Reading development of late talking toddlers with and without familial risk for dyslexia.

A follow up study from age 2 to 15

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Tiivistelmä – Abstract

Expressive language delay is one of the most frequent concerns for parents and health care providers, and it is also one of the most common reasons that young children are referred for evaluation. In the present study, it was examined whether late-talkers with and without familial risk for dyslexia have weaker reading fluency and comprehension at school age (grades 2, 3, 8 and 9) than typically developing, age-matched children. The sample of the study was 200 Finnish-speaking children, who were divided into 5 subgroups: 1) Risk Group with no Delay, 2) Risk Group with Expressive Language Delay, 3) Risk Group with Expressive and Receptive Language Delay, 4) Control Group with Expressive Language Delay, 5) Control Group with no Delay. The children belonging to the family risk group have a family history of dyslexia and as a result they are at risk for reading difficulties. The results showed that late talkers had problems particularly in reading comprehension but problems were persistent only if they had also receptive vocabulary problems. On the other hand, family risk for dyslexia was linked to reading fluency problems but only if the children had both expressive and receptive vocabulary problems. As a result, it seems that expressive delay only is not informative enough considering school age reading development and it seems that late talking could be a persistent risk factor for reading development only if it is combined with receptive language delays.

Asiasanat – Keywords
late-talking, reading development, fluency, comprehension

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1 INTRODUCTION

While early language development is considered the foundation for later educational and academic achievement and is important for social adaptation (Reilly et al., 2010), language delays and disabilities related to language development are often identified at the age of 5 or even later (P. Lyytinen, Eklund, & Lyytinen, 2005). It has been reported that children with language delays have poorer reading, spelling and math skills and more emotional and behavioural difficulties (Hohm, Jennen-Steinmetz, Schmidt, & Laucht, 2007; Justice, Bowles, Pence Turnbull, & Skibbe, 2009). From a clinical and educational perspective, it is advantageous to predict, prior to kindergarten, which children will have weak language skills in middle childhood (P. Lyytinen et al., 2005). By examining the reading development of children with early weaknesses in language development we can guide specific and targeted interventions in order to minimize the detrimental effects of the early language delays.

Of the language learning disabilities, expressive language delay is one of the most frequent concern for parents and health care providers, and it is also one of the most common reasons that young children are referred for evaluation (Ghassabian et al., 2014; Rescorla, 2011). Despite the fact that some late talkers demonstrate only expressive language delays, there are others delayed in receptive language as well (Rescorla, 2011) and so far findings reveal that early delays in both receptive and expressive language are more detrimental for later language and reading development (P. Lyytinen et al., 2005).

Both environmental and genetic factors and their interactions affect children's language development (P. Lyytinen, Poikkeus, Laakso, Eklund, & Lyytinen, 2001; Reilly et al., 2010). Late talking has been studied extensively as an indicator of language development at age 2, and it is found to be a risk factor for later weakness in language ability (Reilly et al., 2010; Rice, Taylor, & Zubrick, 2008; Zubrick, Taylor, Rice, & Slegers, 2007). The main interest of the present study is to examine whether late-talkers identified at 24-30 months continue to have weaker language and reading skills at school age. The development of reading fluency and reading comprehension is compared in grades 2, 3, 8 and 9 between groups of children with delays in expressive and/or receptive language to children with typical language development. This study is a continuation to study by P. Lyytinen et al. (2005) who examined the

paths of late talkers and effects of early expressive and/or receptive language delays until age 8 and it is a part of the Jyväskylä Longitudinal Study of Dyslexia (JLD) in which children with and without familial risk for dyslexia have been following from birth to school age (H. Lyytinen et al., 2004). The study focuses on reading fluency and comprehension development and excludes reading accuracy because the Finnish orthographic system is considered to be one of the most transparent (Seymour, Aro, & Erskine, 2003) and consequently most Finnish children can easily read accurately already during the first year of formal education (H. Lyytinen et al., 2006).

2   IDENTIFICATION OF LATE TALKERS

In the literature, the term "late talkers" or "children with expressive language delay" refers to those toddlers who developmentally demonstrate delays in particular aspects of language, e.g. vocabulary, phonology or syntax (Hawa & Spanoudis, 2014). Late talkers' main characteristic is a substantial delay in linguistic production compared to that of their typically developing peers. They are typically identified on the basis of their limited expressive vocabulary and/or receptive language at the age of 18–35 months old (D'odorido, Assanelli, Franco, & Jacob, 2007; Hawa & Spanoudis, 2014; Rescorla, 2011) considering that they do not have any other deficits (cognitive, neurological, socio-emotional or sensory) (Hawa & Spanoudis, 2014). The term "late talker" is used in order to discriminate these children from those with specific language impairment, because of the significant percentage of them who recover and the relatively positive outcomes that are typically associated with this group of children (Roos & Weismer, 2008).

Over the past decades, researchers have focused on the early identification of young children with delayed language acquisition and expressive language difficulties (see for example: Ellis & Thal, 2008; Henrichs et al., 2011; Paul & Roth, 2011; Rice et al., 2008). As it has already been cited above, one the most common characteristic of late talkers is the expressive language delay which is observed in many other syndromes related with speech and language problems (e.g intellectual disability, autism spectrum disorder) (Rescorla, 2011; Rice, Warren, & Betz, 2005). This makes the identification of late talkers problematic. Another challenge is the differentiation between the transient and the persistent difficulties in young children. According to

Scarborough (2001) it seems that milder language delays are associated with more transient and domain specific patterns of the observed deficits. On the other hand, severe delays are associate with more persistent and across the board patterns of deficits.

On research, late talkers are usually identified using parent reports of expressive vocabulary such as the Language Development Survey (LDS), a screening tool for the identification of language delay in toddlers which obtains parent report on vocabulary and word combinations (Rescorla, 1989a; Rescorla & Alley, 2001), or the MacArthur-Bates Communicative Development Inventory (CDI) which is similarly a parent report instrument for measuring early vocabulary and syntax (Fenson et al., 2007). However, despite that the CDI is much longer and more comprehensive (Rescorla, Ratner, Jusczyk, & Jusczyk, 2005), significant correlations have been reported between the two measures even though the words that are included on both instruments differ (Rescorla et al., 2005). Nonetheless, in the case of LDS, there are various degrees of severity of delay within the late talking group since the same criterion is used for children 24-35 months of age. This could affect the group heterogeneity and consequently the external validity of the results. It seems that the CDI is a more precise instrument than the LDS since it provides percentile ranks for every 1-month age grouping until 30 months of age (Desmarais, Sylvestre, Meyer, Bairati, & Rouleau, 2008).

A variation of cut-off criteria for the identification of late talkers have been used in the literature. For example, Rescorla, (1989b) used a cut-off of LDS expressive vocabulary of fewer than 50 words or lack of two-word combinations at two years of age. In Rescorla and Achenbach's (2002) study, the identification of a late-talker between 18 and 23 months of age was based on an expressive vocabulary of 20 words or less or below the 15th percentile on the LDS. Criteria of performance below the 10th percentile of a normative sample according to the CDI has also been used by Henrichs et al., (2011), P. Lyytinen et al. (2001), P. Lyytinen et al. (2005), Moyle, Weismer, Evans, & Lindstrom (2007) and Reilly et al. (2010). In the present study the same criteria is used as in the P. Lyytinen's et al. (2005) paper at the age of 2 and 2.5 years based on three measures: 1) the Finnish adaptation of the CDI (MacArthur Communicative Development Inventory) at the age of 2, 2) the Bayley expressive score (Bayley, 1993) at the age of 2 and 3) the Reynell Developmental Language

Scales (Reynell & Huntley, 1987) at the age of 2.5 years (see P. Lyytinen et al., 2005).

3 FAMILIAL FACTORS RELATED TO EARLY LANGUAGE DELAY

Research on the language development of late talkers has looked at the influence of several intrinsic or extrinsic factors, such as the presence of a family history of language delay (Bishop, Price, Dale, & Plomin, 2003; P. Lyytinen et al., 2001; P. Lyytinen et al., 2005; Rice, 2012; Zubrick et al., 2007), maternal education (Hoff, 2003; Horwitz et al., 2003), parental stress (Desmarais et al., 2008; Horwitz et al., 2003) and socioeconomic status (Hoff, 2003; Horwitz et al., 2003; Reilly et al., 2009; Zubrick et al., 2007).

Other factors that have been reported to be associated with early language delays are gender (boys have been found to be more likely to be late talkers), number of siblings (one child or the first born child has higher odds for early language delays), premature birth, low birth weight or other early neurobiological growth difficulties (Zubrick et al., 2007). In this study, focus is on family risk for reading difficulties.

It is often speculated that the age at which language development starts is dependent on the language stimuli that the child receives. Although many factors have been examined, including family history of language related difficulties, maternal education, maternal depression, socioeconomic factors and birth related factors, the one that seems consistent in all of them is the family history of language related problems (Bishop et al., 2012; DeThorne, Petrill, Hayiou-Thomas, & Plomin, 2005; Hadley & Holt, 2006; Reilly et al., 2010; Zubrick et al., 2007). As a result the role of genes in the emergence and manifestation of language impairments is one of the ongoing topics in late talking studies (Rice, 2012). Research data indicate that neurobiological and genetic mechanisms play an important role in late language emergence and that language problems run in families. The hypothesis that genes and genetic factors impact on language delay, is supported by twin studies (Bishop et al., 2003; Rice, Zubrick, Taylor, Gayán, & Bontempo, 2014). Twin design provides an opportunity to segregate genetic and non-genetic influences on language acquisition due to the fact that monozygotic co-twins inherit identical genomes while dizygotic

share only half of their segregating DNA (Rice et al., 2014). In a twin study conducted by Rice et al. (2014) it was also found that twins performed at a lower level that single born children demonstrated in that way a twinning effect. However it seems that there is a distinction between transient and persistent language difficulties in heritability. The transient language delay has been found to be largely environmental in origin, whereas persistent language difficulties seem to be significantly heritable (Bishop et al., 2003).

Family risk studies have shown that language problems run in families. Of children with a family history (meaning that either one or both of the parents had or have a language related problem) 18-48% are likely to have some kind of language problem (Bishop et al., 2003; DeThorne et al., 2005; Hayiou-Thomas, Oliver, & Plomin, 2005). Family history of language delay has been reported to increase significantly the odds of being a late talker at the age of 2 years old (Zubrick et al., 2007) and at the age of 4 (Reilly et al., 2010). As a result, it seems that family history is one of the most important risk factors for early language delay.

Family risk is an important predictor also in reading development and dyslexia (H. Lyytinen et al., 2008). Dyslexia is a language-based neurodevelopmental disorder that primarily affects the development of reading accuracy and fluency and it is identified by difficulties in single-word reading (Lyon, Shaywitz, & Shaywitz, 2003; Pennington, 2009). Studies have well established that dyslexia runs in families and it has been shown that family risk for dyslexia is a risk factor also for language development (H. Lyytinen et al., 2008; Snowling, Gallagher, & Frith, 2003a; Vellutino, Fletcher, Snowling, & Scanlon, 2004; Vlachos et al., 2013). Scarborough, (2001; 1990) found that children with familial risk for dyslexia used shorter and syntactically simpler sentences as well as less accurate pronunciation at the age of 2.5 years. Especially those of the children who later faced reading problems, at the age of 3 and 3.5 years had less developed receptive and expressive vocabulary skills than those who did not. Similarly, in the same Finnish data (Jyväskylä Longitudinal Study of Dyslexia, JLD) that is used in this study, it was found that children with familial risk for dyslexia used shorter sentences at the age of 2, less inflectional morphology in expressive language at 3.5 years, and poorer vocabulary growth at the age of 5 comparing with children with no family history (H. Lyytinen et al., 2001; H. Lyytinen et al., 2004). Comparison of late talkers with and without family history for dyslexia

has revealed that the two groups demonstrated different language outcomes at the end of the second grade (P. Lyytinen et al., 2005). Furthermore children with a history of late talking and familial risk for dyslexia were more likely to experience delays in language acquisition and to continue facing language difficulties. In contrast late talkers with no family history reached age-appropriate level in both receptive and expressive language by the age of 3.5 years old (P. Lyytinen et al., 2001; P. Lyytinen et al., 2005). Consequently, it seems that a combination of family risk for dyslexia and difficulties in early language development may be a strong predictor for child's reading development. The presence of both early expressive and receptive language delays could be an even stronger predictor as it has been showed that it could lead to more persistent difficulties (P. Lyytinen et al., 2005).

4   LANGUAGE AND READING OUTCOMES

Several researches have focused on late talkers. However, despite the fact that there is a wide range of research as regards to late talkers' language outcomes, the description of the language profile of those who will continue to experience language difficulties is still a challenging task (Roos & Weismer, 2008). So far, data analysis has shown that at around 40-80% of 2 year-old late talking children will show spontaneous improvement, compensate this initial delay, and develop appropriate language skills by 3 or 4 years of age (Dale, Price, Bishop, & Plomin, 2003; Whitehouse, Robinson, & Zubrick, 2011). Nevertheless, a large proportion of late talkers will continue to demonstrate difficulties during the school age and even until their adulthood (Roos & Weismer, 2008) and these children are usually identified as children with specific language impairment (Hawa & Spanoudis, 2014). Small scale studies (Feldman et al., 2005; Fernald & Marchman, 2012; P. Lyytinen et al., 2001; Moyle et al., 2007; Rescorla, Dahlsgaard, & Roberts, 2000; Rescorla, 2002; Rescorla, 2005; Rescorla, 2009) and large scale studies (Dale et al., 2003; Ellis & Thal, 2008; Henrichs et al., 2011; Horwitz et al., 2003; Reilly et al., 2010; Rice et al., 2008; Schjolberg, Eadie, Zachrisson, Oyen, & Prior, 2011; Zubrick et al., 2007) that examined the language development of late talkers have reported that most of the late talking children make a good progress after a slow start and they are named as "late-bloomers" (Bishop et al., 2012). Despite of this good progress, even if they score in the normal range, they still tend to have significantly weaker language skills than typically developed children

with the same age and same socio-economic status by pre-school (Moyle et al., 2007; Thal, Miller, Carlson, & Vega, 2005) or school age (Moyle et al., 2007; Rescorla, 2002; Rescorla, 2005; Rescorla, 2009; Rescorla, 2011).

Most of the previous studies are focusing on language and reading outcomes during preschool or during the first and the second grade in primary school and little research has focused on development beyond the early grades. The present study moves after the second grade and examines the reading fluency and comprehension development of late talkers until the 8th and 9th grade.

4.1   Language outcomes of late talkers during preschool

The studies focusing on language development of late-talkers prior to school entry have shown that late talkers score in the normal range on language tests by the age of their entry in pre-school but they demonstrate significant differences comparing with typically developing peers (Moyle et al., 2007; Thal et al., 2005). Moreover it seems that expressive (Feldman et al., 2005; P. Lyytinen et al., 2001) and receptive (P. Lyytinen et al., 2001) vocabulary as well as family risk (P. Lyytinen et al., 2001) for dyslexia are good predictors for later language development.

Thal et al. (2005) reported the language outcomes of 64 children at 4 years of age. Twenty of the children scored below the 10th percentile in expressive vocabulary on the Communicative Development Inventory (CDI) at 16 months while 44 had a history of typical language development. Although both groups scored in normal range on language and cognitive tests, there were significant group differences still at the age of 4.

Feldman et al. (2005) by using the CDI- Words and Sentences (CDI-WS), reported limited sensitivity (50%) and limited positive predictive value (64%) when language delay at age 2 was used to predict language delay at age 3 for 113 children. Their findings suggested that satisfactory expressive vocabulary scores at age 2 could predict normal language skills at age 3, although some children with apparently normal development at age 2 demonstrated limited skills at age 3 and many children with poor vocabulary scores at 2 caught up by age 3. On the other hand, vocabulary size at age 2 seemed to be a better predictor of outcome than utterance length or sentence complexity score.

P. Lyytinen et al. (2001) analyzed the language skills of 200 Finnish children, 106 were from families with familial risk for dyslexia (FRD) and 96 were age-matched controls with no family history of dyslexia (noFRD), at 14, 24, 30 and 42 months using the CDI. Children's receptive and expressive language as well as symbolic play were assessed. Although there were no differences between the two family risk groups in receptive language and symbolic play, there were differences in expressive language measures. By the age of 2 years, the FRD group demonstrated shorter maximum sentence length and at 3.5 years poorer object naming and inflectional morphology skills than the noFRD group. A subsample of 34 late talkers (20 FRD and 14 noFRD) was identified based on scores 1 SD below the mean on age 2 expressive language. By 3.5 years, only the FRD late talkers were still delayed in both expressive and receptive language while late talkers belonging in the noFRD group performed as it was anticipating according to their age, indicating that late talkers with familiar risk for dyslexia are at higher risk for persistent language delays comparing to children with no such a risk. In general it was found that symbolic play, parental education, history of dyslexia, vocabulary comprehension at 14 months, expressive language at 24 months, and receptive language at 30 months were all significant predictors of expressive language outcome at the age of 3.5 years.

Rescorla et al. (2000) examined the expressive language outcomes at ages of 3 and 4 of 34 late talkers with normal receptive language and non-verbal ability (identified at 24-31 months), and 16 typically developing comparison children matched on age, socioeconomic status (SES), and nonverbal ability. Although findings revealed that late talkers made greater gains in both Mean Length of Utterance (MLU) and productive syntax raw scores from age three to four, they remained significantly below typical peers. At age three, the majority of the late talkers demonstrated delays in syntax while by the age of four only 29% pursued to experience delays when compared to typically language developed peers.

Moyle et al. (2007) investigated the association between lexical and grammatical development in 30 late talking children who had been identified at the age of 24 months by scoring below the 10th percentile on the CDI and 30 typically developing children (TD) matched on age, nonverbal cognition, socioeconomic status, and gender. Results of standardized language testing at 5 years and 6 months showed that

most of the late talkers achieved scores in the normal range but these scores were significantly lower comparing to typically developed age-matched children.

4.2   Language and reading outcomes of late-talkers at school-age

Studies focusing on the reading development during school age have shown that late talkers demonstrate significant differences (Rescorla, 2002; Rescorla, 2005; Rescorla, 2009) from typically developing peers Specifically those late talkers with both expressive and receptive language delays face more persistent delays even comparing with late talkers with only expressive language delays (P. Lyytinen et al., 2005).

Rescorla (2002) examined the development of language skills and the school achievement of 34 late-talkers and 25 children with typical language development and similar age, socio-economic status and nonverbal ability. By age 5 late talkers on most of the language tasks and only 6% of them had scores below the 10th percentile on at least two TOLD-2 (Test of Language Development-2, primary) subtests. However the means of the late talkers were significantly lower than control group on vocabulary, grammar, phonology, and verbal memory tasks. Moreover, while late talkers were not performing poorly in reading skills at ages 6 or 7, they had significantly poorer reading skills at ages 8 and 9. An explanation for this could be that at the age of 6 or 7 all the children were at the initial stages of learning to read while at the age of 8 and 9 the reading skills have established in both groups. Later, the language and reading development of the children from this initial sample belonging to the two groups, were examined at the age of 13 (28 late talker, 25 typically developed children) (Rescorla, 2005) and at the age of 17 (26 late talkers, 23 typically developed children) (Rescorla, 2009). In both cases the two groups of children were matched at intake on age, socio-economic status, and nonverbal ability. At the age of 13, it was found that, although, late talkers' scores were in the average level on all standardized language and reading tasks, they still scored significantly lower than their peers on aggregate measures of vocabulary, grammar, verbal memory and reading comprehension (Rescorla, 2005). Similar results were also reported for the language and reading outcomes at 17 years of age: despite the fact that late talkers achieved average scores on every language and reading task, they demonstrated significantly lower vocabulary, grammar and verbal memory factor scores than their peers (Rescorla, 2009).

P. Lyytinen et al. (2005) also examined the association between language development and reading outcomes of late-talkers with and without familial risk for dyslexia at school age. The late talkers were identified at the age of 2 and 2.5 years using parent- and test- based assessment (CDI) and their reading skills were assessed during the second grade. The findings revealed that children with both expressive and receptive language delays demonstrated lower scores in comparison with the toddlers with only expressive language delays or no language delays in reading measures at the second grade. The late talkers with an expressive language delay and without familial risk for dyslexia performed as their age-matched controls. The most noteworthy differences were observed in reading among late talkers belonging in the group with receptive and expressive language delays and the two groups of the children with and without familial risk for dyslexia who had age-appropriate or better language development. In addition, it was found that children who had familial risk for dyslexia and age-appropriate or better language development scored significantly lower on the oral reading than those children without familial risk for dyslexia and age-appropriate or better language development. This suggests that family risk children had high risk for reading difficulties even if they were not late talkers.

Rice et al. (2008) studied the language outcomes of 128 children with reported late talking history as compared to 109 typically developing peers at seven years of age. Their findings revealed that early delays of expressive language was correlated with difficulties in particular aspects of language such as morphosyntax at 7 years, whereas there was no association with vocabulary or semantics. Moreover it was found that despite the fact that late talkers performed on the average range of language development, a significantly higher proportion of late talking children performed more than a SD below the mean in spoken language, syntax and morphosyntax.

A recent study by Preston et al. (2010), in which participated children whose age was from 4 years and 10 months to 12 years and 8 months (mean 8 years 1 month, SD 17 months) and the late-talking assessment was based on parental assessment, also showed that late talkers had lower levels of performance on all language and literacy-related measures in addition to early talkers who demonstrated higher levels of performance on many oral and written language measures. Neural differences were also identified in school-age early and late talkers. Functional neuroimaging findings showed that late talkers' activation in the bilateral thalamus and putamen, and left

insula and superior temporal gyrus was significantly lower during listening to or reading words and non-words. These findings that late talking status is not only found in behavioural test of oral or written test but it also affects the distributed cortical-subcortical neural circuits which supports speech and print processing during the school-age years

5 SYNTHESIS OF THE MAIN CONCEPTS AND PREVIOUS FINDINGS

Late talkers are a heterogeneous group with a variety of individual and environmental characteristics. The term "late talker" is used to describe those toddlers who lag behind in the beginning and the progression of expressive language. Language is a complex set of skills and their development requires both genetic and environmental influences and their interactions (P. Lyytinen et al., 2001; Reilly et al., 2010). There have been several studies that attempted to identify the risk factors that lead to linguistic delay as well as the diagnostic and prognostic indicators. A large number of biopsychosocial factors are possible to be related and responsible for individual differences. Although early in development biological factor may have the most important influence, parents provide both the genes and the home environment which can affect those genetic factors (Rescorla, 2011).

Summarizing the results, it seems that most of the late talkers score in the normal range on language tests by the age of their entry in pre-school as well as during their school years. However, despite of this good progress, they continue to have significantly weaker language skills than their age-matched, typically developing peers, with the same SES, through adolescence (Moyle et al., 2007; Rescorla, 2002; Rescorla, 2005; Rescorla, 2009; Rescorla, 2011; Thal et al., 2005).

With regard to risk factors for late language emergence, although research has looked at the influence of several intrinsic or extrinsic factors, such as the presence of a family history of language delay, maternal education, parental stress and socioeconomic status, it emphasizes the importance of genetic factors (Bishop et al., 2003; Zubrick et al., 2007). More specifically, it seems that children's language difficulties are possible to be genetic in origin particularly when they are persistent.

6 THE PRESENT STUDY

Even though there is an increasing body of studies examining late talkers' reading development, most of the studies are focusing on language and reading outcomes of late talkers during preschool or until the second grade in primary school and little research focused on development after the early grades. This study moves after the second grade and examines the reading development of late talkers until the 8th and 9th grade. Both reading fluency and comprehension are examined and it is attempted to be identified how family risk and early delays in expressive and/or receptive language affect these two skills. In this study expressive and receptive language delays are taken into account and it is examined whether late talking with and without early receptive language delays has different consequences on children's reading development and if it affects fluency and comprehension in different ways.

The main research question of this study was: Are problems in early expressive vocabulary (late talking) and receptive vocabulary predicting grade 2, 3, 8 and 9 reading fluency and reading comprehension development? Based on previous studies (P. Lyytinen et al., 2005) it is expected the most detrimental outcome for children with both expressive and receptive language difficulties. It is also expected that there is a strong effect of family risk (P. Lyytinen et al., 2005) and children with familial history for dyslexia and age appropriate language level are expected to have reading difficulties despite lack of language problems. Following Rescorla, (2002; 2005; 2009) as well as P. Lyytinen et al. (2005) it is assumed that children with no familial risk for dyslexia and early expressive language delays will manage to catch up their peers who had no familial history for dyslexia and no early delays. On the other hand, children with familial risk for dyslexia and early expressive and receptive language delays is expected to demonstrate the most severe difficulties and less improvement comparing with the children from all the other groups.

7 METHOD

7.1 Participants

The children were participants of the Jyvaskyla Longitudinal Study of Dyslexia (JLD) and were originally selected from among 9368 newborns born in the province of

Central Finland between April 1993 and July 1996. The selection was made using a three-stage procedure: (1) A short parental questionnaire including three questions concerning difficulties in learning to read and spell among parents and their close relatives (8417 respondents); (2) A detailed parental questionnaire concerning the reading history, the persistence of reading and spelling difficulties, and the reading habits of parents and their close relatives (3130 respondents); (3) Testing of the reading and spelling skills (410 parents) (P. Lyytinen et al., 2005).

For the child to be originally included in the familial risk group (FR, n = 108) either of the parents had to show deficient performance in oral text reading, or spelling, and in single word reading tasks tapping phonological and orthographic processing. In addition, a reported onset of literacy problems during early school years and a first-degree relative with corresponding difficulties were required for inclusion in the familial risk group. In the control group without familial risk, both parents (NR, n = 92) had no reported family history for dyslexia and had a z-score above -1.0 in all reading and spelling tasks described above (see P. Lyytinen et al., 2005). The IQ of all parents, assessed with the Raven B, C, and D matrices (see P. Lyytinen et al., 2005), had to be equal to or above 80 (for full details of recruitment, see Leinonen et al., 2001).

Based on receptive and expressive vocabulary assessed at the age of 2-2.5 years, the children (FR, N= 105; NR, N=89) were divided into 5 subgroups which were identified using parent- and test-based assessments of receptive and expressive vocabulary and grammar at 2 and 2.5 years (see P. Lyytinen et al., 2005). The intake criterion for the late talking group 1 (LT1, expressive language delay) was at least one standard deviation below the mean of the composite score of expressive language. Both the LT1 children with familial risk for dyslexia (FR-LT1) and the LT1 children from control group (NR-LT1) included 10 children. Children belonging to these two late talking groups had age-appropriate receptive vocabulary. Children in the late talking group 2 (LT2) demonstrated both expressive and receptive language delay. In this group there were 12 children from the FR group only. There were only three NR group children who fulfilled the expressive and receptive intake criterion for the LT2 group and as a result they were excluded from the comparisons. In addition to these three groups, there were also two groups without language problems, one for the FR

group (N=83) and one for the NR (N=79). Their language development was age-appropriate or better (see P. Lyytinen et al., 2005).

7.2 Measures

Trained testers assessed reading skills (oral text, oral list, and oral pseudoword text reading tasks) individually in a laboratory setting. The reading comprehension tasks and the word reading fluency task were assessed during spring term in the classrooms of the children as a part of the JLD assessment procedure. The measures that were used to assess reading fluency were: 1) Oral text reading (grades 2, 3 and 8), 2) Oral pseudoword text reading (grades 2, 3 and 8), 3) Oral word list reading (Lukilasse)(grades 2, 3 and 8), and 4) Word reading fluency task (Allu TL2) (grades 2 and 3. For assessing comprehension the measures that were used were: 1) short passage reading comprehension (grades 2 and 3) and 2) PISA reading comprehension (grade 9). The measures are described in detail below. Furthermore a new composite variable for fluency at each grade was calculated using the z-scores of the fluency measures. In grades 2 and 3 the fluency composite was calculated using the z-scores of the: 1) Oral text reading, 2) Oral pseudoword text reading, 3) Oral word list reading, 4) Word reading fluency task (Allu TL2). For the 8th grade the fluency composite included the z-scores of: 1) Oral text reading 2) Oral pseudoword text reading and 3) Oral word list reading. The Cronbach alpha reliability for the fluency composite scores was .93, .87, .90 in Grades 2, 3 and 8 respectively.

Oral text reading (Grades 2, 3, and 8). At each grade level, participants read aloud an age-appropriate text for oral text reading. In Grade 2, the text (title "Exciting journeys") consisted of 19 sentences in 5 paragraphs with a total of 124 words / 877 letters (mean word length = 7.07 letters and mean sentence length = 6.53 words). For Grade 3, the text (title "Useless belongings") consisted of 18 sentences in 4 paragraphs and a total of 189 words / 1154 letters (mean word length = 6.11 letters and mean sentence length = 10.50 words). Finally, the Grade 8 text (title "Fields of Lapland") consisted of 16 sentences in 3 paragraphs and a total of 207 words / 1591 letters (mean word length = 7.68 letters/word and mean sentence length = 12.94 words). Reading performance was recorded on a Walkman tape recorder (Grades 2 and 3) or a laptop computer (Grade 8). The total time to read the text was measured

with a stop watch. The tapes and sound files were subsequently used to check the scoring of the children's speed.

Oral pseudoword text reading (Grades 2, 3, and 8). Participants read a short text aloud made up of 19 pseudowords / 137 letters (Grade 2) or 38 pseudowords / 277 letters (Grades 3 and 8). The words and structure of the sentences 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. Similarly to the oral text reading, the child's reading performance was recorded and correctness of reading and time spent on reading were checked.

Oral word list reading, (Grades 2, 3, and 8). In the standardized reading test of Lukilasse (Häyrinen, Serenius-Sirve, & Korkman, 1999) the participant had 2 minutes to read aloud as many words as possible from a 90-item (Grade 2) or 105 item (Grade 3) list, assembled vertically in columns. The same list which was used in Grade 3 was administered also 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 word reading fluency task (**ALLU TL2)** (Grades 2 and 3) is a subtest of the nationally normed reading test battery (ALLU; Lindeman, 2000). Each of the 80 items consisted of a picture with four phonologically similar words attached to it. The child silently read the four words and then drew a line connecting the picture with the word, semantically matching it. The words and pictures were easy and frequently used words familiar to very young children. For example, there was a picture of a bunny (*pupu* in Finnish) and three distractors (English word is in parentheses): *pipo* (cap), *papu* (bean), and *apu* (help). Completing the test requires detailed fluent decoding. The score was the number of correct answers within a 2-minute time limit. Because of the nature of this timed test, the score reflects both the child's fluency in reading the stimulus words and accuracy in making the correct choice from among the alternatives. Lindeman (2000) reported the Kuder-Richardson reliability coefficient to be .97 in grade 1, and .82 in grade 2. Alternate-form reliability between forms A and B was .84. In our sample, the Pearson correlation coefficient between grades 2 and 3 was .66 (p=.000).

Reading comprehension Grade 2 and Grade 3. A group-administered subtest of the nationally normed reading test battery (ALLU; Lindeman, 2000) was used to assess reading comprehension. The children silently read a fiction story and then answered 11 multiple-choice questions and one question in which they had to arrange five statements in the correct sequence based on the information gathered from the text.. The children received 1 point for each correct answer (max = 12). Each child completed the task at his or her own pace, but the maximum time allotted was 45 minutes. Lindeman (2000) reported the Kuder–Richardson reliability coefficients were .80 in grade 2, and .75 in grade 3.

Reading comprehension Grade 9: PISA Reading. The reading tasks were the PISA reading link items used repeatedly in each cycle of the survey to ensure the comparability of the measurement (OECD, 2010b, p. 26; 2013, p. 45). In the booklet, there were eight different texts for which the students were asked to read and answer several questions. The reading materials included texts, tables, graphs, and figures. 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 for all the PISA reading items was calculated. Cronbach's alpha reliability coefficient for the total score in this sample was .80.

8 RESULTS

8.1 Group differences in Reading Fluency and Comprehension

One-way ANOVAs were used to compare reading skills in the groups (Table 1). According to our results the most significant differences in Grade 2 were found on reading pseudoword text ($F(4,185)=4.539$, $p=.002$), reading text ($F(4,185)=4.59$, $p=.001$) and word list reading ($F(4,185)=4.832$, $p=.001$). Further post-hoc analysis showed that on reading pseudoword text the children belonging to the control group with no delay (NR) were significantly faster compared to the children belonging to the family risk group with no delay (FR) and the control group with expressive language delay (NR-LT1). In text reading the control group children with no delay

were significantly faster readers than all of the groups including children at risk for dyslexia (FR, FR-LT1, LT2).

For the 3rd grade significant differences between the groups were identified for text reading ($F(4,189)=3.656$, $p=.007$) and word list reading ($F(4,188)=5.202$, $p=.001$). Post-hoc comparisons showed that on text reading the children belonging to the control group with no delay were faster compared to the children belonging to the family risk group with no delay and the family risk group with expressive language delay (FR-LT1). In word list reading the control group children with no delay were significantly faster readers than all of the groups including children at risk for dyslexia (FR, FR-LT1, LT2).

In 8th grade significant differences were found for the word list reading ($F(4,173)=2.49$, $p=.045$), text reading ($F(4,174)=4.056$, $p=.004$) and pseudoword text reading ($F(4,174)=3.579$, $p=.008$). Post-hoc comparisons showed that in word list reading the control group children with no delay were significantly faster readers than the children belonging to the family risk group with no delay and the family risk group with expressive language delay. For both text and pseudoword text reading it was found that the control group children with no delay performed significantly better than the children belonging to the family risk group with no delay.

Finally, one-way ANOVAs for group comparisons in a reading fluency composite score were conducted (Table 2). The results showed significant differences for fluency outcomes in grade 2 ($F(4,172)=4.76$, $p=.001$) and grade 8 ($F(4,173)=4.011$, $p=.004$). Pairwise comparisons revealed that the family risk group with no delay performed significantly lower at each grade than the control group children with no delay. However the observed effect sizes (Cohen's d was calculated using the means and standard deviations) were moderate in grade 2 for the comparisons between the family risk group with no delays and the control group with no delays as well as between the family risk group with expressive and receptive language delays and the control group with no delays. In 8th grade moderate effect sizes were also observed in the comparisons between the control group with no delays and all the other groups including children at risk for dyslexia (Table 3).

8.2   Group differences in Reading Comprehension

One-way ANOVAs for reading comprehension showed significant group differences in grades 2 (F(4,166)=5.266, p=.001) and 9 (F(4,139)=8.689, p=.000) (table 1). Post hoc comparisons showed that in grade 3 the children belonging to the family risk group with expressive and receptive language delay were significantly slower comprehenders than all the other groups except from the children belonging to the control group with expressive language delay (FR, FR-LT1, NR). At the 9th the children belonging to the family risk group with expressive and receptive language delay were significantly slower comprehenders than all the other groups (FR, FR-LT1, NR-LT1, NR). As it can be seen in table 3 Cohen's d effect sizes were mostly large for the comprehension outcomes between the family risk group with expressive and receptive language delays and the family risk group with expressive language delays as well as between the family risk group with expressive and receptive language delays and the control group with no delays while in 9th grade the effect sizes were very large between the family risk group with expressive and receptive language delays and all the other groups.

TABLE 1   Descriptive statistics and group comparisons for the reading measures.

	FR[a]		FR-LT1[b]		LT2[c]		NR-LT1[d]		NR[e]		F	df
	M	SD	M	SD	M	SD	M	SD	M	SD		
Grade 2												
Fluency												
Reading speed non-word text (words/minute)	25.60[1]	10.00	28.50	10.64	31.69	11.79	33.36[2]	9.87	32.87[2]	12.73	4.54**	4,185
Reading speed text (words/minute)	56.04[1]	25.40	53.33[1]	26.85	50.96[1]	21.45	61.40	27.85	71.10[2]	24.30	4.59***	4,185
Reading fluency, LukiLasse (correct answers)	-.63[1]	1.08	-.48	1.13	-.78[1]	1.22	-.16	1.13	.05[2]	.96	4.83***	4,185
Allu TL2 (correct answers)	26.81[1]	9.15	28.56	8.26	26.08	10.67	29.11	12.08	31.24[2]	8.99	2.32	4,173
Comprehension												
Allu LY2 (correct answers)	8.99	3.00	8.44	2.92	6.55	3.33	7.00	2.55	9.77	1.79	5.27***	4,166
Grade 3												
Fluency												

Reading speed nonword text (words/minute)	32.19	10.45	35.05	13.57	32.04	7.59	36.56	15.12	34.63	11.23	.71	4,169
Reading speed text (words/minute)	67.07[1]	28.78	59.07[1]	32.86	68.01	23.39	68.37	33.22	81.42[2]	24.80	3.66**	4,189
Reading fluency, LukiLasse (correct answers)	-.57[1]	1.03	-.81[1]	1.32	-.77[1]	1.06	-.41	1.32	.07[2]	.94	5.2***	4,188
Allu TL2 (correct answers)	34.16[1]	10.95	33.60	8.61	34.73	11.05	36.10	8.21	38.03[2]	10.61	1.42	4,179
Comprehension												
Allu LY3 (correct answers)	9.76[1]	1.76	10.20[1]	1.32	8.64[2]	2.01	10.00	2.78	10.15[1]	1.40	2.12	4,170
Grade 8												
Fluency												
Reading fluency, LukiLasse (correct answers)	67.69[1]	14.44	64.70[1]	13.72	70.20	14.54	71.38	17.69	73.96[2]	11.73	2.49*	4,173
Reading text (seconds)	163.58[1]	52.07	166.61	35.11	165.42	32.50	167.63	81.17	138.63[2]	20.21	4.06**	4,174
Reading nonword text (seconds)	52.81[1]	20.35	48.03	14.67	50.97	9.97	51.04	29.73	42.55[2]	11.10	3.58**	4,174

Grade 9											
Comprehension											
PISA	.92[1]	.19	.90[1]	.14	.54[2]	.19	.86[1]	.29	.97[1]	.20	8.69***	4,139

Notes [a] FR= children belonging to the at-risk group with no language delay; [b] FR-LT1 = children belonging to the at-risk group and have expressive language delay; [c] LT2 = children belonging to the at-risk group and have expressive and receptive language delay; [d] NR-LT1 = children belonging to the control group and have expressive language delay; [e] NR= children belonging to the control group with no language delay

Groups with different superscripts ([1,2]) differed from each other in post-hoc comparisons, using either LSD or Dunnett T3, depending on equality of the variances.

*p≤.05, **p≤.01. ***p≤.001

TABLE 2   Descriptive statistics and group comparisons in each grade in fluency and comprehension skills

	FR		FR-LT1		LT2		NR-LT1		NR			
	M	SD	M	SD	M	SD	M	SD	M	SD	F	df
Grade 2												
Fluency	-.33[1]	.88	-.12	.89	-.31[1]	.93	.05	1.05	.28[2]	.86	4.77***	4,172
Comprehension	.02	1.08	-.18	1.06	-.86	1.20	-.70	.92	.30	.65	5.27***	4,166
Grade 3												
Fluency	-.16[1]	.80	-.27	1.00	-.11	.77	-.06	1.06	.16[2]	.83	1.54	4,160
Comprehension	-.07[1]	1.03	.19[1]	.77	-.73[2]	1.18	.07	1.63	.16[1]	.82	2.12	4,170
Grade 8												
Fluency	-.22[1]	1.05	-.21	.79	-.13	.71	-.12	1.59	.33[2]	.53	4.01**	4,173
Grade 9												
Comprehension	.15[1]	.89	.04[1]	.66	-1.64[2]	.87	-.16[1]	1.36	.37[1]	.91	8.69***	4,139

Note. Groups with different superscripts ([1,2]) differed from each other in post-hoc comparisons, using either LSD or Dunnett T3, depending on equality of the variances.

*p≤.05, **p≤.01, ***p≤.001

TABLE 3   Effect sizes for group comparisons in fluency comprehension.

	Effect size[a]									
	FR vs FR-LT1	FR vs LT2	FR vs NR-LT1	FR vs NR	FR-LT1 vs LT2	FR-LT1 vs NR-LT1	FR-LT1 vs NR	NR-LT1 vs LT2	NR-LT1 vs NR	LT2 vs NR
Grade 2										
Fluency	**-**.24	**-**.02	**-**.39	**-**.70	.21	**-**.18	**-**.46	**-**.36	**-**.24	**-**.66
Comprehension	.19	.77	.72	**-**.31	.60	.52	**-**.55	**-**.15	**-1.26**	**-1.20**
Grade 3										
Fluency	.12	.06	**-**.11	**-**.39	**-**.18	**-**.20	**-**.47	**-**.05	**-**.23	**-**.34
Comprehension	**-**.29	.60	**-**.10	**-**.25	**.92**	.09	.04	**-**.56	**-**.07	**-.88**
Grade 8										
Fluency	.01	**-**.10	-.07	-.66	-.11	**-**.36	.80	.01	.38	.73
Grade 9										
Comprehension	.14	**2.03**	.27	**-**.24	**2.18**	.19	**-**.42	**-1.30**	**-**.46	**-2.26**

Note. Large (> .80) effect sizes with bold

[a] The value of Cohen's d was calculated using the means and standard deviations of two groups.

8.3 Developmental changes of the groups in fluency and comprehension.

In order to investigate the change of relative differences of fluency and comprehension skills within the groups a 3(Grade) x 5(Groups) repeated measures MANOVA was conducted using the Pillais Trace F-approximation as the criterion.

A 3(Grade) x 5(Groups) repeated measures MANOVA for fluency development revealed that the main effect of grade was not significant ($F(2,136)=.332$, $p=.718$, $n^2=.005$) while the Grade x Group interaction was not significant either ($F(8, 274)=1.325$, $p=.231$, $n^2=.037$) (Figure 1).
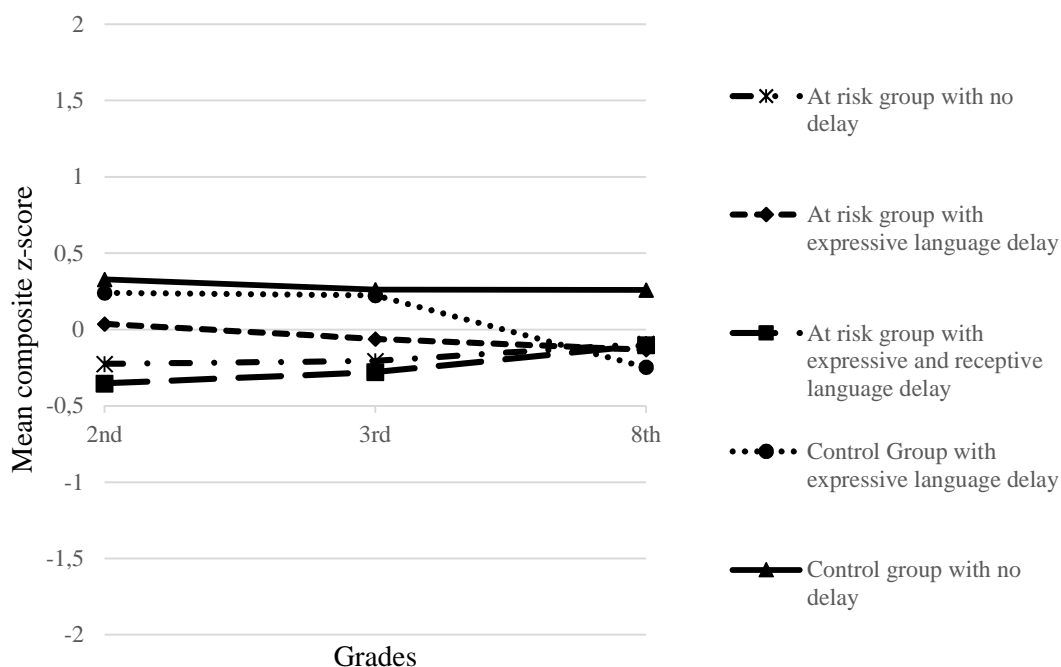

FIGURE 1 Development of fluency skills by groups at each grade

A 3(Grade) x 5(Groups) repeated measures MANOVA for reading comprehension development revealed that the main effect for grade was not significant ($F(2,111)=.096$, $p=.908$, $n^2=.002$) and Grade x Group interaction was not significant either ($F(8,224)=1.096$, $p=.367$, $n^2=.075$). However, as can be seen in Figure 2, the trend in the at-risk group with both expressive and receptive language delay is declining (less than 1 standard deviation below average controls in grade 2 but 1.5

standard deviations below the controls in grade 9) whereas in the other groups the development is very similar.

Note that in the present analyses standardized scores (according to the control group distribution) were used and therefore the changes are relative to average developmental level of control group.
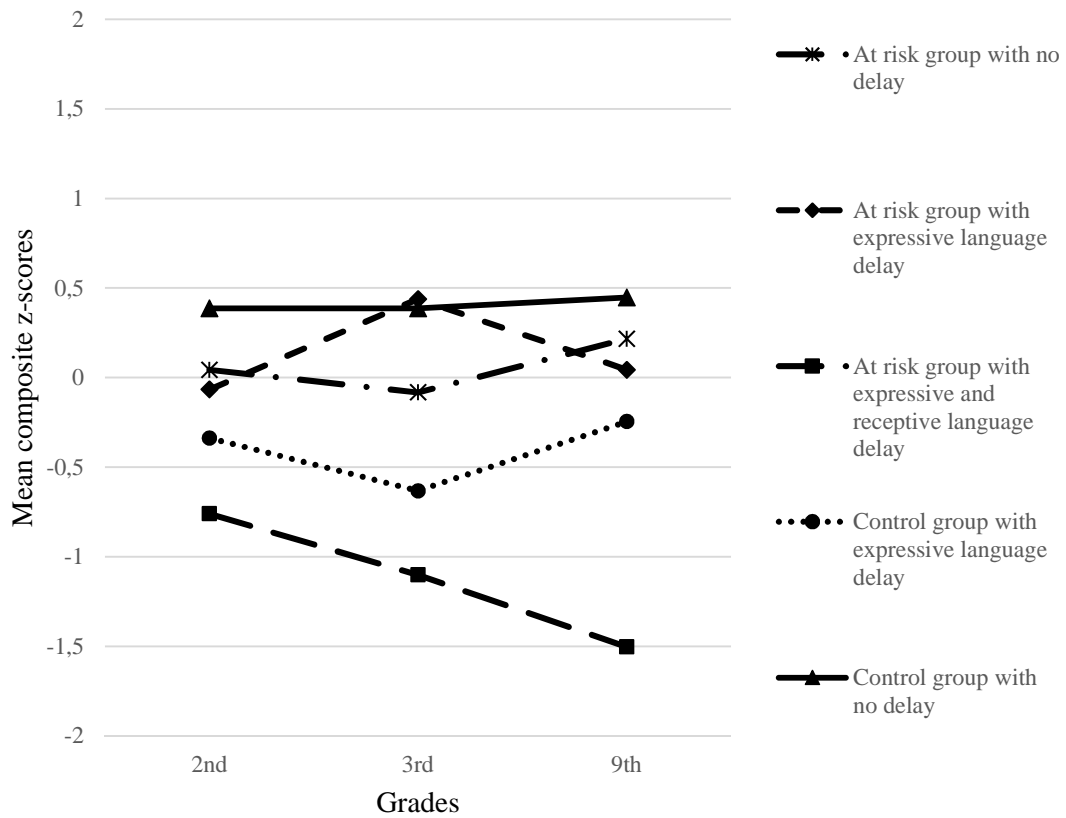

FIGURE 2 Development of comprehension skills by groups at each grade

9 DISCUSSION

In the present study, it was examined whether late-talkers with and without familial risk for dyslexia continue to have weaker reading skills than typically developing, age-matched children in grades 2, 3, 8 and 9 (from age 8 to 15 years). The sample of the study was 200 Finnish-speaking children, who were divided into 5 subgroups: 1) Risk Group with no Delay, 2) Risk Group with Expressive Language Delay, 3) Risk Group with Expressive and Receptive Language Delay, 4) Control Group with Expressive Language Delay, 5) Control Group with no Delay. The children belonging to the at risk group have a family history of dyslexia and as a result are at risk for reading difficulties. The five groups were compared with each other in reading fluency and comprehension measures. The clearest differences on fluency tasks were observed between the at-risk group with no delay and the control group with no delay whereas on comprehension tasks they were identified between the at risk group with expressive and receptive language delays and all the other groups. In addition, our findings add to the literature by showing the reading fluency and comprehension trajectories of children with expressive and/or receptive language delays from the age of 8 until the age of 15.

The findings revealed a differentiation between fluency and comprehension development among the five groups. Reading comprehension was closely linked to problems in early vocabulary development. Particularly the toddlers with delays in both expressive and receptive language demonstrated persisting weaknesses with large effect sizes in reading comprehension measures. Children with both expressive and receptive language delays had significantly lower scores comparing with all the other groups at the end of the second grade and they continued this declining trajectory even at the end of the ninth grade. Consequently, it seems that a delay in expressive and receptive language can lead to a persistent deficit which is in line with P. Lyytinen's et al. (2005) results and it seems that while children's reading skills are developed during school years this deficit primarily affects comprehension skills. These findings are also consistent with Rescorla's (2005) reports that age 13 late talkers demonstrated no differences on the basic reading mechanisms (including fluency) but they had significantly lower scores in reading comprehension. Late talking with both receptive and expressive language delays at 24-30 months, was a

persistent deficit associated with children's reading comprehension skills, a finding which concurs also with Rescorla (2002; 2005; 2009) and Scarborough (2001). However it should be noted that only children with familial risk for dyslexia were belonging to that group in this data and as a result this conclusion is adequate only if family risk is taken as a second criterion.

Reading fluency on the other hand was linked to family risk for dyslexia. The effect of family risk was clear as the reading fluency outcomes of the children belonging to the at-risk group (even with no language delays) did not manage to reach the reading level of the children belonging to the control group with no delays. This finding support previous finding on the strong familial risk on the developmental dyslexia (DeThorne et al., 2005; Snowling, Gallagher, & Frith, 2003b; Vellutino et al., 2004; Vlachos et al., 2013) and the reading fluency being the best indicator of reading difficulties in Finnish (H. Lyytinen et al., 2008). Family risk has been found to be closely linked to code-related problems such as phonological awareness (H. Lyytinen et al., 2008; Scarborough, 1990) in addition to language problems and as it was revealed in another JLD study age appropriate or better early expressive and receptive language skills may not ensure age appropriate language skills for all children later (H. Lyytinen et al., 2006). In fact, there are also other risk factors that could affect children's later reading skills. Pennington's (2006) multiple deficit model proposes that complex developmental disorders are depended on the interaction of multiple risk factors and that there is not one single etiology that is sufficient enough. Phonological awareness has been widely accepted as one of the main causes of reading difficulties (Caravolas et al., 2012; Hulme & Snowling, 2013; Moll, Göbel, Gooch, Landerl, & Snowling, 2014; Snowling, 2013; Vellutino et al., 2004). Difficulties in phonological awareness could lead to difficulties in phonological learning (Carroll & Snowling, 2004), difficulties in letter knowledge and word recognition and consequently to difficulties in reading fluency and comprehension (Snowling, 2013). Phonological deficit that affects reading development can be associated with the difference that has been found in our sample, between the at risk group with no delay and the control group with no delay. Other important underlying risk factor that can affect later reading development include slow processing speed since deficits in rapid automatized naming (RAN) are frequently identified in individuals with reading

difficulties (Caravolas et al., 2012; Hulme & Snowling, 2013; Moll et al., 2014) also in the current sample (Torppa, Georgiou, Salmi, Eklund, & Lyytinen, 2012).

There are some limitations that should be taken into account of this study which include the small sample size and that there was only one reading comprehension measure at each age. With a larger sample size, the issues described above could have been examined with more statistical power and also a group with difficulties in both receptive and expressive language but no family risk could have been included. This would have provided the opportunity the effects of family risk and early language development to be separated more clearly. In addition, broader measurement of language and reading comprehension at school age would have given deeper understanding of the links between early language development and school-age skills.

In conclusion, children belonging to the late talking groups without early receptive delay demonstrated an improvement on their fluency and comprehension skills trajectories. Whereas, children with both receptive and expressive language delay, had a declining trajectory in reading comprehension. Comprehension plays an important role in children's development, because it supports the development of expressive skills and it is closely related with the development of cognitive skills (Dale et al., 2003). Our results indicate that expressive language delay is not the only factor that should be paid attention when an early language delay is observed. Receptive skills should also be noticed since late talking with only expressive language delay is not informative enough when it comes to school age reading development. In addition, it seems that late talking could be considered as a persistent risk factor for school age reading development only in case it is combined with receptive language delays.

Practical implications

It is generally accepted that intervention is more effective when it is provided early enough (Dale et al., 2003). Although this study did not assess intervention effects, it is suggested, conforming with Rescorla (2002; 2005; 2009) that providing late talkers and especially those with family risk for dyslexia and receptive language delays, extra exposure to games and play activities, may help them to strengthen their language processing, phonological discrimination, verbal memory and word retrieval and consequently to reduce the gap with their peers. Such activities could include for example shared reading experiences with their parents since it has been found that this

kind of activities could support children's oral language and vocabulary development (Sénéchal & LeFevre, 2002). In fact, shared reading has been found to be associated with both vocabulary development and phonological awareness (Mol & Bus, 2011; Torppa et al., 2007) which consecutively could lead to better reading comprehension outcomes.

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