudinal Study of Australian Children (LSAC). The study was conducted through a partnership between the Australian Government Department of Social Services, the Australian Institute of Family Studies (which provided ethics approval) and the Australian Bureau of Statistics. The ethics committee is registered with the Australian Health Ethics Committee. For all children participating, written consent was obtained from their parent or guardian, and verbal assent from the child.

Participants

To date, five waves of the Longitudinal Study of Australian Children (LSAC) data have become available. LSAC is a nationally representative study funded by the Australian Government Department of Social Services. In the current study, we used data from the LSAC Birth Cohort ($N = 5107$) from Wave 2 (2–3 years), Wave 3 (4–5 years) and Wave 5 (8–9 years). A detailed description of the study design can be found in Soloff, Lawrence, and Johnstone (2005). The initial sample was broadly representative of the general Australian population, but slightly under-representative of single-parents, non-English speaking families and families living in rental properties. These biases were further increased by attrition, meaning that there was a higher attrition rate for children from non-

English speaking backgrounds, children whose parents had achieved a lower level of formal education, and children from families that moved house relatively often (Mission & Sipthorp, 2009). Such attritions are not uncommon in longitudinal studies.

The present study has a final sample of $n = 4{,}768$ ($n = 2{,}438$ boys and $n = 2{,}330$ girls). Cases with missing values on all covariates (0.1%) and on all dependent variables (6.6%) were excluded. Compared to included cases, children who were not included were more likely to come from families of lower socio-economic status ($F = 89.48$, $p < 0.001$), Indigenous families ($\chi^2 (1) = 52.50$, $p < 0.001$) or from families where a language other than English is predominately spoken at home ($\chi^2 (1) = 36.47$, $p < 0.001$). These patterns are typical of attrition characteristics in longitudinal studies (see Taylor, Christensen, Lawrence, Mitrou, & Zubrick, 2013).

Measures

Toddlerhood variables (2–3 years): Shared reading and the covariates

Frequency of shared reading practice: As part of the parent face-to-face interviews, LSAC interviewers asked parents to report on how often in the past week they have read to the child on a rating scale of zero (none) to 3 (every day).

Home activities index: During the LSAC interview, parents were also asked to report on the frequency of a range of home activities they have done with children in addition to shared book reading, rated on a scale from zero (none) to 3 (everyday). Other home activities include “Told child a story not from a book”, “Drawn pictures or did other art or craft activities”, “Played music, sang songs, danced or did other musical activities”, “Played with toys or games indoors, like board or card games”, “Involved child in everyday activities at home such as cooking or caring for pets”, “Played a game outdoors or exercised together”. These items were adapted from the Early Childhood Longitudinal Study-Birth Cohort (NCES, 1999) (Cronbach’s alpha = .71). Responses to the six items were averaged and a mean score of home activities index was created for further analyses.

Number of children’s books at home: During the LSAC interview, parents were also asked to report on the number of children’s books they have at home, rated on a scale of zero (none), one (1–10), two (11–20), three (21–30) and four (more than 30).

Socioeconomic status: At each wave, the LSAC data were used to generate a composite indicator of family SES. The indicator is a standardized summary measure of parent reports of equivalized (adjusted for household size) annual family income, number of years of formal education completed, and parents’ current or most recent occupational status (Adhikari, 2006). It has a mean of zero and standard deviation of one. This composite variable has been validated against other proxies of socio-economic disadvantage, and is associated with negative outcomes that are often highly socially patterned (Blakemore, Gibbings, & Strazdins, 2006). In this study, the SES measure was used from Wave 1 of the LSAC data.

Intelligence: We also controlled for the effect of children's intelligence on their later academic achievement using WISC-IV Matrix Reasoning (Wechsler, 2003) at 6–7 years. Children's scores on this measure in the LSAC dataset are standardized on age norms given in the WISC-IV manual.

Early childhood variables (4–5 years): Vocabulary and early academic skills

Vocabulary: Receptive vocabulary was measured using an adapted form of the PPVT-III, a widely used measure of oral receptive vocabulary which targets children's knowledge of spoken words (Dunn & Dunn, 1997). A shortened version of the PPVT-III was adapted based on work done in the US for the Head Start Impact Study with the permission of the publisher (Rothman, 2003, 2005). By applying item response theory (Rasch modeling) to the results of the full PPVT-III undertaken by 215 non-study children aged from 3 years 7 months to 5 years 6 months (mean 54.7 months), with the best set of 40 items, an Adapted PPVT-III test was developed which has been used in several previous studies (e.g., Spilt et al, 2015; McLeod, Harrison, Whiteford, & Walker, 2016). The Adapted PPVT-III yields a standardized Rasch modelled score. Correlations of between .93 to .97 were found between the full PPVT-III and the Adapted PPVT-III in separate samples of 215 children aged from 41 to 66 months and 421 children aged 67 to 95 months, which indicates the high validity of the shortened version (Rothman, 2005). Trained research assistants individually administered the test during their visits to the participating families' homes. For each item, the child is shown four pictures, and the experimenter repeats a word indicating an act being performed in one of the pictures. The child is asked to point to the correct picture. Final scores were transformed with a mean score of 64 and a standard deviation of 6.

Early academic skills: Early academic skills were measured by the 'Who Am I?' (WAI) test (De Lemos & Doig, 1999), which is designed to capture general cognitive abilities that underlie early academic skills including early literacy concepts, early numeracy concepts, and fine motor skills in children aged 4 to 6 years. The test consists of activities that involve copying shapes and writing symbols, including letters, words and numbers. For example, children are asked to copy shapes such as circles, triangles and crosses, as well as letters. To carry out this test, a trained research assistant went through the test booklet with the child and asked them to complete each section. Children responded to eleven tasks, with each response assessed on a four-point scale (Rothman, 2005). Final scores were transformed with a mean score of 64 and a standard deviation of 8 (Rothman, 2005). Rasch modeling was used to create the overall Who Am I Score in the LSAC dataset, which has shown high internal consistency (person separation reliability .89). This score is considered to represent children's abilities across a range of early academic skills that are linked to children's successful performance in formal classroom settings (Edwards, Baxter, Smart, Sanson, & Hayes, 2009).

School age variables (8–9 years): Academic achievement—Students' academic achievement was measured by the National Assessment Program for Literacy and Numeracy (NAPLAN). The data are available through data linkage in LSAC. NAPLAN, which is conducted bi-annually, commenced in 2008 and assesses all Australian students in Grades 3, 5, 7, and 9 of school in reading, writing, language conventions (spelling, grammar and

punctuation) and mathematics. In the current study, scores from Grade 3 NAPLAN testing conducted in 2012 (when students were 8 to 9 years of age) were used.

Statistical Analysis

To test our hypotheses, we used path analyses with maximum likelihood estimation using Mplus v.7.1 (Muthén & Muthén, 2007). Path analyses enable us to estimate simultaneously the relations among all variables instead of running several regression models. We referred to several model fit indices to determine whether the mediation model has a good fit. Following Hu and Bentler's (1999) recommendation, Comparative Fit Index (CFI) > .90, Root Mean Square Error of Approximation (RMSEA) < .05, Standardized Root Mean Square Residual (SRMR) < .05, and Tucker Lewis Index (TLI) > .90 were used to assess adequate model fit. Missing data on the dependent variable was accounted for by using full information maximum likelihood indicator (FIML) incorporated in Mplus (Muthén & Muthén, 2007), which produces more accurate parameter estimates (Baraldi & Enders, 2010). Bootstrapping with a resampling of 1,000 draws was used to examine indirect effects. Bootstrapping is a nonparametric procedure which does not rely on the assumption of the normality of sampling distribution. It has been shown to have high power to detect intervening variable effect (Preacher & Hayes, 2008).

Results

Means, standard deviation and zero order correlations among all variables are reported in Table 1. As shown, the majority of correlations ranged from small to medium with a few large correlations.

Path Analyses

We conducted path analyses in which we estimated the direct effect of book reading at age 2–3 years on children's NAPLAN scores of reading, writing, spelling, grammar and mathematics at age 8–9 years, as well as its indirect effect through receptive language and early academic skills (see Figure 1). In addition, we controlled for the effects of socio-economic status and the child's gender on book reading, receptive language, and early academic skills. In addition to SES and gender, we also controlled for children's intelligence on their later NAPLAN outcomes. The model fitted the data adequately, $\chi^2(4) = 34.38$, RMSEA = .04; CFI = .99, TLI = .98; SRMR = .01. Overall, the path model explained 25%, 17%, 21%, 25%, and 24% of the variance in reading, writing, spelling, grammar and mathematics, respectively. Also, 13% of the variance in receptive language and 14% of the variance in early academic skills were explained by book reading, family SES, and gender.

Testing Hypothesis 1: Shared Reading and Cognitive Competencies

The effect of book reading on receptive language and early academic skills— As shown in Figure 1 (all paths were estimated but only significant paths were shown in Figure 1 for clarity), book reading positively predicted children's receptive language (*beta* = .21, $p < .001$) and early academic skills (*beta* = .06, $p < .001$). The results also showed that families' SES was positively associated with book reading (*beta* = .30, $p < .001$), receptive

language (*beta* = .23, $p < .001$) and early academic skills (*beta* = .21, $p < .001$). Girls had higher receptive language and early academic skills than boys.

The effect of receptive language and early academic skills on later academic achievement—Children's NAPLAN scores of reading, writing, spelling, grammar and mathematics at age 8–9 years were positively predicted by their receptive language and early academic skills at age 4–5 years. Specifically, receptive language positively predicted reading (*beta* = .21, $p < .001$), writing (*beta* = .09, $p < .001$), spelling (*beta* = .06, $p < .01$), grammar (*beta* = .14, $p < .001$) and mathematics (*beta* = .12, $p < .001$) scores. Similarly, but with comparatively larger magnitude, early academic skills positively predicted reading (*beta* = .15, $p < .001$), writing (*beta* = .22, $p < .001$), spelling (*beta* = .27, $p < .001$), grammar (*beta* = .22, $p < .001$) and mathematics (*beta* = .19, $p < .001$) scores. On average, girls had higher writing, spelling and grammar scores than boys, whereas, boys had higher mathematics scores than girls. There were no significant differences between boys and girls on reading achievement. Children from higher SES families did better on all five NAPLAN subtests (*beta* ranges from .11 to .14, $p_s < .001$) and children with higher intelligence also scored significantly higher on all five NAPLAN subtests (*beta* ranges from .13 to .25, $p_s < .001$).

The effect of early shared reading on children's later academic achievement—After including the mediators, shared book reading at 2–3 years still had direct relations with all NAPLAN subtests (except for spelling) when children were 8–9 years, indicating partial mediation. Specifically, shared book reading positively predicted scores on reading (*beta* = .08, $p < .001$), writing (*beta* = .04, $p < .05$), grammar (*beta* = .07, $p < .001$), and mathematics (*beta* = .06, $p < .001$), indicating that book reading is associated with higher academic achievement not only through receptive language and early academic skills, but also as a sole significant predictor. There was no significant direct effect of book reading on spelling, indicating full mediation. Note that the benefits of shared book reading at age 2 to 3 years had lasting effects on academic achievement six years later.

Indirect effects—We used bootstrapping with a resampling of 1,000 draws to test the significance of the indirect effects of early book reading on students' NAPLAN outcomes six years later. The direct effects and indirect effects through each mediator, as well as the significance of mediation and 95% confidence interval are specified in Table 2. As shown in Table 2, all of the indirect effects of early book reading on later NAPLAN outcomes through receptive language and early academic skills were significant. The indirect effects accounted for 36%−50% of the variance of the total effects between early book reading and later NAPLAN outcomes. In addition, the paths through receptive language accounted for a larger proportion of the indirect effects for four out of five NAPLAN outcomes as compared to the indirect effects through early academic skills.

Testing Hypothesis 2: Shared Reading Uniquely Associates with Children's Cognitive Competencies and Academic Achievement

To test our second hypothesis, we ran a similar model but this time controlled for the role of home activities index and the number of books children have at home on children's

cognitive competencies and academic achievement. The model is displayed in Figure 2 and as can be seen, the pattern of results generally stayed similar to results obtained from our original model, with a small difference in the magnitude of association between book reading and receptive language as home activities index, and the number of children's books at home explained some of the variance in children's receptive language. There was also a significant direct effect between book reading and spelling. These results show that the frequency of reading associated with the outcomes over and above other home activities that parents do.

Testing Hypothesis 3: SES Moderates the Effect of Shared Reading on Cognitive Competencies and Academic Achievement

Multigroup analyses—To understand whether the pattern of relationships among variables in the mediation model is similar for children from families of different SES, we divided the sample into three subgroups: lower SES quartile (lowest 25%) (n = 1,111), middle 50% (n = 2,426) and high SES quartile (highest 25%) (n = 1,231). We then conducted the same path model for each of the three subgroups. All three subgroup path models showed adequate fit to the data, $\chi^2(4) = 5.19$, RMSEA = .02; CFI = 1.00, TLI = .99; SRMR = .01 for the low SES group, $\chi^2(4) = 29.79$, RMSEA = .05; CFI = .99, TLI = .96; SRMR = .02 for the middle SES group, and $\chi^2(4) = 7.72$, RMSEA = .03; CFI = .99, TLI = .99; SRMR = .01 for the high SES group. The direct and indirect effects for each of the three subgroups are shown in Tables 3–5 (see Appendix for the path model for each subgroup).

As shown in the Tables 3–5, the low and middle SES groups are generally similar in that early shared book reading showed benefits for children's later academic achievement directly and/or indirectly. One difference between the low and middle SES groups was that the indirect effects were only through receptive language for the middle SES group. Unlike the low and middle SES groups, however, for the high SES group—except for having benefits for later reading through receptive language—early shared book reading had no effects on writing, spelling, grammar and mathematics scores either directly or indirectly.

Multigroup analyses were conducted to examine whether the relationships among book reading, receptive language, early academic skills and children's later NAPLAN achievement outcomes were significantly different across the three SES groups. We compared the model in which all of the parameters were fully constrained and the model in which these parameters were freely estimated. Chi-square difference tests results indicated that the fully constrained model significantly worsens the model fit, $\Delta\chi^2 = 140.49$, $\Delta df = 82$, $p <$. 001. Further analyses using the "Model Test" command in Mplus to examine which specific parameters contributed to the overall significant differences revealed that the path between book reading and early academic skills was significantly larger in magnitude in the low SES group compared to the middle group, Wald's test =6.66, df = 1, $p <$ .001 and compared to the high group, Wald's tests = 7.93, df = 1, p = .005. The path from receptive language to NAPLAN writing scores was significantly larger in magnitude in the low SES group compared with the high SES group, Wald's tests = 4.17, df = 1, p =.04 and larger in magnitude in the middle SES group compared with the high SES group, Wald's tests =

10.23, df = 1, p =.001. Similarly, the path from receptive language to NAPLAN spelling scores was significantly larger in magnitude in the low SES group than the high SES group, Wald's tests = 5.01, df = 1, p = .03 and larger in the middle SES group than the high SES group, Wald's tests = 4.29, df = 1, p = .04. In addition, the path from receptive language to NAPLAN mathematics achievement was significantly larger in magnitude in the middle SES group than the high SES group, Wald's tests = 5.67, df = 1, p = .03.

Discussion

In a relatively large sample longitudinal study, we examined the associations between shared reading in infancy and subsequent cognitive development and academic achievement in preschool and elementary school. We found that a child's early shared reading experiences at home are associated with their cognitive development and academic achievement across both the preschool and elementary school years. This result is in line with a large body of research documenting associations between shared reading and children's language development, school readiness and school achievement. Our study is unique in testing these associations across an eight-year period, and in examining a diverse assortment of academic achievement outcomes, including mathematics performance. Our study also uniquely contributes to the research area of children's development by testing the hypothesis that family SES moderates the relationships between early shared reading and later cognitive competence and academic achievement. We found that shared reading at home is uniquely associated to children's cognitive and school outcomes and that it is more beneficial for children from lower SES families compared to higher and middle SES ones.

Findings From Testing Hypothesis 1 - Shared Reading Associated with Children's Cognitive Development

Early shared reading is associated with language and early academic skills— In support of our first hypothesis, we found that shared book reading in toddlerhood predicted children's cognitive school readiness two years later. In line with previous research, we found that toddlers who spend more shared reading time with their parents had a better knowledge of vocabulary in early childhood (Fletcher & Reese, 2005; Raikes et al., 2006). This association is not surprising given that, as discussed above, stories in books give toddlers the opportunity to hear and practice new vocabulary and become familiar with lexis not used in day-to-day conversations. While the effects of early shared reading on preschoolers' language development has been explored previously, our study is one of the few that has examined this effect from toddlerhood onwards. Our results confirmed that shared book reading was also related to the development of emergent academic skills such as knowledge of shapes, letters, words and numbers. Children who are read to more often become familiar with pictures, book drawings and shapes, and parents who read to their children more frequently also often teach their children to read the print words, to copy the letters and pictures, and to become familiar with the alphabet (Evans, Shaw, & Bell, 2000; Fitzgerald, Spiegel, & Cunningham, 1991). Thus, shared reading may be associated with subsequent cognitive development by way of both direct effects on learning that are propagated forward in time, and by way of its value in indexing a wider assortment of

resources and parenting behaviors that are important for child cognitive development and learning.

Early shared reading is associated with school achievement, through direct and indirect paths—Still in support of our first hypothesis, we found that enhanced cognitive school readiness, as measured by a range of cognitive skills at age four, predicted children's literacy and mathematics competencies at school. These results are also in line with the findings of a large body of research indicating that children's early cognitive abilities, including language skills and emergent literacy, are predictors of later cognitive performance and academic achievement (Bus et al., 1995; Sénéchal & LeFevre, 2002; Tucker-Drob & Briley, 2014). We also found a significant direct relationship between early shared reading at age two and academic achievement six years later. A critical finding here is that vocabulary and emergent academic skills are positively associated not only with shared reading experiences during the early years, but also multiple dimensions of children's achievement at school in areas such as reading, writing, spelling, grammar, and mathematics. Whilst there exists a large body of evidence pointing to the importance of book reading for children's vocabulary acquisition (Sénéchal & LeFevre, 2002; et al., 1988), and numerous studies that explain how knowledge of vocabulary is a prerequisite to later literacy skills (Cunningham & Stanovich, 1997; Ouellette, 2006), this study adds the significant finding that shared reading experiences during the early years have important implications for children's later school performance in a variety of academic areas such as mathematics.

We propose that at least four mechanisms may be responsible for the patterns identified here. Firstly, shared book reading during the early years positively influences children's domain general cognitive skills, and consequently can result in higher performance in a wide range of school performance variables (Cutting & Scarborough, 2006; Passolunghi, Lanfranchi, Altoè, & Sollazzo, 2015). Book reading may promote gaining basic skills such as being able to recognize letters and numbers, then words, and, concurrently, phonological awareness, grammar competency and understanding complex words (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003; Ouellette, 2006). Secondly, children who are exposed to a rich shared reading environment during their early years become more engaged with reading and show more interest and greater competence in reading later on (for similar evidence see Cunningham & Stanovich, 1997; Mol & Bus, 2011; Stanovich, 1986). This may lead to a dynamic feedback process: When children gain better reading skills early on, they become more comfortable with and more interested in reading, and as a result they are read to more often (Raikes et al., 2006). In this way, they become proficient in cognitive skills related to reading text over their life span. Third, shared book reading may index a wide constellation of resources and parenting behaviors that are relatively stable and recurring over long periods of time and are important for child cognitive development and learning. Finally, shared book reading may index cognitive and motivational traits in parents that are inherited by these parents' children (Scarr & McCartney, 1983)

Findings From Testing Hypothesis 2: Shared Reading Uniquely Associates with Children's Cognitive Competencies and Later Academic Achievement

Testing our second hypothesis, we found that shared reading is uniquely associated with children's cognitive competencies and academic achievement even after controlling for the different activities that parents do with their children at home. These activities include telling a story, teaching music, drawing pictures and also keeping children books at home. This suggests that the relation between shared book reading and later academic achievement is not simply attributable to more general tendencies of parents to engage with and stimulate their children. It is of course important not to draw a causal conclusion from these data. Shared book reading itself may not directly affect cognitive development. For instance, a more general parental orientation toward home literacy (but more specific than general engagement), rather than book reading per se, may be causal. It is also possible that shared book reading indexes parental factors (such as verbal intelligence) that are inherited by children (Scarr, 1992), or that shared book reading is elicited in parents in response to the child's interest or verbal precociousness that is itself predictive of later achievement (Tucker-Drob & Harden, 2012). Our results indicate that, should shared reading act as a proxy-rather than causal- variable for unmeasured predictors of later academic achievement, it is an important proxy that acts over and above predictors tapped by other engaging parenting activities such as telling a story or playing music. Indeed, there is reasons to suspect that shared reading may be directly cause, as shared reading provides unique learning opportunities for children. Stories in the books are systematic ways to teach children new words and concepts, and even parents who are less familiar with ways to teach their children new words and concepts, can benefit from books.

Findings From Testing Hypothesis 3: SES Moderates the Relationship Between Shared Reading and Children's Cognitive Competencies and Later Academic Achievement

An important finding of this study was that shared reading is more strongly associated with subsequent cognitive development for children raised in low SES and middle SES families. This finding is noteworthy given the evidence that children from low SES families display lower language processing skills and vocabulary knowledge from very early ages (i.e. 18 months of age) (Fernald, Marchman, & Weisleder, 2013). Our research suggests the possibility that parents of low SES families may be able to improve their children's language skills and academic achievement by appropriate home literacy practices. That shared reading is less strongly associated with cognitive development for children from high SES families may result from the other learning opportunities that these children also receive (e.g. potentially higher quality childcare and early academic programs). As such, early shared reading alone may be a less salient experience for these children as compared to children from low SES families who are not exposed to equally rich learning environments.

Conclusions, Limitations and Future Directions

Despite the large body of research examining the effects of shared book reading on children's development of reading skills and later academic success, the current study is one of the very few that has used a longitudinal design, accompanied with a large sample size of

children and parents, and it is also unique in having observed the effects of shared reading on children from toddlerhood onwards.

We follow previous large-scale investigations of shared reading between parents and children (e.g., Bast & Reitsma, 1998; Raikes et al., 2006) in relying on parents' reports of the amount of time they spend reading to their 2-year-old toddlers. While such an approach to indexing shared reading does not have the strengths of more intensive observational approaches, e.g. in which video-recorded parent-child dyads are coded on several dimensions of interaction, still it has a number of clear strengths. First, parent reports are retrospectives on typical parenting behavior in the family's natural ecology that is aggregated over time, whereas observational approaches are snapshots of behavior during a somewhat ratificational situation at a single point in time. Second, although parent reports of time spent reading provide less information about reading quality, they are considerably more informative than observational approaches about reading frequency. Third, parent reports can be obtained at low cost from large representative samples, whereas the demands of observational approaches often yield smaller and less representative samples. Additionally, the small correlations might bring doubts that the presented results are insignificant. It is noteworthy that the data are obtained over 6 years of development. Of course, book reading is only one indicator in the complex picture of what factors influence children's development. The significance of our study is in showing that the early reading practices associate with children's school performance after 6 years.

Overall, our study corroborates the hypothesis that children whose parents read to them often, also experience better opportunities for learning and developing cognitive skills. This result is especially heightened for children of low SES families.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Early shared reading is associated with children's school achievement directly and indirectly through receptive language and early academic skills.
- Frequency of reading predicts the child's cognitive outcomes, over and above other home activities such as telling child a story or practicing music.
- The associations were stronger for children of low and middle SES groups compared to the high SES group.
- Shared reading is uniquely associated to indicators of children's cognitive development such as language and early academic skills as well as children's school achievement.

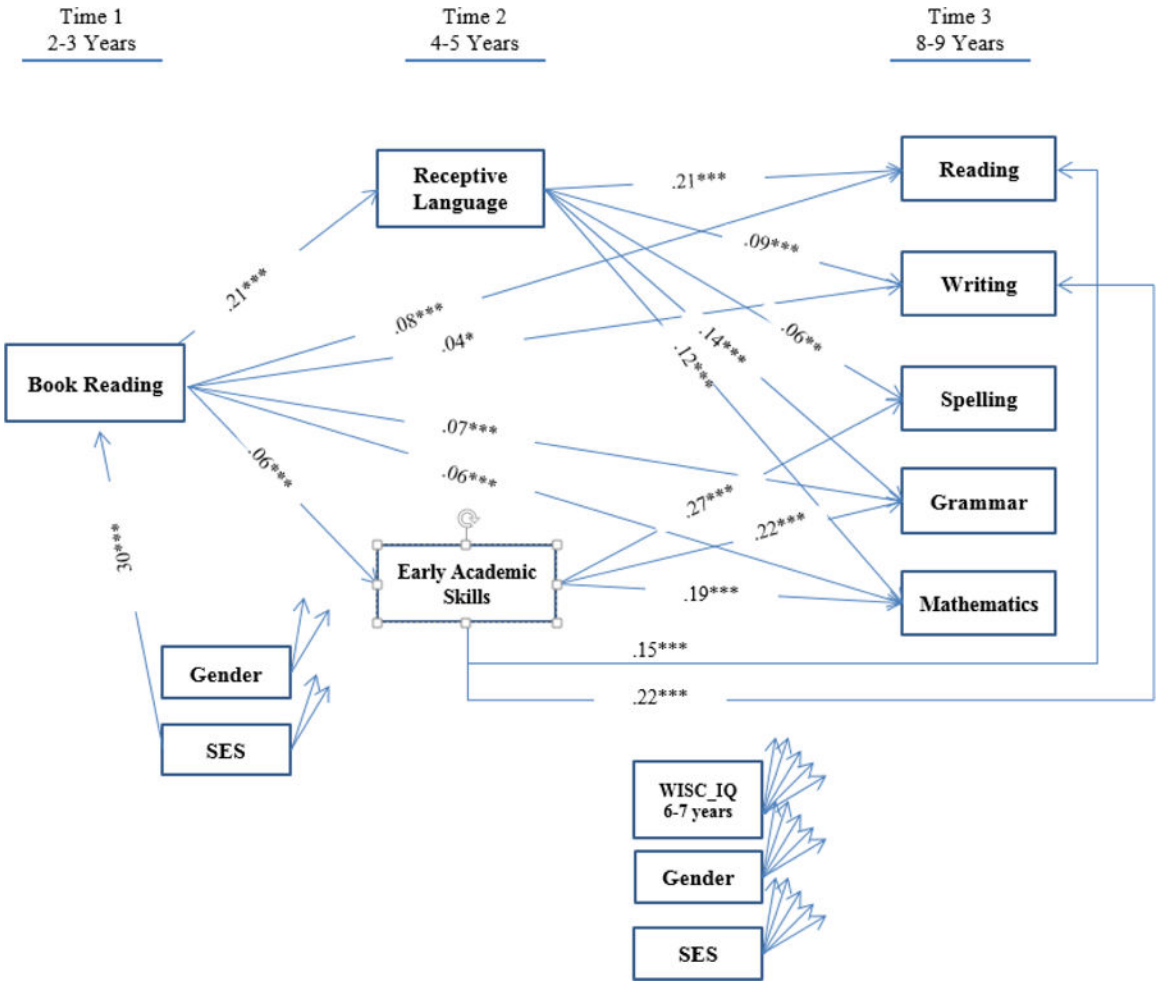

Figure 1.

This is the path model depicting partial mediating role of receptive language and early academic skills in the associations between book reading and NAPLAN reading, writing, spelling, grammar, and mathematics outcomes for the whole sample (n = 4,768). For clarity, the path coefficients of the effect of gender, SES and intelligence on the mediators and NAPLAN outcomes are not shown. All path coefficients are standardized.

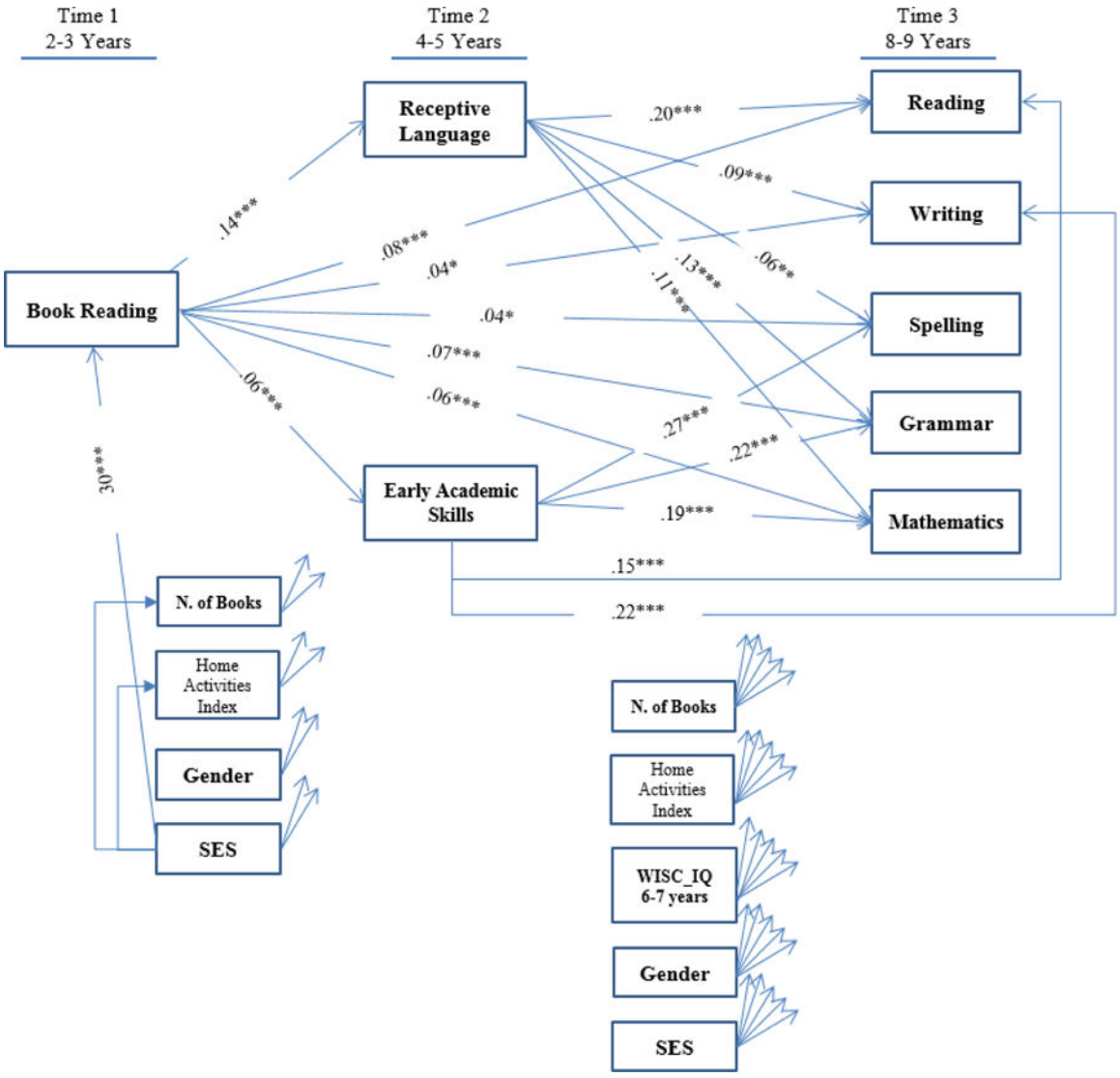

Figure 2.

This is the supplementary analysis to our original model where we controlled for the role of home activities index and number of children's books at home on children's later cognitive competencies and academic achievement (n = 4,768). For clarity, the path coefficients of the effect of home activities index, number of books at home, gender, SES and intelligence on the mediators and NAPLAN outcomes are not shown. All path coefficients are standardized.

Table 1

Means, Standard Deviation, and Zero Order Correlations among All Measured Variables (n = 4,768)

		1	2	3	4	5	6	7	8	9	10	11	12
Toddlerhood variables (2–3 years)													
1	Book reading												
2	Number of children's books at home	39											
3	Home activities index	36	23										
Early childhood variables (4–5 years)													
4	Receptive language PPVT	28	30	17									
5	Early academic skills (WAI)	14	09	06	35								
School age variables (8–9 years)													
6	NAPLAN reading	25	19	12	39	31							
7	NAPLAN writing	17	13	06	25	36	57						
8	NAPPAN spelling	15	10	05	22	38	68	62					
9	NAPLAN grammar	22	17	10	32	36	75	61	73				
10	NAPLAN mathematics	20	17	07	31	33	70	53	63	67			
Covariates													
11	Family SEP	30	29	12	28	22	37	33	31	36	37		
12	Intelligence	14	11	05	26	27	35	27	32	36	43	23	
	Mean (SD)	.39 (.90)	.49 (.92)	.87 (.59)	5.24 (6.07)	5.49 (8.56)	33.67 (91.52)	21.48 (63.91)	16.51 (79.53)	35.48 (96.21)	07.62 (74.80)	.00 (1.00)	0.74 (2.99)

Note: All correlations are significant $p_S < .01$.

Table 2

Total, Direct and Indirect Effects Between Book Reading and NAPLAN Academic Achievement with Receptive Language and Early Academic Skills as Mediators (n = 4,768)

Paths	Total Effects	Direct Effects	Indirect Effects	95% CI	Proportion of Total Effects
Book reading-->NAPLAN Reading	.13***	.08***	.05***	[.04, .06]	**39%**
-->through receptive language			.04***	[.03, .05]	31%
-->through early academic skills			.01***	[.004, .01]	8%
Book reading-->NAPLAN Writing	.07***	.04*	.03***	[.02, .04]	**43%**
-->through receptive language			.02***	[.01, .03]	29%
-->through early academic skills			.01***	[.006, .02]	14%
Book reading-->NAPLAN Spelling	.06**	.03(ns)	.03***	[.02, .04]	**50%**
-->through receptive language			.01**	[.005, .02]	17%
-->through early academic skills			.02***	[.01, .023]	33%
Book reading-->NAPLAN Grammar	.11***	.07***	.04***	[.03, .05]	**36%**
-->through receptive language			.03***	[.02, .04]	27%
-->through early academic skills			.01***	[.006, .02]	9%
Book reading-->NAPLAN Numeracy	.10***	.06***	.04***	[.03, .05]	**40%**
-->through receptive language			.03***	[.02, .033]	30%
-->through early academic skills			.01***	[.005, .02]	10%

Note.

*$p<.05$.

**$p<.01$.

***$p<.001$. All coefficients are standardized. Due to rounding, the total effects may not necessarily be the sum of indirect and direct effects. Effect size refers to the proportion of the total effect accounted for by the indirect effect

Table 3

Total, Direct and Indirect Effects among Low SES Group (n = 1,111)

Paths	Total Effects	Direct Effects	Indirect Effects	95% CI	Proportion of Total Effects
Book reading-->NAPLAN Reading	.14***	.06 (ns)	.08***	[.06, .11]	**57%**
-->through receptive language			.06***	[.04, .08]	43%
-->through early academic skills			.03***	[.01, .04]	21%
Book reading-->NAPLAN Writing	.10*	.04 (ns)	.06***	[.04, .09]	**60%**
-->through receptive language			.03***	[.004, .05]	30%
-->through early academic skills			.04***	[.02, .06]	40%
Book reading-->NAPLAN Spelling	.07 (ns)	.00 (ns)	.07***	[.04, .10]	**100%**
-->through receptive language			.03**	[.01, .05]	43%
-->through early academic skills			.04***	[.02, .06]	57%
Book reading-->NAPLAN Grammar	.13***	.05 (ns)	.08***	[.05, .10]	**62%**
-->through receptive language			.04***	[.02, .06]	31%
-->through early academic skills			.04***	[.02, .06]	31%
Book reading-->NAPLAN Numeracy	.12**	.06 (ns)	.06***	[.04, .09]	**50%**
-->through receptive language			.03**	[.01, .05]	25%
-->through early academic skills			.03***	[.01, .05]	25%

Note.

* $p<.05$.

** $p<.01$.

*** $p<.001$. All coefficients are standardized. Due to rounding, the total effects may not necessarily be the sum of indirect and direct effects. Effect size refers to the proportion of the total effect accounted for by the indirect effect

Table 4

Total, Direct and Indirect Effects among Middle SES Group (n = 2,426)

Paths	Total Effects	Direct Effects	Indirect Effects	95% CI	Proportion of Total Effects
Book reading-->NAPLAN Reading	.15***	.10***	.05***	[.03, .06]	**33%**
-->through receptive language			.04***	[.03, .06]	27%
-->through early academic skills			.00 (ns)	[−.00, .01]	na
Book reading-->NAPLAN Writing	.07**	.04 (ns)	.03***	[.02, .05]	**43%**
-->through receptive language			.03***	[.01, .04]	43%
-->through early academic skills			.00 (ns)	[−.00, .01]	na
Book reading-->NAPLAN Spelling	.07**	.05*	.02**	[.01, .04]	**29%**
-->through receptive language			.02**	[.004, .03]	29%
-->through early academic skills			.00 (ns)	[−.00, .02]	na
Book reading-->NAPLAN Grammar	.12***	.08**	.04***	[.02, .06]	**33%**
-->through receptive language			.03***	[.02, .04]	25%
-->through early academic skills			.01 (ns)	[−.00, .02]	na
Book reading-->NAPLAN Numeracy	.11***	.08**	.04***	[.02, .05]	**36%**
-->through receptive language			.03***	[.02, .04]	27%
-->through early academic skills			.01 (ns)	[−.00, .01]	na

Note.

* $p<.05$.

** $p<.01$.

*** $p<.001$. All coefficients are standardized. Due to rounding, the total effects may not necessarily be the sum of indirect and direct effects. Effect size refers to the proportion of the total effect accounted for by the indirect effect

Table 5

Total, Direct and Indirect Effects among High SES Group (n = 1,231)

Paths	Total Effects	Direct Effects	Indirect Effects	95% CI	Proportion of Total Effects
Book reading-->NAPLAN Reading	.07**	.05 (ns)	.03**	[.01, .05]	**43%**
-->through receptive language			.03***	[.01, .05]	43%
-->through early academic skills			−.00 (ns)	[−.01, .01]	0%
Book reading-->NAPLAN Writing	.00 (ns)	.01 (ns)	−.00 (ns)	[−.02, .02]	**na**
-->through receptive language			−.00 (ns)	[−.01, .01]	na
-->through early academic skills			−.00 (ns)	[−.02, .01]	na
Book reading-->NAPLAN Spelling	.00 (ns)	−.01 (ns)	−.01 (ns)	[−.03, .02]	**na**
-->through receptive language			−.00 (ns)	[−.01, .01]	na
-->through early academic skills			−.00 (ns)	[−.02, .01]	na
Book reading-->NAPLAN Grammar	.05 (ns)	.03 (ns)	.01 (ns)	[−.01, .03]	**na**
-->through receptive language			.01 (ns)	[.00, .03]	na
-->through early academic skills			−.00(ns)	[−.02, .01]	na
Book reading-->NAPLAN Numeracy	.02 (ns)	.02 (ns)	.01 (ns)	[−.01, .03]	**na**
-->through receptive language			.01 (ns)	[−.00, .02]	na
-->through early academic skills			−.00 (ns)	[−.02, .01]	na

Note.

* $p<.05$.

** $p<.01$.

*** $p<.001$. All coefficients are standardized. Due to rounding, the total effects may not necessarily be the sum of indirect and direct effects. Effect size refers to the proportion of the total effect accounted for by the indirect effect