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Running head: EARLY VOCABULARY DELAY: FOLLOW-UP IN READING

Reading Outcomes of Children with Delayed Early Vocabulary: A Follow-up from Age 2 to  
16.

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## Abstract

### **Background**

Delays in expressive vocabulary have been associated with lower outcomes in reading.

### **Aim**

The aim is to conduct a long-term follow-up study to investigate if early expressive vocabulary delay (late talking) predicts reading development in participants age 16 and under. We examine further if the prediction is different in the presence of family risk for dyslexia (FR) and early receptive vocabulary delay.

### **Methods**

Expressive and receptive vocabulary skills were assessed at the age of 2–2.5 years, and reading skills in Grades 2, 3, 8 and 9 (age 8 to 16). The longitudinal sample consisted of 200 Finnish-speaking children, of which 108 had FR for dyslexia and 92 came from families without reading difficulties. We compared the reading development of five subgroups: 1) FR and no vocabulary delay; 2) FR and late talkers, 3) FR, late talkers and co-existing receptive vocabulary delay; 4) no FR and late talkers; and 5) no FR and no vocabulary delay.

### **Results**

The group with FR and expressive and receptive vocabulary delay had difficulties in reading comprehension, but not in reading fluency. The late talkers without receptive vocabulary difficulties tended to become typical readers.

### **Conclusions and Implications**

Delays in early vocabulary can lead to a reading comprehension deficit, with the specification that expressive vocabulary deficit alone can alleviate in time, whereas the combined deficit is a stronger risk marker.

**Keywords:** expressive vocabulary; receptive vocabulary; reading fluency; reading comprehension; reading difficulties

### **What this paper adds?**

The present study extends the literature by investigating the reading development of children with early expressive vocabulary delay followed up to age 16 (Grade 9) in a Finnish language context in relation to both reading fluency and reading comprehension. In addition, we examine whether this relationship is different in the presence and absence of other co-occurring risk factors, in particular family risk for dyslexia and early receptive vocabulary delay. The existing literature on reading development of children with delays in early vocabulary is almost exclusively limited to findings concerning the early grades of primary school. Furthermore, all the previous studies spanning beyond Grade 2 have been conducted using English-speaking children; thus, further research in other orthographies is needed.

We compared the reading development of five subgroups: 1) FR and no vocabulary delay; 2) FR and late talkers; 3) FR, late talkers and co-existing receptive vocabulary delay; 4) no FR and late talkers; and 5) no FR and no vocabulary delay. Our findings add to the literature by suggesting that a trajectory of later reading comprehension difficulties is much more likely when early expressive vocabulary delay is accompanied by receptive vocabulary delay. Our findings suggest that a delay in early vocabulary can lead to a persistent deficit with the specification that expressive vocabulary deficit alone can be alleviated in time, whereas the combined deficit is a stronger risk marker. Early expressive vocabulary delay represented high risk only for reading comprehension development and only when it co-occurred with other risk factors (family risk for dyslexia and receptive vocabulary difficulties).

**Reading outcomes of children with delayed early vocabulary: A follow-up from age 2 to****16****1. Introduction**

Early years expressive language delay, or late talking, is one of the most common concerns of parents and early health care personnel, and it is one of the common reasons for referring young children for evaluation. This is not surprising, as early language development forms the foundation for later educational and academic achievement and has important links with social adaptation (Reilly et al., 2010). From a clinical and educational perspective, it is important to be able to predict as early as possible which children may be at risk for learning difficulties in their school years. Delays in expressive vocabulary have been associated with lower outcomes in reading (Rescorla, 2002, 2005, 2009), but apart from Rescorla's sample from the USA, little research has focused on literacy development after the early grades of primary school using longitudinal designs. Moreover, most of the previous studies have been conducted among English-speaking children and have focused almost solely on early expressive, but not receptive vocabulary.

The present study will extend previous studies (Duff, Reen, Plunkett, & Nation, 2015; Lyytinen, Eklund, & Lyytinen, 2005; Rescorla, 2002, 2005, 2009) to later years of schooling by examining if late talking (delays in early expressive vocabulary) predict reading development (fluency and comprehension) from early primary Grades 2 and 3 to lower secondary Grades 8 and 9 in Finland. We will also examine the effects of co-occurring receptive vocabulary delay and family risk for dyslexia on the relationship between early vocabulary skills and reading outcomes. Expressive vocabulary may not be a marker of subsequent language and literacy difficulties when it is not accompanied by co-occurring difficulties in receptive vocabulary (Lyytinen et al., 2005). It is also possible that family risk

for dyslexia actually explains the link between expressive vocabulary delay because the children with family risk (due to parental language or reading difficulties) are shown to be at risk for both vocabulary delays (Duff et al., 2015; Lyytinen et al., 2005; Snowling, Gallagher, & Frith, 2003; Snowling, Muter, & Carroll, 2007) and for later language and reading outcomes (Lyytinen, et al., 2005; Reilly et al., 2010).

Early vocabulary skills (expressive or a composite score of expressive and receptive vocabulary) have been shown to be associated with both reading fluency (Nation & Snowling, 2004; Snowling et al., 2003) and reading comprehension (Duff et al., 2015; Nation, Cocksey, Taylor, & Bishop, 2010; Ouellette 2006; Ouellette & Beers 2010). Theories on how early vocabulary skills and reading outcomes are linked depend, however, on the reading skill in question. According to the lexical restructuring hypothesis, the link between early vocabulary and reading fluency is indirect and mediated via phonological skills (e.g. Walley, Metsala, & Garlock, 2003). Phonological awareness plays a critical role in the development of decoding (Ehri et al., 2001; Hulme & Snowling, 2014; Melby-Lervåg, Lyster, & Hulme, 2012), and tasks requiring identification or manipulation at the phoneme level, in particular, have been found to be associated with variations in decoding skills (Georgiou, Parrila, & Papadopoulos, 2008; Lervåg, Bråten, & Hulme, 2009). Walley et al. (2003) suggested that phonological awareness may be linked to vocabulary via the process of restructuring phonological representations (the word *cat*, for example, first segmented at syllable level /k/-/æt/ becoming segmented at phoneme level /k/-/æ/-/t/). Vocabulary growth increases sensitivity towards phonological similarities between words, which elicits a restructuring of the already-existing phonological representations in the lexicon (Walley et al., 2003).

The link between reading comprehension and vocabulary skills may be more direct than that of vocabulary and reading fluency. According to the simple view of reading model (Gough & Tunmer, 1986; Hoover & Gough, 1990), reading comprehension is based on two core skills:

decoding and language comprehension. Reading comprehension has been shown to rely on a variety of oral language comprehension skills (Hulme & Snowling, 2014), including expressive and receptive vocabulary (e.g. Nation et al., 2010) and listening comprehension (e.g. Catts, Adlof, & Weismer, 2006; Nation et al., 2010). Weaknesses in these skills have been found to be manifested before learning to read, thus providing a possible causal link between the influence of oral language comprehension on difficulties in reading comprehension (e.g. Catts et al., 2006; Nation et al., 2010). This association between vocabulary and reading comprehension has also been shown through intervention studies (Clarke, Snowling, Truelove, & Hulme, 2010; Fricke, Bowyer- Crane, Haley, Hulme, & Snowling, 2013).

The vast majority of studies on the reading development of children with expressive vocabulary delay have focused on language outcomes in kindergarten (age range between 2 and 5.5 years) (Feldman et al., 2005; Moyle, Weismer, Evans, & Lindstrom, 2007; Thal, Miller, Carlson, & Vega, 2005) or reading outcomes in the early grades of primary school (Grade 2) (Lyytinen et al., 2005). The documentation on the reading development of the children with expressive vocabulary delay beyond the early grades comes from one sample (Rescorla, 2002, 2005, 2009). Rescorla (2002) showed that children that had been identified as having expressive vocabulary delay in early childhood continued to manifest significantly poorer reading skills (i.e., decoding, comprehension, written language and spelling) than their peers at the ages of 8 and 9. At the age of 13, the children with expressive vocabulary delay demonstrated significantly lower vocabulary and reading comprehension skills than the comparison children (Rescorla, 2005), whereas no differences were observed in reading fluency (Rescorla, 2005). At the age of 17, the children with expressive vocabulary delay had average reading skills but below average vocabulary and verbal memory (Rescorla, 2009). Rescorla's findings show that early expressive vocabulary delay is negatively associated with reading achievement, especially after the initial stages of learning to read (Rescorla 2002, 2005,



2009), and the effect is primarily seen on reading comprehension rather than reading fluency (Rescorla, 2005, 2009). Rescorla, however, did not control for other risk factors or co-occurring difficulties, and it is possible that late talking is not the cause of subsequent reading difficulties. A few studies show that expressive vocabulary delay may actually be a risk factor for reading development only when accompanied by other risk factors, such as family risk for dyslexia or language difficulties and receptive vocabulary delays (Duff et al., 2015; Lyytinen et al., 2005; Poll & Miller, 2013).

Family risk for dyslexia is linked to both vocabulary and reading difficulties and may be the underlying cause for late talkers' problems in reading (Duff, et al., 2015; Lyytinen, et al., 2005; Snowling, et al., 2003; Snowling, et al., 2007; Torppa, Lyytinen, Erskine, Eklund, & Lyytinen, 2010). It has been shown that the combination of family risk for reading difficulties and early delays in expressive and receptive vocabulary impedes reading development in the early grades (Duff et al., 2015; Lyytinen et al., 2005). In the same Finnish sample that is used for this study, Lyytinen et al. (2005) showed that those children with expressive vocabulary delay at the end of the second grade (age 8 years) who also exhibited evidence of receptive vocabulary delay and a family risk for dyslexia were often diagnosed as manifesting reading difficulties, whereas those children with only expressive vocabulary delay were not. We add to their findings by extending the investigation to Grades 3, 8 and 9 and by examining both reading fluency and reading comprehension development from Grade 2 to 9.

## **2. The Present Study**

The existing literature on reading development of children with delays in early vocabulary is almost exclusively limited to findings concerning the early grades of primary school, and all the studies except one (Lyytinen et al., 2005) have been conducted using English-speaking children. The present study extends the literature by investigating the reading development of

children with early expressive vocabulary delay followed up to age 16 (Grade 9) with native Finnish speakers with respect to both reading fluency and reading comprehension. In addition, we examine whether this relationship is different in the presence and absence of other co-occurring risk factors: family risk for dyslexia and early receptive vocabulary delay. We use reading fluency and comprehension as outcomes rather than reading accuracy because most Finnish children can read accurately after the first year of formal education, and accuracy measures are at a ceiling by that time. The use of fluency and comprehension as indicators of reading progress is typical for languages that have a high level of transparency of the orthographic system (Seymour, Aro, & Erskine, 2003; Aro & Wimmer, 2003; Share, 2008). The Finnish orthographic system is considered very transparent (Aro, 2016), and in contrast to English, for instance, there is almost a perfect one-on-one correspondence between phonemes and graphemes, with every letter always having the same sound and every sound always being represented by the same letter. The combination of high-quality reading teaching and the high transparency of the orthography supports faster reading acquisition than in the less consistent orthographies, such as English (e.g. Seymour et al., 2003). In Finland, children start attending primary school in August of the year in which they turn 7. The follow-up period of the present study was from Grade 2 (when the children's ages varied between 8 and 9 years) to the end of Grade 9 (when their ages varied between 15 and 16 years).

The research questions of the present study were as follows: (1) Does early expressive vocabulary delay predict difficulties in reading fluency or reading comprehension at Grades 2, 3, 8 and 9? (2) Is the relationship between early expressive vocabulary delay and reading development different in the presence and absence of receptive vocabulary delay and family risk for dyslexia?

Based on previous studies (Nation & Snowling, 2004; Rose & Rouhani, 2012), we expected that vocabulary skills would be associated with reading development. However, we

predicted that early vocabulary would be a better predictor for reading comprehension than reading fluency (Rescorla, 2005; Rescorla, 2009; Ricketts, Nation & Bishop, 2007). We also expected that children with early expressive vocabulary delay would have more reading comprehension problems in the later grades than in the earlier grades (Rescorla, 2002, 2005, 2009) and that the most severe reading problems would be found among children with both expressive and receptive vocabulary delays (Lyytinen et al., 2005). Finally, we expected that the children with family risk for dyslexia would be slower readers than the children of parents with no reading difficulties (Eklund, Torppa, Aro, Leppänen, & Lyytinen, 2015; Snowling & Melby-Lervåg, 2016).

### **3. Method**

#### **3.1 Participants**

The children ( $n = 200$ ) were participants of the Jyväskylä Longitudinal Study of Dyslexia (JLD), a longitudinal family risk study following children with and without family risk for dyslexia. The participants were selected from among families of 9,368 newborns born in the province of central Finland between April 1993 and July 1996. The selection of the parents with dyslexia followed a three-step procedure. The first stage was a short questionnaire including three questions concerning difficulties in learning to read and spell among themselves and their close relatives. The second stage was a more detailed questionnaire, which focused on demographic information and the occurrence of reading and writing difficulties during childhood, adolescence and among relatives. Those who fulfilled the criteria of inclusion in the first and second stage were invited for an interview and for an assessment of their reading and writing skills to confirm their present status of dyslexia. The criteria used to select the parents with dyslexia were as follows: a self-reported childhood history of reading or writing difficulties, self-reported adulthood situation of reading and writing difficulties, and present performance in diagnostic tasks of reading and writing (for full details of recruitment,

see Leinonen et al., 2001). The criteria for a child to be included in the family risk group (FR,  $n = 108$ ) included that one of the parents was identified as having reading difficulties in the reading and spelling tests, literacy problems during early school years, and at least one first-degree relative with corresponding difficulties. In the control group without family risk, neither parent had reported reading difficulties or a family history of dyslexia, and neither had difficulties in reading and spelling tasks (NR,  $n = 92$ ). The parents' educational backgrounds were assessed using a 7-point scale: 1 = comprehensive school without any vocational education, 2 = comprehensive school with short-term vocational courses, 3 = comprehensive school with a vocational school degree, 4 = comprehensive school with a vocational college degree, 5 = comprehensive school with a lower university degree (Bachelor's) or a degree at a polytechnic, 6 = upper secondary school with a BA degree or a degree at a polytechnic, and 7 = upper secondary school with a higher university degree (master's or a doctorate degree). The mean of the mothers' education was 4.18 ( $SD = 1.48$ ) in the FR group and 4.52 in the control group ( $SD = 1.35$ ). The mean of the fathers' education was 3.68 ( $SD = 1.27$ ) and 3.80 ( $SD = 1.40$ ), respectively. There were no differences in parental education or in their nonverbal IQs. The IQ of all parents, assessed with the Raven B, C and D matrices, was  $\geq 80$  (Raven, Court, & Raven, 1992).

### **3.2 Measures**

The children were assessed at ages 24 months, 30 months, 8–9 years (Grade 2), 9–10 years (Grade 3), 14–15 years (Grade 8) and 15–16 years (Grade 9). Trained testers individually assessed the children's language skills at ages 24 and 30 months in a laboratory setting, and school-age reading fluency and reading comprehension were assessed via group-administered tests in the classrooms. Reading fluency was assessed with three tasks: oral text reading, oral pseudoword text reading and oral word list reading. Reading comprehension was assessed

using a short passage reading comprehension task and PISA reading comprehension (Grade 9). The measures are described in detail below.

**Expressive vocabulary measures at the age of 24 and 30 months.** The composite score of expressive vocabulary was calculated based on the following four measures: vocabulary production and maximum sentence length using the Finnish adaptation of the MacArthur Communicative Development Inventory (Fenson et al., 1994) at the age of 24 months using parental reports, the Bayley Scales of Infant Development (BSID; Bayley, 1993) expressive score (naming pictures and objects) at the age of 24 months and the expressive score of the Reynell Developmental Language Scale (RDLS; Reynell & Huntley, 1987) at the age of 30 months. A z-score based on control group distribution was calculated for each measure, and the average of the z-scored measures served as the composite score for expressive language. The Cronbach alpha reliability for the composite score of expressive language was .86.

**Receptive vocabulary.** The children's verbal comprehension level was assessed using the Reynell Receptive Language Scale at the age of 30 months.

**Oral text reading (Grades 2, 3 and 8).** In the spring term of each grade level, oral text reading was assessed by asking participants to read an age-appropriate text aloud. In Grade 2, the children read a text ("Exciting journeys") consisting of 19 sentences, with a total of 124 words; in Grade 3, they read a text ("Useless belongings") consisting of 18 sentences, with a total of 189 words; and in Grade 8, they read a text ("Fields of Lapland") consisting of 16 sentences, with a total of 207 words. Children's reading performances were recorded, and the accuracy of reading and time spent on reading were checked. The scores of the children's speed were measured as words per minute.

**Oral pseudoword text reading (Grades 2, 3 and 8).** The participants read aloud a short text that was made up of 19 pseudowords (Grade 2) or 38 pseudowords (Grades 3 and 8). The pseudowords and sentence structures resembled real Finnish in form, but had no meaning.

The mean word length was 7.21 letters/word in Grade 2 and 7.29 letters/word in Grades 3 and 8. Children's reading performances were recorded, and the accuracy of reading and time spent on reading were checked. The scores of the children's speed were measured as pseudowords per minute.

**Oral word list reading (Grades 2, 3 and 8).** In the nationally normed Lukilasse reading test (Häyrinen, Serenius-Sirve, & Korkman, 1999), the participants had 2 minutes to read aloud as many words as possible from a 90-item (Grade 2) or 105-item (Grade 3) list of words assembled vertically in columns. The same list which was used in Grade 3 was administered in Grade 8, but the time limit was reduced to 1 minute. The length of the words increased gradually, ranging from 3 to 18 letters/word in Grade 2 and from 3 to 22 letters/word in Grades 3 and 8. The mean length of the words was 9.08 letters in Grade 2 and 9.57 letters in Grades 3 and 8. The children received 1 point for each correct answer.

**Reading comprehension (Grades 2 and 3).** A group-administered subtest of the nationally normed reading test battery (Ala-asteen lukutesti, or ALLU; Lindeman, 2000) was used. The children silently read a fiction story and then answered 12 questions (11 multiple choice questions and one that required arranging five statements into the correct sequence). The length of the text in Grade 2 was five paragraphs and had 114 words. In Grade 3, the length of the text was 4 paragraphs and had 139 words. The children received 1 point for each correct answer (max = 12). The maximum time allotted was 45 minutes. The Kuder–Richardson reliability coefficients reported by Lindeman (2000) were .80 in Grade 2 and .75 in Grade 3.

**Reading comprehension (Grade 9): PISA reading.** The reading tasks consisted of the Programme for International Student Assessment (PISA) reading link items, which are contained in each cycle of the PISA assessments to provide comparability of the measurement. It is a triennial international survey which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students (OECD, 2010, p. 26; 2013, p. 45). The

students were given a booklet with eight texts to read, and they had to answer questions in the allotted space. The reading materials included texts, tables, graphs and figures. The total length of the material is 30 A4 pages. However, because the material includes many pictures and tables, the estimated length of the text is approximately 10 pages. There were 15 multiple-choice questions and 16 questions that required written responses. Of the questions, 12 required students to access and retrieve information, 12 to integrate and interpret information, and 7 to reflect and evaluate information. Students had 60 minutes to complete the task. A total score was calculated representing all the PISA reading items. The Cronbach's alpha reliability coefficient for the total score in this sample was .80.

### **3.3 Statistical Analysis**

First, all the variable distributions were examined. In grade 8, two extreme outliers were observed in the pseudoword text reading and three in the text reading and skewness values were rather high. Outliers were moved to the tails of the distributions, and log<sub>10</sub> transformations were performed. After the transformations, the distributions approximated normal distribution. In the examination of reading fluency, a composite variable for each grade was calculated by converting the scores for each reading fluency measure into z-scores and by calculating mean composite scores. Cronbach alpha reliability for the fluency composite was .91, .88 and .90 in Grades 2, 3 and 8, respectively.

One-way ANOVAs were conducted to compare the five groups in reading fluency and reading comprehension performance. The groups were identified with the following criteria: Expressive vocabulary delay was identified based on three tests at 2–2.5 years: 1) vocabulary production and maximum sentence length from the Finnish adaptation of the CDI (MacArthur Communicative Development Inventory) 2) the Bayley expressive score (Bayley, 1993), and 3) the expressive score from the Reynell Developmental Language Scales (Reynell & Huntley, 1987). The Reynell Receptive Language Scale scores from the RDLS were used to further

divide late talkers (i.e., children identified with expressive vocabulary delay) into groups with and without receptive vocabulary delay. Of the five subgroups, three were with family risk and two with no family risk: 1) family risk and no vocabulary delay (FR); 2) family risk and late talkers (FR-LT1); 3) family risk, late talkers and receptive vocabulary delay (FR-LT2); 4) no family risk and late talkers (NR-LT1), and 5) no family risk and no vocabulary delay (NR).

There were two groups of late talkers (FR-LT1 and NR-LT1) who had only expressive vocabulary delay. They had expressive vocabulary score at least one standard deviation below the mean of children in the control group but age-appropriate receptive skills. There were 10 children with family risk for dyslexia (FR-LT1) and 10 children with no risk for dyslexia (NR-LT1). The second subtype of late talkers demonstrated both an expressive and receptive vocabulary delay (at least one standard deviation below the mean on both scores). There were 12 children from the family risk sample (FR-LT2), but only three children from the no-risk sample fulfilled these criteria, and they were subsequently excluded from the analyses. Finally, the analyses involved two groups with no vocabulary delay: the FR group (N = 83) and the NR group (N = 79) with age-appropriate or better early expressive and receptive vocabulary. In addition to the group comparisons, we also examined the correlations between all measures.

The descriptive statistics of the measures used in the identification of the five groups are presented in Table 1. Three children of the family risk sample were not included in the analysis because the Reynell expressive and receptive scores were missing for two of them and because one of the children attended school one year later than his age-mates and we did not have his reading measure outcomes. None of the children had reports on Specific Language Impairment (SLI) diagnoses at any age. In Finland, physicians use the International Classification of Diseases (ICD) when diagnosing specific language impairment (SLI) (Asikainen, 2005). However, some milder language or language-related difficulties were diagnosed in 11 children (one had naming difficulty, five demonstrated delayed



language/speech development, four had dysphasic features, and one faced learning difficulties, especially in language). Of these 11 children, six belonged to the group with family risk and both expressive and receptive vocabulary delays (FR-LT2); three belonged to the group with family risk, but no early vocabulary delays (FR); and two belonged to the control group with expressive vocabulary delay (NR-LT1).

## **4. Results**

### **4.1 Group Differences in Reading Fluency**

The one-way ANOVAs for reading fluency showed significant group differences in Grades 2, 3 and 8 (Table 2, Table 3, Figure 1). Pairwise comparisons (LSD) revealed that in Grades 2 and 3 the NR group children were faster readers than the FR group children. In grade 3, the NR group children were also faster readers than the FR-LT2 group children. In Grade 8, the pairwise comparisons (Dunnett T3) showed that the NR group children were faster readers than the FR group children. Further inspection of the effect sizes showed that the comparisons between the three groups with family risk for dyslexia and the two groups without family risk for dyslexia all had small to medium effect sizes.

### **4.2 Group Differences in Reading Comprehension**

The one-way ANOVAs for reading comprehension showed significant group differences in Grades 2 and 9, but not in Grade 3 (Table 2, Table 3, Figure 2). In Grade 2, the pairwise comparisons (Dunnett T3) showed no significant differences between the groups but the effect sizes were large in favour of the NR group compared to the FR-LT2 and NR-LT1. In Grade 3, the pairwise comparisons (LSD) suggested that children in the FR-LT2 group were poorer comprehenders than children in the FR, FR-LT1 and NR groups. The effect sizes were medium for the FR-LT2 comparison with FR and large in comparison with the FR-LT1 and NR groups. In Grade 9, the pairwise comparisons (LSD) showed lower reading comprehension scores for

the FR-LT2 group than for all the other groups, and these differences were accompanied by large effect sizes.

### **4.3 Correlations between Early Expressive and Receptive Vocabulary and Literacy Measures**

Correlations (Table 4) showed that expressive and receptive vocabulary measures were strongly associated. Both expressive and receptive vocabulary had stronger correlations with reading comprehension than reading fluency. The correlations were non-significant between the vocabulary measures and Grade 8 reading fluency. In contrast, the correlations between expressive and receptive vocabulary and reading comprehension were statistically significant across all grades.

## **5. Discussion**

The reading outcomes of children with expressive vocabulary delay were investigated in this study by analyzing their reading development up to 16 years of age using measures of both reading fluency and comprehension. The role of the additional risk factors of family risk for dyslexia and poor early receptive vocabulary were also examined. Five subgroups were identified based on children's early expressive vocabulary, receptive vocabulary and family risk status, and they were compared in reading fluency and comprehension measures in Grades 2, 3, 8 and 9. In general, the findings suggest that early expressive language delay predicts reading comprehension, but not reading fluency development. Late talking alone was not, however, a sufficient risk index for reading comprehension difficulties for children with family risk for dyslexia or for children without such risk. Only the children with both expressive and receptive vocabulary delays and family risk had clear difficulties in reading comprehension, and the difficulties were sustained to adolescence.

The children who had delays in both expressive and receptive vocabulary as toddlers demonstrated persistent weaknesses in comparison to the other groups in reading comprehension measures. As indicated by moderate to large effect sizes, these children had lower scores compared to all the other groups at the end of Grade 2 and 3, and they continued on a declining trajectory to the end of Grade 9. Although the comparison between all the groups in Grade 3 did not reveal statistically significant differences, the differences were clear in pairwise comparisons and in the effect sizes of the group comparisons, which become larger from Grade 3 onwards. All the groups except FR-LT2 performed at a similar level in Grade 3.

Our findings add to the literature (Duff et al., 2015; Lyytinen et al., 2005; Rescorla, 2002, 2005, 2009) by suggesting that a trajectory of later reading comprehension difficulties is much more likely if early expressive vocabulary delays are accompanied by receptive vocabulary delays. In our sample, the children with both receptive and expressive vocabulary delay also had family risk for dyslexia, which makes it difficult to separate the effects of family risk and receptive vocabulary delay. However, because the other family risk children (the group who did not have a vocabulary delay and the group who had only an expressive delay) manifested average reading comprehension, it can be assumed that it is the combined vocabulary difficulty (expressive and receptive), rather than family risk per se, that underlies reading comprehension difficulties. Moreover, the fact that the combination of receptive and expressive vocabulary delays was more common in the family risk group (12 children) than in the no-risk group (only three children) suggests a link between family risk for reading difficulties and combined vocabulary delay.

The findings suggest that a delay in early vocabulary can lead to a reading comprehension deficit, which is in line with suggestions in the previous studies (Duff et al., 2015; Lyytinen et al., 2005; Rescorla, 2005, 2009), with the specification that an expressive vocabulary deficit alone can be alleviated in time, whereas the combined deficit is a stronger

risk marker. Previous studies have also shown correlative evidence for the predictive association between language skills and reading comprehension (Catts et al., 2006; Duff et al., 2015; Nation et al., 2010). The present findings are in line with Rescorla's (2005) findings indicating that children with delays in early vocabulary demonstrated no differences in basic reading mechanisms (including fluency) at age 13, but they had significantly lower scores in reading comprehension. In addition, they are in line with the findings of Duff et al. (2015) suggesting that early vocabulary (in their study combination of expressive and receptive) has a stronger relationship with reading comprehension than reading accuracy. Because early vocabulary was measured at the age of 2–2.5 years in the present study, which was long before reading had started to develop and which prevented any concerns about the direction of effects, a predictive association between early vocabulary and reading comprehension outcomes could be suggested. This link between reading comprehension and early vocabulary could be explained by the simple view of reading model (Gough & Tunmer, 1986; Hoover & Gough, 1990). Reading comprehension has been shown to rely on a variety of oral language comprehension skills (Hulme & Snowling, 2014), including expressive and receptive vocabulary (e.g. Nation et al., 2010) and listening comprehension (e.g. Catts et al., 2006; Nation et al., 2010). Weaknesses in these skills have been found to be manifested before learning to read, which could provide a possible causal link between the influence of oral language comprehension on difficulties in reading comprehension (e.g. Catts et al., 2006; Nation et al., 2010).

In contrast to reading comprehension, reading fluency was found to be linked with family risk for dyslexia and not with the presence of early expressive vocabulary delay. The finding that family risk was predictive of reading fluency was expected and supports previous studies indicating the strong effects of family risk in developmental dyslexia (Lyytinen et al., 2015; Snowling et al., 2003; van Bergen et al., 2012). Based on our findings, it is thus likely

that children with reading difficulties who show early vocabulary difficulties have additional risk factors, such as family risk (Nation & Snowling, 2004; Snowling et al., 2003; Torppa et al., 2010).

The finding of no link from late talking to reading fluency development appears to contradict the lexical restructuring hypothesis (e.g. Walley et al., 2003), which suggests a link between early vocabulary and reading fluency mediated via phonological skills. In addition, we have shown earlier in this same sample that early vocabulary is linked via phonological skills to kindergarten precocious reading ability (Torppa et al., 2007), supporting the lexical restructuring hypothesis. However, in the present study, we focused on a phase in reading development where phonological skills may not be strong predictors of reading fluency anymore, at least in the context of a transparent orthography (see e.g. Aarnoutse, van Leeuwe, & Verhoeven, 2005; Georgiou, Torppa, Manolitsis, Lyytinen, & Parrila, 2012). Thus, the mediated effect from vocabulary also ceases to exist. In the English language context, phonological processing is a strong predictor of reading for a longer time (e.g. Gallagher, Frith, & Snowling, 2000; Torgesen, Wagner, & Rashotte, 1994). In line with this, our results for the early grades show differences only in reading comprehension, while the studies from the English language context report differences in various reading skills (Duff et al., 2015; Rescorla, 2002). In later grades, however, our results are similar to the findings in English language context studies (Rescorla, 2005, 2009). It seems that the transparency of the orthography affects the speed of decoding development (e.g. Ellis et al., 2004; Seymour et al., 2003) and the importance of phonological processing in the development. Consequently, the mediated impact of expressive and/or receptive vocabulary delay via phonological processing to reading skills may thus be broader and may be sustained longer in the less transparent orthographies.

The limitations in this study include its small sample size and the inclusion of only one reading comprehension measure at each age. Analyses with a larger sample size would have more statistical power. However, samples with extensive assessments and such a long follow-up are rare and provide unique information. Further, it was not possible to identify a large enough group with difficulties in both expressive and receptive vocabulary but no family risk, which would have been informative. In addition, it would have been interesting to know how these children scored in expressive and receptive vocabulary at adolescence and whether the early language difficulties experienced persisted and co-occurred with literacy skills in adolescence. Based on the findings by Rescorla (2005, 2009), we expect that this is the case, but unfortunately, we could not examine the issue due to the lack of such data in our sample. Moreover, data on family risk for reading comprehension or language skills would have been an interesting addition.

In conclusion, the findings indicate that the reading trajectories of late talkers depended on the co-occurrence of other risk factors and on the nature of the reading outcome in question. Early expressive vocabulary delay represented a high risk only for reading comprehension development and only when it co-occurred with other risk factors (family risk for dyslexia and receptive vocabulary difficulties). Late talking without receptive vocabulary difficulties did not increase the risk for reading difficulties among either group (family risk or no family risk). Our results indicate that in addition to expressive vocabulary delay, it is critical to recognize a delay in receptive skills as an early risk factor, since a delay in only expressive vocabulary is not informative enough to predict school age reading development. Based on the findings of the present study and those by Rescorla (2002, 2005, 2009), it is suggested that children with expressive vocabulary delay (especially those with family risk for dyslexia and receptive vocabulary delay as additional risk factors) should be provided extra support (e.g. exposure to language games and book reading). Finally, based on the results of the present study and those

of previous studies, we suggest that the effects of receptive vocabulary should be examined more in depth, since all the studies so far have used a combination of expressive and receptive vocabulary delays. In addition, certain protective factors could lead to cognitive and socio-emotional resilience and influence the reading outcomes of children with reading difficulties. Based on the current findings, one potential protective cognitive skill may be receptive vocabulary. In line with the results of the study conducted by Haft, Myers and Hoeft (2016), we propose that future studies include investigations of the factors that contribute to the resilience of students who have reading difficulties or who are at risk of developing them.

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**Figure Captions**

*Figure 1* Development of fluency skills by group for each grade

*Figure 2* Development of reading comprehension by group for each grade

Table 1 Descriptive statistics for the vocabulary measures used to determine the subgroups

	Family risk, no language delay (FR) (N=83)		Family risk, Late talkers (FR-LT1) (N=10)		Family risk, Late talkers and receptive language delay (FR-LT2) (N=12)		No family risk, Late talkers (NR-LT1) (N=10)		No family risk, no language delay (NR) (N=79)		F	df
	M	SD	M	SD	M	SD	M	SD	M	SD		
<i>2 years</i>												
Vocabulary production (CDI)	305.92	135.79	57.70	39.81	87.25	72.88	33.10	39.24	321.36	138.50		
Maximum sentence length (CDI)	5.67	2.24	2.10	1.12	2.70	1.47	1.63	1.30	6.47	2.67		
Bayley expressive vocabulary	10.32	3.51	1.40	1.95	3.18	3.52	1.10	2.33	10.97	2.89		
<i>2.5 years</i>												
Reynell Receptive Language Scale	37.07 <sup>2</sup>	6.07	36.50 <sup>2</sup>	2.27	26.75 <sup>1</sup>	3.86	36.40 <sup>2</sup>	2.99	37.91 <sup>2</sup>	5.83	10.40	4,184***
Reynell Developmental Language Scale	36.05	5.00	28.50	2.84	24.08	5.23	22.60	8.47	35.87	4.55		
Composite score for expressive vocabulary	.15 <sup>2</sup>	.57	-1.31 <sup>1</sup>	.17	-1.27 <sup>1</sup>	.49	-1.63 <sup>1</sup>	.46	.28 <sup>2</sup>	.58	56.44	4,189***

*Notes:* Groups with different subscripts (<sup>1,2</sup>) differed from each other in post-hoc comparisons, using LSD. The composite score for expressive vocabulary was calculated as average of the standardized scores for the a) Vocabulary production, b) Maximum sentence length, c) Bayley expressive vocabulary and d) Reynell Developmental Language Scale. Standardized scores are based on the distribution of the control group.



The five groups (FR, FR-LT1, FR-LT2, NR-LT1, NR) were identified with respect to status of expressive and receptive vocabulary delay and family risk for dyslexia. The FR-LT1 (N=10) and the NR-LT1 (N=10) groups had at least 1 SD below the mean of children in the control group in the composite score of expressive vocabulary but age-appropriate receptive skills. The FR-LT2 (N=12) group demonstrated both an expressive and receptive vocabulary delay (at 1 SD below the mean on both scores). The FR (N=83) and the NR (N=79) groups had age-appropriate or better early expressive and receptive vocabulary.

\* $p \leq .05$ , \*\* $p \leq .01$ . \*\*\* $p \leq .001$

Table 2 Descriptive statistics and group comparisons for the reading measures

	FR		FR-LT1		FR-LT2		NR-LT1		NR		F	df
	M	SD	M	SD	M	SD	M	SD	M	SD		
<i>Grade 2</i>												
Reading Fluency <sup>z</sup>	-.26 <sup>1</sup>	.95	-.18 <sup>1,2</sup>	1.05	-.19 <sup>1,2</sup>	.98	.21 <sup>1,2</sup>	1.01	.36 <sup>2</sup>	.95	4.40**	4,185
Reading comprehension	8.99	3.00	8.44	2.92	6.55	3.33	7.00	2.55	9.77	1.79	5.27***	4,166
<i>Grade 3</i>												
Reading fluency <sup>z</sup>	-.22 <sup>1</sup>	.98	-.28 <sup>1,2</sup>	1.25	-.32 <sup>1</sup>	.93	.05 <sup>1,2</sup>	1.30	.33 <sup>2</sup>	.90	3.72**	4,189
Reading comprehension	9.76 <sup>1</sup>	1.76	10.20 <sup>1</sup>	1.32	8.64 <sup>2</sup>	2.01	10.00 <sup>1,2</sup>	2.78	10.15 <sup>1</sup>	1.40	2.12	4,170
<i>Grade 8</i>												
Reading fluency <sup>z</sup>	-.23 <sup>1</sup>	1.13	-.28 <sup>1,2</sup>	.96	-.22 <sup>1,2</sup>	.85	-.03 <sup>1,2</sup>	1.55	.37 <sup>2</sup>	.68	3.95**	4,174
<i>Grade 9</i>												
Reading comprehension	.12 <sup>1</sup>	.79	-.17 <sup>1</sup>	.73	-1.14 <sup>2</sup>	1.12	-.15 <sup>1</sup>	1.09	.25 <sup>1</sup>	.90	5.91***	4,153

Notes: Groups with different subscripts (<sup>1,2</sup>) differed from each other in post-hoc comparisons, using either LSD or Dunnett T3, depending on equality of the variances. Subscript z refers to standardized score. The reading fluency measures are composite scores calculated as average of the standardized scores for the three reading fluency tasks. Standardized scores are based on the distribution of the control group.

\*p≤.05, \*\*p≤.01. \*\*\*p≤.001

Table 3 Effect sizes for group comparisons in reading fluency and reading comprehension

	Effect size <sup>a</sup>									
	FR vs FR-LT1	FR vs FR-LT2	FR vs NR-LT1	FR vs NR	FR-LT1 vs FR-LT2	FR-LT1 vs NR-LT1	FR-LT1 vs NR	FR-LT2 vs NR-LT1	FR-LT2 vs NR	NR-LT1 vs NR
<i>Grade 2</i>										
Reading fluency	.08	.07	.50	.65	.01	.38	.54	.40	.57	.15
Reading comprehension	.19	.77	.72	.31	.60	.53	.55	.15	<b>1.20</b>	<b>1.26</b>
<i>Grade 3</i>										
Reading fluency	.05	.10	.23	.58	.04	.26	.56	.33	.71	.25
Reading comprehension	.29	.60	.10	.25	<b>.92</b>	.09	.04	.56	<b>.88</b>	.07
<i>Grade 8</i>										
Reading fluency	.05	.01	.15	.64	.07	.19	.78	.15	.77	.33
<i>Grade 9</i>										
Reading comprehension	.37	<b>1.30</b>	.30	.16	<b>1.03</b>	.02	.51	<b>.90</b>	<b>1.37</b>	.40

*Note:* Large (>.80) effect size with bold

<sup>a</sup> The value of Cohen's d was calculated using the means and standard deviations of two groups. Cohen d is considered large when  $d > .80$ , medium when  $d > .50$  and small when  $d > .30$

Table 4 Correlation table for expressive and receptive vocabulary and reading fluency and reading comprehension in grades 2, 3, 8, and 9.

	1.	2.	3.	4.	5.	6.	7.
1. Expressive vocabulary							
2. Receptive vocabulary	.49***						
3. Reading fluency, Grade 2	.16*	.18*					
4. Reading fluency, Grade 3	.20**	.23**	.89***				
5. Reading fluency, Grade 8	.11	.12	.71***	.79***			
6. Reading comprehension, Grade 2	.39***	.34***	.48***	.44***	.40***		
7. Reading comprehension, Grade 3	.19*	.26***	.35***	.36***	.38***	.45***	
8. Reading comprehension, grade 9	.32***	.30***	.29***	.40***	.33***	.37***	.45***

\* $p \leq .05$ , \*\* $p \leq .01$ . \*\*\* $p \leq .001$

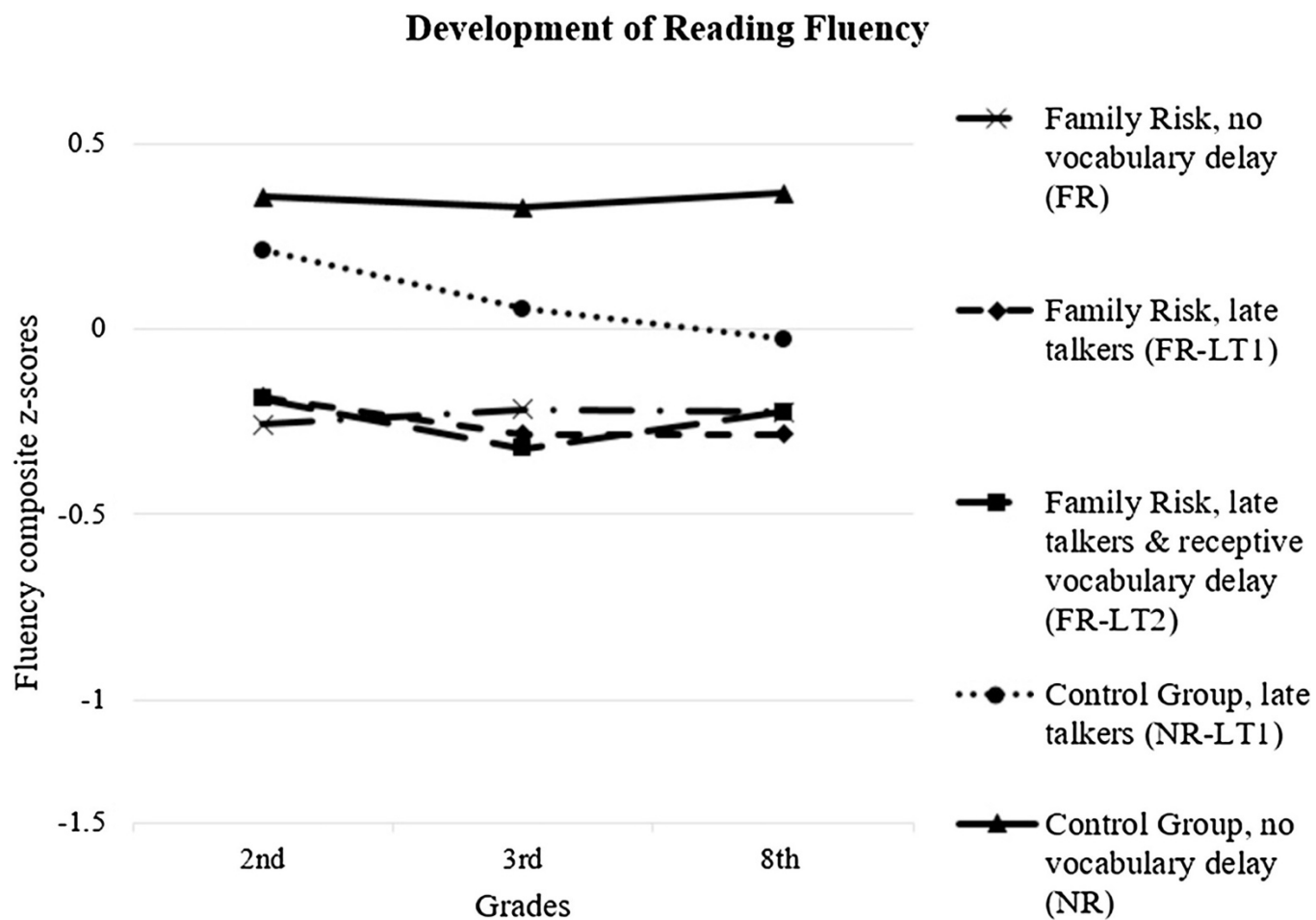


Figure 1 Development of fluency skills by group for each grade

### Development of Reading Comprehension

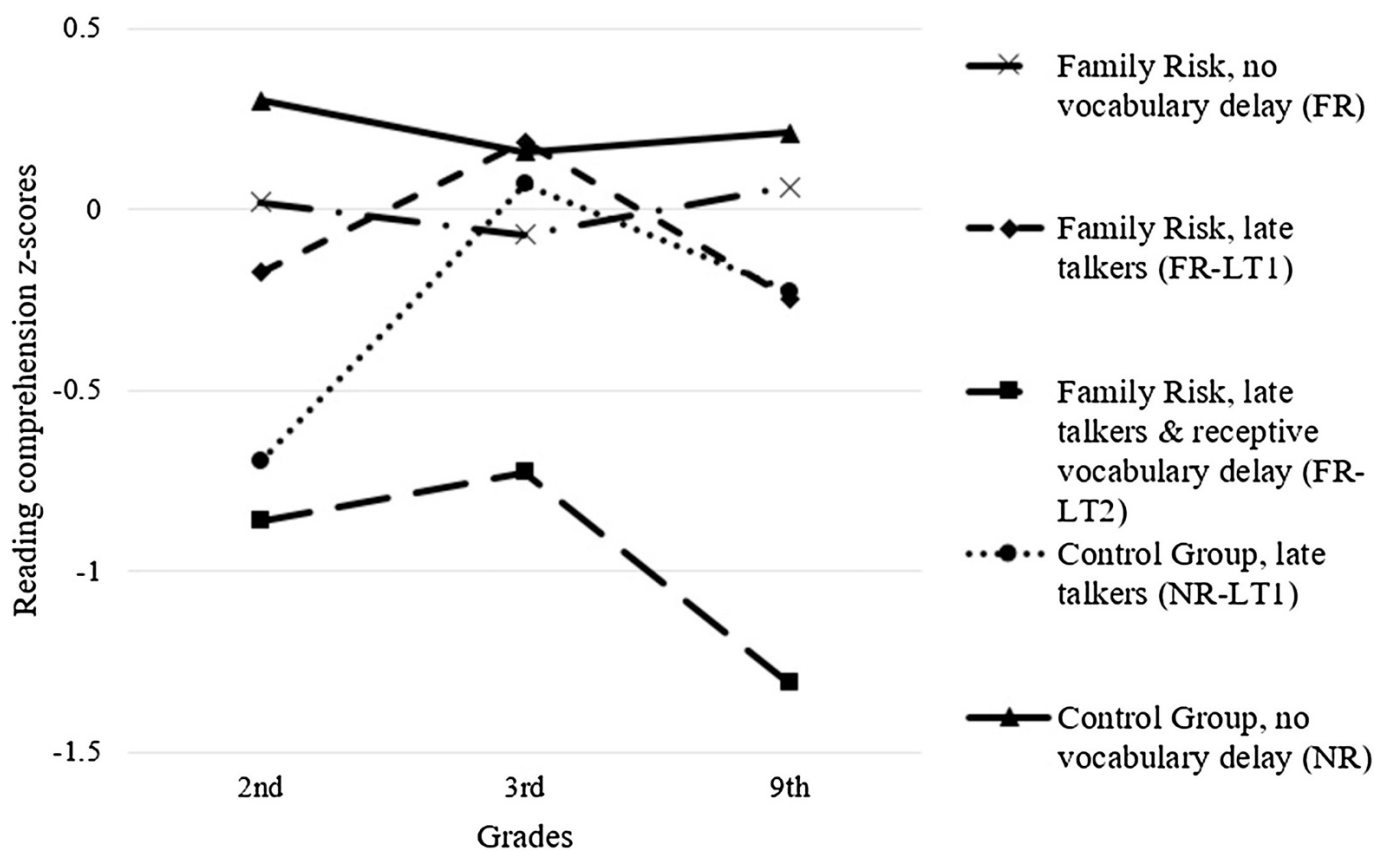


Figure 2 Development of comprehension skills by group for each grade