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Longitudinal vocabulary development in Australian urban Aboriginal children: Protective and risk factors

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## Title Page

**Long Title:** Longitudinal vocabulary development in Australian urban Aboriginal children: Protective and risk factors.

**Short Title:** Vocabulary development in urban Aboriginal children.

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## Abstract

Background: Vocabulary is a key component of language which can impact on children's future literacy and communication. The gap between Australian Aboriginal and non-Aboriginal children's reading and academic outcomes are well reported and similar to Indigenous/ non Indigenous gaps in other nations. Determining factors which influence vocabulary acquisition over time and may be responsive to treatment is important for improving Aboriginal children's communication and academic outcomes.

Aim: To determine what factors influence Australian urban Aboriginal children's receptive vocabulary acquisition and whether any of these are risks or protective for vocabulary development.

Method: 113 Aboriginal children in South Western Sydney from the longitudinal birth cohort Gudaga study were assessed on The Peabody Picture Vocabulary Test (PPVT-IV) multiple times: 3 years, just prior to school entry, at the end of the first and second years of formal schooling. Multilevel models were used to determine the effects of thirteen fixed and manipulable maternal, child and family variables drawn from previous research.

Results: Higher maternal education was found to be protective at 3 years and over time. The number of children in urban Australian Aboriginal households made an impact on vocabulary development and this varied over time. From 3 to 6 years those with early poor non-verbal cognitive skills had vocabulary skills

that remained below those with stronger non-verbal skills at 3 years. Girls exhibit an earlier advantage in vocabulary acquisition but this difference is not sustained after 4 years of age.

**Conclusions:** The risk and protective factors for vocabulary development in Australian Aboriginal children are similar to those identified in other studies with some variation related to the number of children in the home. In this limited set of predictors, maternal education, gender, non-verbal cognitive skills and the number of children in households were all shown to impact on the acquisition of vocabulary to 3 years and on the developmental trajectory over time.

## **Introduction**

Australian Aboriginal children come from a rich long history of oral storytelling alongside a more recent history of trauma beginning with the colonisation of Australia over 200 years ago. In recent years it has been highlighted that following the decades of disadvantage suffered by Aboriginal (Indigenous Australian) children their health, academic and employment outcomes are poorer than their non-Aboriginal peers. In response to these findings the annual Australian Prime Minister's "Closing the Gap" report (Department of the Prime Minister & Cabinet, 2016) has again recommended that interventions are required to ameliorate the differences between Aboriginal and non-Aboriginal children's developmental outcomes. This study focuses on one developmental area: vocabulary acquisition.

In a child's first 12 months vocabulary begins to develop and continues throughout the life course. Vocabulary skills allow us to name and share objects, ideas and emotions and as such, are a fundamental developmental component of language use for all humans. It has been shown both receptive (understanding words) and expressive (spoken words) vocabulary acquisition may have influence not just on future oral communication (Law, Rush, Anandan, Cox, & Wood, 2012; Rowe, 2012) but also on skills which require vocabulary, for example cognitive development (Rice & Hoffman, 2015), academic performance (Durham, Farkas, Hammer, Tomblin, & Catts, 2007) and literacy (Lee, 2011; Schoon, Parsons, Rush, & Law, 2010).

One large population study of Australian children which included a subset of Aboriginal children demonstrated that these Indigenous, sometimes non English speaking children had poorer receptive vocabulary skills (Taylor, Christensen, Lawrence, Mitrou, & Zubrick, 2013). If we are to intervene and impact vocabulary and its associated skills, it is important we understand the factors that influence acquisition particularly those which could be manipulable by interventions (McKean et al., 2015).

- *Influences on vocabulary development*

There are a variety of maternal, child, family and environmental protective and risk factors that influence vocabulary development. For example, time spent with the child, income available, psychological and social capacity (Zubrick, Silburn, & Prior, 2005). Longitudinal studies have indicated that there may be different influences on vocabulary development in the early years (to 4 years) and in its growth over time. Receptive vocabulary acquisition has been shown to be related to a group of influencing factors (Harrison, McLeod, Berthelsen, & Walker, 2009; Taylor et al., 2013) which have a cumulative impact over time. Some of these risks are manipulable such as book reading at home and others less or not manipulable such as socio economic status and gender.

There are a range of *maternal* characteristics which have been shown to be related to vocabulary acquisition such as the mother's age when they birthed their child (Skeat et al., 2010), their education level at the child's birth (Baydar et al., 2014; Beitchman et al., 2008; Farkas & Beron, 2004; Hoff, 2002; Law et al., 2012; Taylor et al., 2013) and maternal distress or mental health (Baydar et al., 2014; Bornstein, Hahn, & Haynes, 2004; Harrison & McLeod, 2010).

There are also *child* factors which have been shown to relate to vocabulary development. It has been frequently reported that girls outperform boys under 4 years of age (Harrison & McLeod, 2010; Reilly et al., 2009; Skeat et al., 2010; Zambrana, Pons, Eadie, & Ystrom, 2014) and girls and boys respond differently to

known risks such as SES and parental input (Bornstein et al., 2004; Zambrana et al., 2014) while other studies have found no gender based differences (Jackson, Schatschneider, & Leacock, 2014). Other child factors which have been found to be related to the acquisition of words are low birth weight (Leijon, Ingemansson, Nelson, Wadsby, & Samuelsson, 2016; Taylor et al., 2013) children's behaviour, and non-verbal cognitive skills (Beitchman et al., 2008; Law et al., 2012).

Finally, *family and environmental* factors have been demonstrated to be related to vocabulary. Socio economic status (SES) in the early childhood years (Hoff, 2002), preschool years (Farkas & Beron, 2004) and at school age (Beitchman et al., 2008; Calvo & Bialystok, 2014) has a relationship with vocabulary acquisition. The broader language environment in which a child has been raised may also impact on acquisition. Specifically, single parent status and more than 3 siblings in a household has in previous studies, predicted poorer vocabulary development. The home literacy environment, measured by amount children are read to or the number of books in the home and the of quality early childhood education have both been shown to positively influence vocabulary size at 3 years and subsequent academic and language outcomes (Farrant & Zubrick, 2013; Harrison, McLeod, et al., 2009; Harrison, Ungerer, et al., 2009; Mol & Bus, 2011; Mol, Bus, de Jong, & Smeets, 2008; Taylor et al., 2013).

- *Influences on children's vocabulary over time*

The developmental trajectory of vocabulary acquisition and possible influencing factors has had little research attention until recently but is necessary to understand if interventions are to be targeted at the right time to the right children (McKean et al., 2015). To do this, it is important to determine factors of influence that can be manipulated in treatment and have an impact on vocabulary development (e.g. child care attendance and book reading) compared to those which are less manipulable (e.g. gender). A recent longitudinal study found both high non-verbal cognition and higher maternal education, were positive

factors of influence on vocabulary growth over time for children when tracked from two and a half to 21 years (Rice & Hoffman, 2015) . However, of these only non-verbal cognition is likely to be manipulable in very early childhood interventions. Socio economic disadvantage in Australian children (Taylor et al., 2013) was related to slower vocabulary development, though is again hard to influence in interventions. However some early variables of influence for lower vocabulary, such as low school readiness and maternal distress both of which may be considered manipulable by intervention have been related to *faster* trajectories of development between 4 and 7 or 8 years (McKean et al., 2015; Taylor et al., 2013). In a good sign for future language interventions McKean et al's (2015) study of overall language development (not just vocabulary), found there was significant variability in children's language development which was related to manipulable factors such as shared book reading.

- *Influences on Australian Aboriginal children's vocabulary*

Aboriginal peoples have lived on the Australian continent for the past 50 000 years and have some of the oldest practices and languages in the world. They now comprise 2.6% (Australian Bureau of Statistics, 2011) of the Australian population. There is limited research pertaining to the communication development of Australian Aboriginal children. However it is frequently reported that there is a known educational achievement "gap" evident prior to school (Guthridge et al., 2016; Leigh & Gong, 2009) which widens over time (Zubrick et al., 2006). This is also evident in Indigenous communities around the world (McRae, 2007). When considering Aboriginal children's communication development it is important to note that estimates suggest there are approximately 20 different "living" Aboriginal languages spoken in Australia (Butcher, 2008) . This makes English (the Australian national language) often the second, third or sometimes fourth language some Aboriginal children learn. At the last census 83% of Aboriginal participants reported speaking English as their only language (Australian Bureau of Statistics, 2011), and around one in ten (11%) report speaking an Indigenous language at home. Interestingly and not collected in this study, most

Aboriginal children in Australia are thought to be exposed to and speak variants of Australian Aboriginal English (AAE), a documented dialect of English (Butcher, 2008). In this study all participants, though Aboriginal, only speak one language, English, some with AAE, providing a unique opportunity to investigate language development without the confounding influence of multiple language acquisition.

There is limited evidence pertaining to the specific risks and protective factors influencing the language development of Australian and in fact any indigenous children across the world. The Longitudinal Study of (Australian) Indigenous Children (LSIC) found maternal age, education and children being read to were all significantly associated with Aboriginal children's vocabulary in early childhood (FaHCSIA, 2012; Farrant, Shepherd, Walker, & Pearson, 2014; Skelton & Bennetts Kneebone, 2015). The receptive vocabulary of most (69%) Aboriginal children at 4 years was within the normal range when compared with a large cohort of other Australian children (Christensen et al., 2014). However, utilising the same data Taylor et al (2013) found that Aboriginal children, as a subgroup of all Australian children, had vocabularies that were on average around 8 months behind peers at 4 years and overtime this gap did not change. Further, lower expressive vocabulary growth was related to the remoteness of Aboriginal children's homes (i.e., more remote the lower the vocabulary) and child care attendance (Buckley, Underwood, & Purdie, 2013; FaHCSIA, 2012).

There are some key risk and protective variables which may be uniquely important in Australian Aboriginal cohorts to consider. Poor hearing is a risk for good communication development and an important consideration for Indigenous populations (Roberts, Rosenfeld, & Zeisel, 2004). Hearing loss is highly prevalent in Australian Aboriginal children (Closing The Gap Clearinghouse, 2014) and up to 90% will have an episode of otitis media at some time before 5 years of age (Mahadevan et al., 2012). Otitis media has been shown to have downstream effects impacting educational and cognitive outcomes, of which vocabulary plays a part (Williams & Jacobs, 2009). Some features of Aboriginal communities may also provide

“protection” against some of the commonly reported risks for vocabulary development. As an example, Aboriginal communities are known to have broad concepts of family, having a number of adults with active parenting roles which may protect against the risks of single parent status and having many children in the home.

Finally, not all Aboriginal communities are the same, and in previously studied cohorts a sizeable percentage of the Aboriginal children lived remotely and did not speak English as their first language (Butcher, 2008). Thus, urban Aboriginal children, such as those reported in this paper who speak English as their first language, may demonstrate different patterns of language acquisition than rural or remote groups speaking Indigenous first languages.

This paper reports data on the Gudaga study, a longitudinal urban Australian Aboriginal birth cohort study that began in 2005. The aim of this study was to describe the factors of influence on the 3 year old receptive vocabulary skills of urban Australian Aboriginal children and quantify and the association of these factors with vocabulary development over time to 8 years. Specifically, we were interested in determining what, if any, protective or risk factors emerge for Aboriginal children’s vocabulary development.

## **Methods**

- *Study Design*

The Gudaga study’s objective is to describe the health, development and service use of urban Aboriginal children (0-9yrs) and their families. The study is guided by a team of Aboriginal and non-Aboriginal academics and practitioners who have strong links with the local Tharawal community and provides a unique opportunity to look in detail at the language development of urban Aboriginal children. Between October 2005 - May 2007, all mothers and babies on the maternity ward of Campbelltown Hospital, New South Wales were surveyed and asked if either parent identified as Aboriginal. If so they were invited to

participate in this study (N = 178) and 159 children of Aboriginal families consented and were recruited. Later a further 6 children were recruited via friends and family, thus 165 children were recruited by 2 years of age. For a detailed explanation of recruitment methods see Comino et al. (2010).

Mothers and carers were surveyed about themselves and their children and family every 6 months by trained Aboriginal research assistants, and some data for the current study were taken from these surveys.

Children's developmental progress was also formally assessed at 4 time points: 3 years (T1), prior to formal schooling (T2), and end of the first (T3) and second year of formal schooling (T4). This study utilises data collected at each of these time points. The longitudinal nature of the study means some participants contributed data at some but not all time points (see figure 1).

*Insert figure 1 about here*

- *Participants*

Of the 165 participants recruited, 128 were assessed at the 3 year assessment (37 were lost to follow up). 117 participants completed two or more of the primary outcome measures over the four testing time periods. Another four participants had missing predictive data points. Thus, 113 (68% of total cohort) were eligible for inclusion in the analyses with primary outcome data. Participant retention is shown in figure 1. Comparison of the current study group (the vocabulary cohort) and the original total Campbelltown birth population (table 1), demonstrates participants in this study are representative of the original cohort. Notably, this cohort is all English speaking with no other reported languages by the families. As shown in a previous study on the Gudaga cohort (Miller, Webster, Knight, & Comino, 2013) some Aboriginal English may be present, but this was not reported by the families as a different language.

***Insert Table 1 about here***

- *Outcome Measure*

The outcome measure of interest was receptive vocabulary. A score for each participant was derived from the number of words correctly identified on The Peabody Picture Vocabulary Test (Fourth Edition: PPVT-IV)(Dunn & Dunn, 2007) a norm referenced test of receptive vocabulary. Raw scores were utilised in analysis as they have been found to be valid indicators of vocabulary longitudinally, can be sensitive to small growth changes over time (Sullivan, Winter, Sass, & Svenkerud, 2014). Use of these rather than standard scores allowed comparison of language growth trajectories within the sample and avoided comparing Australian Indigenous children to an American normed sample. Age is accounted for in the multilevel model as outlined below. The PPVT was administered at the four time points outlined above. Table 2 contains the number of children tested at each time, age and PPVT score mean, range and standard deviations.

***Insert Table 2 about here***

- *Independent Predictors*

Two groups of variables have been collected and explored (see table 3), their choice guided by the ecological model (Bronfenbrenner, 1977), and evidence for associations and influence on the outcome of interest: vocabulary. Firstly, *less manipulable variables* (Schjolberg, Eadie, Zachrisson, Oyen, & Prior, 2011), unchanging constructs or those not easily influenced by treatment (e.g. gender) or those with complex associations with many other factors (e.g. maternal education). Notably SES has not been included as there was little variability in this factor. The majority of the sample live in low SES suburbs (table 1). Thus, this variable was less able to differentiate between members of the cohort. Secondly, more *manipulable*

*variables* were included, which we hypothesised could be influenced by treatment to improve vocabulary development. Both less and more manipulable variables were divided into three broad groups (maternal, child and family/environment), containing the following thirteen variables. Less manipulable (see table 3): Maternal- age at birth, education and antenatal psychosocial distress; child - gender and birth weight; family - single parent status and the number of children in the household. Rather than the usual number of siblings the number of children in the home was an attempt to accommodate for the well reported broader concept of family within the Australian Indigenous culture with more extended family members living together (Baxter, 2013). More manipulable variables (see table 3): Maternal- distress at 3 years; Child- documented hearing loss and behaviour at 3 years, non-verbal cognitive skill; Family/environment- the amount the child had been read to at 3 years and child care attendance. All variables were dichotomised for statistical analysis based on previous findings in the literature for example the number of children in the home (Taylor et al., 2013) except in the case of “amount read to” where a mean split was used to achieve maximum variance/significance in the model. Univariate analysis of interaction with PPVT at baseline and overtime was conducted.

***Insert Table 3 about here***

- *Data Analysis*

Multilevel models were used to analyse the PPVT raw scores over 4 time points. Model parameter estimates were estimated by restricted maximum likelihood (REML) and Satterthwaite degrees of freedom were used. Each of the 13 maternal, child and family/ environment characteristics and children’s receptive vocabulary

were individually modelled against the outcome after adjusting for time (in months). An interaction variable between these characteristics and time was included in the model to determine whether the characteristics were associated with the slope of vocabulary raw scores over time. Any variable that had  $p < 0.1$ , either at baseline or over time in the individual risk factor analysis was included in the initial adjusted model (Table 3). Due to the sample size, we restricted the number of variables included in the initial model to a maximum of 5 variables which showed the strongest effects based on the coefficients and p-values. Variables that maintained significance at  $p < 0.05$  either at baseline or over time were kept in the adjusted model (Table 4). The data analysis for this paper was generated using SAS Enterprise Guide software, Version 6.1 of the SAS System for Windows.

- *Ethics*

The study was approved by the Ethics Committees of Sydney South West Local Health District, UNSW Australia & the NSW Aboriginal Health & Medical Research Council.

## **Results**

- *Trajectory of PPVT by Age*

To assess the trajectory pattern of PPVT over time, a range of models including random intercepts, random slopes, fixed/random quadratic models, and fixed/random piecewise models were constructed. Log-likelihood ratio tests were performed between each model to determine the significance of additional parameters in more complex models. A random slope model with a linear age term was found to be the most parsimonious that described the trajectory of vocabulary development sufficiently. This suggests that a linear trend explains the trajectory of vocabulary over time. In particular, 95% of children began baseline (3

years) understanding between 16-53 words on the PPVT, and grew 1-2 words per month. This is illustrated in figure 2.

***Insert figure 2 about here***

- *Individual effects of variables at baseline and longitudinally*

Five predictors met the criteria of  $p < 0.1$  at baseline or longitudinally for inclusion into the adjusted model (Table 3). These included one maternal (education), two family / Environmental (number of children in the household and amount the children were read to ) and two child factors (gender & non-verbal cognitive skills); Mothers education, number of children in the household and child gender were considered less manipulable factors whilst non-verbal cognitive skills and amount read to were considered more manipulable risk factors.

***Insert Table 4 about here***

- *Adjusted effects of variables at baseline and longitudinally*

All five predictors that were significant at baseline and/or longitudinally were included in the initial model. Amount the children were read to was subsequently removed since it no longer remained significant in the multivariate model. The final model included four variables as outlined in table 4. In this final model, age alone explained 76% of the variation in PPVT score (Table 5). The less manipulable factors explained an extra 2%, and the more manipulable factor explained another 2% of the variation in vocabulary. Table 5 shows the fixed effects of these variables by age alone, followed by less manipulable factors added, then finally the more manipulable factor included.

***Insert Table 5 about here***

At 3 years the children of more educated mothers had on average 5.2 more words than children of mothers with 11 or less years of schooling ( $p = 0.04$ ). Whilst the trajectory of development was not significantly different ( $p = 0.33$ ), by 8 years of age the children of more educated mothers were on average 10 words ahead (figure 3). At baseline, the children of smaller households had on average 5.3 more words than children in larger households at 3 years ( $p = 0.02$ ). Children in larger households learnt faster by 0.16 words per month compared to households with fewer children ( $p = 0.05$ ) (see figure 3).

At 3 years, the children with higher non-verbal cognition had on average 9.3 more words than children with lower non-verbal cognition ( $p < 0.01$ ) (figure 3). Whilst the longitudinal effect was not significant ( $p = 0.41$ ), the actual difference did decrease from on average 10 more words known (at 3 years) by the higher non-verbal group and remained significant until 6 years and by 8 years was non significant.

*Insert Figure 3 about here*

At 3 years, girls performed significantly better than boys on receptive vocabulary with on average 4.4 more words than boys at this time point ( $p = 0.04$ ) (figure 3). The trajectory of development was not significantly different between the two groups ( $p = 0.33$ ), and by 5 years ( $p = 0.28$ ) there was no significant difference between boys' and girls' vocabulary.

- *Sensitivity Analysis*

An analysis was conducted comparing the group of children who completed all four PPVT assessments ( $n = 57$ ) and those who did not ( $n = 56$ ). Children with mothers of low education ( $p = 0.0006$ ), and those children older at their kindergarten assessment ( $p = 0.0003$ ) were significantly more likely to receive all assessments. There were no significant differences in the PPVT scores between children who had subsequent assessments and those who did not. A multiple imputation model for the final adjusted model

showed no large or significant differences in the parameter estimates except for gender, however, the p-value at baseline changed from  $p = 0.04$  to  $p = 0.08$ .

## Discussion

This study examined the longitudinal vocabulary development of a population cohort of urban Aboriginal children between 3 and 8 years and explored the risk and protective factors for this development. This hard to reach and maintain group of participants have rarely been studied longitudinally. The results showed, similar to other studies of Australian children's receptive language (Christensen et al., 2014; McKean et al., 2015; Taylor et al., 2013) that the influences on vocabulary development differ during early acquisition to those that have an impact over time. This is the first study to our knowledge to confirm this finding in a cohort of young urban Aboriginal children.

Higher maternal education, like many previous studies, was found to be protective for better vocabulary development at 3 years and this difference was maintained over time. Maternal education can be important for a variety of reasons. Within the context of our analyses, we hypothesize it primarily relates to mothers' own language skills and use of varied words and language structures (Hart & Risely, 1995), however, it may also influence household income and related access to higher quality services such as child care (Baydar et al., 2014). The Gudaga children were no different to other Australian and international cohorts of children in that their mothers education level had a significant impact on their vocabulary acquisition. There is recent research (Magnuson, Sexton, Davis-Kean, & Huston, 2009) that indicates mothers continuing to study after the birth of their baby may have positive influences on their children's development. Further research exploring interventions targeting Aboriginal mothers return to study may show a beneficial outcome for both the mothers, children and the community.

The influence of the number of children in the home, taps into the parent to child ratio at home and thus the opportunity for focused parent child interaction and rich language experiences. We included the number of

children in the home rather than siblings to represent the broader concept of family that exists in Australian Indigenous families and in fact it showed a unique pattern of influence not seen in other studies.

Interestingly this longitudinal study has shown those children with many other children in their home made a rapid increase in development around the time of starting school. We hypothesise this boost may be related to the children's introduction to school and supports ongoing efforts to improve Indigenous children's attendance at school and even more so, quality preschool education settings. Additionally, this finding may relate to changes socio - developmentally in the most common interactive partner of the child. Early on the parent – child dyad is crucial in development which in these families is protective for early vocabulary development with fewer children interacting with the mother. However later, after 4 years, may be a shift to more peer interactive play which facilitates the influence of the broader Aboriginal family and network on learning. Future research should explore this phenomena.

Non-verbal cognitive skills and the relationship with vocabulary in this cohort were also found to be similar to children of other nations (Beitchman et al., 2008; Law et al., 2012). Those children with significantly lower non-verbal cognitive skills at 3 years had significantly lower vocabulary and there was no catch up over time. Vocabulary remained significantly low to 8 years. We considered this a manipulable construct and as such, intervention prior to 3 years may be an opportunity to change this trajectory. Future research of developmental interventions prior to 3 years needs to be explored for the long term protective impact on vocabulary.

Girls in the Gudaga cohort were ahead of boys at younger ages but this difference did not maintain over time. Longitudinally, the finding is consistent with international research that has shown boys have a faster trajectory of development between 3 and 5 years and catch up to girls (Law et al., 2013; Zambrana, Ystrom, & Pons, 2012). This observation supports the notion that, despite girls having an early language advantage,

there is little difference between boys and girls by school entry, Australian Aboriginal children performing similarly to other children across the world.

Interestingly little of the variance found in the receptive vocabulary development over time was explained by the four factors. Contrary to McKean et al's (2015) findings, where a sizable portion of the variance was explained by manipulable factors, the majority of the change in this study was explained by age then 4% by the four predictors, only 2% of which was classed as manipulable. This may be related to limiting language skill to the measure of receptive vocabulary in this study. The PPVT only measures single word comprehension where as an investigation of broader language skills including syntax, expression and memory components may have resulted in different findings. Also, the sample size required use of dichotomised variables which will have limited the within group variance. Similarly this specialist cohort is likely to display less variance than a full population cohort. Future research with larger samples would help build more comprehensive models of these risks and protection.

This cohort is unique in Indigenous communities in that none of the children spoke a first language other than English, though AAE may have been present. This has allowed exploration of the social and family factors affecting English language development without the influence of bilingualism. However in future studies a measure of the use of AAE would be beneficial. Most of the children in this cohort came from low SES homes, this is similar to Aboriginal children across Australia. There is now a history of research (Hart & Risley, 1995) showing children from low SES homes as a group have access to less rich language environments. Consequently, we call for early intervention (antenatal – 2 or 3 years) treatments designed specifically for Aboriginal communities allowing for culturally specific sensitivity, intergenerational poverty and long term educational disadvantage. Home visiting models, tailored for these at risk children and families which include training of mothers and maybe other key people in the family / community network in the facilitation of language skills may be one promising option. In the future we require research that

investigates the impact of these types of interventions on language and other developmental outcomes in this population.

- *Limitations*

This study presented many challenges which are also limitations for example sample size and retention. However this is one of the few studies to work with this hard to reach and maintain population in a longitudinal manner. All variables were dichotomised for the purposes of this analysis which necessitated decisions about cut points were made. These require scrutiny and replication. The outcomes of our model could potentially change were different cut points chosen. While receptive vocabulary has been studied internationally in research, it only explores one aspect of language development. There are many more aspects to language development which warrant close attention and have long term impacts on the educational and life outcomes of Aboriginal children.

## **Conclusion**

This study longitudinally followed a cohort of low SES urban Aboriginal children and found the drivers of receptive vocabulary development was similar to other children from Australian and international cohorts. Aboriginal children's vocabulary development is protected by more highly educated mothers and good early non-verbal cognitive skills. Indigenous children living in households with many other children have faster developing vocabulary when they enter school. Over four years of age there were no differences based on gender in understanding words. Interventions and public policy to improve maternal engagement with education prior to having children, incorporating the community network around the child into treatments and early childhood interventions promoting verbal and non-verbal cognitive skills may have potential to improve vocabulary acquisition in Aboriginal children. This in turn may be protective for later language, social-emotional wellbeing, literacy and academic outcomes.

### Key Messages

- Australian Aboriginal children's vocabulary development is similar to children of other ethnicities.
- Maternal education is protective for urban Aboriginal children's vocabulary development at 3 years and over time. We continue to need interventions to keep young girls and women in the education system.
- The number of children in Aboriginal households makes an impact on children's vocabulary and this impact varies over time.
- From 3 to 6 years those with early poor non-verbal cognitive skills have vocabulary skills that remain below the stronger non-verbal performers
- Girls have more advanced vocabulary at earlier ages on but this is not maintained over time

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## References

- ABS. (2006). *Information paper: An introduction to Socio-Economic Indexes for Areas (SEIFA)*. Canberra, Australia.
- AIHW. (2009). *Measuring the social and emotional wellbeing of Aboriginal and Torres Strait Islander peoples (Cat. No. 24)*. Canberra: Australian Institute of Health Welfare.
- Australian Bureau of Statistics. (2011). *Census of Population and Housing: Characteristics of Aboriginal and Torres Strait Islander Australians (Cat. no. 2076.0)* Canberra, Australia: Australian Bureau of Statistics.
- Baxter, J. A. (2012). The family circumstances and wellbeing of Indigenous and non-Indigenous children. *Growing up in Australia: The Longitudinal Study of Australian Children Annual statistical report*.
- Baxter, J. A. (2013). *The family circumstances and wellbeing of Indigenous and non-Indigenous children. Growing up in Australia: The Longitudinal Study of Australian Children annual statistical report 2012*. Melbourne: Australian Institute of Family Affairs.
- Baydar, N., Kuntay, A. C., Yagmurlu, B., Aydemir, N., Cankaya, D., Goksen, F., & Cemalcilar, Z. (2014). "It takes a village" to support the vocabulary development of children with multiple risk factors. *Developmental Psychology*, 50(4), 1014-1025.
- Beitchman, J. H., Jiang, H., Koyama, E., Johnson, C. J., Escobar, M., Atkinson, L., . . . Vida, R. (2008). Models and determinants of vocabulary growth from kindergarten to adulthood. *Journal of Child Psychology and Psychiatry*, 49(6), 626-634.
- Bornstein, M. H., Hahn, C.-S., & Haynes, O. M. (2004). Specific and general language performance across early childhood: Stability and gender considerations. *First Language*, 24(3), 267-304.

- Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist*, 32(7), 513-531.
- Buckley, S., Underwood, C., & Purdie, N. (2013). Footprints in Time: Who Am I? and Renfrew Word Finding Vocabulary Test, Report on Wave 2 Data. In T. A. C. o. E. Research (Ed.). Retrieved from [http://www.fahcsia.gov.au/sites/default/files/files/about-fahcsia/publication-articles/footprints/who\\_am\\_i.pdf](http://www.fahcsia.gov.au/sites/default/files/files/about-fahcsia/publication-articles/footprints/who_am_i.pdf) on 18/6/13.
- Butcher, A. (2008). Linguistic aspects of Australian Aboriginal English. *Clinical linguistics & phonetics*, 22(8), 625-642.
- Calvo, A., & Bialystok, E. (2014). Independent effects of bilingualism and socioeconomic status on language ability and executive functioning. *Cognition*, 130(3), 278-288.
- Christensen, D., Zubrick, S. R., Lawrence, D., Mitrou, F., & Taylor, C. L. (2014). Risk Factors for Low Receptive Vocabulary Abilities in the Preschool and Early School Years in the Longitudinal Study of Australian Children. *PLoS ONE*, 9(7), e101476.
- Closing The Gap Clearinghouse. (2014). *Ear disease in Aboriginal and Torres Strait Islander children (Resource Sheet No. 35)*. Canberra: Australian Institute of Health and Welfare & Melbourne: Australian Institute of Family Studies.
- Comino, E., Craig, P., Harris, E., McDermott, D., Harris, M., Henry, R., . . . Knight, J. (2010). The Gudaga Study: establishing an Aboriginal birth cohort in an urban community. *The Australian and New Zealand Journal of Public Health*, 34 Suppl 1, S9-17.
- Comino, E., Knight, J., Webster, V., Pulver, L. J., Jalaludin, B., Harris, E., . . . The Gudaga Research Team. (2012). Risk and protective factors for pregnancy outcomes for urban Aboriginal and non-Aboriginal mothers and infants: the Gudaga cohort. *Maternal and Child Health Journal*, 16(3), 569-578.
- Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression: Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry*, 150, 782-786.

- Department of the Prime Minister & Cabinet. (2016). *Closing the Gap Prime Minister's Report 2016*. Canberra, Australia.
- Dunn, L. M., & Dunn, D. M. (2007). *Peabody Picture Vocabulary Test* (Fourth Edition ed.). Bloomington, MN: Pearsons.
- Durham, R. E., Farkas, G., Hammer, C. S., Tomblin, B. J., & Catts, H. W. (2007). Kindergarten oral language skill: A key variable in the intergenerational transmission of socioeconomic status. *Research in Social Stratification and Mobility*, 25(4), 294-305.
- Epstein, M. H., & Nelson, J. R. (2006). USA Patent No. Lincoln: University of Nebraska: Center for At-Risk Children's Services.
- FaHCSIA. (2012). *Footprints in Time: The Longitudinal Study of Indigenous Children Key Summary Report from Wave 3*. Canberra, Australia: Department of Families Housing Community Services and Indigenous Affairs.
- Farkas, G., & Beron, K. (2004). The detailed age trajectory of oral vocabulary knowledge: Differences by class and race. *Social Science Research*, 33(3), 464-497.
- Farrant, B. M., Shepherd, C. C. J., Walker, R. D., & Pearson, G. C. (2014). Early Vocabulary Development of Australian Indigenous Children: Identifying Strengths. *Child Development Research*, 2014, 7.
- Farrant, B. M., & Zubrick, S., R. (2013). Parent-child book reading across early childhood and child vocabulary in the early school years: Findings from the Longitudinal Study of Australian Children. *First Language*, 33(3), 280-293.
- Griffiths, R. (2006). *Griffiths Mental Development Scales* (Third Edition ed.): Hogrefe Ltd.
- Guthridge, S., Li, L., Silburn, S., Li, S. Q., McKenzie, J., & Lynch, J. (2016). Early influences on developmental outcomes among children, at age 5, in Australia's Northern Territory. *Early Childhood Research Quarterly*, 35, 124-134.

- Harrison, L., & McLeod, S. (2010). Risk and protective factors associated with speech and language impairment in a nationally representative sample of 4- to 5-year-old children. *Journal of Speech, Language, and Hearing Research*, 53(2), 508-529.
- Harrison, L., McLeod, S., Berthelsen, D., & Walker, S. (2009). Literacy, numeracy, and learning in school-aged children identified as having speech and language impairment in early childhood. *International Journal of Speech-Language Pathology*, 11(5), 392-403.
- Harrison, L., Ungerer, J., Smith, G., Zubrick, S., Wise, S., Press, F., . . . The LSAC Research Consortium. (2009). *Child care and early education in Australia. The Longitudinal Study of Australian Children*. Retrieved from Canberra, Australia
- Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*: Paul H Brookes Publishing.
- Hoff, E. (2002). The Specificity of Environmental Influence: Socioeconomic Status Affects Early Vocabulary Development Via Maternal Speech. *Child Development*, 74(5), 1368-1378.
- Hoff, E. (2003). The Specificity of Environmental Influence: Socioeconomic Status Affects Early Vocabulary Development Via Maternal Speech. *Child Development*, 74(5), 1368-1378.  
doi:10.1111/1467-8624.00612
- Jackson, C. W., Schatschneider, C., & Leacox, L. (2014). Longitudinal analysis of receptive vocabulary growth in young Spanish English-speaking children from migrant families. *Language, Speech, and Hearing Services in Schools*, 45(1), 40-51.
- Kessler, R., & Mroczek, D. (1992). An update of the development of mental health screening scales for the US National Health Interview Survey. *Ann Arbor MI: Survey Research Centre of the Institute for Social Research, University of Michigan.*, 22.
- Law, J., Rush, R., Anandan, C., Cox, M., & Wood, R. (2012). Predicting language change between 3 and 5 years and its implications for early identification. *Pediatrics*, 130(1), e132-e137.

- Law, J., Rush, R., Parsons, S., & Schoon, I. (2013). The relationship between gender, receptive vocabulary, and literacy from school entry through to adulthood. *International Journal of Speech-Language Pathology*, 15(4), 407-415.
- Lee, J. (2011). Size matters: Early vocabulary as a predictor of language and literacy competence. *Applied Psycholinguistics*, 32(1), 69-92.
- Leffel, K., & Suskind, D. (2013). Parent-directed approaches to enrich the early language environments of children living in poverty. *Seminars in Speech and Language*, 34(4), 267-278.
- Leigh, A., & Gong, X. (2009). Estimating cognitive gaps between Indigenous and non-Indigenous Australians. *Education Economics*, 17(2), 239-261.
- Leijon, I., Ingemansson, F., Nelson, N., Wadsby, M., & Samuelsson, S. (2016). Reading deficits in very low birthweight children are associated with vocabulary and attention issues at the age of seven. *Acta Paediatrica*, 105(1), 60-68.
- Magnuson, K. A., Sexton, H. R., Davis-Kean, P. E., & Huston, A. C. (2009). Increases in maternal education and young children's language skills. *Merrill-Palmer Quarterly*, 55(3), 319-350.
- Mahadevan, M., Navarro-Locsin, G., Tan, H. K., Yamanaka, N., Sonuwan, N., Wang, P. C., . . . Vijayasekaran, S. (2012). A review of the burden of disease due to otitis media in the Asia-Pacific. *International Journal of Pediatric Otorhinolaryngology*, 76(5), 623-635.
- McKean, C., Mensah, F. K., Eadie, P., Bavin, E. L., Bretherton, L., Cini, E., & Reilly, S. (2015). Levers for Language Growth: Characteristics and Predictors of Language Trajectories between 4 and 7 Years. *PLoS ONE*, 10(8), e0134251.
- McRae, D. (2007). *What works: The Work Program. Indigenous education: International perspectives*. Canberra, Australia.

- Miller, E., Webster, V., Knight, J., & Comino, E. (2013). The use of a standardized language assessment tool to measure the language development of urban Aboriginal pre-schoolers. *International Journal of Speech-Language Pathology*, 16(2), 109-120.
- Mol, S. E., & Bus, A. G. (2011). To read or not to read: a meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin*, 137(2), 267-296.
- Mol, S. E., Bus, A. G., de Jong, M. T., & Smeets, D. J. H. (2008). Added Value of Dialogic Parent–Child Book Readings: A Meta-Analysis. *Early Education and Development*, 19(1), 7-26.
- Pearce, W. M., Williams, C., & Steed, W. (2015). Dialectal grammatical differences in oral narratives of school-aged Indigenous Australian children. *Int J Speech Lang Pathol*, 17(4), 335-345.  
doi:10.3109/17549507.2014.979878
- Reilly, S., Bavin, E. L., Bretherton, L., Conway, L., Eadie, P., Cini, E., . . . Wake, M. (2009). The early language in Victoria study (ELVS): A prospective, longitudinal study of communication skills and expressive vocabulary development at 8, 12 and 24 months. *International Journal of Speech-Language Pathology*, 11(5), 344-357.
- Rice, M. L., & Hoffman, L. (2015). Predicting Vocabulary Growth in Children With and Without Specific Language Impairment: A Longitudinal Study From 2; 6 to 21 Years of Age. *Journal of Speech, Language, and Hearing Research*, 58(2), 345-359.
- Roberts, J. E., Rosenfeld, R. M., & Zeisel, S. A. (2004). Otitis media and speech and language: a meta-analysis of prospective studies. *Pediatrics*, 113(3 Pt 1), e238-248.
- Rowe, M. L. (2012). A Longitudinal Investigation of the Role of Quantity and Quality of Child-Directed Speech in Vocabulary Development. *Child Development*, 83(5), 1762-1774.
- Schjolberg, S., Eadie, P., Zachrisson, H. D., Oyen, A.-S., & Prior, M. (2011). Predicting language development at age 18 months: Data from the Norwegian Mother and Child Cohort Study. *Journal of Developmental and Behavioral Pediatrics*, 32(5), 375-383.

- Schoon, I., Parsons, S., Rush, R., & Law, J. (2010). Childhood language skills and adult literacy: A 29-year follow-up study. *Pediatrics*, 125(3), e459-e466.
- Skeat, J., Wake, M., Reilly, S., Eadie, P., Bretherton, L., Bavin, E. L., & Ukoumunne, O. C. (2010). Predictors of early precocious talking: A prospective population study. *Journal of Child Language*, 37(5), 1109-1121.
- Skelton, F., & Bennetts Kneebone, L. (2015). *The effect of maternal age at first birth on vocabulary and social and emotional outcomes for Aboriginal and Torres Strait Islander children*. Canberra, Australia.: Department of Social Services, Australian Government.
- Sullivan, J. R., Winter, S. M., Sass, D. A., & Svenkerud, N. (2014). Assessing growth in young children: A comparison of raw, age-equivalent, and standard scores using the Peabody Picture Vocabulary Test. *Journal of Research in Childhood Education*, 28(2), 277-291.
- Taylor, C. L., Christensen, D., Lawrence, D., Mitrou, F., & Zubrick, S. R. (2013). Risk Factors for Children's Receptive Vocabulary Development from Four to Eight Years in the Longitudinal Study of Australian Children. *PLoS ONE*, 8(9), e73046.
- Williams, C. J., & Jacobs, A. M. (2009). The impact of otitis media on cognitive and educational outcomes. *Medical Journal of Australia*, 191(9), s69-s72.
- Zambrana, I. M., Pons, F., Eadie, P., & Ystrom, E. (2014). Trajectories of language delay from age 3 to 5: persistence, recovery and late onset. *International Journal of Language & Communication Disorders*, 49(3), 304-316.
- Zambrana, I. M., Ystrom, E., & Pons, F. (2012). Impact of gender, maternal education, and birth order on the development of language comprehension: A longitudinal study from 18 to 36 months of age. *Journal of Developmental and Behavioral Pediatrics*, 33(2), 146-155.
- Zubrick, S., Silburn, S., De Maio, J., Shepherd, C., Griffin, J., Dalby, R., . . . Cox, A. (2006). *The Western Australian Aboriginal Child Health Survey: improving the educational experiences of Aboriginal*

*children and young people* Perth: Curtin University of Technology and Telethon Institute for Child Health Research.

Zubrick, S., Silburn, S. R., & Prior, M. (2005). Resources and contexts for child development: Implications for children and society. In S. Richardson & M. Prior (Eds.), *No time to lose: The wellbeing of Australia's children*. Carlton, VIC: Melbourne University Press.

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Figure 1: Participant recruitment and retention

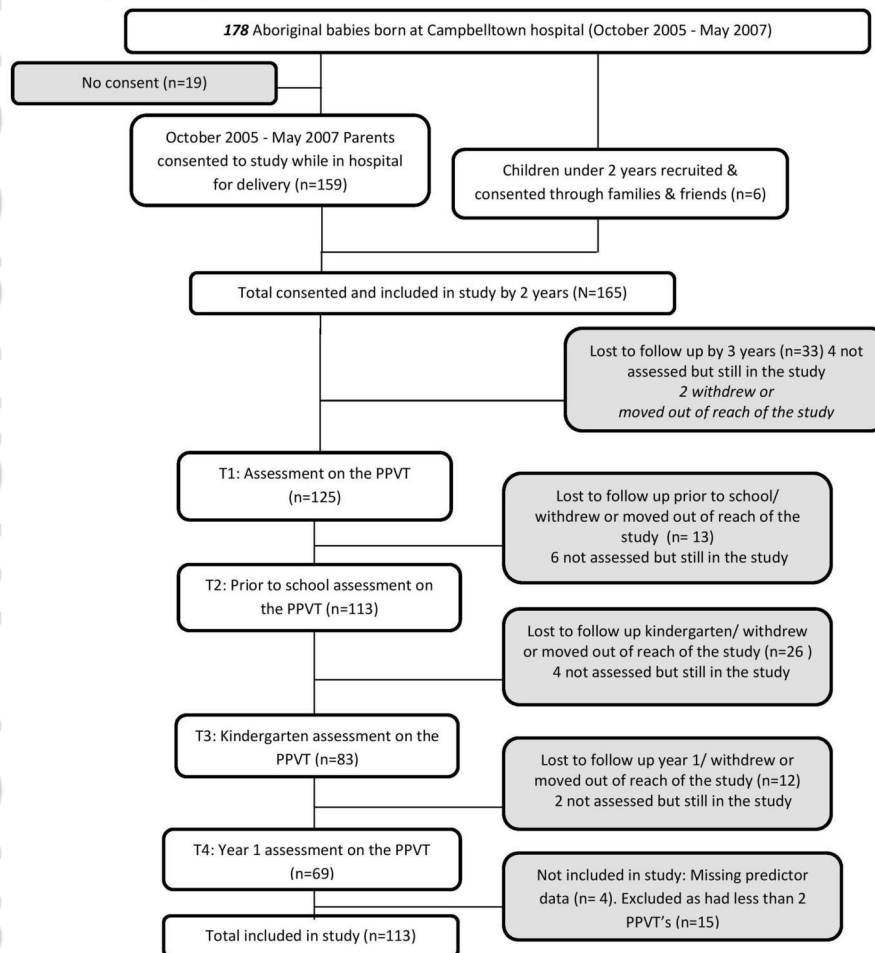
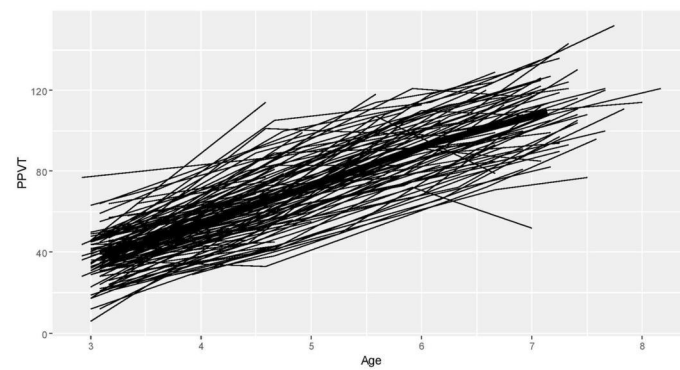
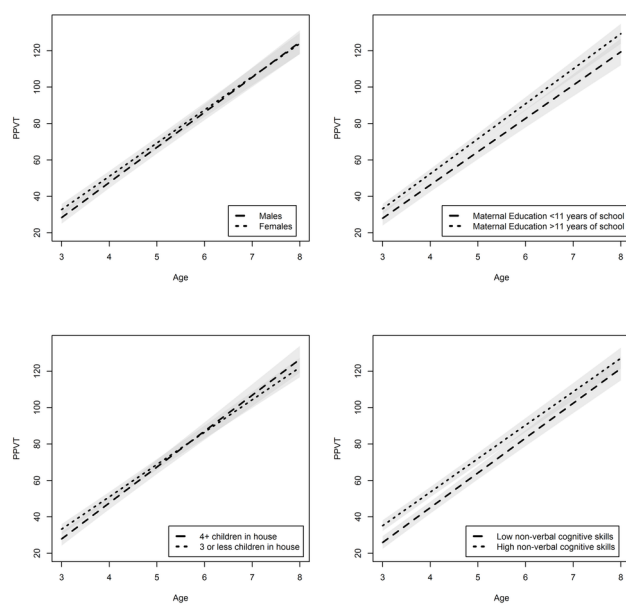


Figure 2: Empirical growth plots for all participants





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