Factors of the early learning environment that promote early learning outcomes in Aotearoa / New Zealand

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Disclaimer

The views and interpretations in this report are those of the researchers, and are not the official position of the Ministry of Social Development.

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Executive summary

This study focused on two main research questions using data from more than 6,000 participants in the demographically diverse *Growing Up in New Zealand* (GUiNZ) longitudinal study:

1. What are the early learning environment factors that promote early learning at age 54 months (4.5 years)?
2. Are there ethnic differences in early learning environments that predict early learning at age 54 months (4.5 years)?

General policy relevance

Children's early learning in language, literacy, and numeracy predicts their ultimate academic success and has clear implications for the child, and for New Zealand society.

Determining the child, parent, and home environment factors that promote children's early learning *before* they enter primary school is paramount for New Zealand children. This information is especially critical to support equity for children from all socio-demographic backgrounds.

GUiNZ data allows us to trace the pathways to success in early learning for children from diverse backgrounds in Aotearoa/New Zealand. We hope our findings will inform policy initiatives aimed at promoting optimal early learning environments for all New Zealand children.

Key findings

In terms of direct effects on early learning outcomes, the most important predictor was parental engagement in the *teaching* of early academic skills at 54 months (eg encouraging their child to write or read letters). We also found that children's oral language at age two was an important mediator of early learning, and that shared book reading in the first two years was the best predictor of oral language. While there were some important variations made by maternal self-prioritised ethnicity, most predictors explored in our models remained important predictors across ethnicities.

Parents from all ethnic groups studied reported engaging in teaching behaviours to similar extents, indicating there is a broadly similar value placed on teaching activities across ethnic groups. Importantly, however, there was considerable variation *within* groups. Therefore, further support to parents may be useful to ensure that they have the skills and resources necessary to teach early academic skills to their children as effectively as possible.

Several factors affected the extent to which parents engaged in teaching behaviours. The frequency of shared book reading at nine and 24 months was associated with increased parental teaching of early academic skills at 54 months – especially among Pacific mothers. Given the strength of this association for all ethnic groups, these teaching behaviours at 54 months likely represent a natural progression to complement shared book reading routines with older children.

We also found that more children's books in the home at nine months predicted fewer concerns about emotional and hyperactivity difficulties at age 24 months for all groups except NZ European (the relationship was not substantive for emotional difficulties). Given there was considerable variation in terms of the number of children's books in

homes, with fewer books on average in the homes of mothers identifying as Māori, Pacific, or Asian, this finding warrants further attention to ensure that all parents can easily access children's books that sufficiently reflect the diversity of their families.

Mothers' reports of their children's vocabulary at 24 months were strongly associated with their children's learning outcomes at 54 months, indicating the importance of supporting early language development via activities such as shared book reading.

In addition, concerns about a child's behaviour at 24 months had a significant relationship with parental teaching behaviours at 54 months. There were no effects associated with concerns about hyperactivity (eg restlessness, fidgeting, distractibility etc), but children whose mothers reported some concerns about their child's conduct (eg temper tantrums, disobedience etc) at 24 months tended to report engaging in fewer teaching behaviours at 54 months (except NZ European mothers). Given the positive association of parental teaching with early learning for all groups, early interventions that support parents who have concerns about their child's conduct may be beneficial, though further research about the complementarity of early childhood education alongside such teaching is needed.

Parents indicating some concerns about their children's emotional difficulties (eg unhappy, nervous, worried etc) at 24 months typically reported more frequent teaching behaviours at 54 months across all groups. This relationship was unexpected; it is possible parents may find engaging in such behaviours is useful in managing emotional difficulties.

Finally, we found that book reading frequency was higher for firstborn children compared with subsequent children (with some variation across maternal ethnicity). It is a reality of parenting that the activity of shared book reading is likely to be adversely affected by additional children joining the household, but we found no difference in early learning outcomes between first and subsequent children, indicating other factors may be helping to mitigate the effect of reduced parental co-reading (most obviously, the environmental effects of having an older sibling, and more experienced parents).

Policy summary

Our study explored home environment factors relating to children's early learning outcomes, finding that the factors most strongly associated with positive outcomes typically held across the various ethnic groups, though with some important differences which we describe in more detail in the main body of this report.

Since our research was non-interventional, we cannot be certain that interventions based on these results *would* result in improved learning outcomes, but the strength and consistency of the results supports close consideration of policies that could further support parents.

Our recommendations are as follows:

1. The most important predictor of positive learning outcomes at 54 months was the extent to which parents were engaged in *teaching* early academic skills (eg early shared book reading and later encouragement of their child to write or read letters and/or words, count or recognise numbers). On average, parents who identified with any of the ethnic groups we studied (NZ European, Māori, Pacific and Asian or 'other') engage in these teaching behaviours frequently. However, there was considerable variation *within* each ethnic group, suggesting that further support to ensure that all parents have the skills and resources necessary to teach early academic skills as effectively as possible, would be beneficial.

2. There was marked variation in the number of children's books in homes, and the greater number of books predicted fewer concerns about emotional and hyperactivity difficulties at 24 months. Considering these findings, along with the importance of shared book reading for early learning and subsequent teaching behaviours, we recommend policies that help ensure all parents can easily access children's books relevant to their personal context.

3. Previous research has indicated that conduct disorders have lasting and serious impacts on development, but these have typically focused on older children and adults. Our results indicate that concerns about conduct among children as young as 24 months tended to predict less frequent parental teaching at 54 months, suggesting that earlier support may be warranted.

Introduction

Aims and objectives

This research focused on two main questions, using data from the demographically diverse *Growing Up in New Zealand* (*GUiNZ*) longitudinal study:

1. What are the early learning environment factors that promote early learning at age 54 months (4.5 years)?
2. Are there ethnic differences in the early learning environments that predict early learning at age 54 months (4.5 years)?

General policy relevance

Children's early success in language, literacy, and numeracy predicts their later academic success and can improve secondary school retention, which has clear implications for the child and for New Zealand society.

Identifying the child, parent, and home environment factors that promote children's early learning *before* they enter primary school is paramount for New Zealand children. This information is especially critical to support equity for children from socio-demographic backgrounds that have historically been associated with lower levels of success in literacy and numeracy.

Data from the *GUiNZ* study allows us to trace pathways to success in early learning for children from diverse backgrounds in Aotearoa/New Zealand.

We hope our findings will inform policy initiatives that promote optimal early learning environments for all New Zealand children.

Background

Early childhood is a time of rapid development of social, cognitive, and language skills, in all cultures. Early learning skills, in turn, strongly predict children's academic success in formal schooling (Britto, 2012). Our focus is on early learning, defined for the purposes of this report as the key skills of **'oral language, letter and number knowledge, writing, and counting skills'**.

International consensus holds that these key skills listed above are some of the best predictors of children's reading success in primary school (National Early Literacy Panel, 2008; Shanahan, 2010). Early success in reading and mathematics underpins academic success more generally and can prevent later problems, such as dropping out of school (Alexander, Entwisle, & Horsey, 1997).

Socio-demographic differences in early learning skills are present before formal schooling commences (Buckingham, Beaman, & Wheldall, 2014; Waldfogel & Washbrook, 2011). In their seminal study, Hart and Risley (1995) estimated that children from higher-income homes were exposed to 30 million more words in the first four years of life than children from low-income homes. This '30-million-word gap' has significant implications for children's language development. Critically, gaps in word knowledge between children from more deprived and less deprived areas are already evident at age two years in the *GUiNZ* study (Reese, et al., 2017).

New Zealand children who start school with sufficient early language and literacy skills are more responsive to the comprehensive approach to early reading instruction typically used in the New Zealand education system (Suggate, Schaughency, & Reese, 2013). In

contrast, New Zealand children who do not have early language and literacy skills inevitably read more slowly and fall farther and farther behind by adolescence (Suggate, Schaughency, McAnally, & Reese, 2018). In the US, this effect has been termed a "rich-get-richer" or "cumulative advantage phenomenon" (Stanovich, 2009, p. 37).

Given the critical importance of early learning, what are the best ways to foster children's oral language, literacy, and numeracy skills during early childhood?

Yelverton and Mashburn (2018) proposed a model for understanding factors in children's early learning, based on Bronfenbrenner's (1986) bioecological systems theory. At the level of the individual child, important factors include early temperament, attention span, behavioural issues, and vocabulary skills. At the level of the setting, both the learning environment at home and in early childhood education are crucial. At the larger systems level, government policies support parents and structure early childhood environments in ways that affect children's early learning.

The *GUiNZ* study is well placed to test pathways to early learning across these three different levels simultaneously in the first five years of life, especially around the home learning environment. The home learning environment refers to the informal and formal literacy and numeracy activities parents engage in with their children, and educational resources parents provide (Liu, Georgiou, & Manolitsis, 2018; Niklas & Schneider, 2015; Sénéchal, Lefevre, Thomas, & Daley, 1998). This is the primary focus of this report.

The home learning environment

The home learning environment includes resources in the home that can support children's literacy and numeracy, such as books, paper, and writing tools (Bracken & Fischel, 2008). As early as two weeks of age, there is substantial variation in the number of books in the homes of babies, with 35 percent of babies in the United States living in homes with fewer than 10 books (Sinclair, McCleery, Koepsell, Zuckerman, & Stevenson, 2018)**.** The way parents and others in the household interact with children using these resources, however, is critical, and is dependent on parents' own beliefs and expectations (Puccioni, 2015). Mothers who believe they can contribute to the development of their child's early literacy skills spend more time engaging in shared book reading with their children (Weigel, Martin, & Bennett, 2006). There is a large literature both globally and in Aotearoa / New Zealand about the importance of shared book reading for children's early learning, and specifically for the development of their oral language skills (see Reese, 2019 for a review). When parents and other adults read to children early in the first year of life, those children develop greater expressive language skills than children of parents who begin reading books to their child later (Debaryshe, 1993).

The *frequency* with which parents read to young children is another strong and unique predictor of their later language development (Farrant & Zubrick, 2013), assessed in the current study at nine and 24 months. It should be noted that the *quality* of shared book reading interactions is also critical; intervention research shows that when parents and other adults have open-ended and responsive conversations *about* books, children's language development advances even faster than through simply reading the text of the book (dialogic reading; Mol, Bus, De Jong, & Smeets, 2008; Reese & Cox, 1999), but data about quality were not available. In international research, parents' direct teaching of children's letter and number writing and recognition skills also predicts their early literacy and numeracy outcomes, especially for alphabet and number knowledge (Elliott & Bachman, 2018; Sénéchal & LeFevre, 2002). Information about these parental teaching behaviours was collected when the cohort child was 54 months old.

Child-level factors

Home learning environments differ within families. For example, parents tend to spend more time with their firstborn children than with their later-born counterparts (Keller & Zach, 2002).

Differential language experiences of children, such as firstborns spending more time engaging in shared book reading (Price, 2008) and being spoken to in longer sentences, contributes to differential early language outcomes for children by birth order, such that firstborns often demonstrate larger vocabularies than later-borns (Hoff-Ginsberg, 1998) (Reese, et al., 2017).

Less research, internationally or in New Zealand, has focused on children's behavioural skills that promote or hinder children's early learning. However, children with limited language skills tend to exhibit greater behavioural difficulties over time (Salmon, O'Kearney, Reese, & Fortune, 2016). It has been argued that an inability to express emotions through words may lead these children to resort to aggressive and inattentive behaviours. School-aged children with behavioural problems, such as Attention Deficit Hyperactivity Disorder, are at significant risk of academic underachievement. Further research is needed to better understand this relationship and its determinants in the preschool years (Spira & Fischel, 2005), hence another focus was the interaction between early behavioural concerns and early learning outcomes.

The early childhood education environment

Early childhood education (ECE) can be viewed as an intervention aimed at improving early learning, as well as socio-emotional skills. In New Zealand, Te Whāriki (Ministry of Education, 2017) has an holistic emphasis on children's development, with learning strands of mana atua/wellbeing, mana whenua/belonging, mana tangata/contribution, mana reo/communication, and mana aoturoa/exploration. By ages 3-4 years, participation in New Zealand ECE is high (Education Data and Knowledge, 2018), although there are differences as a function of socio-economic status and ethnicity in terms of participation and attendance. Prior research on ECE in NZ shows enduring links of participation in high quality ECE programmes to adolescents' later learning in high school, even after controlling for features such as maternal education levels and family income (Wylie, Hodgen, Hipkins, & Vaughan, 2008).

In international research on ECE, findings from gold standard experimental designs support the positive impact of ECE on children's early learning, at least in the short-term. These effects tend to "fade out" or dissipate once children enter primary school (Bailey, Duncan, Odgers, & Yu, 2017). However, when the early intervention programmes are of high quality (Hill, Gormley, & Adelstein, 2015) and when the children go on to attend high quality primary schools, the effects of early intervention can be enduring, sometimes into adulthood (Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001) (Cambell, et al., 2014). Many of the cohort children were attending ECE services (particularly at 54 months), but we did not have access to information about quality. The current study therefore focuses on the effects of the *home* learning environment

Contribution of this research

This study addresses two major issues in the existing early learning research, with a particular focus on the home learning environment, parent-child interactions, and children's early skills and characteristics.

The first issue refers to the isolated way determinants of early learning have been studied. While much research has investigated the effects of various factors on early learning (eg the home learning environment, or the contribution of early childhood education), these analyses have largely been conducted in isolation – comparatively few studies have considered the interaction across the different domains, particularly with respect to child factors such as early indicators of behavioural problems.

Developing a holistic model that includes child, parent, and home learning environment factors offers a better understanding about the contribution of these factors to children's early learning.

The second contribution of our study relates to the usual way in which socio-demographic group differences (such as ethnicity) in early learning outcomes have been addressed. Research has repeatedly identified differences in average levels of early learning outcomes by ethnicity. However, these differences have often been explained using a deficit-based approach and tend to assume a single, superior model of early development (Davis-Kean, 2005). Underperforming groups are diagnosed based on their deficiencies within this model. While we acknowledge that such differences exist, these effects are not deterministic and there is invariably considerable overlap across groups.

In other words, there is typically much greater variation *within* groups than *between* groups. Therefore, exploring the specific factors associated with positive early learning outcomes *within* groups is likely to be more informative than reporting differences in average scores *across* groups. This is the first study, to our knowledge, that has investigated whether the determinants of success in early learning differ by ethnicity.

Method

Engagement with policy collaborators

This research project has been a collaboration between researchers at the Universities of Auckland and Otago, and policy experts at the Ministry of Education. Early in the study, the researchers met with key partners at the Ministry of Education to discuss the planned research questions and methodology to help ensure the questions had relevance for policy makers.

We met our policy collaborators again to discuss the findings once the statistical models had been developed, and to provide them an opportunity to raise any concerns or gaps with the analyses. Finally, a full draft of this report was shared with Ministry of Education collaborators, with opportunities to contribute to the policy sections and/or provide broader feedback.

Participants

Participants in our research were mothers in the *GUiNZ* study's longitudinal pre-birth cohort. Mothers were recruited during pregnancy from three contiguous District Health Boards: Auckland, Counties Manukau and Waikato. These regions were chosen due to their ethnic and socio-economic diversity (Morton, et al., 2012). All pregnant women who lived within these regions who were due to give birth between 25 April 2009 and 25 March 2010 were eligible. A multi-faceted strategy was used to recruit a sample broadly generalisable to the contemporary New Zealand national birth cohort (Morton, et al., 2014). The enrolled child cohort included 11% of the births in New Zealand during the recruitment period and is broadly representative of all births between 2007 and 2010 with respect to ethnicity, maternal age, parity (birth order) and socio-economic position (Morton, et al., 2015).

Ethical approval was obtained from the New Zealand Health and Disability "Northern Y" Regional Ethics Committee. Written informed consent was obtained from all participating mothers. In total, 6,822 mothers were interviewed during pregnancy, who between them had 6,853 children (Morton, et al., 2012).

For this study, observations were available for 6,822 mothers from the antenatal interview, 6,383 mothers from the 9-month interview, 6,241 mothers from the 24-month interview, and 6,073 mothers from the 54-month interview. This represented a retention rate of 94% at nine months, 92% at 24 months, and 89% at 54 months. Although data were collected for both mothers and children as part of the same interview, children were understandably less likely to complete all components of the interview resulting in a higher proportion of missing data. Therefore, complete data for all variables of interest were available for 4,454 children. Following our imputation procedure (described in the Data Analysis section), this increased to 5,162 children.

Procedure

Data used in this report were collected by trained interviewers who conducted interviews in mother's homes at the antenatal data collection wave, followed by interviews at the child's 9-, 24- and 54-month time points. Mothers, and in some cases their partners, were interviewed about topics across the multiple life-course domains considered by *GUiNZ*, including health, psychosocial and cognitive development, family and whānau, education, culture and identity, and neighbourhood and societal context (Morton, et al.,

2012). Interviews were face-to-face and computer-assisted and took about 90 minutes each. Interviewers read each survey question aloud. For most questions, mothers were asked to choose from a list of possible responses. A small number of questions allowed a free response. Observational measures were also collected for the cohort child; the early learning outcome measures were collected during the 54-month interviews as part of the child observation schedule.

Measures and variable coding

Several factors of the early learning environment were evaluated to establish their association with early learning at 54 months. Socio-demographic variables were also included since such variables have been found to be associated with early learning and were relevant to investigation of our second research question about the specific factors that predict positive early outcomes for different groups of children.

Socio-demographic measures and ethnicity

Maternal education and area-level socio-economic status were treated as control variables in all models to ensure that the factors predictive of positive early learning outcomes were less affected by extraneous socio-economic factors. This is particularly important when considering the effects by ethnicity since these sociodemographic variables are heavily confounded with ethnicity.

Area-level socio-economic deprivation was measured using the *NZ Index of Deprivation* [*NZDep*] (Salmond, Crampton, & Atkinson, 2007), a ten-point scale that provides an estimate of the relative aggregate-level socioeconomic deprivation of the area in which each participant was living, with *one* reflecting the lowest decile of socioeconomic deprivation and *ten* the highest. As the effects of poverty are considered to be cumulative (Dickerson & Popli, 2016), we controlled for *NZDep* at each time point using a cross-lagged design, to account for the high degree of dependence in this variable over time.

Mothers' education level was included, where 0 indicates no high school qualification, 1 indicates a high school qualification, 2 indicates a diploma or trade qualification, 3 indicates a bachelor's qualification, and 4 indicates higher education. This variable was collected at the antenatal data collection time point but was then included as a control across all time points, since maternal education is also known to have persistent effects on child development.

Mothers were also asked a range of standard demographic questions at the antenatal interview that were included in the analyses as time invariant (fixed) variables. Mothers' self-prioritised ethnicity was grouped into the following categories: European, Māori, Pacific, Asian and "Other' ethnicities. Note that all participants were included in the overall model, but subgroup analyses were conducted only for the four main ethnic groups due to low sample sizes among 'other' ethnicities. Finally, child birth order was measured as a binary variable according to whether the cohort child was the mother's first child or not.

Mother and child variables

We explored the use of several variables related to the behaviours of mothers and their children, but only those that offered useful insights are discussed in detail. These variables include:

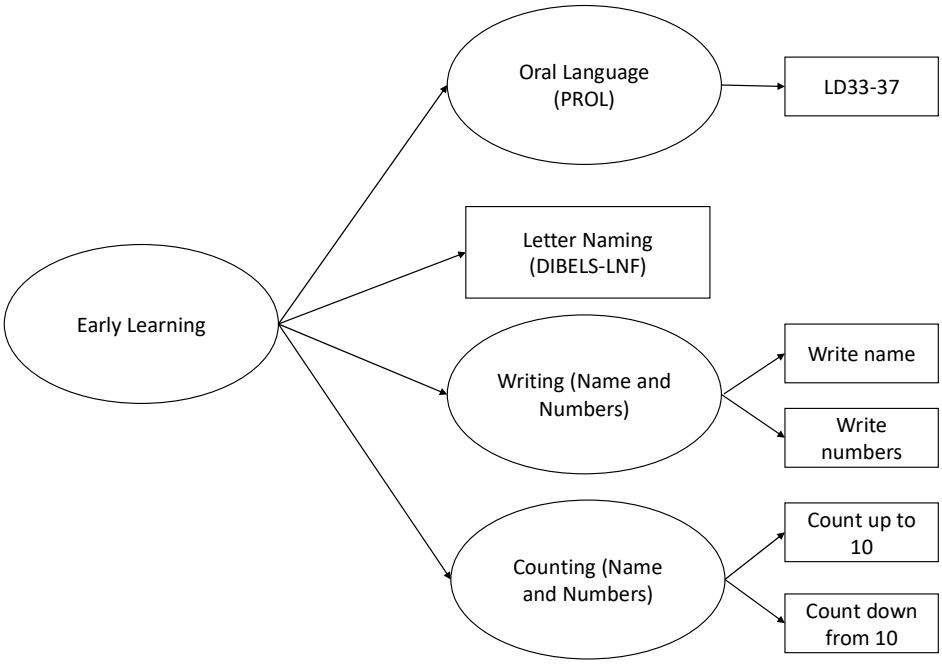
- The number of children's books in the home at nine months.

- The frequency of book reading interactions with their child at both 9 months and 24 months.
- Maternal estimates of child's knowledge of common words in English at 24 months (vocabulary size).
- Indicators of mothers' concerns about their child's behaviours using the *Strengths and Difficulties Questionnaire* (*SDQ*) at 24 months, with higher scores reflecting increased reported concern. Note that the *SDQ* is a widely used battery of tests for children aged five years and over but less is known regarding its application to preschool children. However, D'Souza, Waldie, Peterson, Underwood and Morton (2017) published an article validating the use of the *SDQ* at 24 months using *GUiNZ* data.
- Parental teaching of early academic skills at 54 months. Specifically:
  - How often do you encourage {name} to print letters, words, or numbers?
  - How often do you encourage {name} to read words?
  - How often do you encourage {name} to count?
  - How often do you encourage {name} to recognise numbers?

Early learning outcomes at 54 months

To assess early learning outcomes, a four-factor model was developed (as shown in Figure 1), based on variables collected as part of the child observation schedule at the 54-month data collection wave. The four factors that made up the early learning construct included: Oral Language, measured using the five-item Parent Rating of Oral Language (PROL); Letter Recognition, using the Letter Naming Fluency task (DIBELS-LNF); and early Writing and Counting, based on the Name and Numbers task. Early Learning is therefore modelled as a latent factor comprised of these four sub-domains. Note that there is clearly a range of other early learning outcomes not included in this construct, but these factors cover most of the key aspects of early learning that have been found to predict later literacy outcomes (Lonigan & Shanahan, 2009) (National Early Literacy Panel, 2009).

Figure 1: The four-factor model showing the indicators of the latent factor for early learning used in the current study.



The PROL includes the following items:

- Which of the following best describes {name}'s pattern of asking questions?
- How often does {name} try out new words?
- Which of the following best describes {name}'s ability to communicate questions in a clear and logical way?
- How often is {name} understandable when speaking to adults other than you or other family members?
- Which of the following best describes {name}'s ability to communicate when [he/she] is not first understood?

For the DIBELS Letter Naming Fluency (DIBELS-LNF) task (DIBELS, 2019), children are asked to correctly name as many letters as possible within one minute. This is not a direct test of reading ability (a direct test would not have been developmentally appropriate), but children's letter knowledge is a key indicator of future reading ability (Adams, 1990) (Foulin, 2005).

The Name and Numbers task was a component of the "Who Am I?" developmental assessment tool (De Lemos & Doig, 1999). In this task, children were asked to write their name, and write numbers. A trained observer judged the writing on a 0-4 scale, where 0 indicated no response, 1 a "scribble, or no recognisable numbers/letters from the name", up to 4 for "recognisable name; letters generally clear/several numbers clear". Their numeracy was assessed by the child's ability to count up to and down from 10.

Excluded variables

One of the advantages of the *GUiNZ* dataset is the breadth of information available. However, it is not possible (nor desirable) to include every variable in a statistical model as this ensures that the analyses are theory-driven rather than data-driven. Therefore, we identified the variables that were theoretically most likely to relate to our outcome, and these variables are described above. Nonetheless, there were some other variables that we considered and included in our initial exploratory analyses, but ultimately chose not to include when weighing up the overall impact in terms of parsimony as well as the number of children who were excluded when a particular variable was included. Our aim was to include as many children as possible.

Most importantly, we chose to exclude information about ECE participation. We initially explored multiple models with a binary variable related to participation but found this did not improve model fit. Given that previous research has repeatedly found that quality is of far greater importance than participation (eg Araujo, Dormal, & Schady, 2019; Choi & Dobbs-Oates, 2014; Melhuish, 2016), we excluded participation from our final models. While there is a range of more informative information available about experiences and satisfaction with ECE, including this information would have meant excluding children who were not attending an ECE service.

We also considered the number of children in the family – but this differs across time points and previous literature indicated that whether a child is the first in the family was more likely to be relevant. Other variables initially considered included maternal health and wellbeing and the cohort child's birthweight.

Data analysis

A strength of having a large and diverse cohort is that it allows us to undertake complex analyses within ethnic and socio-economic subgroups, as well as for the whole cohort.

We therefore approached our analyses with the aim of determining whether the factors that promote positive early learning differ by ethnicity.

Imputation

To minimise bias and maximise the number of children who could be included in our analysis, we used the *Amelia package in R* (Honaker, King, & Blackwell, 2011) to impute missing data. To ensure we only impute for cases where data are likely to be missing at random, we have taken a conservative approach to imputation according to the following logic:

- Cases with more than 40% missing data are excluded.
- Cases where a complete construct (PROL, Name and Numbers etc) is missing are excluded.
- Demographic information is **not** imputed.

Data were imputed using *Expectation-Maximisation with Bootstrapping* (*EMB*). In basic terms, this replaces missing data with a distribution of values reflecting the uncertainty in the missing data. These values are informed by relevant other information available in terms of how "similar" participants responded to the missing item.

The imputation process increased the number of children who could be included in the analyses from 4,454 to 5,162. Importantly, this process improved the overall representation for children of mothers who reported no secondary school qualification, those living in areas with higher socio-economic deprivation, as well as those whose mothers reported that their main ethnicity was Asian or Pacific (see Appendix 1 for complete details of sample sizes before and after imputation). To ensure that the imputation did not affect the results, the model was analysed using the original and the imputed dataset separately. There were no practical differences in the overall results after imputation.

Structural equation modelling

We employ *Structural Equation Modelling* (*SEM*) using the *Lavaan package in R* (Rosseel, 2012) to investigate the relationships shared between our variables of interest, and how they relate to early learning. *SEM* has two main components: the measurement model, and the structural model. The measurement model summarises how directly-observed measures load on to latent (un-observed or underlying) constructs, while the structural model summarises how the latent constructs relate to one another. Relationships can be modelled as causal (i.e., an increase in the value of A is linked to a change in the value of B) or correlational (A and B are related but the directionality is unclear).

Model development was theory-driven, initially identifying the factors shown in prior research to be linked to early learning outcomes, then drawing an overall model to represent our theorised model of the effect of these variables. We then evaluated whether the specified model could be identified by the *SEM* algorithm (ie, the model estimates are able to be calculated), and whether the "fit" of the model is sufficient. A model that does not fit well can indicate that items included are not significantly related and can provide an indication that the relationships specified do not make sense theoretically. Our theoretical model fit the data well but some of the explored relationships had little effect and were therefore trimmed from our final model.

This report presents the results from our final model. It is important to interpret relationships between variables in the context of the other relationships specified in the model. In other words, the strength of relationships can be influenced by the inclusion or

exclusion of other variables that share variance (i.e., mothers' education level and area-level socio-economic status – both of which are included in all models as control variables).

The individual results for each ethnicity are described in terms of what predicts early literacy outcomes for each specific group. To simplify these descriptions, the overall model is described first, followed by any specific factors that are important for each subgroup.

Results

Descriptive statistics of early learning variables

As described in the **Method** section, there were four underlying components of our early learning construct, and descriptive statistics for these underlying components are provided at Table 1. On average, children named slightly more than 8 letters within the one minute allocated, but there was considerable variation, with 5% of children naming more than 30 letters. The average scores based on the parent report of oral language (PROL) were relatively high (15.5/20, or around 78% of the maximum score), with modest variation indicated by the standard deviation (2.02) – indeed, more than 95% of children had scores above 10. In comparison, the average scores for the writing (scored out of 8) and counting (scored out of 20) tasks were somewhat lower than for the PROL (~63% for both writing and counting), while variability was proportionally much larger.

Table 1: Descriptive statistics of early learning outcomes at 54 months

Component of Early Learning	Mean	Standard Deviation
Parent Report of Oral Language (PROL)	15.47	2.02
Letter Naming (DIBELS-LNF)	8.38	10.52
Writing (Names & Numbers)	5.08	1.88
Counting (Names & Numbers)	12.67	5.89

Descriptive statistics are also provided for predictor variables (see Appendix 2) and outcome variables (see Appendix 3). These are provided by subgroup for context, but it should be noted that these are simple group averages that do not account for conflation across sociodemographic factors (eg, ethnicity and socioeconomic status). In contrast, the models described below control for household socioeconomic status and maternal education.

Overall predictors of early learning

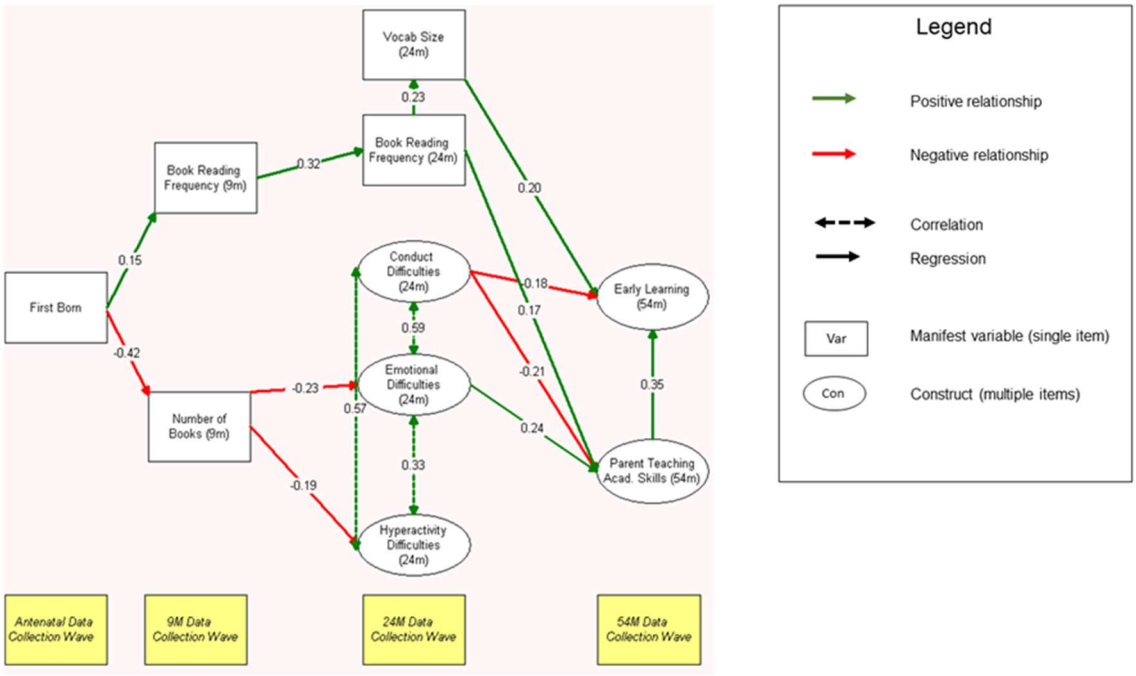
After assessing the descriptive statistics of the included variables, we developed an overall structural equation model that explored early predictors of early learning outcomes. A visualisation of this model, produced by Diagram Designer (MeeSoft, 2019) is shown in Figure 2. Model fit statistics were very good ($\gamma\hat{}$ = .962, CFI = .924, RMSEA = .035, SRMR = .042). These fit statistics are all commonly used but only $\gamma\hat{}$ is consistently robust across model type and with large sample sizes and is therefore the best indicator for the current study (Fan & Sivo, 2007).

Note that some relationships are treated as correlations (shown as a dotted line with bi-directional arrows), while others are treated as regressions (straight lines with a single arrow). Correlations are used for relationships considered to be bidirectional associations. For example, the SDQ measures are likely to be associated with each other

in that parents reporting their child has some indicators of hyperactivity are more likely to also report increased indicators of conduct problems, but this association is reciprocal rather than causal. Conversely, the relationship between whether or not the cohort child is the mother's first child and the number of books in the home at 24 months only makes sense in one direction – while there may be fewer books in the home when a child is the first born, the number of books at 24 months does not cause a child to be the first born. This relationship is therefore treated as a unidirectional regression. In addition, rectangles are used to reflect measured constructs, while ellipses are used for latent constructs (i.e., those that have multiple indicators of an underlying construct, as is the case for the SDQ measures).

The parameter estimates shown in *Figure 2* are standardised (see Appendix 4 for a table of estimates, z-scores and significance levels). Standardised estimates provide an indication of the magnitude of a relationship in standard deviation units and are therefore analogous to Cohen's d effect size (Nieminen, Lehtiniemi, Vähäkangas, Huusko, & Rautio, 2013). Effect sizes less than .15 are small (eg Hattie, 2009), so only substantive relationships larger than this are shown. All relationships shown are statistically significant.

Figure 2: Overall model of predictors of early learning.



In Figure 2 above, relationships that are positive (in the same direction) are shown in green, while negative (inverse) relationships are shown in red. In terms of key findings that held across all groups[1], we found:

- As expected, the *SDQ* measures (emotional, conduct and hyperactivity difficulties) were strongly correlated with each other – that is, mothers who

[1]Note that where relationships held across groups but substantively differed in the strength of the relationship, this is described in the section for each subgroup.

reported concerns about their child's conduct were also more likely to report concerns about hyperactivity and/or emotional difficulties.

- For firstborns, mothers tended to report that there were fewer children's books in the home at 9 months, but despite having fewer books, the frequency of shared reading with their child was higher at 9 months.
- An increased number of books in the home at 9 months predicted lower reported emotional and hyperactivity difficulties at 24 months, but surprisingly there was only a weak relationship between number of books and overall book reading frequency at 9 or 24 months.
- Mothers who reported reading to their child more frequently at 9 months typically reported higher frequencies of shared book reading at 24 months as well and tended to report that their child knew significantly more English words by 24 months of age. Children with stronger vocabularies at 24 months also typically had higher scores in the early learning measure at 54 months.
- There was no direct effect of early book reading on early learning outcomes, but mothers who reported high levels of book reading also reported engaging in a range of teaching behaviours that were strongly associated with early academic skills (eg, print symbols/words, count) at 54 months.
- Reported concerns about emotional or conduct difficulties had both indirect and direct effects on early learning. For example, mothers who reported some concern about their child's emotionality at 24 months tended to report engaging in more direct teaching of early academic skills at 54 months.
- In contrast, mothers reporting concerns about their child's conduct tended to report engaging in direct teaching behaviours *less* frequently – perhaps due to the additional challenges of getting their child to settle. There was also a direct negative effect of conduct difficulties on the outcome measures of early learning at 54 months. The direct effect is modest, but important in the context of the additional indirect effect associated with the lower frequency of teaching behaviours at 54 months. Observed performance on the early learning measures at 54 months was higher for children of mothers who were concurrently engaging in teaching behaviours relating to early academic skills (Parent Teaching Acad. Skills); early learning was also higher among children whose mothers had indicated their English vocabulary was larger at 24 months (which was in turn associated with how often the child was read to at 24 months).

Predictors of early learning by self-prioritised maternal ethnicity

This section describes any substantive differences in the predictors of our early learning measures by self-prioritised maternal ethnicity. It should be noted that the point of these models is to determine any factors that were specifically associated with positive outcomes within these groups (i.e., sources of resilience); it is not our intention to compare across groups in a reductive way that assesses whether one group has higher scores than another.

Rather, comparisons are intended to reflect an understanding that positive outcomes are seen in all subgroups; there is merit in exploring whether there are specific factors associated with positive outcomes that are unique to a particular group.

As with the overall model, area-level deprivation has been controlled for using the *NZDep* score for each data collection wave, as has antenatal maternal education. Note that the structural models for each ethnic group are provided at Appendix 5.

NZ European mothers

- Among children of mothers who identified their main ethnicity as NZ European, the effects associated with being the firstborn were larger than for other groups. In particular, firstborn children of NZ European mothers typically had far fewer children's books in the home than the subsequent children in these families (-.56; -.42 overall).
- Nonetheless, firstborn children of NZ European mothers tended to have more books *overall*, and indeed the number of children's books in the home did not predict reported frequency of book reading at 9 and 24 months, indicating that book reading was not being constrained by a lack of books in these families.
- In addition, in contrast with the overall model, there was no substantive relationship between the number of children's books and reported emotional difficulties at 24 months, while conduct and emotional difficulties did not have a substantive direct effect on either parental teaching of academic skills or early learning at 54 months.
- All other standardised estimates were similar to the overall model.

NZ Māori mothers

- Among children of NZ Māori mothers, birth order was less predictive of the number of children's books in the home at 9 months (-.31; -.42 overall), and also had marginally less effect on book reading frequency at 9 months (.11; .15 overall).
- Having more books was also somewhat less predictive of lower emotional difficulties at 24 months (-.15; -.23 overall), while the positive relationship between parent report of emotional difficulties at 24 months and direct parental teaching of early academic skills was much stronger among Māori (.37; .24 overall). However, so too was the negative relationship between conduct difficulties and teaching behaviours (-.33; -.21 overall). This suggests that Māori mothers are showing an increased responsiveness to concerns about these types of behaviours.
- The overall model also showed a negative association between reported conduct difficulties and early learning outcomes (-.18). However, among children whose mothers identified as Māori, this association was non-significant. Vocabulary size at 24 months and concurrent parental teaching behaviours were the strongest predictors of early learning at 54 months for these children.

Pacific mothers

- Among children of Pacific mothers, the association between being first-born and the number of children's books in the home was much weaker (-.2; -.42 overall). These families tended to have fewer children's books in the home overall.
- Although a higher number of children's books in the home at 9 months predicted fewer concerns about hyperactivity at 24 months, this effect was smaller than in the overall model (-.14; -.19 overall).
- Mothers reporting some difficulties with their child's conduct were less likely to report engaging in parental teaching behaviours (-.37; -.21 overall).
- In addition, children whose Pacific mothers indicated their child had some emotional difficulties tended to report engaging in less frequent book reading at 24 months (-.2; not significant overall).
- However, book reading frequency at 24 months was not associated with increased vocabulary size, while reported vocabulary size at 24 months was much more strongly predictive of early learning outcomes at 54 months (.32; .20 overall).

- Pacific parents who reported reading to their child more frequently at 24 months were also more likely to be engaged in direct teaching of early academic skills at 54 months (.26; .17 overall).

Asian mothers

- While there is still a strong relationship between being first-born and the number of children's books in the home, birth order had no substantive effect on shared book reading frequency among children of Asian mothers (.15 overall). However, these children were also more likely to be firstborns (51%; c.f. 31-33% for Māori/Pacific and 44% for children of European mothers).
- Mothers reporting some difficulties with their child's conduct reported a larger effect on frequency of shared book reading at 24 months (-.24; -.13 overall [not shown in overall model as < .15]). In addition, the effect in the overall model of conduct difficulties at 24 months on early learning outcomes at 54 months was not significant. The standardised parameter estimate was similar, but the variation in the relationship was much larger.
- The positive association between the number of English words known at 24 months, and the early learning outcomes at 54 months, was non-significant among children of Asian mothers. This result may reflect the specific focus on English in the 24-month vocabulary measure used in the current analyses, while the measures at 54 months aimed to assess development in "any" language.

Discussion

To our knowledge, while much research has investigated the effect of different aspects of the early learning environment, this is the first study in Aotearoa / NZ to examine so many factors of early learning in a single model extending across the first 4.5 years of a child's life.

This breadth and depth allows for a more precise understanding of the interaction of the different domains, particularly with respect to child factors, such as early indicators of behavioural problems, and the association between such indicators and subsequent early learning outcomes, while controlling for the effect of maternal education and socioeconomic status over time. The development of an holistic model offers a better understanding about the unique contribution of these factors to children's early learning. Our findings demonstrate the importance of children's language skill at age 24 months for most groups, as well as the universal importance of engagement in direct teaching behaviours by parents – including shared book reading from the first year of life, through to more specific behaviours such as encouraging children to write their own name at 54 months.

In addition, our models explored whether the early learning environments that lead to positive early learning outcomes for a child differ by maternal ethnicity. As noted in the introduction, previous research has repeatedly identified differences in average levels of early learning outcomes by ethnicity. However, a narrow focus on average differences fails to consider the substantial variation *within* ethnic groups, alongside the considerable overlap *between* ethnic groups. The result is often a deficit-based approach that assumes a single, superior model of early development whereby underperforming groups are diagnosed based on their deficiencies within this model (Davis-Kean, 2005). While reducing or removing such differences remains an important goal, exploring the specific factors associated with positive early learning outcomes *within* each group, is likely to yield more positive results than continuing to report simple differences in average scores across groups. This is the first study, to our knowledge, that has investigated whether the determinants of success in early learning differ by ethnicity.

Factors associated with early learning outcomes

While there were some important variations shown by the analyses conducted by maternal self-prioritised ethnicity, most of the predictors explored in our models held as important predictors across groups. In terms of direct effects on early learning outcomes, unsurprisingly the most important predictor was the extent to which parents were currently engaged in *teaching* of early academic skills (eg encouraging their child to print or read letters and / or words, count or recognise numbers). We also found that parents from all ethnic groups engage in these teaching behaviours to similar extents (although Asian mothers tended to report doing this more frequently), indicating that broadly similar value is being placed on these teaching activities across groups. Importantly, however, there was considerable variation *within* groups. Therefore, it would be useful to provide further support to ensure that all parents have the skills and resources necessary to teach these early academic skills as effectively as possible.

In addition, there were several factors that affected the extent to which parents engaged in these behaviours that warrant further attention. In particular, an increased frequency of shared book reading at 9 and 24 months was associated with higher levels of parental teaching of early academic skills at 54 months – and this was particularly the case among Pacific mothers. Given the strength of this association for all ethnic groups, it is

likely that these teaching behaviours at 54 months represent a natural progression of shared book reading behaviours with younger children. This link has typically not been found in the international literature – indeed, international research finds no association between parental book reading frequency and parental teaching of early academic skills (Senechal & LeFevre, 2002; Sparks & Reese, 2013), though much of this previous research has drawn on concurrent measures, meaning the progression was not able to be tested in previous studies. Nonetheless, much research has indicated the importance of early book reading for early literacy and broader academic development. Our models extend this by demonstrating the association with a broader range of early parental teaching behaviours.

We also found that the number of children's books in the home at 9 months predicted fewer concerns about emotional and hyperactivity difficulties at 24 months for all groups except European (the relationship was not substantive for emotional difficulties).

Given there was considerable variation in the number of children's books in the home, with fewer books on average in homes of mothers identifying as Māori, Pacific or Asian, this warrants further attention to ensure that all parents can easily access children's books that sufficiently reflect the diversity of their families.

The other strong predictor of early learning outcomes at 54 months was the children's vocabulary size reported at 24 months, demonstrating the importance of toddler's language development for children's early learning. However, it should be noted this effect was not significant among children of Asian mothers – possibly because reliance on the English vocabulary measure underestimated bilingual children's language development variables.

A further important finding was the relationship between behaviour at 24 months and parental teaching behaviours at 54 months. There were no effects associated with increased hyperactivity for any group. However, children whose mothers reported some concerns about their child's conduct at 24 months tended to report engaging in teaching behaviours at 54 months less frequently (except European mothers). Given the positive effect of early parental teaching on early learning for all groups, early interventions that support parents who have concerns about their child's conduct may be beneficial.

Parents indicating some concerns about their child's emotional difficulties at 24 months typically reported more frequent teaching behaviours at 54 months across all groups. This relationship was unexpected; it is possible parents may find that engaging in such behaviours useful in managing emotional difficulties.

Finally, while the strength of the association differed across maternal ethnicity, the finding that book reading frequency was higher for firstborn children compared with second and subsequent merits some consideration. It is a reality of parenting that shared book reading is likely to become more challenging when additional children join the household. Policies such as ensuring that early learning services are accessible for all families may help to mitigate these challenges. However, we found no difference in early learning outcomes between first and subsequent children, indicating that there are likely to be other variables helping to mitigate the effect of reduced parental co-reading (most obviously, the environmental effects of having more experienced parents as well as an older sibling who may model literate behaviour to support the younger sibling's development).

Policy recommendations

As the current research found that factors relating to children's early learning outcomes tended to hold across different ethnic groups, we argue that the following policy recommendations may be applicable to families across Aotearoa / New Zealand. However, as described above, there were some important differences across maternal ethnic groups that may help ensure interventions are more effectively targeted.

Longitudinal research is inherently non-interventional, therefore we cannot be certain that interventions based on our results *would* result in improved learning outcomes, but the strength and consistency of the results supports close consideration of policies that could further support parents.

Our specific recommendations are:

1. The most important predictor of positive learning outcomes at 54 months was the extent to which parents were engaged in *teaching* early academic skills (eg, early shared book reading and later encouragement of their child to print or read letters and / or words, count or recognise numbers), and on average, parents from all ethnic groups engage in these behaviours fairly frequently. However, there was considerable variation *within* each group, suggesting that further support to ensure all parents have the skills and resources necessary to teach these early academic skills as effectively as possible would be beneficial.
2. There was marked variation in terms of the number of children's books in the home, and an increased number of books predicted fewer concerns about emotional and hyperactivity difficulties at 24 months. Considering these findings, along with the importance of shared book reading for early learning and subsequent teaching behaviours, we recommend policies that help ensure that all parents are able to easily access children's books relevant to their individual context.
3. Previous research has indicated that conduct disorders have lasting and serious impacts on development, but that research has typically focused on older children and adults. Our results indicate that concerns about conduct even among children as young as 24 months tended to predict less frequent parental teaching at 54 months, suggesting that earlier support may be warranted.

Limitations and future directions

This study focused on mother-reported data related to the early learning environment, and predictors of early learning outcomes at 54 months. Although the *GUiNZ* dataset provides far broader information than would usually be available, as with all research, other important predictors of early learning may have been excluded. For example, information about the early learning environment was generally only available from the primary caregiver – most frequently the mother.

The most significant limitation was that the contribution of early learning services to early learning outcomes was not explored in this study. Given almost universal early childhood education participation at 54 months, early childhood education is clearly a significant contributor to the early learning environment. However, though participation is high at 54 months, it is much lower at 9 and 24 months, resulting in a significant reduction in sample size that disproportionately affected particular subgroups. Further, while information about participation and parental satisfaction with the chosen early learning service was available, specific information about the early learning environment provided by these services was not available.

When exploring the predictors of positive early learning outcomes for different ethnic groups, we could only account for the mother's self-identified main ethnic group to keep the sample sizes large enough given the complexity of these models.

Importantly however, ~20% of the mothers identified with more than one ethnic group and approximately a third of the cohort children were identified as having two or more ethnic groups. As a result, we could not consider the full complexity and diversity of ethnic identification in the cohort. Nonetheless, the fact that most of the factors that predicted early learning outcomes held across groups lends weight to our findings.

However, the role of the English language and dominant cultural norms should be considered further in future research. For example, while *GUiNZ* collected information about other languages, the vocabulary measure used in the current analyses does privilege monolingual English-speaking children. Future research should investigate whether the models developed in the current research hold for children and parents who mostly speak languages other than English. Further, the measures of early learning outcomes as well as those relating to parental teaching of early academic skills could not capture all aspects of children's skills (eg phonological awareness or working memory) and may not have had equal relevance to all ethnic groups.

Our findings that children of mothers whose self-prioritised ethnicity was Māori, Pacific, or Asian, had significantly fewer children's books should be investigated further to determine whether this issue relates mainly to access – both in terms of access to libraries and/or books in the home, or to a lack of books reflective of the context of non-Pākeha. If further research finds evidence of the latter, more resourcing may be needed to support development of children's books in the Aotearoa / New Zealand context.

Our findings show the importance of parents teaching early academic skills for all groups, but also indicated there was significant variation within each group in terms of the extent to which parents engaged in early teaching behaviours. Further research should explore whether there are specific reasons or barriers that explain the low level of engagement in these behaviours among some parents.

In future research, we would like to extend the current models to explore the contribution of early learning services to early learning outcomes. While information about the specific activities implemented by different services is not available, we would like to investigate the possibility that parental satisfaction about such services might be a useful proxy. We also aim to update these analyses once the 8-year-old data are available to investigate whether the identified early predictors of learning outcomes remain consistent when considering more distal outcomes.

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Appendix 1: Sample size before and after imputation

		N (complete case)	N (after Imputation)	Percentage increase (%)
Firstborn	Yes	1880	2192	16.60
	No	2574	2970	15.38
Gender	Male	2236	2607	16.59
	Female	2218	2555	15.19
Maternal ethnicity	Asian	491	648	31.98
	European	2822	3150	11.62
	Māori	555	647	16.58
	Pacific	448	553	23.44
Education	No Sec. School	232	291	25.43
	Sec. School	949	1109	16.86
	Diploma/Trade Cert.	1358	1575	15.98
	Bachelors	1114	1291	15.89
	Higher Education	801	896	11.86
Deprivation	1-1.9	1005	1121	11.54
	2-2.9	1111	1268	14.13
	3-3.9	981	1134	15.60
	4-4.9	883	1052	19.14
	5	474	587	23.84
Total	-	4454	5162	15.90

Appendix 2: Means (standard deviations) of predictor variables

		Number of books 9m	Vocab size 24m	Conduct difficulties 24m	Emotional difficulties 24m	Hyperactivity difficulties 24m	Parent teaching acad. skills 54m	Parent assess. acad. skills 54m
Deprivation	1-1.9	4.22 (0.84)	4.96 (2.54)	7.57 (1.68)	6.37 (1.30)	6.96 (1.92)	12.76 (3.54)	3.89 (0.98)
	2-2.9	3.99 (0.94)	4.55 (2.63)	7.74 (1.79)	6.55 (1.39)	7.13 (1.89)	13.02 (3.57)	3.78 (1.04)
	3-3.9	3.83 (1.03)	4.38 (2.68)	7.94 (1.88)	6.60 (1.42)	7.28 (1.88)	12.98 (3.83)	3.65 (1.02)
	4-4.9	3.59 (1.07)	3.64 (2.65)	8.53 (2.05)	7.05 (1.70)	7.54 (1.91)	12.73 (3.83)	3.57 (1.02)
	5	3.37 (1.09)	3.04 (2.44)	9.01 (2.06)	7.54 (1.87)	7.79 (1.74)	13.00 (3.98)	3.53 (0.97)
Education	No Sec. School	3.41 (1.07)	3.71 (2.56)	9.43 (2.05)	7.53 (1.91)	8.00 (1.80)	12.62 (4.06)	3.34 (0.99)
	Sec. School	3.67 (1.08)	3.78 (2.65)	8.38 (1.95)	6.99 (1.63)	7.48 (1.86)	12.77 (3.75)	3.58 (1.02)
	Diploma/Trade Cert.	3.83 (1.01)	3.96 (2.59)	8.25 (1.99)	6.82 (1.62)	7.46 (1.89)	12.99 (3.82)	3.57 (1.03)
	Bachelors	3.99 (0.98)	4.71 (2.69)	7.68 (1.71)	6.46 (1.31)	7.07 (1.88)	12.78 (3.63)	3.88 (0.98)
	Higher Education	4.06 (0.94)	4.84 (2.66)	7.36 (1.67)	6.41 (1.32)	6.81 (1.89)	13.15 (3.55)	3.97 (0.98)
Maternal ethnicity	Asian	3.12 (1.12)	2.77 (2.60)	7.81 (1.76)	7.05 (1.62)	7.34 (1.81)	13.56 (3.63)	3.77 (0.91)

	European	4.17 (0.85)	4.99 (2.50)	7.70 (1.78)	6.39 (1.29)	7.07 (1.91)	12.86 (3.64)	3.81 (1.02)
	Māori	3.62 (1.02)	3.59 (2.38)	9.06 (2.03)	7.22 (1.72)	7.73 (1.92)	12.44 (4.01)	3.35 (1.04)
	Pacific	3.23 (1.02)	2.60 (2.39)	9.14 (2.03)	7.80 (1.86)	7.91 (1.64)	12.85 (3.91)	3.43 (0.96)
Overall	-	3.85 (1.02)	4.25 (2.68)	8.05 (1.93)	6.74 (1.55)	7.28 (1.90)	12.89 (3.73)	3.70 (1.02)

Appendix 3: Means (standard deviations) of early learning outcome variables

		Writing (name & numbers) 54m	Counting (name & numbers) 54m	Letter naming (DIBELS LNF) 54m	Oral literacy (PROL) 54m
Deprivation	1-1.9	5.51 (1.76)	14.36 (5.19)	10.09 (11.11)	15.93 (1.76)
	2-2.9	5.37 (1.75)	13.70 (5.50)	9.24 (10.45)	15.69 (1.85)
	3-3.9	5.12 (1.83)	12.97 (5.89)	8.91 (10.64)	15.64 (1.96)
	4-4.9	4.95 (1.90)	12.06 (5.83)	7.46 (10.37)	15.31 (2.06)
	5	4.50 (1.93)	10.65 (5.91)	5.12 (8.59)	14.94 (2.18)
Education	No Sec. School	4.23 (1.89)	10.09 (5.75)	3.59 (6.48)	15.18 (2.20)
	Sec. School	4.95 (1.87)	12.12 (5.84)	7.03 (9.50)	15.42 (2.03)
	Diploma/Trade Cert.	5.06 (1.83)	12.38 (5.73)	7.42 (10.01)	15.42 (2.00)
	Bachelors	5.43 (1.79)	14.13 (5.43)	10.41 (11.23)	15.73 (1.83)
	Higher Education	5.52 (1.74)	14.52 (5.39)	11.19 (11.46)	15.90 (1.81)
Maternal ethnicity	Asian	5.94 (1.94)	13.55 (5.78)	14.71 (13.19)	15.08 (1.98)
	European	5.23 (1.72)	13.70 (5.49)	8.74 (10.09)	15.84 (1.83)
	Māori	4.45 (1.84)	10.88 (5.79)	4.17 (7.16)	15.40 (1.98)
	Pacific	4.62 (1.96)	10.76 (5.95)	4.54 (7.71)	14.83 (2.21)
Overall	-	5.16 (1.85)	13.00 (5.75)	8.52 (10.53)	15.57 (1.96)

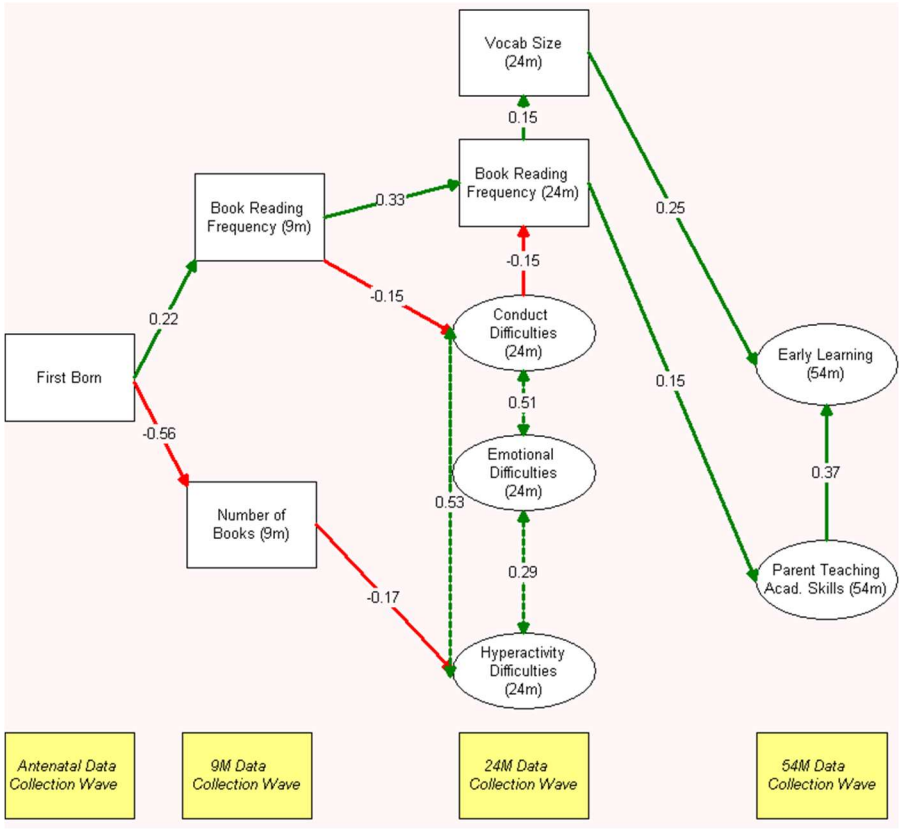
Appendix 4: Parameter estimates for final model

Predicted variable	Predictors	Unstandardised estimate	Standard error	z value	p value	Standardised estimate
Regressions						
DCW0_FirstBorn	DCW0_NZDep	-0.001	0.005	-0.179	0.858	-0.003
	DCW0_MthrEdctn	0.039	0.006	6.342	<.001	0.091
DCW1_NZDep	DCW0_NZDep	0.836	0.008	108.123	<.001	0.831
	DCW0_MthrEdctn	-0.064	0.010	-6.592	<.001	-0.051
DCW1_ChildsBooks	DCW1_NZDep	-0.147	0.009	-16.388	<.001	-0.206
	DCW0_MthrEdctn	0.134	0.011	11.887	<.001	0.150
	DCW0_FirstBorn	-0.876	0.025	-34.931	<.001	-0.424
DCW1_MotherReadBooks	DCW1_NZDep	-0.049	0.012	-3.919	<.001	-0.055
	DCW0_MthrEdctn	0.181	0.016	11.520	<.001	0.162
	DCW0_FirstBorn	0.395	0.035	11.292	<.001	0.153
DCW2_NZDep	DCW1_NZDep	0.794	0.008	94.728	<.001	0.793
	DCW0_MthrEdctn	-0.088	0.011	-8.402	<.001	-0.070
SDQ_Emotional_Problems	DCW2_NZDep	0.018	0.002	8.443	<.001	0.163
	DCW0_MthrEdctn	-0.021	0.003	-7.928	<.001	-0.153
	DCW1_MthrRdBks	-0.005	0.002	-2.304	0.021	-0.041
	DCW1_ChildsBks	-0.035	0.003	-11.400	<.001	-0.227
SDQ_Conduct_Problems	DCW2_NZDep	0.042	0.004	9.757	<.001	0.171
	DCW0_MthrEdctn	-0.072	0.006	-12.906	<.001	-0.234

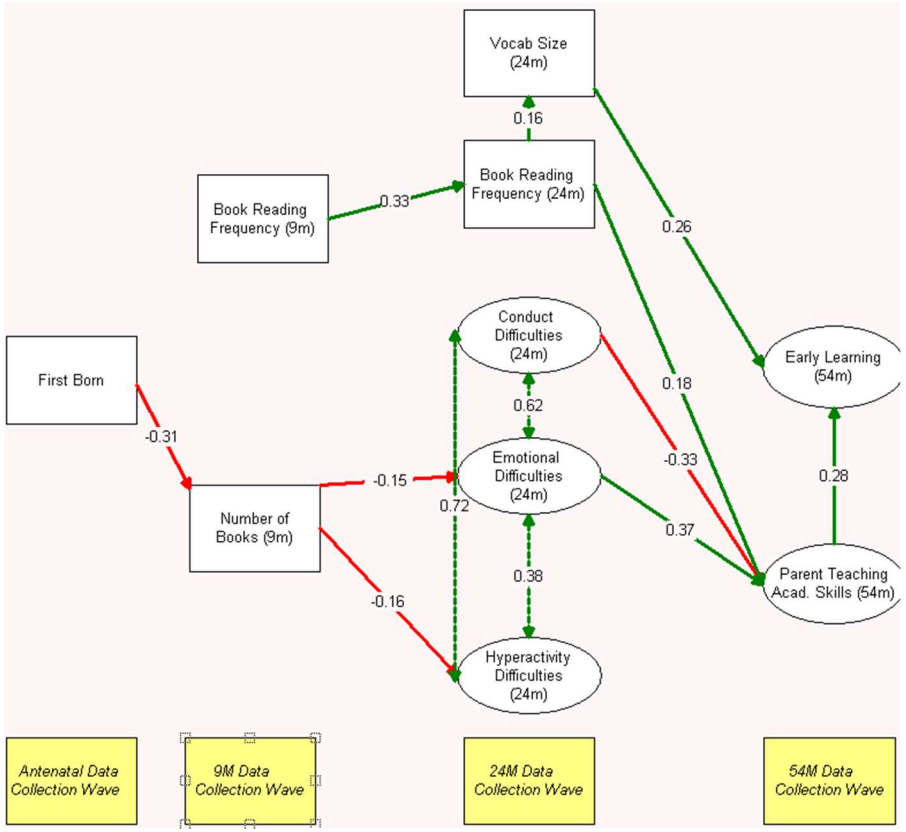
	DCW1_MthrRdBks	-0.039	0.005	-8.367	<.001	-0.142
	DCW1_ChildsBks	-0.014	0.006	-2.468	0.014	-0.041
SDQ_Hyperactivity	DCW2_NZDep	0.025	0.006	4.227	<.001	0.072
	DCW0_MthrEdctn	-0.057	0.007	-7.659	<.001	-0.133
	DCW1_MthrRdBks	-0.018	0.006	-2.823	0.005	-0.047
	DCW1_ChildsBks	-0.092	0.008	-11.119	<.001	-0.190
DCW2_MotherReadBooks	DCW2_NZDep	-0.085	0.010	-8.391	<.001	-0.108
	DCW0_MthrEdctn	0.120	0.013	9.277	<.001	0.122
	SDQ_Emtnl_Prbl	-0.733	0.187	-3.930	<.001	-0.102
	SDQ_Cndct_Prbl	-0.380	0.099	-3.852	<.001	-0.118
	SDQ_Hyperctvty	0.023	0.049	0.464	0.643	0.010
	DCW1_MthrRdBks	0.284	0.011	25.595	<.001	0.321
	DCW1_ChildsBks	0.125	0.015	8.142	<.001	0.113
DCW2_EnglishWords	DCW2_NZDep	-0.158	0.026	-6.141	<.001	-0.085
	DCW0_MthrEdctn	0.074	0.033	2.249	0.025	0.031
	DCW1_ChildsBks	0.265	0.036	7.454	<.001	0.101
	DCW1_MthrRdBks	0.176	0.030	5.883	<.001	0.084
	DCW2_MthrRdBks	0.555	0.036	15.575	<.001	0.234
DCW5_NZDep	DCW2_NZDep	0.628	0.011	57.666	<.001	0.615
	DCW0_MthrEdctn	-0.206	0.014	-15.056	<.001	-0.161
EncourageLiteracyW5	DCW5_NZDep	0.027	0.009	3.117	0.002	0.050
	SDQ_Cndct_Prbl	-0.496	0.084	-5.816	<.001	-0.214

	SDQ_Emtnl_Prbl	1.206	0.165	7.311	<.001	0.242
	SDQ_Hyperctvty	0.123	0.043	2.857	0.004	0.077
	DCW2_MthrRdBks	0.118	0.013	9.417	<.001	0.169
	DCW2_EnglshWrd	0.021	0.005	4.467	<.001	0.073
Literacy	DCW5_NZDep	-0.012	0.002	-7.525	<.001	-0.134
	DCW0_MthrEdctn	0.017	0.002	7.912	<.001	0.150
	SDQ_Cndct_Prbl	-0.069	0.014	-4.797	<.001	-0.181
	SDQ_Emtnl_Prbl	0.047	0.026	1.784	0.074	0.055
	SDQ_Hyperctvty	-0.005	0.007	-0.687	0.492	-0.018
	DCW2_MthrRdBks	0.000	0.002	0.186	0.853	0.003
	DCW2_EnglshWrd	0.010	0.001	9.973	<.001	0.193
	EncourgLtrcyW5	0.060	0.005	12.689	<.001	0.352
Covariances						
SDQ_Emtnl_Prbl	SDQ_Cndct_Prbl	0.028	0.002	16.091	<.001	0.591
SDQ_Cndct_Prbl	SDQ_Hyperctvty	0.088	0.004	19.991	<.001	0.578
SDQ_Emtnl_Prbl	SDQ_Hyperctvty	0.023	0.002	12.232	<.001	0.332
DCW0_NZDdep	DCW0_MthrEdct	-0.439	0.024	-18.668	<.001	-0.269
DCW1_ChildsBooks	DCW1_MthrRdBooks	0.256	0.016	16.293	<.001	0.233
DCW5_MotherEncourageCount	DCW5_MthrEncReading	0.230	0.014	16.171	<.001	0.390
DCW2_SDQ16	DCW2_SDQ24	0.079	0.006	14.088	<.001	0.227
DCW2_SDQ7	DCW2_SDQ25	0.054	0.004	13.056	<.001	0.192

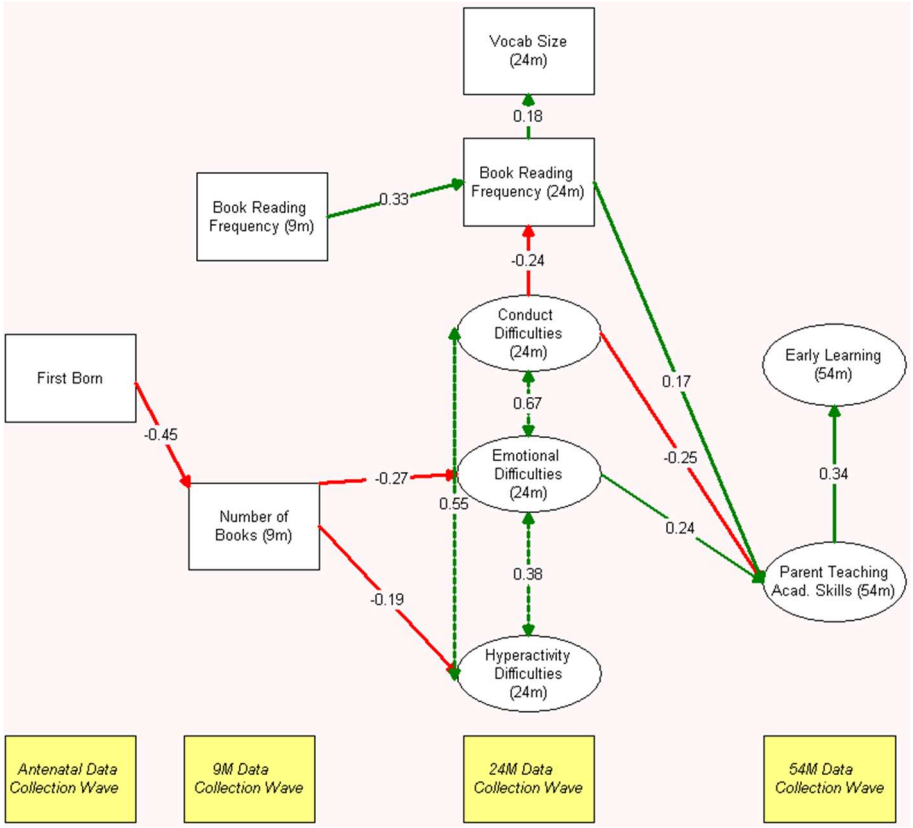
Appendix 5: Path diagrams by ethnicity



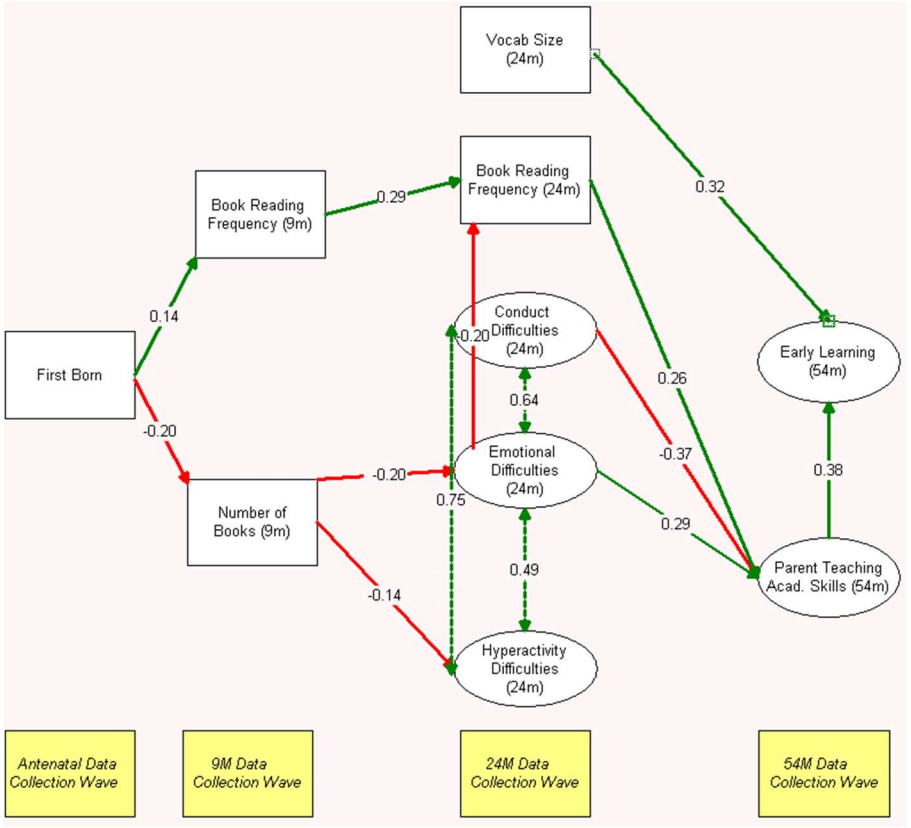
A. European



B. Māori



C. Asian



D. Pacific