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Very Early Language Skills of Fifth-Grade Poor Comprehenders

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Abstract

This study tested the theory that future poor comprehenders would show modest but pervasive deficits in both language comprehension and production during early childhood as compared with future poor decoders and typical readers. Using an existing database (NICHD ECCRN), fifth-grade students were identified as having poor comprehension skills ($n = 516$), poor decoding skills ($n = 511$) or typical reading skills ($n = 535$) based on standardized assessments of word recognition and reading comprehension. Language comprehension and production during the toddler and preschool years were retrospectively compared across these subgroups. Compared with future typical readers and poor decoders, poor comprehenders had the lowest abilities on language assessments at 15, 24, 36 and 54 months. For nearly all contrasts, the difference between poor comprehenders and the other groups of readers exceeded .5 standard deviation in magnitude, indicating that the early language skills of poor comprehenders exhibit appreciable lags.

Comprehension-specific reading problems represent a particular type of reading difficulty in which a child can read fluently and accurately but has significant problems understanding what is read (Catts, Adlof & Weismer, 2006; Nation, Cocksey, Taylor & Bishop, 2010; Yuill & Oakhill, 1991). By definition, these children have age-appropriate decoding skills concomitant with unexpectedly poor reading comprehension; they therefore are often referred to as ‘poor comprehenders’ (Stothard & Hulme, 1992). The reading problems of poor comprehenders, who represent about 7–10% of school-aged children (Clarke, Snowling, Truelove & Hulme, 2010; Stothard & Hulme, 1992), appear to be aetiologically distinct from those with developmental dyslexia (i.e. unexpectedly poor decoding skills). Whereas developmental dyslexia reflects a child’s difficulty with developing and applying the alphabetic principle, often attributed to core deficits in phonological processing (Catts, Fey, Zhang & Tomblin, 1999), comprehension-specific reading problems appear to reflect a modest but pervasive impairment of language skill that impacts one’s ability to derive meaning from text even in the context of fluent wordlevel reading (Cain & Oakhill, 2006; Nation, Adams, Bowyer-Crane & Snowling, 1999).

In the last decade, the early identification of reading problems, particularly developmental dyslexia, has taken a prominent place in national health and educational policies and practices (American Academy of Pediatrics, 1998; Snow, Burns & Griffin, 1998). This

focus is supported by results of a large body of longitudinal research systematically linking early indicators of risk, such as poor phonological processing as measured before formal reading instruction, to children's likelihood of exhibiting word-level reading difficulties in the early primary grades (Catts, Fey, Zhang & Tomblin, 2001). This body of work has been very influential for design and implementation of early dyslexia screening programmes and interventions (e.g. Invernizzi, Justice, Landrum & Booker, 2005); such programmes typically seek to monitor and address, when deemed necessary, children's development of those skills closely aligned to decoding achievement before or at the start of reading instruction (e.g. Gillon, 2000). An important gap in this literature on the prevention of reading difficulties, however, is the very limited attention to early detection of comprehension-specific reading problems.

In comparison with what is known about the precursors to and intervention for developmental dyslexia, far less is known about comprehension-specific reading problems, particularly the antecedents of poor comprehension in the absence of decoding deficits, as in the case of poor comprehenders. In general, research conducted on the component reading skills of poor comprehenders in the later grades suggests that comprehension-specific reading problems are the result of pervasive language deficits that affect grammatical, morphological and lexical abilities (Cain & Oakhill, 2006; Catts et al., 2006; Nation, Clarke, Marshall & Durand, 2004; Stothard & Hulme, 1992). These deficits are best represented as modest rather than clinical in nature, as the language skills of poor comprehenders are significantly lower than those of good readers (as well as poor decoders) but are not so low as to be clinically impaired (Nation et al., 2010). For instance, Nation and colleagues compared the vocabulary skills of 15 8-year-old poor comprehenders with 15 control readers. Differences between the two groups, who were matched for reading accuracy, were consistent with a large difference ($d = 0.82$). However, while the poor comprehenders had significantly depressed vocabulary skills in relation to normal readers, their skills were not so depressed as to render them impaired; in fact, on average, standardised vocabulary scores were within the average range ($M = 92.34$).

Such findings, consistent with results of other work (e.g. Cain, Oakhill & Bryant, 2000; Stothard & Hulme, 1992), can be interpreted to show that the reading problems of poor comprehenders stem from weaknesses in 'general purpose language processing mechanisms and not in mechanisms specialised for reading' (Stothard & Hulme, 1992, p. 254). While the language problems of poor comprehenders are not sufficiently severe to warrant diagnoses of specific language impairment (SLI), they are pervasive enough to affect the child's ability to effectively integrate language processing with the additional text and task demands required for skilled reading comprehension. Moreover, it is probable that these language processing difficulties are present from the earliest stages of reading development and that these may represent causal antecedents of the reading comprehension deficits of poor comprehenders. The consensus that language deficits are central to the difficulties experienced by poor comprehenders is important for conceptualising how poor comprehenders might be identified early – before experiencing reading failure – and, in turn, provided effective and earlier intervention (Clarke et al., 2010).

Nonetheless, despite this consensus in the literature that modest and pervasive language deficits represent an important cause of poor reading comprehension (e.g. Catts et al., 2006), an alternative explanation is the possibility that language deficits observed among poor comprehenders are the consequent rather than the antecedent of reading problems (Nation et al., 2010). As compared with more advanced readers, children who struggle to comprehend what they read may derive less linguistic information from their reading experiences, read less often, read less sophisticated materials and/or be less engaged when reading, any one of which could contribute to language deficits (Nation et al., 2010). If this is the case, language deficits might be the result, rather than the cause, of comprehension-specific reading problems.

Prospective longitudinal studies present an important opportunity to determine the extent to which language deficits may serve as key antecedents to comprehension-specific reading problems. Indeed, if modest but pervasive language deficits are the antecedent rather than consequent of comprehension-specific reading problems, we can expect poor comprehenders to show an observable history of language deficits well before the emergence of reading skills. To date, only two longitudinal studies have identified children who are poor comprehenders in the later grades and retrospectively examined whether early language deficits were apparent before beginning reading. Both Catts et al. (2006) and Nation et al. (2010) described the language skills of poor comprehenders at 5 years of age, which was the earliest age for which longitudinal data were available in these studies. Catts and colleagues retrospectively examined the language skills at 5 years for three groups of readers based on eighth-grade reading scores: poor comprehenders ($n = 57$), poor decoders ($n = 27$) and typical readers ($n = 98$). At 5 years (kindergarten assessment), the poor comprehenders significantly differed from both the poor decoders and typical readers on a composite measure of language comprehension representing lexical, syntactic and narrative skills. Differences were large in size ($d = 0.76$ and 1.37 as compared with poor decoders and typical readers, respectively). Nation and colleagues retrospectively examined the language skills at 5 years for two groups of readers based on reading scores at eight years: poor comprehenders ($n = 15$) and good readers ($n = 15$) matched for reading accuracy. At 5 years, the poor comprehenders significantly differed from the good readers on measures of grammar ($d = 1.05$), vocabulary ($d = 0.64$) and listening comprehension ($d = 1.14$).

In the aggregate, these findings show that (a) poor comprehenders' reading problems are foreshadowed by a history of modest language deficits that differentiate them from not only good readers but also poor decoders and (b) these language deficits are apparent before the advent of reading instruction. Such findings provide an important source of evidence for arguing that language deficits are a cause rather than consequence of comprehension-specific reading problems. Nonetheless, given that many children by age 5 are developing beginning reading skills and may be interacting with simple texts (Invernizzi et al., 2005), this evidence base would be further strengthened if the language deficits of poor comprehenders were apparent before age 5. If poor comprehenders can be shown to exhibit lags in language development during the toddler and preschool years, lags that are sufficiently pervasive to differentiate them from children who will become good readers but also those who will become poor decoders, we can conclude quite strongly that poor

comprehenders exhibit a developmental weakness of language skill that initially manifests through deficits in language comprehension and production but subsequently yields to comprehension-specific reading problems.

In the present study, we tested the hypothesis that reading-comprehension deficits are the consequents of developmental deficits of language skill, as would be suggested if deficits in both language comprehension and production were apparent across the toddler and preschool years for children who would become poor comprehenders. We hypothesised that poor comprehenders would exhibit deficits in both language comprehension and production throughout the course of early childhood, sufficient in magnitude to differentiate them from young children who would become good readers and from those who would become poor decoders. An important contribution of the present study is inclusion of measures of both language production and comprehension; no studies of which we are aware have retrospectively examined both comprehension and production among poor comprehenders in the years before kindergarten. Examination of poor comprehenders' language production and comprehension skills at 5 years, as presented in Nation et al. (2010), suggests that language comprehension may be relatively more affected than language production. We therefore anticipated that language comprehension would be particularly poor in relation to production when comparing the historical language skills of poor comprehenders as compared with poor decoders and typical readers.

We further proposed that the gap in language skill differentiating future poor comprehenders from future poor decoders and future typical readers would become larger in magnitude as children progress from toddlerhood through the preschool years. This proposal is based on two premises. First, in general, language weaknesses tend to become more pronounced over time (among children with enduring difficulties, as we propose that poor comprehenders experience), potentially because language-assessment tasks become more taxing and require integration of multiple linguistic domains (Sansavini et al., 2010). By extension, assessments given to older children (e.g. at 54 months) may be more sensitive to developmental weaknesses in language skill than assessments given to young children (e.g. at 15 or 24 months). Second, prior evidence on the developmental trajectories of children with language difficulties over the course of early childhood has shown that future literacy performance is more strongly predicted by the presence of language difficulties at entrance to formal schooling (4.5 years of age) than the persistence of such difficulties over early childhood (Justice, Bowles, Pence Turnbull & Skibbe, 2009). This time-point appears to have special developmental significance, presumably because the gap between future good and poor readers becomes more apparent than in the earlier years.

METHODS

Participants

This research utilised the database of the NICHD Early Child Care Research Network (NICHD ECCRN, 1993, 1996). This national study ascertained 1,364 children whose mothers gave birth in selected US hospitals during 24-hour sampling blocks over a 10-month period at 10 separate locations across the United States. Children's mothers were required to be over the age of 18, conversant in English and have no known substance abuse problems;

the target child was required to have no identified disabilities or serious medical issues. Upon birth, children were followed longitudinally through adolescence to study the effects of various childcare experiences on children's development (see <http://secc.rti.org>). The NICHD ECCRN public-domain database has been widely used by developmental researchers (e.g. Justice et al., 2009; La Paro, Justice, Skibbe & Pianta, 2004; NICHD ECCRN & Duncan, 2003).

Study sample

The 62 children in the present study were selected from among those in the NICHD ECCRN database who had completed fifth-grade reading assessments (n=5991) involving both the Woodcock-Johnson Passage Comprehension (PC) and Letter-Word Identification (LWID) subtests; these two measures are commonly used to assess children's reading comprehension and decoding skills, respectively. On the basis of children's PC and LWID scores at fifth grade, three subgroups of children (poor comprehenders, poor decoders, typical readers) were identified based on their percentile scores relative to the normative population using procedures similar to those of Catts et al. (2006). Recall that Catts and colleagues is one of the two longitudinal studies featuring retrospective analysis of the language skills of poor comprehenders. In that study, poor comprehenders, poor decoders and typical readers were identified at eighth grade on the bases of comprehension and decoding performance. We replicated their procedures albeit with different but analogous measures of reading achievement and at a different point in time (fifth grade vs eighth grade).

The 62 children were primarily white (74%) and from non-poor backgrounds (80%) based on families' income-to-needs ratios. Sixteen children (57% boys, 43% girls) were identified as poor comprehenders. These children scored at the 25th percentile or lower on PC and at the 40th percentile or higher on LWID. Eleven children (64% boys, 46% girls) were identified as poor decoders; these children scored at the 40th percentile or higher on RC and at the 25th percentile or lower on LWID. Thirty-five children (43% boys, 57% girls) were selected to comprise a group of typical readers from among a larger group of 349 children who scored between the 40th and 84th percentile on both RC and LWID; from the larger group, 10% ($n = 535$) were randomly selected for this study. Figure 1 depicts the average reading comprehension and decoding percentile scores at fifth grade for children in each of these subgroups, whereas Table 1 provides descriptive data (mean, standard deviation, range) for these groups on the two reading measures.

Measures

A comprehensive array of language measures were collected from children at 15, 24, 36 and 54 months. In total, 13 different subtests and measures of language skill were administered indirectly or directly to children between birth and school entry. For the purposes of parsimony, we selected at each age the two measures that most directly provided an index of general language production (the ability to produce or express spoken language) and language comprehension (the ability to understand or comprehend spoken language). At 24 months, no measure of comprehension was available; therefore only one measure was selected for inclusion at this assessment point. Note that the codebook (including administration directions, scoring protocols and the like) is available in the public domain

and can be directly consulted for specific information about the tools used (<http://www.nichd.nih.gov/research/supported/seccyd/overview.cfm>).

At 15 months, language production and language comprehension were assessed using the percentile scores derived from the Vocabulary Produced and Phrases Understood subtests of the MacArthur Communicative Development Inventory – Infant Form (CDI; Fenson et al., 1993), respectively. Both subtests were completed by the child’s parent; the Vocabulary Produced subtest is derived from a 396-item vocabulary list that is structured so that the parent can indicate which words the child understands and which words the child understands and produces. The Phrases Understood subtest includes a three-item section used to determine whether the child has begun to show signs of understanding vocabulary.

At 24 months, the CDI Toddler Form was administered in a similar manner to the CDI Infant Form. The CDI Toddler Form does not contain a measure of language comprehension; rather, it contains only a measure of language production. To assess the child’s language production, parents completed the Words Children Use checklist – a 680-word list in which parents indicated whether their child uses each word.

At 36 months, language production and comprehension were assessed using the Reynell Developmental Language Scale (RDLS; Reynell, 1991). The RDLS was administered by a researcher during a 36-month lab visit and is designed to test verbal comprehension and expression. The RDLS contains two 67-item scales: Expressive Language and Verbal Comprehension.

At 54 months, language production and comprehension were assessed using the Preschool Language Scale-3 (PLS-3; Zimmerman, Steiner & Pond, 1979). The PLS-3 is a norm-referenced, standardised measure that has previously been used to identify children with language disorders (King et al., 2005). This measure was administered by a researcher during a 54-month home visit and contains two standardised subscales: Expressive Communication and Auditory Comprehension.

Analytical framework

Each language production and comprehension score was converted to a percentile that represents the child’s abilities relative to an age-adjusted normative sample of children. Analysis of variance (ANOVA) compared language abilities at 15, 24, 36 and 54 months for children classified as poor comprehenders, typical readers and poor decoders at fifth grade. For cases in which the ANOVA F-test was statistically significant, planned contrast tests using a Bonferroni correction to account for multiple comparisons were conducted to assess whether poor comprehenders exhibited significantly poorer language skills compared with typical readers and poor decoders. Nonetheless, because of the relatively small sample sizes in each subgroup (which is characteristic of studies of poor comprehenders; e.g. Nation et al., 2010), mean differences between subgroups may have practical significance but may not achieve statistical significance. Thus, for each early language assessment, the magnitude of the difference between poor comprehenders and typical readers and poor comprehenders and poor decoders was expressed in terms of effect sizes. Effect sizes (Cohen’s *d*) were computed by dividing the difference between the two groups’ means by the pooled standard

deviation for the two groups on each early language assessment. Effect sizes are generally defined as small ($d = 0.2$), medium ($d = 0.5$) and large ($d = 0.8$). We remind readers to be cautious in interpreting findings that are not statistically significant (and therefore may be attributable to chance alone) but that may appear to be practically significant based on effect-size estimates.

RESULTS

Table 2 presents the mean and standard deviation for typical readers, poor decoders and poor comprehenders on each of the seven early language assessments and it also includes the F -value from the ANOVA to indicate whether these mean differences across groups are statistically significant. Figure 2 presents effect size estimates for the differences between typical readers and poor comprehenders and poor decoders and poor comprehenders on each early language assessment. Here, we provide an overview of comparisons across the time-points studied, discussing not only the tests for statistical significance but also the effect size estimates.

At 15 months, differences in language comprehension for typical readers ($M = 47.6$), poor decoders ($M = 45.5$) and poor comprehenders ($M = 29.0$) were not statistically significant, $F(2,43) = 1.32, p = .28$. In terms of effect sizes, the magnitude of the differences between typical readers and poor comprehenders and poor decoders and poor comprehenders were $d = 0.61$ and 0.53 , respectively, consistent with medium-sized effects. Similarly, mean language production scores at 15 months for typical readers ($M = 36.1$), poor decoders ($M = 32.5$) and poor comprehenders ($M = 26.5$) were not statistically different across the three groups, $F(2,42) = .50, p = .61$. The effect size for the differences were $d = 0.37$ for typical readers compared with poor comprehenders and $d = 0.22$ for poor decoders compared with poor comprehenders, both small- to medium sized effects.

Language production scores at 24 months for typical readers ($M = 49.1$), poor decoders ($M = 53.1$) and poor comprehenders ($M = 28.6$) were overall not statistically different, $F(2,45) = 2.25, p = .12$. The effect sizes were medium to large in magnitude. Specifically, the effect size for the difference between typical readers and poor comprehenders was $d = 0.70$ and the effect size for the difference between poor decoders and poor comprehenders was $d = 0.76$. At 36 months, language comprehension scores for typical readers ($M = 54.6$), poor decoders ($M = 44.5$) and poor comprehenders ($M = 23.9$) were significantly different, $F(2,57) = 6.65, p = .003$. Planned contrasts indicated a statistically significant difference between typical readers and poor comprehenders and the effect size for the difference was large in magnitude ($d = 1.15$). The difference between poor decoders and poor comprehenders was not statistically significant; however, the magnitude of the effect size ($d = 0.82$) indicated a large difference between the groups. Differences in language production at 36 months for typical readers ($M = 44.8$), poor decoders ($M = 44.9$) and poor comprehenders ($M = 31.5$) were not statistically significant, $F(2,56) = 1.44, p = .25$. Effect size estimates show that the magnitude of differences between typical readers and poor comprehenders and poor decoders and poor comprehenders were $d = 0.52$ and 0.52 , respectively.

Language comprehension at 54 months was significantly different, $F(2,54) = 7.75, p = .001$, for typical readers ($M = 57.8$), poor decoders ($M = 37.9$) and poor comprehenders ($M = 19.5$). Planned comparisons indicated that the difference in language comprehension between typical readers and poor comprehenders was statistically significant and the effect size ($d = 1.27$) was large in magnitude. The means for poor decoders and poor comprehenders were not statistically different; however, the effect size estimate ($d = 0.68$) indicated that the difference was medium to large in magnitude. Language production at 54 months was also statistically different across the three groups, $F(2,53) = 3.80, p = .03$. Planned comparisons indicated that the difference between typical readers ($M = 57.4$) and poor comprehenders ($M = 27.6$) was statistically significant, consistent with a large effect ($d = 0.87$). The difference between poor decoders ($M = 57.5$) and poor comprehenders ($M = 27.6$) was large in magnitude ($d = 0.89$) but not statistically significant.

Prior evidence has suggested that language comprehension might be more closely related to future reading ability than production and findings presented thus far implied that this might be the case (Justice et al., 2009). As a final set of analyses and conducted largely for exploratory purposes, we used two methods to compare the predictive relations between children's language comprehension and language production at 54 months and their reading ability at fifth grade. In the first method, we regressed fifth grade reading comprehension on language production and language comprehension at 54 months, which were entered simultaneously in the model. Results corroborated prior evidence. Specifically, among the 53 children with complete data for both language measures and the reading comprehension measure, the association between language comprehension at 54 months and reading comprehension at fifth grade was large and statistically significant ($\beta = 0.52, p = .002$). In comparison, the association between language production at 54 months and reading comprehension at fifth grade was not statistically different from 0 ($\beta = .08, p = .62$). Thirty-three per cent of the variance in fifth-grade reading comprehension was explained by the two language measures at 54 months.

Using a second method among the same subsample of children described above, we conducted a multinomial logistic regression to predict membership in the reading ability subgroups (poor comprehenders, poor decoders, typical readers) at fifth grade using the measures of language comprehension and language production at 54 months. The poor comprehender subgroup was the reference category and the analysis examined the extent to which language comprehension and language production at 54 months predicted membership in (a) the poor decoder subgroup compared with the poor comprehender subgroup and (b) the typical reader subgroup compared with the poor comprehender subgroup. Partial odds ratios were calculated for each regression coefficient by taking the natural base log raised to the power of the coefficient (e^B). For the first contrast (poor decoders vs poor comprehenders), results indicated that for each 10-percentile increase in language comprehension and language production at 54 months, the odds of membership in the poor decoder subgroup compared with the poor comprehender subgroup at fifth grade increased by 15% and 18%, respectively. These coefficients are not statistically significant, due in part to the small subsample in the analysis. For the second contrast, language production at 54 months was not significantly associated with membership in the typical

reader subgroup compared with the poor comprehender subgroup at fifth grade. Specifically, each 10-percentile increase in language production at 54 months increased the odds of membership in the typical reader subgroup compared with the poor comprehender group at fifth grade by only 4%. In contrast, for each 10-percentile increase in language comprehension at 54 months, the odds of membership in the typical reader subgroup compared with the poor comprehender group at fifth grade increased by 41%, which is statistically different from 0 ($\beta = .04, p = .02$).

DISCUSSION

Overall, results of this study at least tentatively support the hypothesis that poor comprehenders exhibit deficits in both language comprehension and production throughout the course of early childhood, sufficient in magnitude to differentiate them from children who would become good readers and from those who would become poor decoders. Specifically, this study showed that compared with fifth-grade typical readers and poor decoders, fifth-grade poor comprehenders had the lowest abilities on each assessment of language comprehension and production at 15, 24, 36 and 54 months, although in some cases these results were not statistically significant and thus should be considered cautiously. Of particular note is that study findings showed that all comparisons of early language comprehension for future poor comprehenders, as compared with both future typical readers and poor decoders, exceeded a medium-sized effect (all d s > 0.50 at 15, 36 and 54 months); the same was also true for all comparisons of language skill – comprehension and production – as measured at 24 months or beyond for poor comprehenders as compared with typical readers and poor decoders (all effects were at least medium in size).

The results of this study, considered in conjunction with two prior retrospective analyses of the language skills of poor comprehenders at 5 years (Catts et al., 2006; Nation et al., 2010), help to support for the hypothesis that comprehension-specific reading difficulties are a consequence of pervasive deficits in language skill, to transcend both comprehension and production and that these deficits are developmental in nature (i.e. present very early in life with a tendency to persist over time). The results further support conceptualisation of the fairly modest nature of the early language deficits of poor comprehenders: although the early language skills of future poor comprehenders are consistently depressed as compared with future typical readers and poor decoders, their early language skills are not generally so poor as to constitute a clinical level of impairment (Nation et al., 2010). While there is little consensus regarding the threshold that functionally demarcates impaired from typical language, the 10th and 16th percentiles are most commonly used as cut-points (e.g. Heilman, Ellis Weismer, Evans & Hollar, 2005; Tomblin et al., 1997; Zubrick, Taylor, Rice & Slegers, 2007). By way of reference, the average level of language skill displayed by poor comprehenders at 15, 24, 36 and 54 months was somewhat above these cut-points, ranging from the 19th percentile (54 months language comprehension) to the 31st percentile (36 months language production). It is therefore important to recognise, for both theoretical and practical reasons, that the language skills of poor comprehenders are not severely impaired during early childhood, at least from a functional perspective, yet do appear to be insufficiently developed so as to support growth in higher-level text comprehension within written contexts.

Several additional findings of this work warrant elaboration. First, as we had proposed, differences in the language comprehension skills of poor comprehenders as compared with poor decoders and typical readers tended to grow larger over time. In fact, whereas the language comprehension skills of poor decoders and typical readers were generally stable when looking across the assessment time-points, largely hovering around the 50th percentile at 15, 36 and 54 months, the average language comprehension skills of future poor comprehenders actually declined over time, from the 29th and 34th percentiles at 15 and 36 months to the 19th percentile at 54 months. At the 54-month time-point, language comprehension skills most markedly differentiated future typical readers from future poor comprehenders. This finding may reflect the difference in assessment approaches used over time (a shift from indirect to direct assessments) as well as the different and potentially more taxing foci of the comprehension assessments at the latter time-points. The measures used at the 36- and 54-month assessments examined children's language comprehension within discourse-level tasks that required integration of syntactic, morphological and lexical dimensions of language. It is plausible that these more taxing types of linguistic tasks are sensitive to revealing the comprehension weaknesses of future poor comprehenders.

Second, and relatedly, it is also important to note that, with one exception, the greatest differences in language skill when comparing poor comprehenders to typical readers and poor decoders occurred at the 54-month assessment point. (The exception to this rule occurred for the comparison of poor comprehenders and poor decoders on language comprehension, for which the greatest difference in language skill occurred at 36 months.) In fact, the absolute largest effect-size contrasts were seen for the 54-month comparison of poor comprehenders and typical readers for both language comprehension ($d = 1.27$) and production ($d = 0.87$), with comprehension weaknesses most defining of the language differences between poor comprehenders and their peers. This finding can be considered to provide support for the critical age hypothesis, first proposed by Bishop and Adams (1990), which posits that children with a history of speech and language difficulties whose impairments do not resolve by the advent of beginning reading instruction are at particularly high risk for reading problems. Several tests of this theory have shown quite persuasively that children whose language skills lag behind others at school entry, corresponding to the start of formal reading instruction, exhibit a high risk for literacy-related problems and that the timing of these problems is a particularly crucial variable (Justice et al., 2009; Nathan, Stackhouse, Goulandris & Snowling, 2004). Considered in conjunction with the present findings and in accordance with our exploratory regression analysis that compared the associations between reading comprehension at fifth grade and language comprehension and language production at 54 months, we might conclude that poor language comprehension at 54 months is a salient indicator of a child's risk of comprehension-specific reading problems.

As a final comment, we also want to point to findings in our data showing reasonably clear delineation of the early language skills – both production and comprehension – for future poor comprehenders as compared with future poor decoders. With the exception of the comparison for 15-month language production, poor comprehenders and poor decoders showed moderate to large differences in their early language development. Although this

was not an unexpected finding, this work provides further evidence of the aetiological distinctiveness of these two varieties of reading problems (Catts et al., 2006). Whereas developmental dyslexia is well understood to reflect difficulties developing and applying the alphabetic principle, typically attributed to phonological-processing limitations (see Gillon, 2000), comprehension-specific reading problems appear causal consequents of general developmental deficits in language processing mechanisms (Stothard & Hulme, 1992). That these two primary types of reading problems are aetiologically distinct has important implications for the early identification of and intervention for reading problems. For instance, whereas early identification of and intervention for developmental dyslexia typically focuses on phonological processing and print-related skills (e.g. Schneider, Roth & Ennemoser, 2000), results of this study suggest that identification of and intervention for comprehension-specific reading problems should address language comprehension and production. Although a variety of language-intervention approaches have been described in the literature (e.g. Bowyer Crane et al., 2008; Justice, Mashburn, Pence & Wiggins, 2008), these are not typically targeted to children who are at high risk of developing comprehension-specific reading problems. Of note, however, are recent findings suggesting that language-focused intervention can improve the comprehension skills of 8–10-year-old poor comprehenders (Clarke et al., 2010). The potential efficacy of using language-focused interventions for reducing children's risk of comprehension-specific reading problems is a highly important avenue for the prevention of reading problems.

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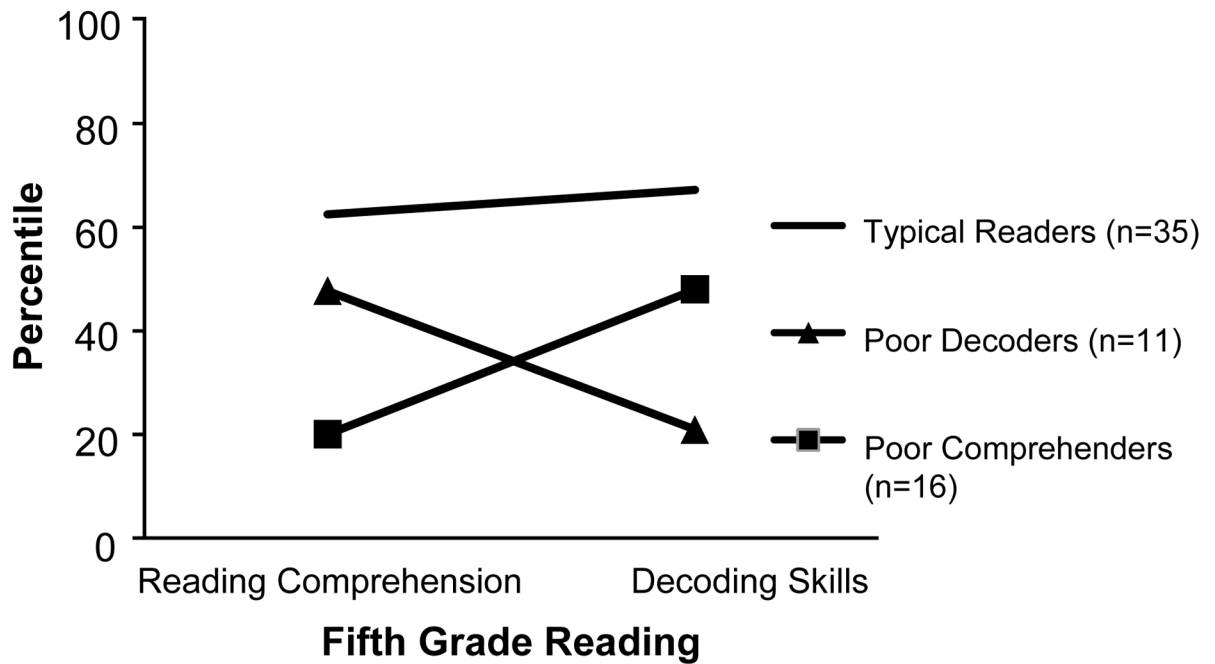


Figure 1. Fifth grade reading comprehension and decoding skills for typical readers, poor decoders and poor comprehenders

Note: Reading Comprehension and Decoding 5 Percentile scores on the Woodcock-Johnson Passage Comprehension and Letter-Word Identification subtests, respectively.

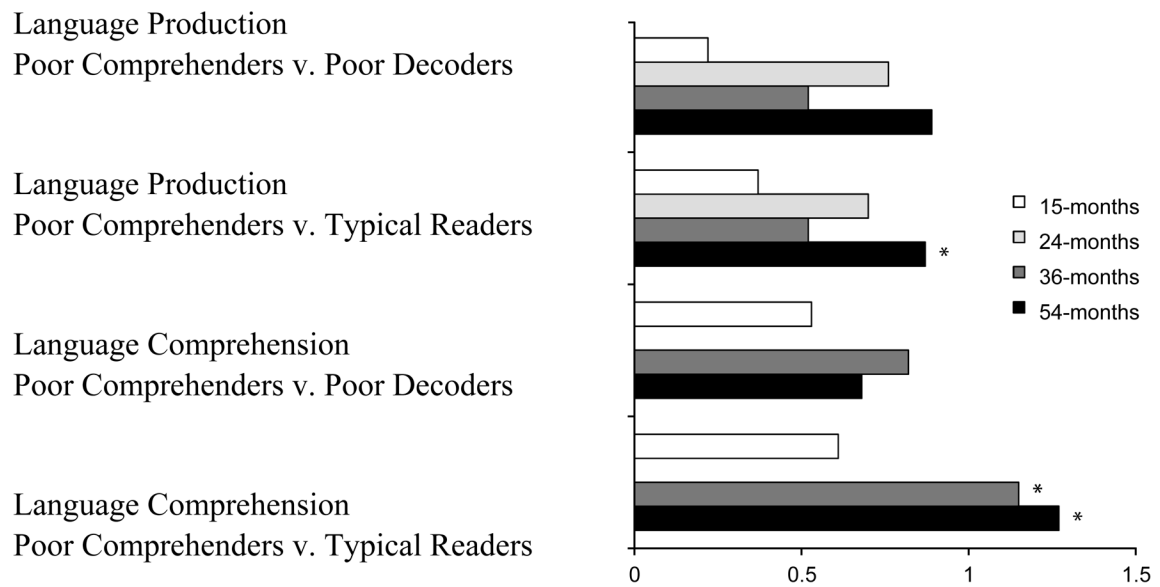


Figure 2. Effect sizes for the differences in language production and language comprehension between poor comprehenders and poor decoders and poor comprehenders and typical readers

Note: Language Comprehension scores were not available at 24 months.

An asterisk (*) indicates that the difference between the two groups is statistically significant based upon post hoc comparisons.

Descriptive statistics for fifth-grade reading comprehension and decoding skills (percentile scores) for typical readers, poor decoders and poor comprehenders.

Table 1

	Reading comprehension			Decoding		
	Mean	SD	Range	Mean	SD	Range
Typical readers (n = 35)	62.4	12.5	41–81	67.1	12.0	47–84
Poor decoders (n = 11)	47.6	5.9	41–60	20.8	3.5	13–24
Poor comprehenders (n = 16)	19.9	5.2	6–24	47.9	6.9	42–70

Note: Reading Comprehension and Decoding 5 Percentile scores on the Woodcock-Johnson Passage Comprehension and Letter-Word Identification subtests, respectively.

Descriptive statistics on early language skills (percentile scores) for typical readers, poor decoders and poor comprehenders at fifth grade.

Table 2

	Typical readers			Poor decoders			Poor comprehenders			<i>F</i>
	<i>n</i>	Mean	<i>SD</i>	<i>n</i>	Mean	<i>SD</i>	<i>n</i>	Mean	<i>SD</i>	
15 months language comprehension	28	47.6	31.5	8	45.5	34.7	10	29	28.3	1.32
15 months language production	27	36.1	25.5	8	32.5	27	10	26.5	26.5	0.5
24 months language production	29	49.1	28.2	8	53.1	31.2	11	28.6	32.7	2.25
36 months language comprehension	34	54.6	28.4	11	44.5	29	15	23.9	22.5	6.65**
36 months language production	33	44.8	26.6	11	44.9	28.2	15	31.5	24.1	1.44
54 months language comprehension	32	57.8	34.2	10	37.9	35	15	19.5	21.7	7.75**
54 months language production	32	57.4	36	10	57.5	39	14	27.6	29.7	3.80*

* *p* < .05;

** *p* < .01.