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Title: Literacy Skill Development of Children With Familial Risk for Dyslexia Through Grades 2, 3, and 8

Year: 2015

Version:

Please cite the original version:

Eklund, K., Torppa, M., Aro, M., Leppänen, P. H., & Lyytinen, H. (2015). Literacy Skill Development of Children With Familial Risk for Dyslexia Through Grades 2, 3, and 8. Journal of Educational Psychology, 107(1), 126-140. https://doi.org/10.1037/a0037121

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Literacy Skill Development of Children with Familial Risk for Dyslexia through Grades 2, 3, and 8

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Abstract

This study followed the development of reading speed, reading accuracy, and spelling in transparent Finnish orthography through Grades 2, 3, and 8. We compared two groups of children with familial risk for dyslexia, with or without dyslexia in Grade 2 (Dys_FR, n = 35 and NoDys_FR, n = 66) to a group of children without familial risk and dyslexia (Controls, n = 72). The Dys_FR group showed persisting deficiency especially in reading speed, and, to a minor extent, in reading and spelling accuracy. The Dys_FR children, contrary to the other two groups, relied heavily on letter-by-letter decoding in Grades 2 and 3. In children not fulfilling the criteria for dyslexia in Grade 2, the familial risk did not substantially affect the subsequent development of literacy skills.

Keywords: Reading speed, Reading accuracy, Spelling, Familial risk, Dyslexia, Reading disability, Development, Longitudinal

Introduction

Literacy skills are a key to educational and occupational success in most societies. For a considerable proportion of the population, difficulties in reading and spelling development make them vulnerable to underachievement throughout their school years and even beyond (Snowling, Adams, Bishop, & Stothard, 2001). Children with a family history of dyslexia comprise a substantial part of this population: 34 % – 66 % of children born to families with dyslexia have been reported to have severe difficulties in reading and spelling acquisition during the first grades at school (Pennington & Lefly, 2001; Puolakanaho et al., 2007; Scarborough, 1990; Snowling, Callagher, & Frith, 2003). The majority of studies of reading development have focused on reading accuracy, and less is known about the development of reading speed (Landerl & Wimmer, 2008; Share, 2008) and spelling (Lervåg & Hulme, 2010). In reading speed there are a few longitudinal follow-ups spanning beyond Grade 3 (de Jong & van der Leij, 2003; Landerl & Wimmer, 2008; Parrila, Aunola, Leskinen, Nurmi, & Kirby, 2005), but follow-ups at school age with samples including children with familial risk for dyslexia are scarce (see, however, Snowling, Muter, & Carroll, 2007; van Bergen et al., 2010). This longitudinal study examines reading and spelling development across Grades 2, 3, and 8 in three groups: children with familial risk for dyslexia and dyslexia in Grade 2, children with familial risk but no dyslexia in Grade 2, and children without a familial risk and without dyslexia. We have three aims: to study the stability of reading and spelling skills beyond the literacy acquisition phase, to examine the effect of familial risk on reading and spelling development, and to examine the effect of reading task and material (word list, text, and pseudoword text) on reading speed in different groups at different ages.

Stability in Reading Speed, Reading Accuracy, and Spelling

Only a few studies have described reading and spelling development from childhood to adolescence in a longitudinal design, and most of them involve English-speaking children and have focused on the development of reading accuracy (Francis, Shaywitz, S.E., Stuebing, Shaywitch, & Flecther, 1996; Parrila et al., 2005; Shaywitch et al., 1995). During recent years reading speed and fluency (speed adjusted for accuracy), have begun to attain more attention in developmental reading research. In one of the few studies focusing on the development of reading speed, Landerl and Wimmer (2008) reported high stability and steady growth in a sample of German-speaking (Austrian) children in Grades 1, 4, and 8. Correlations between reading speed measures at different grade levels varied from .59 to .81, indicating high stability, which was confirmed at the individual level: 8 out of 11 slow readers in Grade 1 were still at least one standard deviation below the sample average in Grade 8. Similarly, high correlations were reported in reading speed between words (.69) and nonwords (.66) in a shorter Dutch follow-up ranging from Grades 1 to 3 (de Jong & van der Leij, 2002) as well as in English between grades 1 and 2 in word list (.79) and oral text reading (.82) fluency (Kim, Wagner, & Lopez, 2012). In Finnish, correlations between Grade 1 (fall) and Grade 2 (spring) have varied from .59 in text reading fluency (Parrila et al., 2005) to .67 in word recognition fluency (Torppa et al., 2007).

The stability of reading accuracy has also been reported to be high. In an English-speaking Canadian sample the across-grade correlations varied between .47 and .94 in the yearly assessments from Grades 1 to 5 (Parrila et al., 2005). In transparent orthographies, the development of reading accuracy is very different from English, because the acquisition of reading accuracy in transparent orthographies is fast. In a cross-language comparison of seven languages, Aro and Wimmer (2003) reported that the percentage of accurately read pseudowords approached 90 % at the end of Grade 1 in all six orthographies (German, Dutch, Swedish, French, Spanish, and Finnish) other than English. Even children with dyslexia have been reported to read at least words with high accuracy after Grade 1: the average accuracy percentage was 91 % in a Dutch sample of children with dyslexia (de Jong & van der Leij, 2003). Therefore, reading accuracy is seldom followed up and reported on in transparent orthographies after Grade 1. Leppänen, Niemi, Aunola, and Nurmi (2006) have, however, reported moderate to high correlations, ranging from .52 to .91, in reading accuracy of words and sentences in a Finnish sample between four assessments during Grades 1 and 2.

As noted in various definitions of dyslexia, including the one from the International Dyslexia Association, problems in spelling are one key marker of dyslexia: “Dyslexia is a specific learning disability… characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities” (p. 2) (Lyon, Shaywitz, & Shaywitz, 2003). Spelling development, however, has attracted less attention (Caravolas, Hulme, & Snowling, 2001; Lervåg & Hulme, 2010). There are studies that have examined the early prerequisites and predictors of spelling skill during the early grades of school in different orthographies (e.g., Furness & Samuelsson, 2010; Kim & Petscher, 2011; Leppänen et al., 2006; Torppa et al., 2013; Wimmer & Mayringer, 2002). But there are only a few longitudinal follow-ups that have examined the stability of spelling skill beyond the first grades at school in children without dyslexia (Abbot, Berninger, & Fayol, 2010; Landerl & Wimmer, 2008; Lervåg & Hulme, 2010), and with dyslexia (Shaywitz et al., 1999; Snowling et al., 2007). Several studies have shown that children with reading difficulties are often poor in both reading and spelling (van Bergen, de Jong, Plakas, Massen, & van der Leij, 2012; de Jong & van der Leij, 2003; Pennala et al., 2010; Pennington & Lefly, 2001; Puolakanaho et al., 2008). In addition, the finding that spelling training in children with dyslexia enhances reading skills supports the idea of a close relationship between reading and spelling (Ise & Schulte-Körne, 2010). However, dissociation between spelling and reading has also been reported (Fayol, Zorman, & Lété, 2009; Moll & Landerl, 2009; Wimmer & Mayringer, 2002). Reported correlations between two assessments of spelling have indicated moderate to high stability in English (.62–.92, in Grades 1–7) (Abbott et al., 2010), in Norwegian (.47–.78, Grades 1–3)

(Lervåg & Hulme, 2010), and in German (.44–.77) (Landerl & Wimmer, 2008). A tendency for stronger correlations between words as compared with pseudowords (.67–.78 vs. .47–.59, respectively) (Lervåg & Hulme, 2010) as well as later vs. earlier grades (.44–.47 in Grades 1–4 vs. .77 for Grades 4 and 8; Landerl & Wimmer, 2008) has also been reported. Correlational stability was not reported in the studies with a sample of children with dyslexia, but stable group differences between children with and without dyslexia were found between Grades 6–9 (ages 9 to 14 years) (Shaywitz et al., 1999) and between 8 and 12 years of age (Snowling et al., 2007). Our study is, to our knowledge, the first to examine the stability in reading speed and accuracy, as well as in spelling, in a sample of children with and without familial risk for dyslexia across a long time period from Grade 2 to Grade 8 (ages 8 to 14 years).

Familial Risk as a Continuum

Several candidate susceptibility genes have been found to be linked to developmental dyslexia (Galaburda, LoTurco, Ramus, Fitch, & Rosen, 2006; Giraud & Ramus, 2012; Scerri & Schulte-Körne, 2010), and the idea of multiple risk factors, some of which are transmitted also to offspring without dyslexia, is widely accepted (Bishop, 2009; Pennington, 2006; Pennington & Lefly, 2001; Pennington et al., 2012; Snowling, 2008; Snowling et al., 2003). Pennington (2006) has suggested that multiple risk factors both in the genome and environments lead to a continuum of vulnerability instead of a dichotomous distribution of risk. At the behavioral level, this suggestion has been tested by comparing the performance of children with familial risk, either with or without dyslexia, and controls. If the familial risk is continuous, also the group of children with familial risk but no dyslexia should show lower performance in the underlying cognitive skills (endophenotypes) as compared to controls. The studies comparing these three groups have mainly shown that children with familial risk who do not fulfill the criteria of dyslexia perform significantly below the level of the controls in certain language and literacy skills both prior to and after school entry (Boets et al., 2010;

Gallagher, Frith, & Snowling, 2000; Pennington & Lefly, 2001; Snowling, 2008; Snowling et al., 2003; van Bergen et al., 2012, 2010).

In English-speaking children, Pennigton and Lefly (2001) found that the scores of children with familial risk but without dyslexia in Grade 2 were significantly lower—on average 0.5 standard deviations—than the scores of children with no familial risk and no dyslexia in all except one reading task. In line with this result, Snowling et al. (2003) found that the at-risk children without dyslexia showed poor performance in nonword reading and phonetic spelling at the age of 6 years and poor skills in spelling, nonword reading accuracy, and reading comprehension at the age of 8 years. In addition, in a follow-up study in adolescence Snowling et al. (2007) reported that the at-risk unimpaired performed weaker than controls in exception word reading, text reading accuracy, and in all timed reading tasks. However, the at-risk unimpaired children did not show deficient performance in word reading accuracy at 8 years (Snowling et al., 2003), neither in untimed nonword reading accuracy nor in reading comprehension in adolescence (Snowling et al., 2007). The classification of children with dyslexia in these studies was based on a composite score including word reading and spelling accuracy as well as reading comprehension (Snowling et al., 2003, 2007).

Van Bergen and colleagues (2012, 2010) have also found evidence for the continuity of genetic liability of dyslexia in Dutch samples of children. At the end of Grade 2, children with familial risk but no dyslexia scored higher than children with familial risk and dyslexia, but were impaired, as compared to controls, in all literacy measures (i.e., reading accuracy and fluency), and spelling (van Bergen et al., 2012). It is noteworthy that the differences between the groups were similar irrespective of whether the items were words or nonwords. In another Dutch sample (van Bergen et al., 2010), where dyslexia was diagnosed in Grade 5, the at-risk non-dyslexic children performed worse in nonword reading fluency in Grades 1, 2, and 5 than typically reading control children. However, in word reading fluency the groups did not differ anymore in Grade 5. The classification of children with dyslexia was based solely on reading fluency (van Bergen et al., 2012, 2010).

On the other hand, the Dutch-speaking sample in Boets et al. (2010) showed support for the continuous nature of the effects of familial risk in pre-reading skills before school age only, but not any more in literacy skills at school age. Boets et al. (2010) found that the non-dyslexic at-risk children were poorer than control children in nonword repetition at kindergarten but not in Grades 1 and 3. They also found that this group was as good as the control group in word reading accuracy and speed as well as in nonword reading speed in Grades 1 and 3. The only significant differences found between these two groups at school age were in nonword reading accuracy and spelling, both of which emphasize accurate decoding ability (Boets et al., 2010). In a Finnish sample, no significant differences were found between children with familial risk without dyslexia and typical readers from control families in reading related pre-reading skills, including language skills and phonological sensitivity at 1.5–5.5 years, and rapid serial naming and letter knowledge at the age of 3.5–5.5 years (Torppa et al., 2010). In Grade 2, the same groups did not differ from each other in reading accuracy or speed, nor in spelling irrespective of whether the material was individually presented words or nonwords, or presented in the form of a list or text (Torppa et al., 2010). However, differences between the same three groups were found in brain responses to non-speech pitch change in sounds at birth (Leppänen et al., 2010) as well as in the ability to discriminate speech-stimuli with a barely perceivable difference in Grade 2 and in Grade 3 (Pennala et al., 2010). In the sample, the classification of dyslexia was based on reading speed and accuracy as well as on spelling accuracy (Pennala et al., 2010; Torppa et al., 2010).

Because several factors vary between these studies (e.g., language and orthography, age and way of classifying dyslexia, used stimuli and tasks) it is difficult to draw firm conclusions of the reasons for differing findings. It seems, however, that differences between the groups without reading difficulty and with or without familial risk are more clearly present early in the development of skills (Boets et al., 2010; Snowling et al., 2007; van Bergen et al., 2010). In addition, typical readers with or without familial risk have performed at the same level in tasks such as word reading and reading comprehension, where it is possible to make use of skills other than phonological decoding related skills (i.e., semantic and syntactic skills and contextual cues) to facilitate reading (Boets et al., 2010; Snowling, 2008; Snowling et al., 2007; van Bergen et al., 2010) or when there is less pressure, such as no time limit (Snowling et al., 2007). Based on the previous findings from Grade 2 in the Finnish sample (Torppa et al., 2010), and the fact that group differences tend to diminish along with age (Boets et al., 2010; Snowling et al., 2007; Torppa et al., 2010; van Bergen et al., 2010), we expect that children with familial risk but no reading difficulty in Grade 2 will not differ from the control children in any of the reading and spelling measures in Grades 3 and 8.

The Effect of Task on Reading Speed

Differences in reading speed across tasks have been interpreted to reflect different processes involved in different reading tasks. Reading pseudowords has generally been considered as a good measure of decoding ability because it requires grapheme-to-phoneme decoding (e.g., Coltheart, Rastle, Perry, Langdom, & Ziegler, 2001). Children with reading difficulty have been shown to have serious deficiency with this type of decoding, at least in opaque orthographies (Bergmann & Wimmer, 2008; Ziegler, Perry, Ma-Wyatt, Ladner, & Shulte-Körne, 2003). In word reading, whether presented in a list or text format, the use of lexicon (i.e., activation of lexical representations) can substantially quicken reading speed by enabling fast whole word recognition (Coltheart al., 2001; Frith, Wimmer, & Landerl, 1998).

Reading time of dyslexic readers has been shown to be more dependent on word length both in pseudoword and word reading than in control children (Ziegler, 2003; Zoccolotti et al., 2005). These findings have been interpreted to support the view that dyslexic readers rely more on phonological letter-by-letter decoding than typical readers. On the other hand, Bergmann and Wimmer (2008) have shown that even dyslexic readers (German speaking, aged 15–18 years) rely on the direct access to lexical information when reading from print to phonology for familiar letter strings, even though they are slower than nonimpaired readers. The so-called lexicality effect (i.e., the faster reading of word stimuli compared to nonwords), has been demonstrated to increase with grade level from Grade 1 to Grade 5 (Zoccolotti, De Luca, Di Filippo, Judica, & Martelli, 2009). This finding has been interpreted to be a result of more efficient use of the lexical information as children get older (Zoccolotti et al., 2009). This gradual shift from mainly using sequential letter-to-sound decoding to the predominant use of fast whole word recognition during the development of reading acquisition gets support from Vaessen and Blomert (2010). Their study shows increasing speed differences over years (Grades 1–6) between word and pseudoword reading. In the present study we examine whether in Finnish, similarly as in Italian (Zoccolotti et al., 2009), children with dyslexia show a later developmental shift of emphasis from phonological decoding strategy to lexical processing than typically reading children. We assess this shift by comparing speed in pseudoword text reading to word list and text reading in Grades 2, 3, and 8.

Skilled fluent reading is based on accurate and automatic word recognition in different contexts that facilitates the activation of semantic processes. Together with the appropriate use of prosody, reading fluency supports quick comprehension of reading material (Kuhn, Schwanenfugel, & Meisinger, 2010). Words in context are usually read faster and more accurately than the same words without context (Jenkins, Fuchs, van den Broek, Espin, &

Deno, 2003). According to Posner and Snyder (1975), there are two processes used for speeding up word identification in a textual context: automatic semantic activation of lexical memory and slow-acting attention-demanding conscious use of context and world knowledge. Jenkins et al. (2003) have shown that the mean reading rate of fourth graders with dyslexia was uniformly discrepant from skilled readers both in context and list. However, children with dyslexia seemed to benefit less than skilled readers from the context: their reading rate in text was 1.19 times of the rate of list reading whereas in skilled readers the figure was 1.67 (Jenkins et al., 2003).

According to the verbal efficiency theory (Perfetti, 1985), deficiencies in children's word reading proficiency affect their fluency skills. A certain level of word reading proficiency seems to be needed before cognitive resources may be released for the language processing needed in fluent text reading (Kim et al., 2012). Skillful readers can identify the meaning of familiar words rapidly just by sight without effort (Ehri, 2005). Other factors besides activation of lexical representations may also speed up word recognition in text reading. Stanovich (1980) found that context allows readers to anticipate possible upcoming words, while eye movement studies have shown that it is possible to get information of the next word parafoveally already before fixating on it (Hyönä, 2011). Barker, Torgesen, and Wagner (1992) demonstrated that orthographic skills have a much stronger influence on reading speed of text, as compared to the speed of single word identification: 20 % vs. 5 %, respectively. Deficiency in fluent access to word representations (i.e., poor orthographic skills) would therefore affect more reading speed of text in context, and thus reduce the difference in reading speed between text and single words. Longitudinal design, such as the one used in our study, can reveal whether and at what age children with familial risk and dyslexia acquire sufficient word decoding skills for the release of cognitive recourses in language processing in order to speed up reading text in context compared with word list reading.

The Present Study

In summary, our study addresses three questions. First, what is the stability of reading and spelling skills after the early reading acquisition phase? Second, what is the effect of familial risk on reading and spelling development? We compare the development of reading speed, reading accuracy, and spelling across Grades 2, 3, and 8 in three groups of children: (1) Dyslexia and familial risk, (2) No dyslexia with familial risk, and (3) Control children with no dyslexia and without familial risk. Third, are reading speed differences in varying reading tasks and materials (word list, text and pseudoword text) similar across the three groups of participants and across Grades 2, 3, and 8?

Method

Participants

All children (N = 173) in this study were participants of the Jyväskylä Longitudinal Study of Dyslexia (JLD) (e.g., Lyytinen et al., 2008). They were originally selected for one of two groups: with familial risk for dyslexia or without familial risk for dyslexia[1]. For this study children were further allocated to three groups according to their reading and spelling skills at the end of Grade 2 and familial risk status: (1) Children with dyslexia and familial risk (Dys_FR, n = 35), (2) Children with no dyslexia and with familial risk (NoDys_FR, n = 66),

1) From the 200 children originally screened, 18 children refused to take part in the Grade 8 assessments, of whom 3 were from the group of children with reading disability and familial risk (Dys_FR), 4 from the group of children with no reading disability and with familial risk (NoDys_FR), and 11 were from the Control group (children with no reading disability and without familial risk).

2) Nine children without familial risk fulfilled the criteria for reading disability at the end of Grade 2 and were excluded from this study similarly as in other studies examining the continuity of the genetic risk.

and (3) a Control group of children with no dyslexia and without familial risk, (C, n = 72)[2]. (See below for the descriptions of the familial risk and dyslexia). Characteristics of the groups are presented in Table 1. There were no differences between the groups in the parents' age or education, the children's performance IQ, age or gender distribution. However, the verbal IQ in the Dys_FR group was lower than in the NoDys_FR and C groups ($F(2,169) = 6.63$, $p < .01$).

All the children spoke Finnish as their native language and had no mental, physical, or sensory impairments. An exclusion criterion was both verbal (VIQ) and performance IQ (PIQ) being below 80, assessed in Grade 2 using the Wechsler Intelligence Scale for Children—Third Edition (WISC—III; Wechsler, 1991). Four performance scale subtests (Picture Completion, Block Design, Object Assembly, and Coding) and five verbal scale subtests (Similarities, Vocabulary, Comprehension, Series of Numbers, and Arithmetic) were used to estimate the PIQ and VIQ, respectively. None of the participants were excluded according to the exclusion criterion. All participants attended regular classroom education.

Familial Risk: Screening of the Families

The children 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).

For the child to be originally included in the familial risk group (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 group without familial risk, both parents (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. The IQ of all parents, assessed with the Raven B, C, and D matrices (Raven, Court, & Raven, 1992), had to be equal to or above 80 (for full details of recruitment, see Leinonen et al., 2001).

Identification of Children with Dyslexia in Grade 2

The identification of dyslexia was based on performance in five tasks (see below for the descriptions of the tasks): 1. Oral word and pseudoword reading, 2. Oral text reading, 3. Oral pseudoword text reading, 4. Oral word list reading, and 5. Spelling words and pseudowords. Four measures of reading speed were calculated: 1. Mean response time (reaction time + response duration) of correctly read words and pseudowords presented one by one, 2. The number of read words per minute in Oral text reading task, 3. The number of pseudowords read per minute in Oral pseudoword text reading, and 4. The number of correctly read words in two minutes in Oral word list reading. Respectively, four measures of reading and spelling accuracy were calculated: the number of 1. correctly read words and pseudowords presented one at a time, 2. correctly read words in Oral text reading, 3. correctly read pseudowords in Oral pseudoword text reading, and 4. correctly written words and pseudowords, presented one by one in a dictation task.

For the identification of dyslexia, a two-step procedure was used. First, a cut-off criterion for deficient performance was defined for each of the eight measures using the 10th percentile of the Control group’s performance. Second, a child was considered to have dyslexia if she/he scored below the criteria in at least three out of four measures of reading speed and/or in at least three out of four measures in reading and spelling accuracy. In addition, a child who scored below the criteria both in two speed and two accuracy measures was considered to have dyslexia.

Measures

Trained testers assessed reading and spelling skills individually in a laboratory setting with four different tasks in Grade 2 (June), Grade 3 (April), and Grade 8 (November) as a part of the JLD assessment procedure: 1. Oral text reading, 2. Oral Pseudoword text reading, 3. Oral word list reading, and 4. Spelling pseudowords. In all reading tasks children were instructed to read “as quickly and accurately as they could”. Two different measures were calculated from each task: reading speed (the number of letters read in 1 second) and reading accuracy (the percentage of correctly read items). Arithmetical means, calculated from the three oral reading tasks described above, were used as composite measures of reading speed and reading accuracy separately for Grades 2, 3, and 8. The Cronbach alpha reliability for the reading speed composite was .93, .89, and .88 and for the reading accuracy composite .82, .83, and .75, in Grade 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 “Fjelds 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 accuracy and speed. To assess the reliability of accuracy scoring, the accuracy was scored independently by two trained coders in a randomly selected 10 % of the sample, and the inter-rater agreement was .98.

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. In 10 % of the sample, each pseudoword was judged by two coders as correctly or incorrectly read, and the inter-rater agreement was .95.

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. A trained tester marked the incorrectly read words as the child was reading aloud. The correctness of tester markings was checked by another listener in 10 % of the sample using the recordings, and the inter-rater reliability was .99.

Oral word and pseudoword reading (used only for the identification procedure of dyslexia in Grade 2). Children read aloud three- and four-syllable words and pseudowords (10 of each type, altogether 40 items) presented one by one with the program Cognitive Workshop (developed by the Universities of Dundee and Jyväskylä) on a computer screen.

Spelling pseudowords (Grades 2, 3, and 8). We measured spelling accuracy with a list of pseudowords consisting of 12 four-syllable items in Grades 2 and 3, and 20 three- to five-syllable items in Grade 8. Participants listened through headphones as a computer presented the items twice with a 2-second interval. Each pseudoword was scored as correct if all the phonemes were correctly written without missing or extra letters. The percentage of correctly written pseudowords was used as the spelling accuracy measure separately for each grade. Cronbach's alpha reliability coefficients were .80, .71, and .70 for Grades 2, 3, and 8, respectively.

Spelling words and pseudowords (used only for the identification procedure of dyslexia in Grade 2). Participants used a pencil to write 6 four-syllable words and 12 four-syllable pseudowords presented similarly as described above. Each stimulus (word or pseudoword) was scored as correct if the participants wrote all the phonemes correctly without missing or extra letters. The percentage of correctly written words / pseudowords was used as the spelling accuracy measure. Cronbach's alpha reliability coefficient was .87.

Results

Distributions and Stability of Literacy Skills

All distributions of reading speed measures were normal or close to normal. The distributions of reading and spelling accuracy, instead, showed a ceiling effect in all tasks in all grades. The ceiling effect was particularly clear in Oral word list reading accuracy with 82.5 %, 89.0 %, and 98.3 % of the participants exceeding 90 % accuracy in Grades 2, 3, and 8, respectively. The ceiling effect also appeared in Oral text reading accuracy where the portion of children above the 90% accuracy level was 79.2 %, 86.2 %, and 89.5 % in Grades 2, 3, and 8, respectively. We applied logarithmic transformation to correct the distribution in the Oral text reading task, whereas the distributions of the tasks for Oral word list reading and Spelling pseudowords could not be normalized. Because of the non-normal distributions, we conducted both parametric and nonparametric analyses when applicable. As all conclusions derived from the parametric and nonparametric analysis results were identical, we report only the parametric results. In reading and spelling accuracy measures, one to four extreme outliers were moved to the tail of the distribution before analyses to avoid overemphasising their effects on results. No participants were dropped from the sample.

Table 2 presents correlations between overall (averaged composite measure of) reading speed and accuracy as well as spelling accuracy. For the reading speed measures, the correlations between performance across different grades were high (.72 – .88). For reading accuracy measures, the correlations varied from moderate to high (.51 – .69), and for spelling measure they were moderate (.41 – .59).

Continuity of the Familial Risk: Group Differences in the Development of Literacy Skills

We examined the development of reading speed and accuracy as well as spelling in the groups with Mixed-Design ANOVAs including Grade (2, 3, and 8) as the within-subjects factor and Group (Dys_FR, NoDys_FR, and Controls) as the between-subjects factor. For both reading speed and accuracy, a composite score was used as the measure at each grade level (arithmetic mean from the three tasks: List, Text and Pseudoword text reading). Figure 1 presents the development of each skill in the three groups. To evaluate the gain children made between two grades (Grade 2 and Grade 3; Grade 3 and Grade 8), a difference score was calculated by subtracting the corresponding means from each other. We used One-Way ANOVAs to study group differences in these gains as well as in separate tasks of reading speed and accuracy, and spelling in each grade. In the post hoc pairwise comparisons either Bonferroni (when equal variances) or Dunnett’s T3 (when unequal variances) correction was used when evaluating the significances of group differences (see Table 3).

In the Mixed-Design ANOVA for the reading speed composite both main effects, Grade and Group, were significant (F(1.62, 271.69) = 724.69, p < .001, η_p^2 = .81 and F(2, 168) = 49.79, p < .001, η_p^2 = .37, respectively), as was the Grade x Group interaction (F(3.23, 271.69) = 2.93, p < .05, η_p^2 = .03). For further evaluating the dissimilarity between the groups in the development of reading speed between Grade 2 and Grade 3 as well as between Grade 3 and Grade 8, the tests of within-subject contrast for the Grade x Group interaction were used. The effect was significant for the development between Grade 2 and Grade 3 (F(2,168) = 7.31, p < .001, η_p^2 = .08), but not for the development between Grade 3 and Grade 8, which suggests that the reading speed development differed between groups in Grade 2 and Grade 3, but not in Grade 3 and Grade 8. The ANOVA post hoc pairwise comparisons (with Bonferroni corrections for significance) of the reading speed improvement between Grade 2 and Grade 3 showed that children in the Dys_FR group improved their overall reading speed more than the children in the Control group (p < .001) and the NoDys_FR (p < .01) group between Grade 2 and Grade 3. However, the children in the Dys_FR group still did not reach the level of the other two groups as shown by the post hoc ANOVA comparisons at Grade 3 (see Table 3). The overall reading speed of children in the Dys_FR group was about 50 %, 65 %, and 75 % in Grades 2, 3, and 8, respectively, from the reading speed of children in the two other groups (NoDys_FR and Controls). In Grade 8, the overall reading speed of Dys_FR children was approximately at the level of third graders as compared to the two other groups, indicating a lag of 5 years in development. Effect sizes were estimated (Cohen's d computed using pooled standard deviation) and they were large not only for Grades 2 and 3, but also for Grade 8: Dys_FR vs. NoDys_FR (d = 1.21) and Dys_FR vs. Control group (d = 1.73). No significant differences between the NoDys_FR and Control group were found in ANOVA post hoc pairwise comparisons (with Bonferroni corrections for significance) of the gain children made in overall reading speed between Grade 2 and Grade 3 or between Grade 3 and Grade 8.

For each task in each grade level, we separately conducted One-Way ANOVAs. These showed that children in the Dys_FR group read slower in all tasks throughout Grades 2, 3, and 8 than the two other groups (see Table 3). The two groups without dyslexia, (NoDys_FR and Controls), did not differ from each other in any of the reading speed measures, although the effect sizes varied from small to moderate (.15 – .42).

In the analysis of the reading accuracy composite both main effects, Grade and Group, were significant ($F(1.75, 293.92) = 104.28$, $p < .001$, $\eta_p^2 = .38$ and $F(2,168) = 83.12$, $p < .001$, $\eta_p^2 = .50$, respectively) as well as, the Grade x Group interaction ($F(3.50, 293.92) = 11.72$, $p < .001$, $\eta_p^2 = .12$). The test of within-subject contrasts for the Grade x Group interaction was not significant between Grade 2 and Grade 3, but it was significant between Grade 3 and Grade 8 ($F(2,168) = 18.78$, $p < .001$, $\eta_p^2 = .18$), a result which suggests that there was a difference in the developmental pace of reading accuracy between the groups in Grade 3 and Grade 8. The ANOVA post hoc pairwise comparisons (with Dunnett's T3 corrections for significance) showed that between Grade 3 and Grade 8 the children in the Dys_FR group developed faster in reading accuracy than did the children in the other two groups (both $p < .001$). However, as with reading speed above, the children in the Dys_FR group did not quite reach the level of the other two groups (see Figure 1 and Table 3). In the Dys_FR group the overall reading accuracy level reached 90 % in Grade 8, whereas the two groups without dyslexia, (NoDys_FR and Controls), had reached the 90 % level in overall reading accuracy already at the end of Grade 2. Effect sizes were large not only in Grades 2 and 3 but also for the Grade 8 group comparisons in reading accuracy: Dys_FR vs. NoDys_FR ($d = 1.11$) and Dys_FR vs. Control group ($d = 1.72$). No significant differences between the NoDys_FR and Control group were found in ANOVA post hoc pairwise comparisons (with Bonferroni corrections for significance) of the gain children made in overall reading accuracy between Grade 2 and Grade 3 or between Grade 3 and Grade 8.

One-Way ANOVAs, done separately for each task in each grade, showed that children in the Dys_FR group made more errors in all reading tasks throughout Grades 2, 3, and 8 than the two other groups (see Table 3). The two groups without dyslexia did not differ from each other in any of the reading accuracy measures, except in text reading accuracy in Grade 3. Effect sizes were small or medium (.03 – .66) between these two groups in reading accuracy measures throughout Grades 2, 3, and 8.

In the analysis of pseudoword spelling both main effects, Grade and Group, were significant ($F(1.87, 314.79) = 181.98$, $p < .001$, $\eta_p^2 = .52$ and $F(2,168) = 49.57$, $p < .001$, $\eta_p^2 = .37$, respectively). Also the Grade x Group interaction was significant ($F(3.75, 314.79) = 11.86$, $p < .001$, $\eta_p^2 = .12$). The test of within-subject contrasts for the Grade x Group interaction was significant between Grade 2 and Grade 3, as well as between Grade 3 and Grade 8 ($F(2,168) = 8.64$, $p < .001$, $\eta_p^2 = .09$ and $F(2,168) = 5.84$, $p < .01$, $\eta_p^2 = .06$, respectively). The ANOVA post hoc pairwise comparisons (with Dunnett's T3 corrections for significance) showed that between Grade 2 and Grade 3, children in the Dys_FR group improved their spelling accuracy more than children in the Control group ($p < .05$) and the NoDys_FR group ($p < .01$), and more than the Control group ($p < .01$) between Grade 3 and Grade 8. Note, however, that the starting point of spelling accuracy in the two groups without dyslexia was approximately twice as high as in the Dys_FR group (with accuracy percentages of 73 % vs. 39 %). Although children in the Dys_FR group made better progress in spelling accuracy than the NoDys_FR and Control groups, they reached accuracy level of 82.39 % in Grade 8, which is comparable to the level of third graders in the other two groups (see Table 3). The group differences in Grade 8 were confirmed by effect sizes, which were large: 1.13 (Dys_FR vs. NoDys_FR) and 1.45 (Dys_FR vs. Control group). The two groups without dyslexia, NoDys_FR and Controls, reached close to 95 % accuracy level in pseudoword spelling in Grade 8, and did not differ from each other in any of the spelling measures. Effect sizes were small or moderate (.01 – .36).

Differences in Reading Speed according to Task in Different Groups

To see whether the differences in reading speed between the three tasks were similar in the three groups, we performed three separate Mixed-Design ANOVAs. Task (text vs. pseudoword text, text vs. word list, or pseudoword text vs. word list) was used as the within-subjects factor and Group (Dys_FR, NoDys_FR, and Control group) as the between-subjects factor. We did all ANOVAs separately for each grade level (2, 3, and 8) to see whether the differences between tasks were similar in each grade. Because nine Mixed-Design ANOVAs were conducted, stricter than usual significance cut-offs were used to avoid familywise errors. This was done by dividing the commonly used significance levels by the number of ANOVAs done. As a follow-up analysis, we compared performance in the different tasks within each group using paired sample t tests. Figure 2 presents group differences in the three reading speed tasks in Grades 2, 3, and 8. Table 4 presents F values and estimates of the effect sizes of the Mixed-Design ANOVAs.

Word list vs. pseudoword text. We compared reading speed in word list and pseudoword text reading first to see the effect of lexicality. Both main effects, Task and Group, were significant. The interaction Task x Group was significant in Grades 2 and 3. In paired sample t tests, the difference between tasks was not significant in the Dys_FR group, a result which suggests that children in this group read word lists and pseudoword texts at equal speeds. In the NoDys_FR group and in the Control group, children read the word lists about 1 to 2 letters/second faster than pseudoword texts ($t(64) = 6.47$, $p < .001$ and $t(65) = 12.14$, $p < .001$ in Grade 2 and Grade 3, respectively for the NoDys_FR group, and $t(70) = 8.87$, $p < .001$ and $t(71) = 15.13$, $p < .001$ for the Control group, in Grade 2 and Grade 3, respectively). In

Grade 8, all groups read word lists about 2.5 letters/second faster than pseudoword texts ($t(32) = 11.36$, $t(64) = 11.40$, and $t(70) = 9.60$, all $p < .001$, for the Dys_FR, NoDys_FR, and Control group, respectively; see Table 3).

Word list vs. text. We compared reading speed in word lists and text reading to see the effect of context on reading speed. Both main effects, Task and Group, were significant in all grades (2, 3, and 8). The interaction Task x Group was significant only in Grade 2. In paired sample t tests the difference between tasks was significant in all groups ($t(34) = 9.01$, $t(64) = 17.03$, and $t(70) = 19.61$, all $p < .001$, for the Dys_FR, NoDys_FR, and Control group, respectively) indicating that all groups read words in context faster than isolated words. However, the ANOVA post hoc pairwise group comparisons (with Bonferroni corrections for the significance) indicated that the difference in reading speed between word lists and texts was smaller in the Dys_FR group than in the NoDys_FR group and in the Control group (both $p < .001$). In Grade 3 and in Grade 8, all groups read text faster than they read word lists ($t(34) = 6.92$ and $t(34) = 7.48$, $t(64) = 10.51$ and $t(64) = 8.26$, and $t(71) = 14.62$ and $t(71) = 8.30$, all $p < .001$, for the Dys_FR, NoDys_FR, and Control group in Grade 3 and in Grade 8, respectively).

Text vs. Pseudoword text. Finally, we compared reading speed between text and pseudoword text reading tasks to see the effect of the lexicality and meaning of the text. Both main effects, Task and Group, as well as the interaction Task x Group in Grades 2, 3, and 8 were significant. In the ANOVA post hoc pairwise group comparisons (with Bonferroni corrections for the significance) the difference in reading speed between texts and pseudoword texts was smaller in the Dys_FR group than in the NoDys_FR and Control groups (all $p < .001$ in Grades 2 and 3, and both $p < .01$ in Grade 8) (2 vs. 4 letters/second, respectively in Grades 2 and 3, and 4 vs. 5 letters/second in Grade 8, see Table 3).

Discussion

In this study, we examined three aspects of literacy development: the stability of literacy skills after the initial reading acquisition phase across Grades 2, 3, and 8; the effect of familial risk on literacy skill development during this period; and the effects of different types of reading material (word list, text and pseudoword text) on reading speed. We compared the development of three groups: children with familial risk and dyslexia (the Dys_FR group), children with familial risk but without dyslexia (the NoDys_FR group), and Control group of children with no dyslexia and without familial risk.

We found high stability for reading speed development, whereas in reading and spelling accuracy the development was moderately stable from the second to the eighth grade. Children with familial risk and dyslexia (the Dys_FR group) did not catch up to the other two groups in reading speed, reading accuracy or spelling, although they progressed more than the other two groups in reading speed between Grade 2 and Grade 3, in reading accuracy between Grade 3 and Grade 8, and in spelling accuracy throughout the follow-up. The Dys_FR group's literacy skills in Grade 8 were overall comparable to the level of the third graders in the two other groups. The children with familial risk but no dyslexia (NoDys_FR) did not differ significantly from the Control group children in any of the assessed reading and spelling measures, except in text reading accuracy in Grade 3, although the effect sizes were often of moderate size between the two groups. The reading speed in children with familial risk and dyslexia varied less according to the type of reading material than in the two other groups in Grades 2 and 3, but this effect diminished in Grade 8.

In reading speed, the correlations across groups between the grades were high (.72 – .88). This indicates high stability of development and is in line with earlier findings in consistent orthographies (Landerl & Wimmer, 2008; Parrila et al., 2005; Torppa et al., 2007).

The size of the correlation between the assessments in Grades 2 and 8, was .72, which showed that even after 6 years of school attendance, the relative positions of individuals remained very similar. The nearly parallel developmental paths of the three groups confirm the idea of stability in reading speed. The only exception, the faster progress made by children in the Dys_FR group in reading speed between Grades 2 and 3, could be interpreted to be a delayed developmental spurt that was made by normally developing children before the end of Grade 2. In previous Finnish studies of reading accuracy (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002;Leppänen, Niemi, Aunola, & Nurmi, 2004) as well as in a Finnish study of oral reading fluency (Parrila et al., 2005), initial reading level has been found to be negatively associated with the development of reading skill during the first two grades at school. Our finding that children in the NoDys_FR and Control groups made only a little progress in reading speed between Grades 2 and 3 suggests that this kind of negative association between the initial level and further growth in reading speed continues to be true until the end of Grade 3. Between Grades 3 and 8 the development in the three groups was highly parallel, and we found no evidence suggesting either catching up or falling behind in any group. This supports the idea that differences between the groups are long-lasting, as has been found to be the case in Dutch (Boets et al., 2010; de Jong & van der Leij, 2003; van Bergen et al., 2010) and in English readers with and without dyslexia (Francis et al., 1996; Snowling et al., 2007).

The consistent lag of the Dys_FR group in reading speed, present already at the beginning of the follow-up, could be expected because in transparent orthographies the main characteristic of dyslexia has been shown to be slow reading (e.g., de Jong & van der Leij, 2003; Landerl & Wimmer, 2008; Landerl, Wimmer, & Frith, 1997; Wimmer, 1996; Zoccolotti et al., 1999). The magnitude of the lag in Grade 8, approximately 5 years, was, however, larger than expected. De Jong and van der Leij (2003) have previously reported that Dutch children diagnosed with dyslexia in Grade 3 on the basis of reading fluency showed a delay of 3.5 years by the end of Grade 6 when compared to normal readers in reading speed. In addition, in earlier studies that have used a reading level matched group as controls, the age difference has usually been 3 to 4 years on average (Constantinidou & Stainthorp, 2009; Ziegler et al., 2003).

The stability in reading accuracy development was moderate to relatively high according to correlations (.51 – .69) between Grades 2, 3, and 8, but lower than in reading speed. Correlations were somewhat lower than reported in previous studies of Finnish orthography (Leppänen et al., 2006; Parrila et al., 2005). The size of the correlations could be inflated by ceiling effects, but only for word list and text reading. In these tasks, where the items were real words, the percentage of correctly read words exceeded 90 % before our first assessment point in this study (i.e., the end of Grade 2) in the NoDys_FR and Control groups and in Grade 3 in the Dys_FR group. The accuracy percentages in the NoDys_FR and Control groups are comparable to those reported earlier in transparent orthographies (Aro & Wimmer, 2003; de Jong & van der Leij, 2003). The ceiling effect also explains the finding that children in the Dys_FR group made better progress in reading accuracy between Grades 3 and 8 than children in the two other groups. After Grade 3, the children in the NoDys_FR and Control groups simply had less room for development, having accuracy percentages at or above 96 % in word list and text reading. In Grade 8, the mean percentage of correctly read words in the word list reading task was above 97 % in all groups. Our finding that most children in the Dys_FR group also acquired accurate reading of words is in line with the notion of de Jong and van der Leij (2003) that dyslexic children learning to read in a regular orthography will eventually acquire sufficiently good skills in phonemic awareness to enable accurate decoding ability. However, reading accuracy concerning pseudoword items remained rather low in the Dys_FR group even in Grade 8 (round 82 %) and was equivalent to the accuracy of second graders in the NoDys_FR and C groups. This indicates persistent problems in phonological decoding among reading disabled children when the demands of the task increases, in line with the findings of de Jong and van der Leij (2003). Previously, also the parents of children with familial risk for dyslexia have shown difficulties in phonological decoding in in the Jyväskylä Longitudinal Study of Dyslexia (Leinonen et al., 2001).

Problems in phonological decoding were seen especially clearly in pseudoword spelling, in which children in the Dys_FR group started the follow-up in Grade 2 with a very low accuracy percentage, 39 %. Although they progressed faster than the other groups throughout the whole follow-up period, they remained behind children in the two other groups and ended up with a similar accuracy level as in pseudoword text reading (i.e., 82 %) in Grade 8. This percentage is, however, much higher than the level of German-speaking Austrian children with reading and spelling difficulties: the mean of correctly spelled words for them was around 40 % – 45 % in Grade 4 (Wimmer & Mayringer, 2002). This is probably due to the fact that in Germany a simple phoneme-grapheme translation is not sufficient for accurate spelling (Wimmer & Mayringer, 2002). In contrast to German, Finnish orthography has symmetrically transparent correspondences between phonemes and graphemes, that is, both from the point of view of reading and spelling. The stability in spelling was moderate (.41 – .59), but somewhat lower than found earlier in Finnish (Leppänen et al., 2006). This discrepancy is probably due to this study's use of pseudoword items, whereas in Leppänen et al. (2006) a word spelling task was used. In pseudoword spelling tasks, correlations have been found to be lower than between tasks including words (Lervåg & Hulme, 2010).

The greater gains in literacy skills by children in the Dys_FR group between Grades 2 and 3 could also be due to the extra support and intervention they have received. At Finnish schools, over 20 % of all school children in Grades 1 to 9 receive part-time special education at some point of the school year. This type of extra support is most frequent at the lowest grade levels, and the most common indication for part-time special education is problems in reading development. Altogether, 85.7 % of children in the Dys_FR group received various amount and various kind of extra support at school during Grades 1 to 3. This proportion is much bigger than the amounts of extra support in the NoDys_FR and Control groups (34.8 % and 11.1 %, respectively). In addition, 48.6 % of children in the Dys_FR group (4.5 % in the NoDys_FR and none in the Control group) took part in an intensive intervention study (55 hours within 14 weeks) organized by the JLD project including speech and auditory training as well as practicing of reading and writing. However, despite this support they have received, the literacy skills lagged substantially behind the skills of their peers.

Our findings give weak support to the continuity of familial risk. The means of the NoDys_FR group fell between those of the Dys_FR group and of the Control group, but the NoDys-FR and Control groups differed significantly in only one of the reading and spelling measures: text reading accuracy in Grade 3. Note also that the NoDys-FR group performed constantly better than the Dys_FR group. However, although the difference between the NoDys_FR group and the Control group was overall not significant, the moderate effects sizes suggest that with a larger sample size we might have found significant difference. On the other hand, significant differences between groups with or without familial risk and no dyslexia have been found with much smaller sample sizes in English (Snowling et al., 2003, 2007) and in Dutch (Boets et al., 2010; van Bergen et al., 2010).

The majority of the findings of group differences in literacy skills before and at school age in English and Dutch have supported the idea of continuity of familial risk (Boets et al., 2010; Pennington & Lefly, 2001; Snowling, 2008; Snowling et al., 2003, 2007; van Bergen et al., 2012, 2010), although signs of diminishing group differences along with age have been reported (Boets et al., 2010; Snowling et al., 2007; Torppa et al., 2010; van Bergen et al., 2010). Because in our study the NoDys_FR group and the Control group differed from each other only in one task, no firm conclusions of diminishing vs. expanding group differences could be made.

Most prominent support for the continuous nature of familial risk comes from studies employing tasks relying heavily on accurate grapheme-to-phoneme decoding, that is, pseudoword or nonword word reading accuracy (Boets et al., 2010; Pennington & Lefly, 2001; Snowling et al., 2003, 2007; van Bergen et al., 2010). No differences between the two groups with or without familial risk and no dyslexia, on the other hand, have been reported in tasks where other than phonological processing could be used instead or as support of phonological decoding, i.e. in word reading (Boets et al., 2010; van Bergen et al., 2010; Snowling 2003) and reading comprehension in adolescence (Snowling et al., 2007). No differences have been reported either in reading task, where there has been no time pressure, i.e. un-timed nonword reading accuracy (Snowling et al., 2007) or where the orthography of the language used has been extremely transparent, like in Finnish (Torppa et al., 2010). Therefore, it seems reasonable to think that the requirements of the task or the transparency of orthography, or both, might affect the visibility of the continuity of familial risk. Finnish is in the shallowest end of the orthographic depth continuum, with close one-to-one correspondence between graphemes and phonemes. This high correspondence makes the learning of decoding and foundation level reading easy (Seymour, Aro, & Erskine, 2003), and most of the children, even those with familial risk can learn accurate decoding by the end of Grade 2. In English, on the other hand, where nonword reading has been found to be poorer than in more transparent German (Frith et al., 1998), the complexity and inconsistencies of orthography could bring out differences between groups.

The discrepant results concerning the continuous nature of familial risk can also be a consequence of differences in classifying children with or without dyslexia. Whereas in our study we based the classification on reading speed, reading accuracy, and spelling, Snowling et al. (2003, 2007) based their classification on a composite score that included reading comprehension in addition to word reading and spelling accuracy. It is thus possible that slow readers with good comprehension skills, a group shown to be present at least in the Finnish sample (Torppa et al., 2007), might have ended up in the non-dyslexia group. Likewise, van Bergen et al. (2010) based their classification of children solely on fluency. That is, they did not take reading or spelling inaccuracy as criteria. So, it is also possible that the group of at-risk nondyslexic children in the Dutch sample included children with difficulties in accuracy but not in fluency. This possibility is supported by the finding that in that study children with typical reading skills but with the familial risk differed from control children only in pseudoword reading in Grade 5 (van Bergen et al., 2010), a task which relies heavily on accurate grapheme-phoneme decoding ability. Interestingly, in another Dutch speaking sample the family-risk non-dyslexia and control children were more similar to each other when the classification was based on word reading fluency, word reading accuracy, and spelling accuracy (Boets et al., 2010). To further explore this question, the existing datasets should be re-analysed with applying uniform criteria in classification of children into subgroups.

To better understand the slow reading speed in our Dys_FR group, we compared reading speed in different tasks across groups. In Grades 2 and 3, children in the Dys_FR group read pseudoword texts and word lists at equal speeds, whereas the two other groups read word lists about 1 – 2 letters / second faster than pseudoword texts. This raises at least two potential suggestions for conclusions. First, it might suggest that children in the Dys_FR group used the same processes in word and pseudoword reading, relying mainly on letter-by-letter decoding. This conclusion is in line with the findings of Ziegler et al. (2003) regarding English and German speaking children with dyslexia. In orthographically transparent Italian, Zoccolotti et al. (2005) have found that Italian children with dyslexia showed a clear word length effect in word reading, which suggests that the children were using a sub-lexical reading procedures still in Grade 3. However, it has been reported in an Italian sample that by Grade 6 lexical reading appears to be available even for children with dyslexia (Barca, Burani, Di Filippo, & Zoccolotti, 2006). In the sample of our study, a similar addition of lexical reading process seems to have taken place by Grade 8: children in the Dys_FR group read word lists about 2.5 letters/second faster than pseudoword texts, similarly to the children in the two other groups, albeit with the overall lower speed. Second, the slower reading speed of the Dys_FR group in the word list reading as compared with the other two groups can be a consequence of not only poor decoding skills but also of difficulties in the use of orthographic lexicon, as suggested by Bergmann and Wimmer (2008). These difficulties could result from their lower exposure to printed text and as a consequence lower familiarity with the presented words; word frequency has been shown to have a strong effect on word recognition speed already in school-aged children (Zoccolotti et al., 2009). Children in the NoDys_FR and Control groups seemed able to take advantage of their orthographic lexicon and recognize at least the most frequent and therefore familiar words by sight already in Grade 2. This is in line with the findings in another orthographically transparent language, Italian, where lexicality effect was present in high frequency words already at the end of Grade 1 and low frequency words in Grade 3 (Zoccolotti et al., 2009).

In Grade 2, a similar kind of developmental lag seemed to be present also in the ability of children in the Dys_FR group to use contextual cues, such as syntactic and semantic information: the difference in reading speed between word lists and texts was smaller in the Dys_FR group than in the NoDys_FR and Control groups. At the end of Grade 2, decoding is still toilsome in the Dys_FR group, and thereby fewer cognitive resources are left for language processing (Perfetti, 1985; Kim et al., 2012) in children with dyslexia. In Grades 3 and 8, all groups read texts approximately 2 letters/second faster than word list, a result that is in line with the earlier findings in which the same words in context were read faster than without context by fourth graders (Jenkins et al., 2003). Children with dyslexia were beginning to utilize contextual cues from Grade 3, at least one year later than normally developing children. And finally, the smaller difference throughout the follow-up period in reading speed between text and pseudoword text reading in the Dys_FR group suggests longstanding deficiencies in automatization of decoding in familiar words, as suggested by Share (2008), and/or deficient use of word and sub-word level representations and contextual cues (Snowling, 2008; Stanovich, 1980), or both. Methodological limitations, such as more than one varying factor in comparisons between the tasks, prevent us from making firm conclusions about the processes used in different tasks and to what extent they are specifically compromised in the Dys_FR group.

In conclusion, the findings of the current longitudinal study confirm that the literacy difficulties of children with familial risk for dyslexia and dyslexia in Grade 2 are often persistent. On the other hand, in spite of the familial risk, children who have acquired the basic reading skills follow, for the most part, the developmental track of children without reading difficulties or familial risk also later on. In other words, it appears, at least on the group level, that if there are no signs of reading difficulties in Grade 2, one can anticipate typical literacy development also in later grades. But is this is true also at the individual level? Do the age-appropriate literacy skills shown here guarantee that these children with familial risk of dyslexia will also have age-appropriate reading comprehension skills later, as shown by Snowling et al. (2007) with English-speaking children? These remain important questions for future studies.

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Table 1. Characteristics of Parents and Their Children in the Three Groups: Children with Dyslexia and Familial risk, Children with No Dyslexia and with Familial Risk, and Control Children with No Dyslexia and without Familial Risk.

	Dys_FR[a]		NoDys_FR[a]		C[a]		Paired group comparisons
	M	SD	M	SD	M	SD	
Parents							
Mother's Age	29.62	4.26	29.32	4.22	29.67	4.10	
Mother's Education[b]	4.09	1.42	4.40	1.44	4.60	1.34	Dys_FR=NoDys_FR=C
Father's Age	31.53	5.36	31.64	5.04	32.75	5.34	
Father's Education[b]	3.61	0.99	3.71	1.41	3.75	1.48	
Children					D		
WISC-III[c]							
Verbal IQ	94.17	9.75	100.85	11.77	102.3	11.1	Dys_FR<NoDys_FR* Dys_FR< C**
Performance IQ	97.26	14.25	100.77	11.79	103.2	14.1	
Age, at grade 2	8.98	0.34	8.99	0.32	8.98	0.29	
Age, at grade 3	9.99	0.45	9.85	0.32	9.83	0.29	Dys_FR=NoDys_FR=C
Age, at grade 8	14.48	0.44	14.30	0.54	14.35	0.28	
	Girls	Boys	Girls	Boys	Girls	Boys	
Gender	19	16	32	34	34	38	

Note.

[a)] Dys_FR = Dyslexia with familial risk, n = 35, NoDys_FR = No dyslexia with familial risk, n = 66, and C = Control children with no dyslexia and without familial risk, n = 72.

[b)] Parental education was classified using a 7-point scale: 1 = only comprehensive school (CS); 2 = CS and short-term vocational courses; 3 = CS and a vocational school degree; 4 = CS and a vocational college degree; 5 = CS and a lower university degree / a polytechnic degree; 6 = upper secondary general school and a lower university degree / a polytechnic degree; 7 = CS or upper secondary general school and a higher university degree (Master's or a Doctorate-level degree).

[c)] WISC-III = *Wechsler Intelligence Scale for Children.*

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

Table 2. Spearman Correlations of Reading Speed, Reading Accuracy, and Spelling accuracy in Grades 2, 3, and 8.

	Reading speed			Reading accuracy			Spelling accuracy	
	1.	2.	3.	4.	5.	6.	7.	8.
Reading speed[a]								
1. 2nd Grade	-							
2. 3rd Grade	.88***	-						
3. 8th grade	.72***	.78***	-					
Reading accuracy[a]								
4. 2nd Grade	.53***	.55***	.50***	-				
5. 3rd Grade	.63***	.55***	.54***	.69***	-			
6. 8th grade	.47***	.47***	.38***	.51***	.62***	-		
Spelling accuracy[b]								
7. 2nd Grade	.49***	.46***	.41***	.52***	.49***	.40***	-	
8. 3rd Grade	.40***	.40***	.32***	.52***	.49***	.40***	.59***	-
9. 8th grade	.36***	.35***	.30***	.37***	.39***	.31***	.41***	.44***

Note

[a] Reading speed and accuracy are the arithmetic means of three oral reading tasks at each grade: Word list, Text, and Pseudoword text.

[b] Spelling accuracy is the percentage of correctly spelled items in Pseudoword spelling -task.

N = 173 in all correlations between the 3rd and 8th grade measures, and N = 171 in correlations where a 2nd grade measure is included.

*** $p < .001$

Table 3. Descriptive Statistics and Group Comparisons of Dys_FR, NoDys_FR and Control Groups with One-Way ANOVAs in Reading Speed and Accuracy, and Spelling Accuracy at Grades 2, 3, and 8.

	Dys_FR[a]		NoDys_FR[a]		C[a]			Effect size[b]		
	M	SD	M	SD	M	SD	F[c]	Dys_FR vs. NoDys_FR	Dys_FR vs. C	NoDys_FR vs. C
Reading speed										
Overall[d]										
Grade 2	2.77[x]	.83	5.53[y]	1.55	6.22[y]	1.88	56.81***	2.07	2.12	.40
Grade 3	4.00[x]	1.07	6.21[y]	1.63	6.71[y]	1.72	36.05***	1.53	1.76	.30
Grade 8	6.78[x]	1.74	8.96[y]	1.87	9.49[y]	1.51	30.79***	1.21	1.73	.32
Word list										
Grade 2	2.20[x]	.72	4.87[y]	1.77	5.54[y]	2.09	43.27***	1.80	1.88	.34
Grade 3	3.61[x]	1.13	6.34[y]	2.01	6.88[y]	1.97	38.41***	1.57	1.87	.27
Grade 8	6.96[x]	2.02	9.29[y]	2.61	9.66[y]	2.30	16.23***	0.97	1.23	.15
Text										
Grade 2	4.01[x]	1.51	7.92[y]	2.37	8.89[y]	2.55	54.01***	1.87	2.15	.39
Grade 3	4.92[x]	1.61	8.11[y]	2.17	8.81[y]	2.24	41.99***	1.61	1.89	.32
Grade 8	8.59[x]	1.91	11.17[y]	2.06	11.81[y]	1.58	37.13***	1.30	1.93	.35
Pseudoword text										
Grade 2	2.09[x]	.75	3.80[y]	1.06	4.22[y]	1.43	39.52***	1.79	1.70	.33
Grade 3	3.47[x]	1.19	4.17[y]	1.25	4.43[y]	1.41	6.34***	0.57	0.72	.19
Grade 8	4.54[x]	1.42	6.37[y]	1.55	6.94[y]	1.69	26.08***	1.23	1.50	.35
Reading accuracy										
Overall[e]										
Grade 2	77.38[x]	11.49	90.62[y]	6.76	92.30[y]	4.63	53.22***	1.54	2.04	.30
Grade 3	82.21[x]	7.31	93.15[y]	5.71	95.05[y]	3.88	69.73***	1.75	2.51	.40

Grade 8	90.14^{x}	6.09	95.70^{y}	4.46	96.76^{y}	2.39	31.12***	1.11	1.72	.31
Word list										
Grade 2	87.58^{x}	8.97	94.72^{y}	4.38	96.28^{y}	3.27	32.91***	1.46	1.92	.41
Grade 3	90.84^{x}	6.71	96.04^{y}	3.77	97.35^{y}	2.87	28.67***	1.05	1.50	.40
Grade 8	97.34^{x}	3.66	99.54^{y}	1.11	99.41^{y}	1.85	13.84***	0.96	0.83	.08
Text										
Grade 2	85.25^{x}	10.05	94.52^{y}	4.02	94.64^{y}	4.69	33.24***	1.39	1.40	.03
Grade 3	90.00^{x}	5.52	95.32^{y}	3.93	97.27^{z}	1.89	44.95***	1.18	2.15	.66
Grade 8	90.35^{x}	5.83	95.57^{y}	4.16	96.78^{y}	2.12	31.84***	1.10	1.78	.38
Pseudoword text										
Grade 2	59.10^{x}	21.82	82.63^{y}	15.72	85.94^{y}	10.52	38.10***	1.32	1.83	.25
Grade 3	65.52^{x}	15.05	87.86^{y}	12.15	90.34^{y}	8.38	58.58***	1.71	2.32	.24
Grade 8	82.14^{x}	12.94	92.03^{y}	9.63	94.03^{y}	5.21	20.84***	0.92	1.44	.27
Spelling accuracy[f]										
Grade 2	39.05^{x}	28.99	74.36^{y}	17.32	74.53^{y}	19.10	39.96***	1.62	1.59	.01
Grade 3	64.05^{x}	21.18	82.45^{y}	16.67	87.96^{y}	14.19	24.44***	1.01	1.45	.36
Grade 8	82.29^{x}	15.36	94.32^{y}	7.23	95.49^{y}	4.45	29.90***	1.13	1.45	.20

Note. Groups with different superscript letter ($^{x,\,y}$ or ^{z}) were significantly different in the post hoc pair wise comparisons of ANOVA F tests ($p \leq .05$). Bonferroni or Dunnett's T3 corrections were used depending on equality or inequality of the variances.

a) Dys_FR = Dyslexia with familial risk, n = 35, NoDys_FR = No dyslexia with familial risk, n = 66, and C = Control children with no dyslexia and without familial risk, n = 72.

b) Effect sizes were estimated with Cohen's *d* (computed with pooled standard deviations).

c) Degrees of freedom varied between 2,165 – 2,170 due to missing data in single measures.

d) Overall reading speed = Arithmetic mean of the number of read letters/second in Word list, Text and Pseudoword text reading.

e) Overall reading accuracy = Arithmetic mean of the percentage of correctly read words/pseudowords in Word list, Text and Pseudoword text reading.

f) Spelling accuracy = percentage of correctly written pseudowords.

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

Table 4. F-values and Estimates of Effect Sizes from Mixed-Desing ANOVAs with Reading Speed as the Dependant Measure, Task as the Within-subjects Factor and Group as the Between-subjects Factor.

Compared tasks	Main effect of Task	Effect size[a]	Main effect of Group[b]	Effect size[a]	Interaction effect of Task*Group	Effect size[a]
Word list vs. Pseudoword text						
2nd grade	F(1,168) = 176.47***	.31	F(2,168) = 47.54***	.36	F(2,168) = 12.55***	.13
3rd grade	F(1,170) = 215.07***	.56	F(2,170) = 25.74***	.23	F(2,170) = 36.76***	.30
8th grade	F(1,166) = 244.49***	.60	F(2,166) = 26.77***	.24	F(2,166) = 11.12	.01
Word list vs.Text						
2nd grade	F(1,168) = 597.92***	.78	F(2,168) = 54.67***	.39	F(2,168) = 14.55***	.15
3rd grade	F(1,170) = 292.26***	.63	F(2,170) = 44.36***	.34	F(2,170) = 13.14	.04
8th grade	F(1,169) = 152.17***	.47	F(2,169) = 29.98***	.26	F(2,169) = 11.06	.01
Text vs.Pseudoword text						
2nd grade	F(1,168) = 1591.75***	.78	F(2,168) = 58.93***	.41	F(2,168) = 27.09***	.24
3rd grade	F(1,170) = 1549.10***	.76	F(2,170) = 30.92***	.27	F(2,170) = 35.36***	.29
8th grade	F(1,167) = 2249.39***	.93	F(2,167) = 34.66***	.29	F(2,167) = 16.12*	.07

Note.

[a] Effect size = Partial Eta Squared.

[b] Groups: Dys_FR = Dyslexia with familial risk, n = 35, NoDys_FR = No dyslexia with familial risk, n = 66, and C = Control children with no dyslexia and without familial risk, n = 72.

Because multiple Mixed-Design ANOVAs were conducted a stricter than usual cut-offs for significance were used: * $p \leq .005$, ** $p \leq .001$, *** $p \leq .0001$.

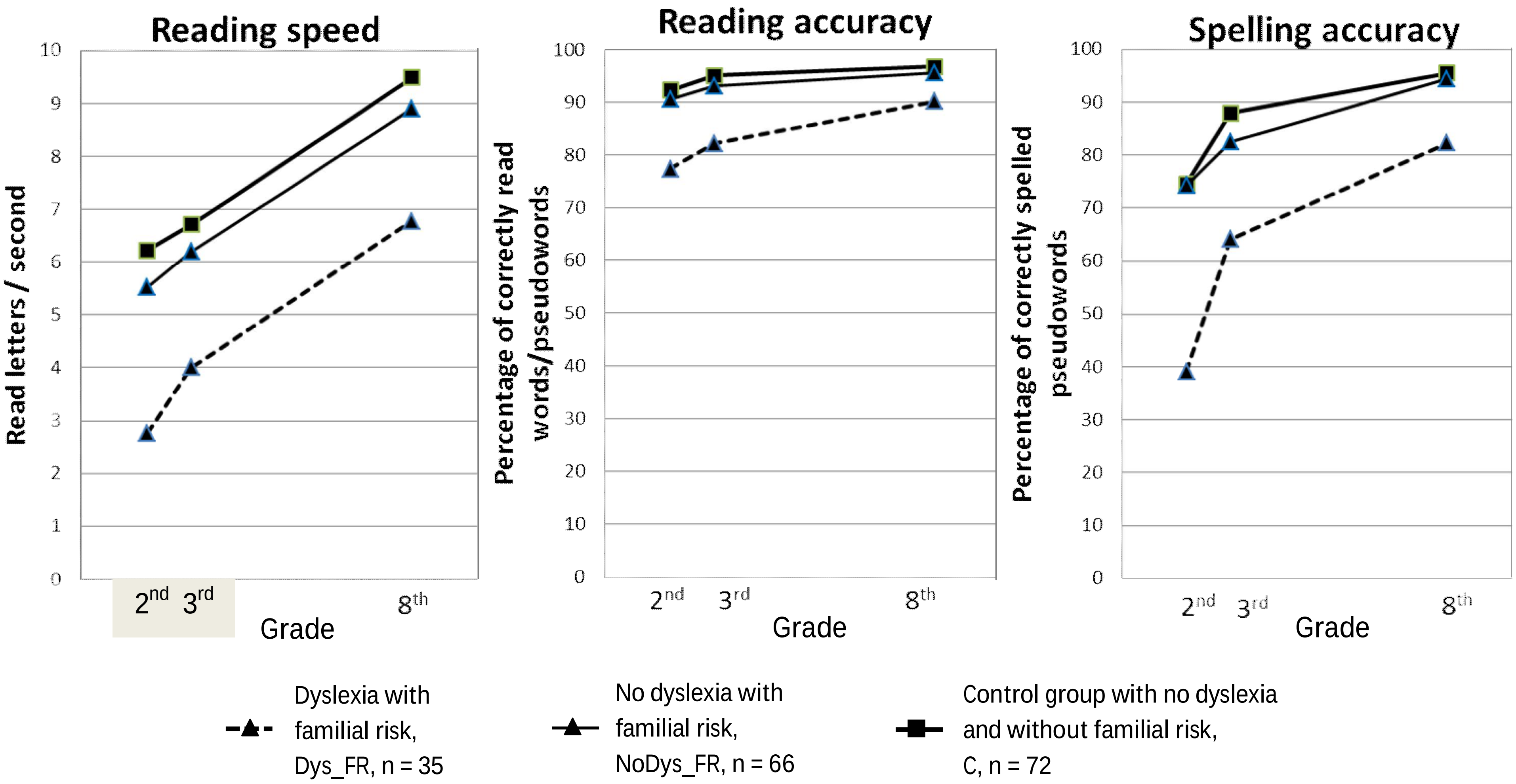

Figure 1. Reading Speed and Accuracy (Composite Means), and Pseudoword Spelling Accuracy in the Three Groups: Children with Dyslexia and Familial Risk, No dyslexia with Familial Risk, and Control children at the 2^{nd}, 3^{rd}, and 8^{th} Grade.

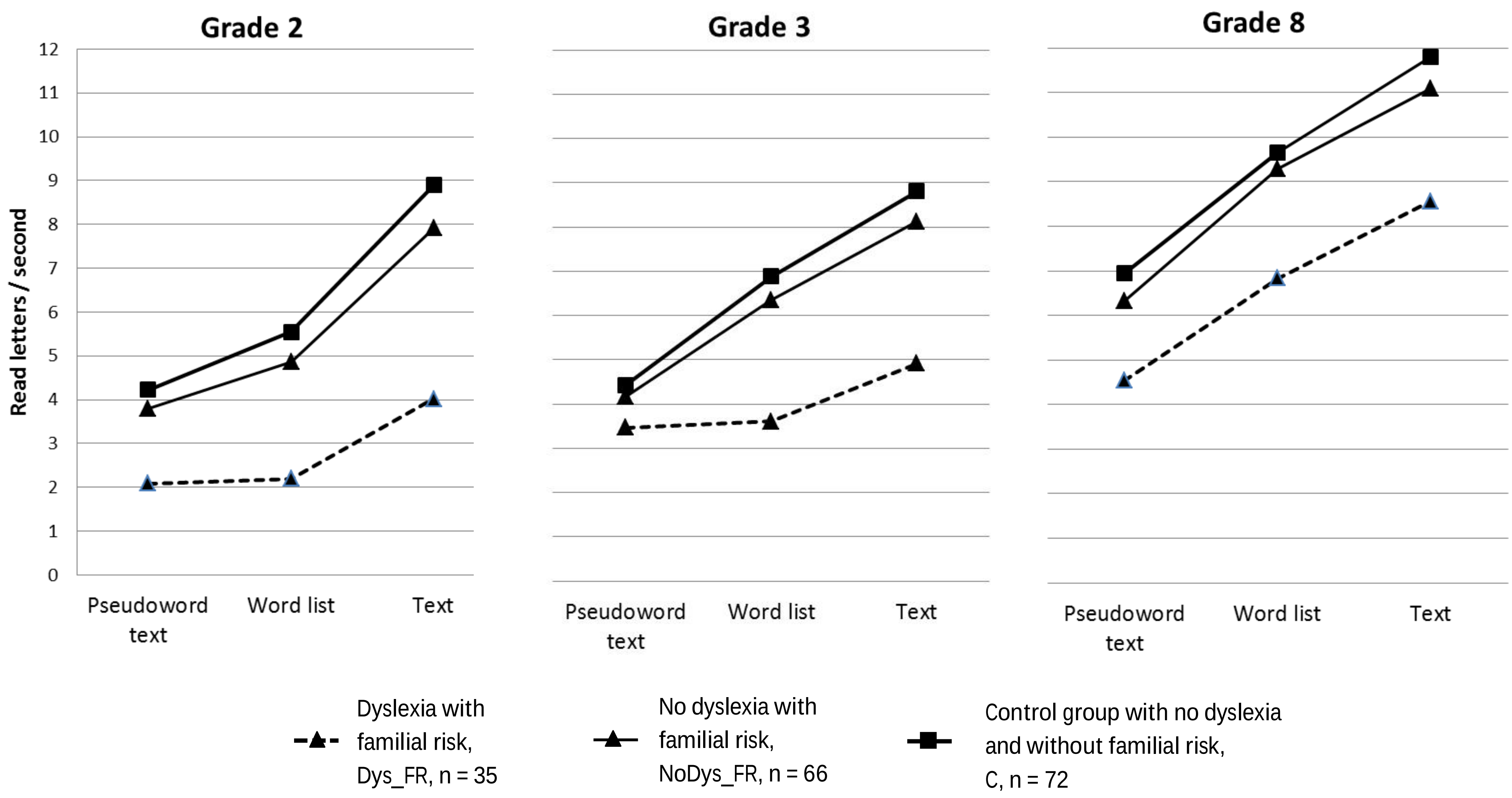

Figure 2. Reading Speed Means in Pseudoword Text, Word List, and Text Reading Tasks in the Three Groups: Children with Dyslexia and Familial Risk, No dyslexia with Familial Risk, and Control children at the 2nd, 3rd, and 8th Grade.