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The impact of book reading in the early years on parent-child language interaction

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Abbreviations: LENA = **L**anguage **E**nvironment **A**nalysis; AWC = adult word count; CT = conversational turns; CV = child vocalizations

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Abstract

Early language development predicts later reading competence, but does reading to young children enhance the language interaction between them and their parents? Automatic assessment of language interaction now yields Adult Word Counts (AWC), Conversational Turn counts (CT) and Child Vocalization counts (CV). This study had 98 families return reading activity logs for a day coinciding with automatic language analysis, and of these 36 reported reading with their children aged 26-61 months on that day. Reading periods yielded much higher AWC and CT than non-reading periods, indicating a greater degree of parent-child language engagement and interaction during reading periods. Such differences were not evident in CV. AWC and CT were high during reading for both high and low education level mothers. Gender effects during reading were evident for AWC (but not CT or CV), indicating greater AWC with male children. These results have important implications for practical action by parents.

149 words

Keywords

reading, language, interaction, mother, young children, effect, LENA

The impact of book reading in the early years on parent-child language interaction

While it is well established that early language development predicts later reading ability, the converse argument (that reading can enhance language development) is less well researched. Accordingly, this study examines evidence for a component of such an argument – that parents' reading to and with their young children enhances the degree of language interaction between them relative to other times (which may in turn yield greater child language competence). Specifically, we examine the quantity of language interaction between parent and child in terms of Adult Word Count (AWC – number of words spoken by the adult), Conversational Turns (CT – number of mutually attentive interactions between child and parent), and Child Vocalization (CV – number of utterances by the child excluding noises) to determine whether these metrics are elevated when books are being read compared to other times. While previous studies used parental self-report of reading practices and/or standardized tests of language and early literacy, the present study used real-time recordings of parent-child language interactions and is the first of its kind.

The quantity and quality of early language interaction have been found to have effects on subsequent child progress in school (Hart & Risley, 1995). Establishing that time spent reading in the early years improves early language interaction has important implications for practical action by parents. In this study, albeit with a small sample, language interaction between parents (particularly mothers) and young children (2-5 years) in the home was compared during book reading versus other times. Based on existing literature, our research hypothesis was that language interaction would be higher during book reading than during non-reading periods on the same day (irrespective of which parent interacted with the child). The study also examined

the effect of mothers' level of attained education, as well as whether overall caregivers read more to female versus male or older versus younger children.

Language interaction in the early years

Children's language skills in the preschool years are widely considered predictive of their later reading success and literacy skills (Harlaar, Hayiou-Thomas, Dale & Plomin, 2008; Noel, Peterson & Beulah, 2008; Reese, Sparks & Leyva, 2010; Shanahan & Lonigan, 2010). Very young children can respond to rich stimulation (Chapman, 2000; Hart & Risley, 1995; Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991; Rowe, 2008) and as children develop language, the quality and volume of language interaction with parents is critical. The rate at which adults talk to children (Huttenlocher, et al., 1991), the rate at which children vocalize (Hart & Risley, 1995) and the responsiveness of parents to their child's vocalizations in conversational turns (Tamis-LeMonda, Bornstein & Baumwell, 2001; Topping, Dekhinet & Zeedyk, 2013) correlate well with child vocabulary size. The opposite has also been observed, in which deprivation in quality or quantity of language input leads to delayed language acquisition, lowered IQ, and reduced subsequent academic achievement (Huttenlocher, Vasilyeva, Cymerman & Levine, 2000; Landry, Smith, Swank, & Miller Loncar, 2000; Topping, Dekhinet & Zeedyk, 2011). The relationship between adult word counts, the presence of conversational turns and the frequency of child vocalizations has even been noted in the development of pre-term infants (Caskey, Stephens, Tucker & Vohr, 2011).

Accessing these interaction measures has recently been facilitated by automatic assessment of daylong audio samples of language. Such a means yields descriptive tools to characterize language environments, but also a potential source of intervention in the form of feedback to adult caregivers on their behaviours throughout the day. Suskind, et al. (2013) reported

significant positive results using such analysis and quantitative linguistic feedback (specifically with AWC and CT) with non-familial caregivers of 17 typically-developing children to increase talk and interaction in the home. Caregivers showed significant and prolonged increases from baseline to post-intervention on AWC (32%) and CT (25%).

Zhang, et al. (2015) used such an analysis with 22 children aged 5–30 months in Shanghai and demonstrated that quantitative language feedback over six months increased word and turn counts significantly for the first three months. Parents below median at baseline maintained significant word increases to study conclusion. Adult word and turn counts were highly related to a subset of language development measures.

Parents reading to young children

Of course, there have been a great many studies of parent-child reading interactions, including some in the early years. A number of these have followed the assumption that early language development leads to later reading competence (e.g., Pillinger & Wood, 2014; Snowling, Hulme, Bailey, Stothard & Lindsay, 2011). Perhaps most persuasively, Preston, et al. (2010) divided 174 elementary school-age children into "early", "on-time" or "late" talkers on the basis of parental report and evaluated them with standardized measures of language, reading and spelling. All measures showed "early" talkers had the highest level of performance and "late" talkers the lowest level of performance. Activation in bilateral thalamus/putamen and left insula/superior temporal gyrus was significantly lower in late talkers, demonstrating that the residual effects of being a late talker were found not only in behavioural tests of oral and written language, but also in distributed cortical-subcortical neural circuits. These findings suggested that the age of functional language acquisition could have long-reaching effects on reading and

language behaviour, and on the corresponding neuro-circuitry that supports linguistic function into the school-age years.

However, other researchers have attempted to show an effect of reading on the child's later language development. Hargrave and Sénéchal (2000) examined the effects of storybook reading on the expressive vocabulary of 36 preschool children with low vocabulary skills. Children with limited vocabularies learned new vocabulary from shared book-reading episodes, especially with dialogic reading. A five-year longitudinal study by Sénéchal and LeFevre (2002) found that children's exposure to books related to vocabulary development and listening comprehension, and that these skills in turn related directly to reading ability at grade 3. With pre-school children of low socio-economic status, Bracken and Fischel (2008) found that parent-child reading interaction was a significant predictor of children's subsequent receptive vocabulary. Sénéchal, Pagan, Lever and Ouellette (2008) found an effect of home shared reading practices on subsequent child expressive vocabulary and morphological knowledge in 106 4-year-olds, irrespective of child nonverbal intelligence, parent education and parent literacy. Mol, Bus, de Jong and Smeets (2008) conducted a meta-analysis of studies of dialogic parent-child book readings and analysed the effect on children's expressive vocabulary. The effect size for dialogic reading was .59, more pronounced for 2-3-year-old than for 4-5-year-old children.

Anthony, Williams, Zhang, Landry and Dunkelberger (2014) evaluated 91 preschool classrooms of low socio-economic status children (n=500) in relation to oral language and print knowledge before and after involvement of the intervention group with family nights delivering parent training in shared reading practices. The intervention had significant effects on both outcome variables. Children who lagged behind most at pre-test benefitted most at post-test. Sim, Berthelsen, Walker, Nicholson, & Fielding-Barnsley (2014) found a similar effect, although in

this case the effect on expressive language had disappeared at three-month follow-up.

Liebeskind, Piotrowski, Lapierre and Linebarger (2014) researched a national sample of American parents of children aged 8–36 months ($n = 500$), evaluating how parent–child interactions were associated with children's language skills. Results indicated a positive association between literacy-based parent–child interactions and children's language production.

However, none of these studies used day-long audio recording (with its greatly enhanced reliability and validity) as a means of analysing parent-child interaction.

Maternal education and child gender effects

It is well established that low maternal education levels constitute a risk factor for children. In a seven-year longitudinal study, Geoffroy, et al. (2010) found that children of mothers with low levels of education showed a consistent pattern of lower scores on academic readiness and achievement tests at 6 and 7 years compared to those of highly educated mothers. Maternal education level was found one of four important risk factors in preschool and first-grade literacy skills by Cadima, McWilliam and Leal (2010). The effects of socioeconomic status on preschool children's cognitive and behavioural outcomes were examined by Mistry, Biesanz, Chien, Howes and Benner (2008), who studied 1459 low-income families. Among both immigrant and native households, maternal education (as compared to household income or public assistance receipts) was the strongest predictor.

Turning to gender effects, we find there is considerable research on gender in reading, but most of it is in the school years (e.g. Meece, Glienke & Burg, 2006). In the early years, shared book reading between 700 pre-schoolers and their families were examined within a nationally representative sample from the Early Childhood Longitudinal Study-Birth Cohort dataset

(Hindman, Skibbe & Foster, 2014). The range of talk techniques that parents used was largely independent of child gender.

However, using real-time audio recording as in the present study, Johnson, Caskey, Rand, Tucker and Vohr (2014) evaluated the verbal interactions of parents with their infants in the first months of life. The study included 33 late preterm and term infants. 16-hour language recordings during the birth hospitalization and in the home at 44 weeks and 7 months were analysed for adult word count, infant vocalizations, and conversational exchanges. Mothers responded preferentially to girls versus boys at birth ($p = .04$) and 44 weeks ($p = .0003$) with a trend at seven months ($p = .15$). Fathers however showed no significant tendency to prefer boys. Mothers appeared to respond preferentially to infants based on gender.

Thus the evidence on gender is conflicting, and the present study addresses this conflict.

Summary

We have noted that while language is widely expected to predict reading in pre-schoolers, fewer studies have focused on the extent to which reading can promote child language and familial language interaction, and none have used automatic assessment of day-long audio samples of language to investigate this. Adult Word Count, Conversational Turns and Child Vocalizations have been found to be important metrics of a child's natural home language environment. In this study we hypothesized that these metrics would show significant increases during reported book reading periods compared with other times of the day. Within this, we expected maternal education level to be significantly negatively related to these metrics. Regarding gender, we were uncertain whether there would be a significant relationship.

Method

Participants

The participants in this study were part of a larger study in the Denver, Colorado, region (Gilkerson & Richards, 2008). Participants were originally recruited through advertisements in newspapers, flyers posted at pre-schools and online postings and were thus self-selected volunteers. Families with children who were not typically developing and living in non-English speaking households were not eligible to participate. Respondents were then randomly selected within child age and maternal education categories to yield a sample which was representative of the US population in both respects. This process yielded 98 families who provided full-day (16-hour) recordings on which they received no feedback. From an ethical standpoint, all parents and children participating were volunteers, and informed consent had been obtained for each participating family. Families recorded on a day of their choice, so long as it was once each week (weekday or weekend). With reference to a recording day in the sequence which was specified at random by the researchers, participants returned an activity log that included detailed questions regarding book reading, to be completed at the end of the recording day. Parents were paid \$85 for successfully completed recording sessions.

From this group, 62 responding families were then excluded who: a) indicated no book reading on that day ($n=34$), or b) did not provide usable reading times ($n=11$), or c) indicated some portion of the day was spent at daycare or preschool ($n=17$). Thirty-six families remained in the sample. Table 1 provides demographic information for responding families. The 36 included children were aged 26 through 61 months ($M= 41.81$ months or $3\frac{1}{2}$ years, $SD= 10.79$). The sample was balanced on gender. Age distribution was approximately uniform across the range of ages. Children from included families were significantly younger ($t(96)=2.22$, $p=.03$)

and were significantly more likely to have mothers with a Bachelor's Degree (BD) than those from excluded families ($\chi^2(1)=6.8, p=.009$).

INSERT TABLE 1 ABOUT HERE

The differences in age and maternal education level were complicated by significantly fewer families reporting book reading sessions in the no-college-degree group (27/60) compared to the degree-holding group (36/38) ($\chi^2(1)=25.1, p<.001$). It seems that book reading to young children is more common in highly educated families. This effect is even more pronounced considering that children in the included group were also younger than the excluded group.

Measures

Language interaction between parents and young children is typically conducted by transcription of parent and child utterances. This is not only slow and time-consuming, leading to transcription of very short sections of interaction, but particularly difficult with very young children. The present study used automated analysis of day-long samples of language. While automated analysis is not perfect, the fact that it is used on such long samples enhances its reliability.

Language Environment Analysis - LENA

The LENA system (Ford, Baer, Xu, Yapanel & Gray, 2008; Gilkerson & Richards, 2008) includes a digital recorder worn by the child in a front chest pocket of clothing designed to optimize microphone placement and minimize clothing friction noise. The recorder captures up to 16 hours of audio at 16 kHz, performing best within a 6-10 foot radius. Recordings are subsequently processed using a digital sound analyser that parses out the child's speech-related vocalizations and exposure to adult speech, the speech of other children, overlapping talk, silence, general noise, and television. Algorithms enable the discarding of crying or vegetative

sounds (e.g., from respiratory or digestive systems) and automatically generate AWC, CV and CT estimates.

LENA has previously been shown to produce reliable language estimates for American English (AE) when compared with the judgments of trained human transcribers (Xu, Yapanel & Gray, 2009). A total of 70 hours of data were taken from 70 LENA files and human transcribers also listened to and coded the audio. There was 82% agreement for AWC, 76% agreement for child vocalizations, 71% for television, and 76% for miscellaneous other sounds. Another study reported the use of LENA to evaluate the home language environments of primarily low-SES Spanish-speaking families (Weisleder & Fernald, 2013). Transcriptions of ten 60-minute recording samples showed a strong correlation between transcriber word counts and AWC ($r = .80$), indicating that LENA could reliably estimate the frequency of adult word use in Spanish-language environments. Gilkerson, et al. (2015) found 79% agreement for Adult Words and 81% for Child Vocalizations in a Chinese-speaking sample - similar to that observed for the American English sample.

Daily Activity Reading Questionnaire

Participants were provided a daily activity questionnaire on which to report book reading activity on the recording day (see Figure 1). Parents were asked to specify the exact times during which they read to their child and who did the reading (mother or father).

INSERT FIGURE 1 ABOUT HERE

Procedure

Participants were provided the audio recording devices, questionnaires and all instructions using express mail service. They were instructed to start recording when the child first woke up in the morning, to proceed in their daily activities as per usual, and to complete questionnaires at the end of the day. Recorders automatically shut off after 16 hours. Parents

returned all materials the next day via prepaid express mail. Participant parents never saw the automated recording results and they were not coached on book reading techniques or other language environment enhancement strategies at any time during the study.

Statistical analysis

After audio recordings were processed using the automated system and full-day results obtained, language environment data (AWC, CT, CV) were extracted. Using the start and end times for reading periods that parents reported we sorted these data into reading and non-reading periods. To reduce the potential impact of periods of inactivity (e.g., naps or other sleep time), recording intervals during which silence was predominant (i.e., 60% silence or more) were excluded. Naps were reported by 20/36 of participants with an average duration of 2.1 hours (SD=0.8). Over all recordings, 18% of the data were excluded on this basis. We summed language measures for the remaining intervals by reading status and computed rates of activity (counts per minute). These data were analysed relative to reading status and demographic measures (age, gender, maternal attained education) via correlation, chi-squared tests and t-tests using IBM SPSS Statistics v. 22 and online calculators by Lee & Preacher (2013a, 2013b). An alpha value of .05 was used. Effect sizes using Cohen's *d* were calculated.

Results

Distribution of reading sessions

Families reported their first reading session of the day occurring at various times across the day from 7:00 am to 9:30 pm, in a more or less linear distribution from 7.30 a.m. to 9.30 p.m., as shown in Figure 2. There were 21 families in which there was a second reading session. Most of the second reading sessions (when present) took place between 7:00 pm and 9:30 pm. There were no second reading sessions before noon. Across all reported sessions, mothers alone did the reading in 50% of families, fathers in 11%, mothers and fathers together in 17%, and

other caretakers (alone or along with other sessions including mother or father) in the remaining 22%. Mothers accounted for two-thirds of the first reported reading session of the day across families.

INSERT FIGURE 1 ABOUT HERE

Reading period length and language measures

Although no direct assessment was made of the reliability or validity of parent-reported reading periods, partial validation was obtained by examining the relationships among reading vs. non reading period durations and absolute counts of language measures during those periods. As could be expected, duration of the reading period was highly correlated with AWC $r(34)=0.71$, CT $r(34)=0.77$ and CV $r(34)=0.74$ (all $p<.001$) during reading periods. Reading period counts were however uncorrelated with duration of non-reading periods and with duration overall. Conversely, non-reading period language counts were uncorrelated with reading period durations. This pattern of results supports our assumption that parent-reported reading times corresponded reasonably well with actual reading times.

Language measures overall

Table 2 summarizes change and corresponding Cohen's d effect sizes for language measure rates overall and for higher and lower education level groups. CT rates (turns per minute) overall were 64% higher on average during reading sessions compared to non-reading times, $t(34)=3.41$, $p=.002$, with an effect size in the moderate range. AWC rates (words per minute) overall were 148% higher on average during reading sessions compared to non-reading times, $t(34)=5.81$, $p<.001$, with an effect size in the large range. No significant difference was observed in CV rates (vocalizations per minute) overall during reading compared to non-reading times, $t(34)=0.36$, $p=.720$.

INSERT TABLE 2 ABOUT HERE

Language measures by maternal education level

Similar patterns of results held for both lower and higher attained education groups. In the lower education group (mothers with less than a bachelor's degree), during reading CT rates were 103% higher, $t(15)=3.04$, $p=.008$, and AWC rates were 213% higher, $t(15)=4.44$, $p<.001$. In the higher education group, reading session rates were 40% higher for CT $t(19)=1.82$, $p=.08$ and were 107% higher for AWC $t(19)=3.85$, $p=.001$. For neither group were changes in CV rates significant.

Changes in language measure rates for reading versus other times did not differ significantly between higher and lower education levels for either CT $t(34)=1.23$, $p=.23$; AWC $t(34)=1.40$, $p=.17$; or CV $t(34)=1.41$, $p=.17$. However, CV showed some interesting tendencies. Child vocalization rates tended to be higher for children of college-educated mothers, both overall, $t(34)=1.97$, $p=.06$, Cohen's $d=.66$, and during non-reading times, $t(34)=2.03$, $p=.05$, Cohen's $d=.68$. This effect did not hold during reading times, $t(34)=.03$, $p=.97$, Cohen's $d=.01$. In the lower education group, child vocalization rates during reading were similar to those in the higher education group, though not significantly higher than during non-reading times, $t(15)=1.41$, $p=.18$, Cohen's $d=.35$.

Effect of child gender

Gender was not a significant predictor of either CT or CV rates. During reading sessions, however, AWC rates were higher for male ($M=56.6$, $SD=26.6$ wpm) than for female ($M=36.2$, $SD=26.8$ wpm) children, $t(34)=2.28$, $p=.03$, Cohen's $d=0.76$. The difference in AWC rate between reading versus non-reading times was borderline larger for male versus female children

($M=36.8$, $SD=25.9$ vs. $M=19.0$, $SD=28.4$), $t(34)=1.96$, $p=.06$, Cohen's $d=.65$. No differences by gender were observed for non-reading times.

Inter-relationship with age

In a much larger sample AWC was reported not to correlate with age (Gilkerson and Richards, 2008), and this result was replicated here. The age of the child correlated positively but not significantly with AWC difference ($r(36)=.223$, $p=.19$) and negatively but not significantly with CT difference ($r(36)=-.118$, $p=.494$) and CVC difference ($r(36)=-.237$, $p=.164$). Overall AWC rate increased somewhat with child age as might be expected $r(34)=.40$, $p=.02$, both during non-reading times $r(34)=.38$, $p=.02$ and to a lesser extent during reading sessions $r(34)=.33$, $p=.05$, but there were no significant relationships between age and overall CT or CV rates.

Inter-relationship of language measures

Considering relationships among the language variables, CT rates correlated strongly with CV rates both during reading $r(34)=.85$, $p<.001$ and non-reading periods $r(34)=.77$, $p<.001$. The correlation between CT rates and AWC rates was somewhat lower during reading $r(34)=.46$, $p=.005$ compared to non-reading periods $r(34)=.87$, $p<.001$. The difference between these two correlations was significant ($z=3.52$, $p<.001$). Similarly, during reading sessions the correlation between CT and CV rates was significantly larger than that between CT and AWC rates ($z=3.04$, $p=.002$). This pattern indicates that outside of reading, turn rates were associated equally strongly with both adult word and child vocalization rates, but during reading sessions turns were more strongly associated with the child vocalization rates.

Discussion

We hypothesized that language interaction during reading sessions would be higher than during non-reading sessions and indeed found this to be the case. It may be unremarkable to find higher rates of AWC during times when adults are reading aloud, but the higher CT rates confirmed that a greater degree of parent-child language engagement and interaction was happening when reading was taking place. The lack of difference for child vocalizations (CV) indicates that the children may have been primarily listening during reading sessions.

AWC and CT (but not CV) were equally high during reading for both high and low education level mothers. Gender effects during reading were evident for AWC (but not CT or CV), indicating greater AWC with male children. Child age correlated with AWC but not CT or CV during reading and non-reading. AWC, CT and CV rates were highly correlated, but the relationship between CV and CT rates was stronger than that between AWC and CT rates during reading.

Interpretation and Future Research

More parent-child language engagement and interaction was happening when reading was taking place. How might these conversational turns be further enhanced? An elevation might have been expected had dialogic reading strategies been specifically taught, and this suggests a future intervention study using automated language analysis. However, the nature of dialogic reading may require adaptation for such young children.

AWC and CT were equally high during reading for both high and low education level mothers. This is a particularly encouraging finding which suggests that this approach may have merit for application with families of low socio-economic status, where the need to promote

language interaction in the early years is arguably greater. A further study exploring this is needed.

Child age correlated with AWC but not CT or CV during reading. This suggests that parents talk more to older children, which may be somewhat natural but a tendency which may need reversing. It also suggests that even very young children are entirely capable of participating in conversational turns and child vocalizations, and this is an important message to pass to parents. Future research may specifically focus on this message as part of the intervention.

Gender effects were evident, indicating greater AWC with male children. As the majority of intervening parents were mothers, this trans-gender favouritism is indeed interesting (and in conflict with previous research). Future studies need to explore this further.

Finally, that those families who read early in the day were very likely to have another reading session later has implications for action by parents. It suggests that all families might be encouraged to establish a morning reading session and then have another later. Again, in a future study this could be suggested as part of the intervention.

Future studies might also directly link enhanced familial language interaction to subsequent measured child language outcomes. In addition, investigating the degree to which these patterns hold over time for young children would be important. The ability to collect, process and characterize full-day language environment measures using automated technology opens up a wide array of possibilities for enhanced research into the impact of reading on child language development.

Contribution to the literature

A number of studies had shown an effect of reading on child language before, but this was the first study specifically considering parent-child interaction using real-time audio recording with automatic analysis of language. Using this measure, language interaction during reading (specifically AW and CT) was found to be higher during reading than during non-reading sessions. Previous studies had indicated that low maternal education levels were a risk factor, but in this study we found no difference in language interaction during reading between low and high maternal education levels. Concerning gender, previous literature had been conflicting. This study found that there was an effect of mothers favouring male children in AWC during reading times, although none in CT or CV. This adds further to the conflict in research in this area.

Of course, all of the literature on automatic analysis of language has so far stemmed from the United States, China and Korea. Papers from China and Korea have been published in Mandarin and in Korean as well as English. Nonetheless, the participants from China and Korea have largely been middle-class families. There are questions about how well automated analysis (coupled with feedback) would work with poor families from the rural regions of all these countries, as well as in less developed countries such as Africa. Such studies are needed.

Limitations

The current study utilized a relatively small sample of convenience moderated by some stratified sampling and should be repeated with larger samples from other geographical areas, while also including children with special needs and from ethnic minorities. Given the potential for self-selection bias and the confounding between reported reading and socioeconomic status, the generalizability of these results is correspondingly limited. However, finding participants for

such research by means other than self-selection seems problematic. Would such results be found in a sample more balanced in maternal education?

The subjective nature of the reading questionnaire was also likely to introduce some degree of noise to the data. We have no data about the reliability of the reported duration and timing of book reading activities. We attempted to minimize these sorts of effects through the elimination of periods of comparative silence, but it remains challenging to identify home reading times other than by self-reporting. At least partial validation was obtained based on the consistency of automated results with expectation, and it is conceivable that with further study it may be possible to identify periods of book reading in an automated manner.

Of course, the place of automated language analysis in the wider range of research methods is also worth consideration. Much work in this area has been done on the basis of transcription, but transcription is a very slow and unreliable process, especially with very young children. Nor does it easily lend itself to the creation of feedback which can be easily accessed and acted upon by families. In automated analysis we may have a tool which is not only applicable to very young children and conducive to the dissemination of feedback, but which is much more economical and capable of being used on a large scale.

Conclusions

We sought to determine whether reading to very young children led to higher familial language interaction than not reading to them, and indeed found support for this hypothesis in two out of three measures. Language use by adults (AWC) was higher during book reading relative to the rest of the day (which is important but may not be surprising), but more importantly the rate of conversational engagement (CT) was much higher as well. Thus we conclude that parents should be encouraged to read to and with their children from an early age,

since they may not realize that this simple-to-engage-in activity can have a profound effect on the child's subsequent language capability. Furthermore, families should be encouraged to hold their first reading session with their child early in the day as this is likely to lead to an additional reading session later.

References

- Anthony JL, Williams JM, Zhang, Z, Landry SH and Dunkelberger, MJ (2014) Experimental evaluation of the value added by Raising a Reader and supplemental parent training in Shared Reading. *Early Education and Development* 25(4): 493-514.
- Bracken SS and Fischel JE (2008) Family reading behavior and early literacy skills in preschool children from low-income backgrounds. *Early Education and Development* 19(1): 45-67.
- Cadima J, McWilliam RA and Leal T (2010) Environmental risk factors and children's literacy skills during the transition to elementary school. *International Journal of Behavioral Development*, 34(1): 24-33.
- Caskey M, Stephens B, Tucker R and Vohr B (2011) Importance of parent talk on the development of preterm infant vocalizations. *Pediatrics*, 128(5), 910-916.
- Chapman R (2000) Children's language learning: An interactionist perspective. *Journal of Child Psychology and Psychiatry*, 41(1): 33-54.
- Ford M, Baer CT, Xu D, Yapanel U and Gray S (2008) *The LENA language environment analysis system: Audio specifications of the DLP-0121*. LENA Foundation Technical Report LTR-03-2. Retrieved 6 December 2013 from http://www.lenafoundation.org/TechReport.aspx/Audio_Specifications/LTR-03-2.
- Geoffroy M, Cote SM, Giguere C, Dionne G, Zelazo PD, Tremblay RE, Boivin M and Seguin JR (2010) Closing the gap in academic readiness and achievement: The role of early childcare. *Journal of Child Psychology and Psychiatry*, 51(12): 1359-1367.
- Gilkerson J and Richards JA (2008) *The LENA natural language study*. LENA Foundation Technical Report No. LTR-02-2. Boulder, CO: LENA Research Foundation. Retrieved from

<http://www.lenafoundation.org/wp-content/uploads/2014/10/LTR-02->

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- Gilkerson J, Zhang Y, Xu D, Richards JA, Xu X, Jiang F, Harnsberger J, & Topping KJ (2015) Evaluating LENA system performance for Chinese: A pilot study in Shanghai. *Journal of Speech, Language and Hearing Research*, 58: 445–452. DOI: 10.1044/2015_JSLHR-L-14-0014.
- Hargrave AC and Sénéchal M (2000) A book reading intervention with preschool children who have limited vocabularies: The benefits of regular reading and dialogic reading. *Early Childhood Research Quarterly*, 15(1): 75-90.
- Harlaar N, Hayiou-Thomas M, Dale PS and Plomin R (2008) Why do preschool language abilities correlate with later reading? A twin study. *Journal of Speech, Language, and Hearing Research*, 51(3): 688-705.
- Hart B and Risley TR (1995) *Meaningful differences in the everyday experience of young American children*. Baltimore: Brookes.
- Hindman AH, Skibbe LE and Foster TD (2014) Exploring the variety of parental talk during shared book reading and its contributions to preschool language and literacy: Evidence from the Early Childhood Longitudinal Study-Birth Cohort. *Reading and Writing: An Interdisciplinary Journal*, 27(2): 287-313.
- Huttenlocher J, Haight W, Bryk A, Seltzer M and Lyons T (1991) Early vocabulary growth: Relation to language input and gender. *Developmental Psychology*, 27(2): 236-248.
- Huttenlocher J, Vasilyeva M, Cymerman E and Levine S (2002) Language input and child syntax. *Cognitive Psychology*, 45(3): 337-374.

- Johnson K, Caskey M, Rand K, Tucker R and Vohr B (2014). Gender differences in adult-infant communication in the first months of life. *Pediatrics*, 134: 1–8. doi:10.1542/peds.2013-4289.
- Landry SH, Smith KE, Swank PR and Miller Loncar CL (2000) Early maternal and child influences on children's later independent cognitive and social functioning. *Child Development*, 71(2): 358-375.
- Lee IA and Preacher KJ (2013a) Calculation for the test of the difference between two dependent correlations with one variable in common [Computer software]. Available from <http://quantpsy.org>.
- Lee IA and Preacher KJ (2013b) Calculation for the test of the difference between two dependent correlations with no variable in common [Computer software]. Available from <http://quantpsy.org>.
- Liebeskind KG, Piotrowski JT, Lapierre MA and Linebarger DL (2014) The home literacy environment: Exploring how media and parent–child interactions are associated with children's language production. *Journal of Early Childhood Literacy*, 14(4): 482-509.
- Meece JL, Glienke BB and Burg S (2006) Gender and motivation. *Journal of School Psychology*, 44(5): 351-373.
- Mistry RS, Biesanz JC, Chien N, Howes C and Benner AD (2008) Socioeconomic status, parental investments, and the cognitive and behavioral outcomes of low-income children from immigrant and native households. *Early Childhood Research Quarterly*, 23(2): 193-212.
- Mol SE, Bus AG, de Jong MT and Smeets DJH (2008) Added value of dialogic parent-child book readings: A meta-analysis. *Early Education and Development*, 19(1): 7-26.

- Noel M, Peterson C and Jesso B (2008) The relationship of parenting stress and child temperament to language development among economically disadvantaged preschoolers. *Journal of Child Language*, 35(4): 823-843.
- Pillinger C and Wood C (2014) Pilot study evaluating the impact of Dialogic Reading and Shared Reading at transition to primary school: Early literacy skills and parental attitudes. *Literacy*, 48(3): 155-163.
- Preston JL, Frost SJ, Mencl WE, Fulbright, RK, Landi N, Grigorenko E, Jacobsen L and Pugh KR (2010). Early and late talkers: School-age language, literacy and neurolinguistic differences. *Brain*, 133(8): 2185-2195.
- Reese E, Sparks A and Leyva D (2010) A review of parent interventions for preschool children's language and emergent literacy. *Journal of Early Childhood Literacy*, 10(1): 97-117.
- Rowe ML (2008) Child-directed speech: Relation to socioeconomic status, knowledge of child development and child vocabulary skill. *Journal of Child Language*, 35(1): 185-205.
- Sénéchal M and LeFevre J (2002) Parental involvement in the development of children's reading skill: A five-year longitudinal study. *Child Development*, 73(2): 445-460.
- Sénéchal M, Pagan S, Lever R and Ouellette GP (2008) Relations among the frequency of Shared Reading and 4-year-old children's vocabulary, morphological and syntax comprehension, and narrative skills. *Early Education and Development*, 19(1): 27-44.
- Shanahan T and Lonigan CJ (2010) The National Early Literacy Panel: A summary of the process and the report. *Educational Researcher*, 39(4): 279-285.
- Sim SSH, Berthelsen D, Walker S, Nicholson JM and Fielding-Barnsley R (2011) A Shared Reading intervention with parents to enhance young children's early literacy skills. *Early Child Development and Care*, 184(11): 1531-1549.

- Snowling MJ, Hulme C, Bailey AM, Stothard SE and Lindsay G (2011) *Better communication research project: Language and literacy attainment of pupils during early years and through KS2 - Does teacher assessment at five provide a valid measure of children's current and future educational attainments?* Research Report DFE-RR172a. London: Department for Education. ERIC accession number: ED526908.
- Suskind D, Leffel KR, Hernandez MW, Sapolich SG, Suskind E, Kirkham E and Meehan P (2013) An exploratory study of "quantitative linguistic feedback": Effect of LENA feedback on adult language production. *Communication Disorders Quarterly*, 34(4): 199-209. DOI: 10.1177/1525740112473146
- Tamis-LeMonda CS, Bornstein MH and Baumwell L (2001) Maternal responsiveness and children's achievement of language milestones. *Child Development*, 72(3): 748-767.
- Topping KJ, Dekhinet R and Zeedyk S (2011) Hindrances for parents in enhancing child language. *Educational Psychology Review*, 23(3): 413-455.
- Topping KJ, Dekhinet R and Zeedyk S (2013) Parent-infant interaction and children's language development. *Educational Psychology*, 33(4): 391-426.
- Weisleder A and Fernald A (2013) Talking to children matters: Early language experience strengthens processing and builds vocabulary. *Psychological Science*, 24(11): 2143-2152. DOI: 10.1177/0956797613488145.
- Xu D, Yapanel U and Gray S (2009) *Reliability of the LENATM language environment analysis system in young children's natural language home environment*. LENA Foundation Technical Report LTR-05-2. Retrieved 13 November 2014 from http://www.lenafoundation.org/wp-content/uploads/2014/10/LTR-05-2_Reliability.pdf.

Zhang Y, Xu X, Jiang F, Gilkerson J, Xu D, Richards JA, Harnsberger J, & Topping KJ (2015)

Effects of quantitative linguistic feedback to parents of young infants: A pilot study in China.

Communication Disorders Quarterly, (in press). DOI: 10.1177/1525740115575771.

Table 1. Participant Family Demographics.

Participants	N	Gender of child F/M	Mother's Education <BD/BD ^a	Child Age Mean (SD) Range
Included	36	19/17	16/20	41.8 (10.8) 26-61
Excluded	62	31/31	44/18	47.2 (12.1) 27-72
Overall	98	50/48	60/38	45.2 (11.9) 26-72

^aBD = Bachelor's Degree.

Table 2. Mean rates of language use per minute by education group.

	Conversational Turns (CT)			Adult Word Count (AWC)			Child Vocalizations (CV)		
	Overall	BD+	<BD	Overall	BD+	<BD	Overall	BD+	<BD
N	36	20	16	36	20	16	36	20	16
All Times	0.89 (0.43)	0.97 (0.48)	0.79 (0.35)	20.01 (7.55)	21.60 (8.20)	18.03 (6.35)	3.99 (1.85)	4.51 (2.07)	3.33 (1.34)
Reading	1.41 (1.02)	1.32 (0.94)	1.52 (1.13)	45.86 (28.28)	41.74 (25.08)	51.00 (31.93)	4.13 (2.82)	4.12 (3.07)	4.15 (2.57)
Other	0.86 (0.43)	0.95 (0.49)	0.75 (0.34)	18.46 (7.50)	20.18 (8.17)	16.31 (6.15)	3.97 (1.89)	4.51 (2.10)	3.28 (1.36)
Change	+0.55 (0.97)	+0.37 (0.92)	+0.77 (1.01)	+27.39 (28.31)	+21.56 (25.02)	+34.69 (31.22)	+0.16 (2.71)	-0.40 (2.83)	+0.87 (2.46)
Effect Size	.57	.40	.76	.97	.86	1.11	.06	.14	.35

Note: SD is provided in parentheses. ^aBD = Bachelor's Degree. Effect Size = Cohen's d

Daily Activity Questionnaire

Please complete at the end of the same day as you record

Recording Date: _____ ID #: _____

Your relationship to child: MOTHER FATHER OTHER

1) Did your child interact with anyone under the age of 10 today (including siblings)?

YES NO

2) At any point today did you or a caregiver read any books to your child in your household?

YES NO

3) If “YES”, approximately what time did you read?

Reading Time 1: __:__ AM / PM until __:__ AM / PM

Reading Time 2: __:__ AM / PM until __:__ AM / PM

4a) Who read to your child today during Reading Time 1?

MOTHER FATHER BOTH OTHER

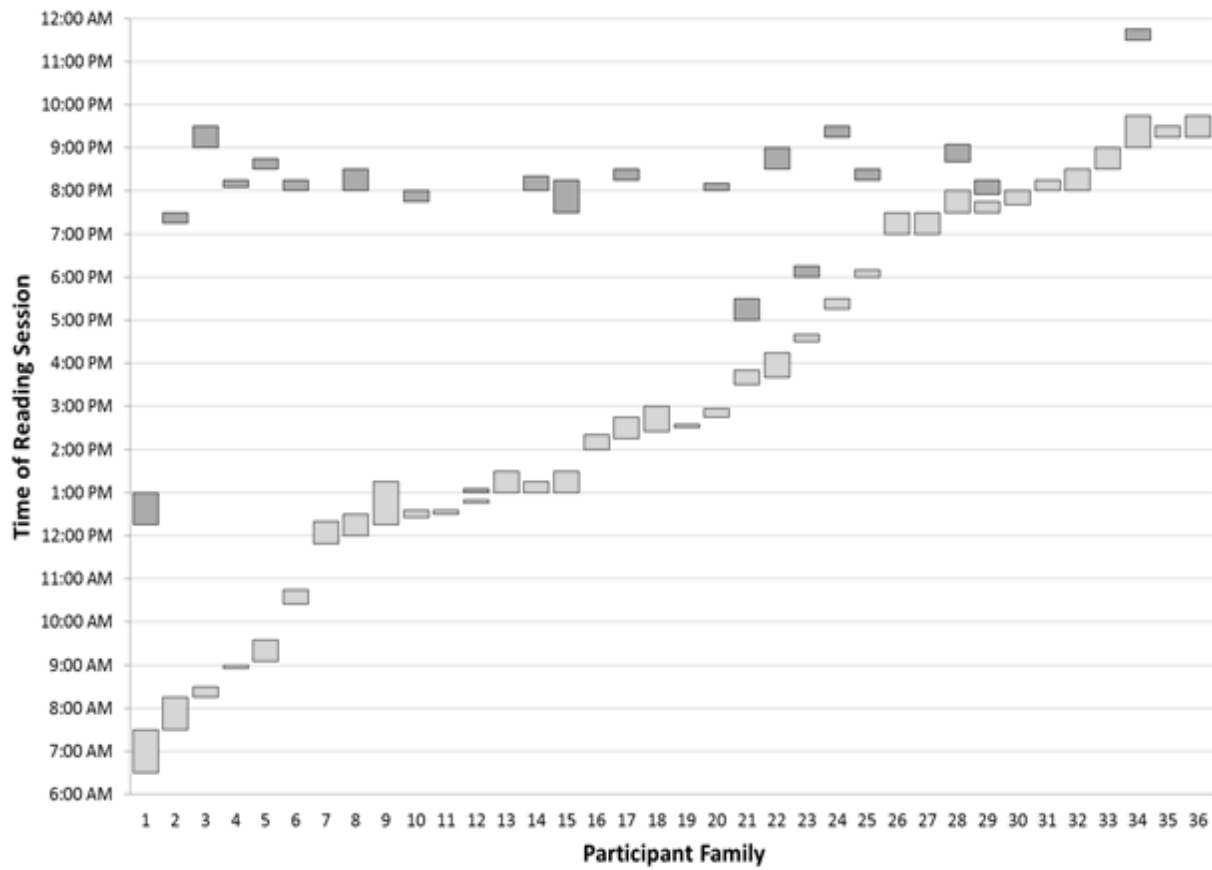
4b) Who read to your child today during Reading Time 2?

MOTHER FATHER BOTH OTHER

5) Please list the titles of any books you read today:

6) Please list who else was present during reading time today: (e.g. older brother, younger sister, friend, etc.)

Figure 1: Daily Activity Questionnaire.



Note. Lower lighter = first reading session, upper darker = second reading session.

Figure 2. Distribution of reading sessions by family during the day.