

Early vocabulary development: The importance of joint attention and parent-child book reading

First Language
32(3) 343–364
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DOI: 10.1177/0142723711422626
fla.sagepub.com


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Abstract

The current study brought a bioecological approach to children's early vocabulary development using data from the Longitudinal Study of Australian Children. Relevant data were available for 2188 children (1119 male) who had a median age of 9 months ($M = 9.3$ months, $SD = 2.1$ months) at Wave 1 and a median age of 34 months ($M = 34.2$ months, $SD = 2.5$ months) at Wave 2. Results support the developmental importance of joint attention and parent-child book reading as well as the argument that the effects of individual (e.g., parent) and environmental (context) characteristics are primarily indirect, mediated through their impact on proximal processes (Bronfenbrenner, 1995). The evidence indicates that joint attention and parent-child book reading are important facilitators of children's early vocabulary development.

Keywords

bioecological theory, joint attention, language development, parent-child book reading, proximal processes, vocabulary development

Although a large body of work has investigated the individual and environmental factors associated with children's language development there is a dearth of research assessing the relations among these factors particularly in early development. Proponents of social constructivist (e.g., Vygotsky, 1934/1962) and bioecological (e.g., Bronfenbrenner, 1979) theories have long pointed out the pivotal developmental role played by ongoing reciprocal social interactions (proximal processes). From this perspective, the developmental

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effects of individual (e.g., child, parent) and environmental (context) characteristics are primarily indirect, mediated through their impact on proximal processes (Bronfenbrenner, 1995). That is, individual and environmental characteristics have developmental importance to the extent that they prompt, facilitate or constrain (Zubrick et al., 2009) the proximal processes through which development occurs. The present study investigated the relations among the individual, contextual, and proximal process factors involved in children's early vocabulary development.

One of the advantages of the bioecological perspective is that it explicitly recognizes that parent-child interaction occurs within and is affected by the family context which is itself embedded in and influenced by the broader community and societal contexts (Bronfenbrenner, 1986). The importance of time is also explicitly recognized in a number of ways. Proximal processes are patterns of reciprocal social interaction that occur on a regular basis over time (Bronfenbrenner, 1995). Different proximal processes are important at different times across the lifecourse and therefore the developmentally relevant individual and environmental characteristics will also vary across time. Proximal processes enable the intergenerational transmission of developmental resources including human, psychological and social capital (Bronfenbrenner, 1995; Zubrick et al., 2009). The dynamic nature of proximal processes means that developmental outcomes can become characteristics or resources that prompt, facilitate or constrain subsequent proximal processes (i.e., developmental ends become developmental means (Taylor, 2010). Thus, this approach recognizes the complex nature of human development and avoids the dichotomies (e.g., nature/nurture, genes/environment) that have long been rejected by biologists and other scientists (e.g., Alcock, 1998; Bateson, 2001; Oyama, 1985, 2001).

The bioecological approach is also reflected in recent theorizing in biology and developmental psychology that focuses on the importance and dynamic nature of parent-child interactions and shared activities, particularly in early development (e.g., Meaney, 2010; Racine & Carpendale, 2007). Because it has the ability to identify the mechanisms (proximal processes) through which development occurs, as well as the characteristics that prompt, facilitate and constrain these, the utility of the bioecological model for public health and epidemiological research is beginning to be recognized (Avan & Kirkwood, 2010). The present paper brings this endeavour to the study of children's early vocabulary development.

Joint attention and parent-child book reading are two of the proximal processes/shared activities that theorists have argued to be involved in early vocabulary development (e.g., Baldwin, 1995; Ninio & Bruner, 1978). Joint or shared attention refers to the practice of sharing attention (usually visual) by following the focus of another person's attention or by drawing their attention to one's own focus of attention (Williams, Whiten, Suddendorf, & Perrett, 2001). Consistent with the argument that developmental ends can become developmental means, joint attention is itself the outcome of earlier proximal processes and the characteristics and resources that prompted and facilitated these. One of the first proximal processes to be established in ontogeny is parent-infant eye contact and this is prompted by parents who, beginning in their earliest interactions, do things to establish eye contact with their infants (Keller & Gauda, 1987; Keller & Zach, 1993). Infants respond to this prompting with increases in looking and gazing at their caregivers between birth and around three to four months (Keller & Zach, 1993). The importance of parent-infant eye contact

as a proximal process for subsequent development is reflected in the finding that deficits in early parent-infant eye contact are associated with long-term adverse effects on interactional harmony, developmental delays, and behavioural problems (Keller & Zach, 1993).

Parent-infant eye contact plays a role in the development of socio-emotional reciprocity during face-to-face interactions which emerges at around six to eight weeks of age (Adamson, 1995). Socio-emotional reciprocity involves successions of changing emotional expressions that are mutually organized within the interaction (Trevvarthen & Aitken, 2001). Parent-infant eye contact and socio-emotional reciprocity facilitate proximal processes involving the mutual regulation of emotions and interests. These interactions have been identified as proto-conversations (Bateson, 1971, 1975, 1979) underlining the importance of these proximal processes for subsequent communication and language development. Note that although the capacity for cultural learning (including language learning) is grounded in the socio-emotional motivation to interact with others and the caregiving practices that foster this (Bruner, 1983; Trevvarthen & Aitken, 2001) it is not possible to reduce these proximal processes to individual (e.g., parent) and/or environmental (context) characteristics without losing that which is most important for development – it is behavioural interaction that drives socio-cultural development (Bronfenbrenner, 1995). Individual and/or environmental characteristics may prompt, facilitate or constrain the proximal processes that produce developmental outcomes but they are not the source of that development. This has parallels with Vygotsky's (1987) argument that we should be more concerned about what the individual can do with the help of a more experienced other (zone of proximal development) than with what the individual can do in isolation because it is the former that is the source of development.

Between three and six months of age objects are increasingly incorporated into parent-infant routines and games (Trevvarthen & Hubley, 1978). Infants respond to this prompting, which builds on proximal processes involving the mutual regulation of emotions and interests, and develop the ability to follow other people's head turns to a target in the infant's visual field (Leekam & Moore, 2001). These proximal processes are elaborated further so that by around nine months of age infants can follow other people's points or head turns to a target that is out of their visual field (Butterworth, 1991; Butterworth & Cochran, 1980; Corkum & Moore, 1998; Scaife & Bruner, 1975). Around nine months infants also start to use pointing gestures (Butterworth, 1991; Desrochers, Morissette, & Ricard, 1995) and, when showing objects to other people, alternate their eye contact between the other person and the object (Butterworth, 1995).

By 12 months of age these proximal processes have been elaborated to the point where children can follow an adult's focus of visual attention to an object (using cues such as the adult's gaze direction) to find the target of the adult's emotional outburst and make mappings between objects and affective states (Moses, Baldwin, Rosicky, & Tidball, 2001). This joint attention skill is involved in social referencing and research has found that the vocal emotional paralinguistic of adults is an effective regulator of child behaviour by 12 months of age (e.g., Mumme, Fernald, & Herrera, 1996). Tomasello and Todd (1983) argued that the provision of a language model during episodes of joint attention provides an effective way to learn word-object mappings. Indeed, by 16 months of age these proximal processes have been further elaborated so that children are able to learn word-object mappings when an adult follows the child's focus of visual attention to the object before

uttering the word (Baldwin, 1991, 1993b). Further elaboration means that at around 18 to 20 months of age, upon hearing an adult utter a novel word, children can follow the adult's focus of visual attention to an object (using cues such as the adult's gaze direction) and learn word-object mappings (Baldwin, 1993a, 1993b; Baldwin, Markman, Bill, Desjardins, & Irwin, 1996). Baldwin (1995) argued that this joint attention skill plays a pivotal role in the 'vocabulary explosion' which also occurs at around 18 to 20 months. This skill undergoes further elaboration such that two-year-olds can follow an adult's focus of visual attention and learn word-object mappings even when the object is temporarily out of sight of the child and/or adult when the novel word is spoken (Scofield & Behrend, 2011).

The findings of a number of studies support the role of joint attention in facilitating language and communication development for typically developing children, children with specific language impairment, and children with autism (Charman, 2003; Charman et al., 2003; Farrant, Maybery, & Fletcher, 2011; Peek, 1998; Poon, 2005; Whalen, Schreibman, & Ingersoll, 2006). Other research underscores the importance of joint attention for vocabulary development in particular (Dunham, Dunham, & Curwin, 1993; Kiernan & Gray, 1998; Saxon, 1997; Tomasello & Todd, 1983).

In many ways parent-child book reading is very similar to the proximal processes discussed above. Indeed, parent-child picture book reading simultaneously involves pointing gestures, joint attention and verbal labelling (Durkin, 1995). Thus, parent-child book reading provides an excellent opportunity for vocabulary expansion by learning word-object mappings in a more structured setting. As children's vocabulary increases, further elaboration of this proximal process allows children to learn the meanings of new words in terms of their existing vocabulary. The empirical evidence indicating that parent-child book reading expands children's vocabulary goes back decades (e.g., Highberger & Brooks, 1973) and the results of meta-analyses support the efficacy of parent-child book reading as a means of promoting vocabulary development (e.g., Bus, van Ijzendoorn, & Pellegrini, 1995; Mol, Bus, de Jong, & Smeets, 2008).

Thus, there is good evidence supporting the importance of the proximal processes of joint attention and parent-child book reading for children's early vocabulary development. Research has also found associations between a number of individual and environmental characteristics and children's vocabulary development. Factors associated with greater vocabulary development include being a girl (e.g., Berglund, Eriksson, & Westerlund, 2005), sociable/extroverted child temperament (Slomkowski, Nelson, Dunn, & Plomin, 1992), higher maternal age (e.g., Berryman & Windridge, 2000) and education (Dollaghan et al., 1999), warm/sensitive parenting (e.g., Roberts, Jurgens, & Burchinal, 2005), and higher socio-economic status (e.g., Arriaga, Fenson, Cronan, & Pethick, 1998). In contrast, having an emotionally reactive temperament (e.g., Noel, Peterson, & Jesso, 2008) and a larger number of siblings in the home (e.g., Nelson, 1973) are associated with smaller vocabulary development.

As noted above, the bioecological model being advocated here argues that the developmental effects of individual and contextual characteristics are primarily indirect, mediated through their impact on proximal processes (Bronfenbrenner, 1995). Thus, this model predicts that being a girl, having a sociable temperament, an older, more educated, or warmer mother, or higher socio-economic status is associated with greater vocabulary development because these characteristics facilitate joint attention and parent-child book

reading. In contrast, this model predicts that having an emotionally reactive temperament or a larger number of siblings in the home is associated with smaller vocabulary development because these characteristics constrain joint attention and parent-child book reading. The current study assessed these predictions with respect to children's vocabulary development between the ages of 9 and 34 months.

Method

Participants

The data reported here are from the ongoing project – Growing Up in Australia: the Longitudinal Study of Australian Children (LSAC). The original sample was broadly representative of all Australian children (Harrison, McLeod, Berthelsen, & Walker, 2009). Details regarding the rationale, sampling, recruitment, and data collection for LSAC have been reported by Gray and Sanson (2005) and Harrison et al. (2009). The analyses for the current paper are based on Waves 1, 1.5, and 2 data from the infant cohort of children who had a median age of 9 months (M age = 8.8 months, SD = 2.6 months) at the commencement of the LSAC project. A total of 5107 children (2610 boys) were recruited for Wave 1 in 2004, and these children were involved in subsequent Waves where possible. The parent who completed the Wave 1 interview was female in 98.7% of the cases and 99.7% were a biological parent of the study child. Hence the vast majority of parents interviewed were the biological mothers of the study children and the data reported here relate to responses from the parent/caregiver identified as the mother.

For the analyses reported here, children whose main language spoken at home was not English were excluded (552 children). The Communication and Symbolic Behaviour Scales were not completed by parents of infants who were less than 6 months of age at the time of the Wave 1 interview and this resulted in 511 children being excluded from the present analyses. Wave 1.5 data (duration of parent-child book reading) was not received from a further 1184 parents. Another 672 children had missing data on one or more variables and this meant that complete sets of the relevant data were available for 2188 children (1119 male) who had a median age of 9 months (M = 9.3 months, SD = 2.1 months) at Wave 1 and a median age of 34 months (M = 34.2 months, SD = 2.5 months) at Wave 2. Consistent with previous research, the group of children for whom complete data were not available (excluded children) were from more disadvantaged backgrounds than the children for whom complete data were available (included children). As can be seen in Table 1, the excluded children were from communities with significantly lower community SES scores, had mothers that were significantly younger and less educated, had significantly lower household incomes, and had significantly more siblings (all $ts > 4.57$, all $ps < .001$).

Measures

Joint attention. Joint attention was assessed at Wave 1 using a scale comprised of four items from the Communication and Symbolic Behaviour Scales (Wetherby & Prizant, 2002). The questions were: 1. When you look at and point to a toy across the room, does this child look at it?; 2. Does this child try to get you to notice interesting objects – just to get

Table 1. Included versus excluded children.

Variable	Excluded		Included	
	M	SD	M	SD
W1 Community SES	999.34	78.28	1009.49	78.69
W1 Household Income (\$)	1019.30	788.35	1286.08	929.67
W1 Number of Siblings	1.02	1.15	0.88	0.94
W1 Maternal Education (max. score 11)	7.00	2.15	7.71	1.88
W1 Maternal Age (years)	30.1	5.8	32.1	4.8

N = 2919 for excluded, 2188 for included.

you to look at the objects, not to get you do anything with them?; 3. Does this child show objects to you without giving you the object?; 4. Does this child point to objects? Mothers rated the frequency of the described behaviour on a 3-point scale ranging from 'not yet' to 'often'. Scores on the four items were averaged to give an overall score. For the present sample, the reliability of the joint attention scale was acceptable ($\alpha = .75$).

Parent-child book reading. The duration of parent-child book reading was measured via a mailout questionnaire between Waves 1 and 2 (Wave 1.5) using a single item ('On average, about how many minutes per day is your child read to at home?') which mothers rated on a 5-point scale ranging from 'less than 5 minutes/day' to 'more than 40 minutes/day'.

Child vocabulary. Child vocabulary was measured at Wave 1 using a question from the Communication and Symbolic Behaviour Scales (Wetherby & Prizant, 2002). Parents rated the question 'About how many different words does this child use so that you know what he/she means?' on a 5-point scale ranging from 'none' to 'over 30'. The Communication and Symbolic Behaviour Scales checklist scores have been found to have good test-retest stability and concurrent and predictive validity (Wetherby, Allen, Cleary, Kublin, & Goldstein, 2002). At Wave 2, child vocabulary was measured using the MacArthur Communicative Development Inventory III (MCDI-III, Fenson et al., 2006). The MCDI-III asks parents to check words their child says on a checklist and provides a valid measure of expressive vocabulary for children aged 30–37 months (Fenson et al., 2006). For the Australian version used in the LSAC the words 'reindeer', 'cracker' and 'sidewalk' were replaced with the words 'kangaroo', 'biscuit' and 'footpath' and the words 'kite' and 'away' were omitted, resulting in a 98-word checklist.

Child temperament. The approach-sociability, cooperation, and irritability subscales from the Short Temperament Scale for Infants (Sanson, Prior, Garino, Oberklaid, & Sewell, 1987; Smart & Sanson, 2005) were used as measures of child temperament at Wave 1. Each subscale contains four items that assess the degree of comfort when encountering new situations/people, adaptability and cooperation, and how fretful or difficult to soothe respectively. Parents rated the frequency of the described behaviour on a 6-point scale ranging from 'almost never' to 'almost always'. Scores on the four items were averaged to give an overall score for each facet of temperament. For the present sample, the

reliability of the approach-sociability ($\alpha = .74$) and cooperation ($\alpha = .66$) subscales was acceptable. However, the reliability of the irritability subscale was not as good ($\alpha = .57$).

Maternal age. The age of the child's mother in years was calculated at the time of the Wave 1 interview.

Maternal education. Self-reported details regarding maternal education level at Wave 1 were compiled into a 11-point scale ranging from 'never attended school' (scored as 1), 'year 8 or below' (scored as 2), 'year 9 or equivalent' (scored as 3), 'year 10 or equivalent' (scored as 4), 'year 11 or equivalent' (scored as 5), 'year 12 or equivalent' or 'still at school' (scored as 6), 'certificate or other' (scored as 7), 'advanced diploma/diploma' (scored as 8), 'bachelor degree' (scored as 9), 'graduate diploma/certificate' (scored as 10), through to 'postgraduate degree' (scored as 11).

Parenting. Warm and hostile parenting were measured at Wave 1 using scales of 6- and 4-items respectively (see Appendix). For warm parenting, parents rated the frequency of the described behaviour on a 5-point scale ranging from 'never/almost never' to 'always/almost always'. For hostile parenting, parents rated the frequency of the described behaviour on a 10-point scale ranging from not at all to all the time. Scores on the items were averaged to give overall scores for warm and hostile parenting. For the present sample, the reliability of the warm ($\alpha = .79$) and hostile ($\alpha = .82$) parenting scales was acceptable.

Number of siblings in the home. The number of siblings the child had in the home was calculated at the time of the Wave 1 interview. As the average age of the study children was 9 months at Wave 1 this measure will largely reflect the presence of older siblings in the home.

Household income. Weekly household income in Australian dollars was used as an indicator of socio-economic status of the family and this measure was derived by combining the reported income of the parent(s) who lived with the child at Wave 1.

Community socio-economic status. The Socio-Economic Index for Areas (SEIFA) index of relative advantage and disadvantage was used as a measure of community socio-economic status (SES). The SEIFA index of relative advantage and disadvantage is calculated by the Australian Bureau of Statistics (ABS) based on population census data relating to householder's education, occupation, employment, income, housing and household composition (ABS, 2004). The index is standardized to a mean of 1000 and standard deviation of 100 with higher scores reflecting greater advantage.

Results

Predicting children's Wave 2 vocabulary

Descriptive statistics are presented in Table 2. Inspection of the correlations between the measures revealed that child age and gender, maternal education and warm parenting,

Table 2. Means and standard deviations.

Variable	Boys and girls		Boys		Girls	
	M	SD	M	SD	M	SD
Child Vocabulary						
W2 Child Vocabulary (max. score 98)	56.64	23.95	53.87	24.47	59.55	23.04
W1 Child Vocabulary (max. score 4)	0.63	0.81	0.60	0.79	0.66	0.83
Proximal Processes						
W1 Joint Attention (max. score 3)	1.84	0.56	1.83	.55	1.86	.57
W1.5 Duration of Parent-Child Book Reading (max. score 5)	2.64	1.05	2.64	1.06	2.64	1.04
Child Characteristics						
W1 Child Approach Temperament (max. score 6)	4.74	0.83	4.82	0.80	4.65	0.84
W1 Child Cooperation Temperament (max. score 6)	4.10	0.87	4.09	0.89	4.12	0.86
W1 Child Irritable Temperament (max. score 6)	2.48	0.80	2.48	0.79	2.47	0.80
Maternal Characteristics						
W1 Maternal Age (years)	32.1	4.8	32.1	4.9	32.1	4.7
W1 Maternal Education (max. score 11)	7.71	1.88	7.72	1.86	7.69	1.91
W1 Maternal Warm Parenting (max. score 5)	4.54	0.40	4.54	0.39	4.53	0.41
W1 Maternal Hostile Parenting (max. score 10)	1.99	1.19	1.99	1.17	2.00	1.20
Environmental Characteristics						
W1 Number of Siblings	0.88	0.94	0.88	0.98	0.88	0.91
W1 Household Income (\$)	1286.08	929.67	1299.79	889.78	1271.73	969.87
W1 Community SES	1009.49	78.69	1009.71	78.54	1009.25	78.88

N = 2188 for boys + girls, 1119 for boys, 1069 for girls.

number of siblings, household income and community SES were all significantly related to Wave 2 child vocabulary and that the degree of multicollinearity between the predictor variables was acceptable (see Table 3).

Both joint attention at Wave 1 and parent-child book reading at Wave 1.5 were significant predictors of Wave 2 vocabulary as were Wave 1 vocabulary, community SES, child age, child gender, and child approach-sociability temperament (see Table 4). Among the predictors, parent-child book reading accounted for the largest unique proportion of Wave 2 MCDI-III vocabulary score (5%). Together the predictor variables explained 17% of the total variance in vocabulary performance.

Gender differences

Descriptive statistics for the children differentiated by gender are presented in Table 2. The boys and girls were matched in terms of child age at Waves 1 and 2 (both $t(2186) < 1.29$,

Table 3. Intercorrelations between variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. W2 Child Vocabulary	—															
2. W1 Child Vocabulary	.21 [†]	—														
3. W1 Joint Attention	.26 [†]	.54 [†]	—													
4. W1.5 Book Reading	.29 [†]	.07 [*]	.18 [†]	—												
5. W2 Child Age in Months	.22 [†]	.38 [†]	.44 [†]	.05 [*]	—											
6. Child Gender	.12 [†]	.04	.03	.00	.01	—										
7. W1 Child Approach Temperament	.02	-.04	-.02	.02	-.12 [†]	-.10 [†]	—									
8. W1 Child Cooperation Temperament	.00	-.01	-.02	.03	-.13 [†]	.02	.31 [†]	—								
9. W1 Child Irritable Temperament	-.01	-.01	-.04	.01	.01	-.01	.27 [†]	.31 [†]	—							
10. W1 Maternal Age	-.02	-.09 [†]	-.08 [†]	.03	.00	.01	-.04 [*]	-.02	.02	—						
11. W1 Maternal Education	.07 [*]	-.06 [*]	.00	.19 [†]	.02	-.01	.03	-.06 [*]	.05 [*]	.16 [†]	—					
12. W1 Maternal Warm Parenting	.05 [*]	.07 [*]	.13 [†]	.11 [†]	-.03	-.02	.17 [†]	.19 [†]	-.15 [†]	-.06 [*]	-.07 [*]	—				
13. W1 Maternal Hostile Parenting	-.01	.05 [*]	.02	-.03	.07 [*]	.01	-.17 [†]	-.15 [†]	.20 [†]	-.07 [*]	-.01	-.19 [*]	—			
14. W1 Number of Siblings	-.10 [†]	-.04	-.11 [†]	-.26 [†]	.01	.00	-.05 [*]	.05 [*]	.00	.28 [†]	-.12 [†]	.08 [†]	-.04	—		
15. W1 Household Income	.06 [*]	-.02	.02	.07 [*]	.04	-.02	.00	-.01	.00	.20 [†]	.28 [†]	-.06 [*]	-.01	.02	—	
16. W1 Community SES	.09 [†]	-.03	.02	.10 [†]	.02	.00	-.04	-.07 [*]	.05 [*]	.22 [†]	.27 [†]	-.06 [*]	-.01	-.05 [*]	.30 [†]	—

*p < .05; †p < .001, N = 2188.

Table 4. Summary of regression analyses for variables predicting Wave 2 child vocabulary.

Variable	<i>b</i>	SE (<i>b</i>)	β	<i>p</i>	Squared part correlation
W1 Child Vocabulary	2.18	.71	.07	< .01	.00
Proximal Processes					
W1 Joint Attention	4.93	1.07	.12	< .01	.01
W1.5 Book Reading	5.56	.48	.24	< .01	.05
Child Characteristics					
W2 Child Age in Months	1.25	.22	.13	< .01	.01
Child Gender	5.63	.94	.12	< .01	.01
W1 Child Approach Temperament	1.34	.62	.05	.03	.00
W1 Child Cooperation Temperament	.21	.60	.01	.73	.00
W1 Child Irritable Temperament	.33	.64	.01	.60	.00
Maternal Characteristics					
W1 Maternal Age	-.14	.11	-.03	.18	.00
W1 Maternal Education	.06	.27	.01	.82	.00
W1 Maternal Warm Parenting	.38	1.24	.01	.76	.00
W1 Maternal Hostile Parenting	-.28	.41	-.01	.50	.00
Environmental Characteristics					
W1 Number of Siblings	-.19	.55	-.01	.73	.00
W1 Household Income	.00	.00	.03	.23	.00
W1 Community SES	.02	.01	.07	< .01	.00

* $p < .05$, † $p < .001$, $N = 2188$, $R^2 = .17$.

both $ps > .20$, two-tailed). Consistent with previous research demonstrating a gender gap favouring girls, significantly greater vocabulary was observed for the girls at Wave 2 ($t(2186) = 5.59$, $p < .001$, two-tailed). However, this gender gap in vocabulary development was only marginally significant at Wave 1 ($t(2186) = 1.89$, $p = .06$, two-tailed). The boys scored significantly higher in terms of approach-sociability temperament ($t(2186) = 4.64$, $p < .001$, two-tailed). Boys and girls did not differ significantly on any of the other measures (all $ts(2186) < 1.36$, all $ps > .17$, two-tailed).

Mediation analyses

According to the bioecological model (e.g., Bronfenbrenner, 1995) the developmental effects of individual (child and maternal) and environmental characteristics are primarily indirect being mediated by their impact on proximal processes such as joint attention and parent-child book reading. Analyses that test for the existence of mediated (indirect) effects are therefore required to test this hypothesis. Thus, mediation analyses were conducted for each individual or environmental characteristic that demonstrated a significant bivariate relationship with Wave 2 child vocabulary (see Table 3).

Because of the questionable nature of the assumption that the sampling distributions of the indirect effects are normal, and the general superiority of bootstrapping over methods that assume such normality (Preacher & Hayes, 2008), the mediation analyses were

Table 5. Bootstrapped point estimates and confidence intervals for the indirect effects of individual and environmental characteristics on Wave 2 child vocabulary.

Indirect effects	Point estimate	SE	Bias corrected and accelerated 95% CI	
			Lower	Upper
Child Gender				
W1 Joint Attention	.07	.10	-.11	.27
W1.5 Book Reading	-.03	.24	-.50	.44
Total Indirect Effect	.04	.27	-.49	.56
Maternal Education				
W1 Joint Attention	.02	.03	-.03	.09
W1.5 Book Reading	.43	.08	.29	.59
Total Indirect Effect	.46	.08	.29	.63
Maternal Warm Parenting				
W1 Joint Attention	.70	.20	.37	1.15
W1.5 Book Reading	1.34	.33	.72	2.02
Total Indirect Effect	2.04	.39	1.31	2.84
Number of Siblings				
W1 Joint Attention	-.23	.07	-.40	-.11
W1.5 Book Reading	-1.63	.21	-2.07	-1.24
Total Indirect Effect	-1.86	.22	-2.35	-1.45
Household Income				
W1 Joint Attention	.00	.00	.00	.00
W1.5 Book Reading	.00	.00	-.00	.00
Total Indirect Effect	.00	.00	-.00	.00
Community SES				
W1 Joint Attention	.00	.00	-.00	.00
W1.5 Book Reading	.00	.00	-.00	.01
Total Indirect Effect	.00	.00	.00	.01

N = 2188.

conducted using Preacher and Hayes' SPSS multiple mediator macro using 5000 bootstrap re-samples. The proximal processes of joint attention and parent-child book reading were entered as mediators. A separate analysis was conducted for each individual or environmental characteristic. In each analysis one of the individual or environmental characteristics was entered as the independent variable and Wave 1 vocabulary and the other individual and environmental characteristics were entered as covariates (Preacher & Hayes, 2008). This analytic approach provides stringent tests of whether the proximal processes of joint attention and parent-child book reading mediated the effects of the individual and environmental characteristics on children's vocabulary development. Table 5 displays the bootstrapped point estimates and 95% bias-corrected and accelerated confidence intervals of the indirect effects of the individual and environmental characteristics on Wave 2 child vocabulary via joint attention and parent-child book reading.

Individual characteristics, joint attention, parent-child book reading, and child vocabulary

The first mediation analysis addressed the hypothesis that being female facilitates child vocabulary development because girls engage in more joint attention and parent-child book reading. This analysis had Wave 2 child vocabulary as the dependent variable, child gender as the independent variable, joint attention and parent-child book reading as the mediators, and the remainder of the variables from Table 4 as covariates. The direct effect of child gender on Wave 2 child vocabulary (c' path) was significant ($b = 5.63, p < .001$). However, the specific indirect effects via joint attention and parent-child book reading and the total indirect effect were all non-significant (see Table 5). Thus, there was a direct effect, but not an indirect effect, of child gender on Wave 2 child vocabulary. These results indicate that although being female is associated with improved vocabulary development this effect is not mediated by increases in joint attention and/or parent-child book reading.

Does having a more educated mother facilitate child vocabulary development because more educated mothers engage in more joint attention and parent-child book reading? The next mediation analysis addressed this hypothesis and had Wave 2 child vocabulary as the dependent variable, maternal education as the independent variable, joint attention and parent-child book reading as the mediators, and the remaining variables as covariates. The direct effect of maternal education on Wave 2 child vocabulary (c' path) was not significant ($b = .06, p = .82$). The specific indirect effect via parent-child book reading and the total indirect effect were both significant but the specific indirect effect via joint attention was not significant (see Table 5). Thus, parent-child book reading completely mediated the effect of maternal education on Wave 2 child vocabulary. These results suggest that having a more educated mother facilitates child vocabulary development because more educated mothers engage in more parent-child book reading.

The next mediation analysis addressed the hypothesis that warm parenting facilitates child vocabulary development because warmer mothers engage in more joint attention and parent-child book reading. This analysis had Wave 2 child vocabulary as the dependent variable, maternal warm parenting as the independent variable, joint attention and parent-child book reading as the mediators, and the remaining variables as covariates. The direct effect of warm parenting on Wave 2 child vocabulary (c' path) was not significant ($b = .37, p = .76$). The specific indirect effects via joint attention and parent-child book reading and the total indirect effect were all significant (see Table 5). Therefore, the effect of warm parenting on Wave 2 child vocabulary was completely mediated by joint attention and parent-child book reading. These results suggest that warm parenting facilitates child vocabulary development because warmer mothers engage in more joint attention and parent-child book reading.

Environmental characteristics, joint attention, parent-child book reading, and child vocabulary

The next mediation analysis addressed the hypothesis that having more siblings in the household constrains child vocabulary development because parents have less time to engage in joint attention and parent-child book reading. This analysis had Wave 2 child vocabulary as the dependent variable, number of siblings in the home as the independent variable, joint attention and parent-child book reading as the mediators, and the remaining

variables as covariates. The direct effect of number of siblings on Wave 2 child vocabulary (c' path) was not significant ($b = -.19, p = .73$). The specific indirect effects via joint attention and parent-child book reading and the total indirect effect were all significant (see Table 5). Therefore, joint attention and parent-child book reading completely mediated the effect of number of siblings on Wave 2 child vocabulary. These results suggest that increasing the number of siblings in the home constrains vocabulary development by decreasing joint attention and parent-child book reading.

Does household income facilitate child vocabulary development because households with higher incomes engage in more joint attention and parent-child book reading? The next mediation analysis addressed this hypothesis and had Wave 2 child vocabulary as the dependent variable, household income as the independent variable, joint attention and parent-child book reading as the mediators, and the remainder of the variables as covariates. The direct effect of household income on Wave 2 child vocabulary (c' path) was not significant ($b = .00, p = .23$). The specific indirect effects via joint attention and parent-child book reading and the total indirect effect were all non-significant (see Table 5). Thus, there was neither a direct nor indirect effect of household income on Wave 2 child vocabulary. The present findings suggest that household income has no effect on child vocabulary acquisition at this point in development.

The final mediation analysis addressed the hypothesis that living in a higher SES community facilitates child vocabulary development because parents who live in higher SES communities engage in more joint attention and parent-child book reading. This analysis had Wave 2 child vocabulary as the dependent variable, community SES as the independent variable, joint attention and parent-child book reading as the mediators, and the remainder of the variables as covariates. The direct effect of community SES on Wave 2 child vocabulary (c' path) was significant ($b = .02, p < .01$). However, the specific indirect effects via joint attention and parent-child book reading and the total indirect effect were all non-significant (see Table 5). Thus, there was a direct effect, but not an indirect effect, of community SES on Wave 2 child vocabulary. These results indicate that although increasing community SES is associated with improved vocabulary development this effect is not mediated by joint attention and/or parent-child book reading.

Discussion

The current study sought to bring a bioecological approach to the study of children's vocabulary development between the ages of 9 and 34 months. This was achieved by investigating whether the proximal processes of joint attention and parent-child book reading mediate the effects of individual and environmental characteristics on children's vocabulary development.

The importance of proximal processes for children's vocabulary development

The current findings provide support for the emphasis that bioecological theory (Bronfenbrenner, 1979, 1995) places on the pivotal developmental role played by proximal processes (ongoing reciprocal social interactions). Parent-child book reading uniquely accounted for 5% of the variation in Wave 2 vocabulary and joint attention was also a

significant predictor. These findings are consistent with previous research that has underlined the importance of joint attention (e.g., Dunham et al., 1993; Kiernan & Gray, 1998; Saxon, 1997; Tomasello & Todd, 1983) and parent-child book reading (e.g., Bus et al., 1995; Mol et al., 2008) for children's vocabulary development.

Furthermore, consistent with the argument that the developmental effects of individual (e.g., child, parent) and environmental (context) characteristics are primarily indirect, mediated through their impact on proximal processes (Bronfenbrenner, 1995), the effects of maternal education, warm parenting, and number of siblings in the home were completely mediated by the proximal processes of joint attention and/or parent-child book reading. However, the developmental influence of child gender and community SES were not mediated by the proximal processes of joint attention and parent-child book reading. This suggests that proximal processes other than joint attention and parent-child book reading may mediate the effects that child gender and community SES have on vocabulary development. For example, previous research found that the length of child-directed maternal utterances mediated the effect of SES on child vocabulary development such that mothers with higher SES backgrounds used longer utterances when talking to their two-year-old children and this was associated with larger subsequent child vocabulary growth (Hoff, 2003). Gender differences are discussed further below.

Contrary to previous research (e.g., Noel et al., 2008) the present analyses failed to find significant relations among child temperament and vocabulary development. However, it should be noted that much of this previous research has assessed temperament when the children are much older (e.g. 48 months, Noel et al., 2008) than when assessed in the present study ($M = 9$ months). Hence it may be that child temperament begins to have an effect on vocabulary development between 9 and 48 months of age. Alternatively, it could be that the low reliability of the irritability subscale used in the present study contributed to the failure to find a significant effect. The present analyses also failed to find either a direct or indirect effect of household income on vocabulary development. Indeed, when taken as a whole, the present findings suggest that the previously observed effect of family SES (e.g., Arriaga et al., 1998) is more likely to be a result of differences in maternal education rather than household income per se. Indeed, the fact that the effect of maternal education was completely mediated by differences in the proximal process of parent-child book reading indicates that these differences in vocabulary development are the product of differences in the amount of reciprocal parent-child interactions that prompt and facilitate vocabulary development.

One of the limitations of the current study is the use of maternal report measures of joint attention and parent-child book reading. Future research would profit from using observational measures and/or a multi-method multi-informant approach. Furthermore, because the current measure of number of siblings in the home largely reflects the presence of older siblings, further research is required into the outcomes associated with having younger siblings in the home.

Gender differences

Consistent with previous research (e.g., Berglund et al., 2005; Bornstein, Hahn, & Haynes, 2004; Bouchard, Trudeau, Sutton, Boudreault, & Deneault, 2009; Wehberg et al., 2008) girls were found to have significantly greater vocabulary development at Wave 2 ($M = 34$ months of age). However, this difference was only marginally significant at Wave 1

($M = 9$ months of age). Although this could simply be a product of the fact that children are generally producing few words at this age or of the reduced sensitivity brought about by using a single question to measure vocabulary at Wave 1, there is some evidence suggesting that differences in vocabulary size do not begin to emerge until around 13 months of age (Bouchard et al., 2009). Indeed, although Bornstein et al. (2004) found significant differences at later ages they found no gender differences on MCDI expressive or receptive vocabulary in a small group (34) of children when they were 13 months old. Thus, further research using larger samples and more sensitive measures such as the MCDI is required to ascertain whether gender differences exist in this earlier age range.

A number of explanations have been put forward for gender differences in language development. These include biological/neurological differences as well as gender differences in interests and stereotypes, identification and modelling, and opportunities to learn (Bornstein et al., 2004). Although it is difficult to disentangle the effects of each of these, research has found that the amount of mother to child speech predicts child vocabulary growth (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991) and the meta-analysis by Leaper, Anderson, and Sanders (1998) found that mothers talk less to sons than to daughters. There is also evidence indicating that fathers engage in more complex conversations with daughters than with sons at 24 months (Lovas, 2011).

Practical implications

The present findings support the importance of joint attention and parent-child book reading for children's vocabulary development. Correlation is not causation however, and it has been argued that convergence between the findings of correlational analyses of real-world relationships and the results of training studies allow more powerful inferences to be made because the particular strengths of each type of research compensate for the weaknesses of the other (Bradley & Bryant, 1983; Harris, 2005). Thus, combining the present results with previous findings that joint attention training improves the communicative ability of children with autism (Isaksen & Holth, 2009; Jones, Carr, & Feeley, 2006; Rocha, Schreibman, & Stahmer, 2007; Whalen et al., 2006) and that joint attention training for childcare staff fostered the language development of typically developing children, (Rudd, 2003) provides some convergent support for the role of joint attention. However, the findings of future joint attention training studies with typically developing children that assess the effects on children's vocabulary development would allow more powerful causal inferences to be made.

There is also evidence that interventions which provide children's books and instruction that increase the frequency and quality of parent-child book reading have a positive effect on the vocabulary development of children from families with low levels of income and maternal education (e.g., Taverne & Sheridan, 1995) and that instructing parents or teachers in adult-child book reading facilitates the language development of children with language delays (Crain-Thoreson & Dale, 1999). Thus, although some may argue that the measure of parent-child book reading used in the present study is a proxy for a more generally nurturant, elaborative and stimulating caregiving style, there is convergent evidence indicating that parent-child book reading plays a causal role in children's vocabulary development. Importantly, the facilitative effects of family literacy programs for disadvantaged children continue in the years following intervention (Phillips, Hayden, & Norris, 2006). Hence

parents and professionals would be well served by targeting proximal processes like joint attention and parent-child book reading especially when working with disadvantaged children. To this end, there are a number of book reading training programs that have been found to change adults' book reading style and facilitate children's language development (e.g., Crain-Thoreson & Dale, 1999; Whitehurst et al., 1994). The possibility of improving the effectiveness of parent-child book reading is also highlighted by the finding that parents of kindergarten and school-aged children often miss opportunities to explain novel words when reading with their children (Evans, Reynolds, Shaw, & Pursoo, 2011).

Implications for theory and research

The present findings are consistent with bioecological approaches that recognize the developmental importance of proximal processes. The current results encourage scientific approaches that are able to provide insights into the individual and environmental characteristics that have developmental importance to the extent that they prompt, facilitate or constrain the proximal processes through which development occurs.

The findings of the present study also have implications for the way research into children's development is conducted and the way the results are analyzed. The finding that the effects of maternal education, warm parenting and number of siblings in the home were completely mediated by proximal processes (and therefore that none of these were significant predictors in standard regression analyses) means that research that does not hypothesize and test for mediated (indirect) effects via proximal processes will almost certainly lead to incorrect conclusions about the roles of personal and/or environmental characteristics.

Conclusions

The results of the present study converge in supporting the developmental importance of proximal processes and the argument that the effects of individual (e.g., child, parent) and environmental (context) characteristics are primarily indirect, mediated through their impact on proximal processes (Bronfenbrenner, 1995). When combined with the findings of training studies, the current results provide convergent support for the causal roles of the proximal processes of joint attention and parent-child book reading in children's vocabulary development. Furthermore, given the early emergence of individual and gender differences and the demonstrated effectiveness of book reading training programs, interventions targeting children's language development would be well served by focusing on book reading as early as possible in children's lives.

Appendix

Warm and Hostile Parenting Scales

Warm Parenting Scale

1. How often do you express affection by hugging, kissing and holding this child?
2. How often do you hug or hold this child for no particular reason?
3. How often do you tell this child how happy he/she makes you?

4. How often do you have warm, close times together with this child?
5. How often do you enjoy doing things with this child?
6. How often do you feel close to this child both when he/she is happy and when he/she is upset?

Hostile Parenting Scale

Now thinking about the last 4 weeks, how much do these statements describe how you have been feeling or behaving with this child?

1. I have been angry with this child.
2. I have raised my voice with or shouted at this child.
3. When this child cries he/she gets on my nerves.
4. I have lost my temper with this child.

Funding

The Longitudinal Study of Australian Children is funded by the Commonwealth Department of Families, Housing Community Services and Indigenous Affairs. We are grateful too for the support of the staff from both the Australian Institute for Family Studies and the Australian Bureau of Statistics. The authors wish to thank all of the children and families for their generous support and participation in the Longitudinal Study of Australian Children. This research was supported by a National Health and Medical Research Council of Australia Program Grant (ID 572742). We also thank Kevin Durkin and the anonymous reviewers for helpful comments on earlier versions of this article.

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