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## Language Development and Literacy Skills in Late-talking Toddlers with and without Familial Risk for Dyslexia

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*The relationship between late-talkers' language development and reading and spelling outcomes was examined in children with and without familial risk for dyslexia. The late-talking subgroups were defined using parent- and test-based assessments of receptive and expressive vocabulary and grammar at 2 and 2.5 years as intake criteria. The language skills of late talkers and the remainders of these two groups were assessed at 3.5, 5, and 5.5 years. Reading/spelling outcomes were compared at the end of the second grade. Late-talking toddlers of the at-risk group who had both poor receptive and expressive skills performed less well than all other groups on language measurements at 5.5 years. In contrast, the control group's late talkers with an expressive delay reached the language level of their age-mates already by 3.5 years, and maintained their age-appropriate position two years later. The most significant differences in the reading skills were found between the at-risk children with receptive and expressive delay and the remainder of the controls. Age-appropriate early language skills did not, however, ensure norm-level fluent reading in the at-risk group. The remainder of the at-risk group performed at a significantly lower level than did the remainder of the controls, both on the oral reading and spelling tasks.*

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**Key Words:** Familial dyslexia, language development, late talkers, reading and spelling

It is crucial to identify potential language delays in children as early as possible. The cumulative effects of such delays on subsequent language development and reading acquisition are well documented, especially if a child has a familial component that increases the probability of experiencing language problems (e.g., Choudhury & Benasich, 2003; Scarborough, 1990, 2001, 2005; Snowling, Gallagher, & Frith, 2003; Spitz, Tallal, Flax, & Benasich, 1997). In a meta-analysis, Scarborough (1998) summarizes several follow-up studies that confirm that preschoolers with language impairments are at considerable risk to develop continued language difficulties and reading disabilities at older ages. With regard to reading disability, the data show that this is highly likely to continue throughout the school careers of such children.

Language delays and disabilities are often identified when children are 5 years of age or older. The availability of research knowledge and of reliable and valid assessments could, however, lead to earlier identification of children with language delays and disorders (Lyytinen et al., 2004; McCathren, Warren, & Yoder, 1996; Scarborough, 2005). A question of considerable clinical importance is also how to distinguish transient from persistent language difficulties in young children (Dale, Price, Bishop, & Plomin, 2003). Scarborough (2001) suggested that the milder the language delay, the more transient and domain-specific will be the pattern of observed deficits. In contrast, a severe delay will be characterized by a more persistent and across-the-board deficit profile.

The second and third years of life represent a period of rapid change in children's language acquisition. Most children have made the transition to multiword speech and have learned the basic sentence structure and inflections of their native language before the age of 3 years (Bates & Goodman, 2001). For some children, delayed acquisition of these language milestones may be the first indication of language impairment that will persist through childhood. Bates, Dale, and Thal (1995) have found a powerful relationship between vocabulary size and the increase of utterance length and sentence complexity in early childhood. This kind of continuity has been observed in comparisons between children who start to talk early and those whose expressive language emerges slowly. The latter group,

referred to in the literature as "late talkers," has recently received a lot of attention as an index of potential risk for subsequent language-related problems (e.g., Dale et al., 2003; Girolametto, Wiigs, Smyth, Weitzman, & Pearce, 2001; Rescorla, Dahlsgaard, & Roberts, 2000) and reading outcomes (Paul, 2000; Rescorla, 2000, 2002).

Previous research has demonstrated that most late talkers with normal receptive language skills will perform within the average range by the time they enter school, although they are often still below norm and score less well than the comparison children on most language measures and some reading tests (Paul, 2000; Paul, Murray, Clancy, & Andrews, 1997; Rescorla, 2000; Whitehurst & Fischel, 1994). In interpreting the findings concerning the late talkers, it is important to note methodological factors that could influence results. The intake criteria for the late talker groups have varied considerably in previous studies. Rescorla's (1989) cut-off was fewer than 50 words or no word combinations. Bates et al. (1995) defined late talkers as children who were in the lowest 10 percent for vocabulary production on the MacArthur Communication Development Inventory (CDI) (Fenson et al., 1994). These findings were based on parental report measures that are nowadays widely used for toddlers. Rescorla (2000, 2002) stresses that late-talkers' receptive skills are also worthy of attention. Children with delayed production who have no problems in comprehension are more likely to catch up with their age-mates later. In contrast, children with receptive and expressive delays are at higher risk for persistent language problems (Rescorla, 2002; Whitehurst & Fischel, 1994). In order to elicit a reliable assessment that could distinguish transient from persistent language delays, Dale et al. (2003) suggest a two-stage process where parental report is complemented by a professional assessment of a high-risk group of children isolated on the basis of these reports.

Late talkers have been the focus of follow-up studies by several researchers. Paul and her colleagues (Paul et al., 1997) followed 30 late talkers identified between 20 and 34 months and their comparison group into school age. Late talkers were children who had been reported to have fewer than 50 words. The participants of this study had an advantageous socioeconomic background and relatively high nonverbal skills. At age 3 and 4, the late talkers were in the average range for receptive and expressive vocabulary and for receptive grammar. At ages 6 and 7, the percentage of recovered children was 84. Despite recovery, the late talkers were still inferior to comparison children on

a general expressive language scale at 7 years, but they did not differ in receptive language, reading, spelling, or phonological skills. Paul's (2000) conclusion was that a large part of late-talkers' problems are likely to resolve spontaneously. Thus, for late talkers from supportive families with no other risk factors, parental optimization of language input and monitoring of the child's linguistic progress is the intervention of choice.

Rescorla (2002) followed language and reading outcomes of a sample of 34 children up to the age of 9 years who had been late talkers as toddlers. The late talkers, who all had age-adequate receptive language at intake (24 to 31 months) and a score of greater than 85 on the Bayley Mental Development Scale (Bayley, 1993), were compared to a group of 25 typically developing children matched on age, socioeconomic status, and nonverbal ability. Late talkers performed in the average range on most language tasks by age 5. However, they had significantly poorer scores on language measures at the age of 9 years. Late talkers were also slightly less skilled in reading at ages 8 and 9, although no significant group differences were found at ages 6 or 7. Findings by Rescorla (2000, 2005) showed that late talkers still continued to score below typically developing children on a variety of language and academic measures at age 13 years. Her findings suggest that slow early language development is a risk factor for subsequent language-related skills, reflecting a predisposition toward lower performance on most language measures and some reading tests in middle childhood and early adolescence. Could it be the case that, in some of these children, language difficulties aggregate in families?

Children at familial risk for dyslexia who have manifested reading problems at 8 years have been observed to show changing patterns of language difficulties over time (Scarborough, 1990, 2001; Snowling et al., 2003). Scarborough found that as early as 2.5 years, the spoken language of children at risk, as compared with their controls, contained shorter sentence length, less syntactic complexity, and less accurate production of phonology. The receptive and expressive vocabulary skills of the children who later faced reading problems were less well developed at ages 3 and 3.5 years than those who did not have later reading disabilities. According to Snowling et al. (2003), the early precursors of reading disability in family studies appear to include not only a specific phonological deficit, but also slow vocabulary development and poor expressive language and grammatical skills. This raises the question as to whether a child's late onset of talking in a family with a positive history of dyslexia might be one of

the early markers that predicts impairments in subsequent language development and in reading and spelling.

The predictive role of a child's late talking has been examined in the Jyväskylä Longitudinal Study of Dyslexia (JLD) whereby children of families with and without dyslexia have been followed from birth to school age (Lyytinen et al., 2004). Previous findings revealed that the 2-year-old children, who were late talkers in terms of showing delayed expressive speech and belonged to the at-risk group, still had difficulties in language skills at 3.5 years. In contrast, children with a comparable late-talking history in the control group, almost without exception, reached the level of their agemates (Lyytinen, Poikkeus, Laakso, Eklund, & Lyytinen, 2001). The children identified as late talkers were also less advanced in their production at all levels of phonology (word, syllable, phoneme, and phoneme sequence) in comparison to their peers in the JLD at-risk or control groups at 2.5 years of age (Turunen, 2003).

In this study, we further specified the intake criteria for late-talking subgroups and continued the follow-up of the late talkers and the remaining children into school age. We extended the age range of intake by examining children's language skills at two age points (at 2 and 2.5 years), and used both parental reports and the number of standardized tests conducted professionally as our intake criteria. Previous findings of the JLD have revealed that infants' compromised speech processing and perception precedes persistent delays of language development and reading acquisition (e.g., Guttorm et al., 2005; Leppänen et al., 2002) and differentiates the groups with and without familial risk for dyslexia (Richardson, Leppänen, Leiwo, & Lyytinen, 2003). This result stresses the importance of the domain of comprehension in early language development. Poor linguistic comprehension is also a candidate for early identification as it places later constraints on reading comprehension (Nation, 2005). Consequently, our specific interest was to provide information concerning whether late talking, with and without receptive problems, has different consequences for children's language development and reading/spelling outcomes.

Two main questions were addressed. First, we examined whether the late talkers differed from the remainder of the at-risk and control groups in language development at age 3.5 and 5.5 years. Our hypothesis was that expressive delayed late talkers of the control group would catch up with their agemates in language development before school entry, as has been suggested by Paul et al. (1997) and Rescorla (2002). In contrast, late

talkers among the offspring of parents with dyslexia were expected to have continuing residual impairments in language development, as previously shown by Lyytinen et al. (2001; documented until the age of 3.5 years). Second, we examined the relationship between late-talking group status and children's reading/spelling outcomes at the end of the second grade. Following on from Scarborough (1990, 2001), we assumed that toddlers with receptive and expressive delays would reveal persistent, across-the-board deficits that will be reflected in their reading/spelling skills.

## METHOD

### PARTICIPANTS

Children with familial risk for dyslexia (the dyslexic risk [DR] group;  $N = 107$ ) and children without this risk (the no risk [NR] group,  $N = 93$ ) were followed from birth to school age (see Lyytinen et al., 2004). The follow-up period was up to the end of the second grade when the children's ages varied between 8 and 9 years ( $M = 8.9$  years,  $SD = 0.29$ ). The families of this study were recruited with the help of maternity clinics of central Finland. The children of the DR group came from families where one or both parents were diagnosed as reading-disabled and this parent had at least one other close relative who experienced the same problem. Parental risk status was confirmed with extensive individual assessment comprising reading/spelling, phonological and orthographic processing (Leinonen et al., 2001). Parental education was classified using a 7-point scale: 1 = comprehensive school (CS) without any vocational education, 2 = CS with short-term vocational courses, 3 = CS with a vocational school degree, 4 = CS with a vocational college degree, 5 = CS with a lower university degree (Bachelor's) or a degree at a polytechnic, 6 = upper secondary school with a BA degree or a degree at polytechnic, and 7 = upper secondary school with a higher university degree (Master's or a doctorate degree). The mean of the mothers' education was 4.18 ( $SD = 1.48$ ) in the DR group and 4.52 in the control group ( $SD = 1.35$ ). The comparable numbers of the fathers' education were 3.68 ( $SD = 1.27$ ) and 3.80 ( $SD = 1.40$ ), respectively. There were no group differences, either in parents' education, or in their non-verbal IQs, as assessed by Raven's Standard Progressive Matrices, subtests B, C, and D (Raven, Court, & Raven, 1992).

There were 54 girls and 53 boys in the DR group, and 40 girls and 53 boys in the control group. At birth, the at-risk and control group newborns did not differ in gestational age, birth weight, or in Apgar scores (a quick test administered after birth to determine the physical condition of the newborn). A detailed neuropsychiatric examination soon after birth revealed no abnormalities in either group. The means on the Bayley Mental Development Index (Bayley, 1993) were equivalent for children of the DR ( $M = 100.87$ ,  $SD = 13.09$ ) and NR ( $M = 102.30$ ,  $SD = 12.32$ ) groups at the age of 2 years. Similarly, no group difference was found on the Bayley Physical Development Index that measures gross and fine motor skills (the DR group,  $M = 99.33$ ,  $SD = 11.72$  and the NR group,  $M = 98.75$ ,  $SD = 10.98$ ). Group differences were also not observed in Verbal IQ (*WISC-III*) (Wechsler, 1991) (the DR group,  $M = 98.67$ ,  $SD = 11.64$  and the NR group,  $M = 101.01$ ,  $SD = 11.76$ ) or Performance IQ (the DR group,  $M = 99.75$ ,  $SD = 12.59$ , and the NR group,  $M = 102.30$ ,  $SD = 13.54$ ) assessed at 8.5 years.

#### LANGUAGE MEASURES AT 2 AND 2.5 YEARS

The toddlers' *composite score of expressive language* was based on four separate measures. Vocabulary production and maximum sentence length were derived from parental reports using the Finnish adaptation (Lyytinen, 1999) of the MacArthur Communicative Development Inventory (Fenson et al., 1994) at 2 years. The scoring of maximum sentence length was based on the mean number of morphemes in the three longest utterances produced by the child (Lyytinen & Lyytinen, 2004). Recently, Heilman, Ellis Weismer, Evans, and Hollar (2005) have demonstrated that the CDI is an effective tool with which to sort toddlers into lower and higher language levels. The Bayley expressive score (naming pictures and naming objects) was obtained at 2 years and the expressive score of the Reynell Developmental Language Scales (RDLS) (Reynell & Huntley, 1987) was derived at 2.5 years. In order to give equal weight, all the scores were standardized (using the mean and *SD* of the control group) before computing the composite scores. Cronbach Alpha reliability was .86 for this expressive score. *Verbal comprehension level* was assessed by the Reynell Receptive Language Scale at 2.5 years. These two scores were used as intake criteria for the late-talking groups.

#### LANGUAGE MEASURES AT 3.5 AND 5–5.5 YEARS

The *expressive language skills* of 3.5-year-old children were assessed using the Boston Naming Test (BNT) (Kaplan,

Goodglass, & Weintraub, 1983) and the Inflectional Morphology Test. The mastery of the highly inflected Finnish morphology was measured with the Berko-type elicitation test (Lyytinen & Lyytinen, 2004) that covers items of adjective inflection (comparative and superlative), verb inflection (present), and noun inflection (relative; i.e., from something). Two inflectional forms (adverb and past) were added for the older children. The test words were old Finnish words that are no longer in use but adhere to the phonotactic rules of Finnish. Thus, they were unfamiliar to the children. The items are presented orally, together with a colorful drawing, and the child is instructed to generate the inflection of the target word. In the scoring, it was examined whether the child used the target word, what suffix was used, and whether there were errors in the word stem. The Inflectional Morphology Test was readministered at 5 years, and the Boston Naming Test at 5.5 years. Cronbach Alpha reliability for the mean z-score of the expressive composite was .61 at 3.5 years and .62 for 5.5 years.

*Receptive language skills* were assessed using the *Peabody Picture Vocabulary Test-Revised (PPVT-R)* (Dunn & Dunn, 1981) and the subtest of Comprehension of Instruction, belonging to Korkman's Developmental Neuropsychological Assessment (NEPSY) (Korkman, 1998) at ages 3.5 and 5.5 years. This test assesses the ability to process and respond quickly to verbal instructions of increasing complexity. The subtest involves a stimulus booklet with pictures of rabbits of different sizes and colors, and with different facial expressions. For each item, the examiner asks the child to point to the rabbit that matches the description given orally (e.g., "Show me the rabbit that is big and blue and happy"). Cronbach Alpha reliability for the mean z-score of the receptive composite was .61 at 3.5 years and .64 at 5.5 years.

#### MEASURES OF LITERACY SKILLS AT THE END OF THE SECOND GRADE

*Oral reading* composite score consisted of four separate word lists: three-syllable words (10 items) and nonwords (10 items), four-syllable words (10 items) and nonwords (10 items), and two oral text reading tasks ( a meaningful story "Exciting adventures," 124 words and a nonword story, 19 words). Word lists were presented in written form on the computer screen that the child was asked to read aloud one word at a time. Reading speed and accuracy were assessed separately for each word item in the list. Accuracy of nonword list reading was used

solely because there was no variance in the performances on meaningful word lists (too many maximum scores). The texts of the stories were written on separate papers and the reading of each story was recorded. Reading speed (words/minute) and accuracy (number of correct words) were measured. Cronbach Alpha reliability was .90 for the mean z-score of this reading composite.

*Reading comprehension* was assessed using two tests. Lindeman's (2000) nationally normed reading comprehension task for second grade (ALLU, LY2, "Morning exercises") required the child to read a text and then to respond to 12 multiple choice questions (time allocated for the task performance was 45 minutes). In the second task, Vekku's Stories, children were administered a booklet of 12 pictures. Each of the pictures was connected to four sentences, all of which the child was required to read in order to ascertain which of the sentences, due to its containing a semantic or syntactic error, did not match with the picture. The time limit was 10 minutes. Cronbach Alpha reliability was .76 for the mean z-score of the reading comprehension composite.

*Spelling* was assessed by asking the child to write four-syllable words (six items; e.g., "vahingossa" [accidentally], "leivän-paahdin" [toaster], "lahjakortti" [gift-voucher], four-syllable nonwords (six items presented orally two times before spelling, one additional repetition by child's request) and four-syllable nonwords (six items presented two times, no further repetition). The items (18) were delivered via headphones. The mean number of correct items was counted. Cronbach Alpha reliability was .87 for the mean z-score of the spelling composite.

#### SUBGROUP DIVISION OF THE TODDLERS ACCORDING TO LANGUAGE SKILLS

Children were divided into five subgroups. Three late-talker groups were formed based on criteria of delayed development in both expressive and receptive language at ages 2 and 2.5 years. Intake criterion for the late-talking group 1 (*LT1 expressive delayed*) was at least one *SD* below the mean of the composite score of expressive language: vocabulary production, maximum sentence length, and the Bayley expressive score and the expressive score of the RDLS. The *LT1<sup>DR</sup>* comprised 10 late talkers (nine boys, one girl), and the *LT1<sup>NR</sup>* comprised 10 late talkers (seven boys, three girls). Children in these groups had age-appropriate receptive skills. Children belonging to the late-talking group 2 (*LT2*) were *delayed both in receptive and expressive*

language. There were 12 children (five boys, seven girls) belonging to the DR group who had obtained 1 *SD* or more below norm in the receptive score of the RDLS at 2.5 years. Seven of these children also had at least 1 *SD* below the norm expressive language score, and five of the children's expressive mean *z* score varied between -0.59 to -0.95. The LT2 group was formed only from the DR group as among the NR group, only three children fulfilled expressive and receptive intake criterion for this group. Due to the small number, these participants were not included in the group comparisons. In addition to these three late-talking subgroups, there were *two remainder groups*: one for the DR ( $N = 85$ ) and one for the NR ( $N = 80$ ) groups whose language development was age-appropriate or better.

The three LT subgroups showed no differences in terms of parental education or on the Bayley mental and physical indexes at 2 years, or on the Verbal Scale of *WISC-III* (Wechsler, 1991) at the age of 8.5 years. Late talking was reflected in the language-based Bayley mental score: all late-talking subgroups performed at a lower level than their remainder groups. A similar difference was found between the LT2 and the remainder groups on the Verbal Scale of *WISC-III*.

During the years of this study, approximately one-third of the later talkers received 15 hours of group treatment for language and play skills between the age of 3 and 4 years. These children emerged evenly from all three subgroups. Individual naming and phonological treatment was administered to three children from the LT2 in the DR group and two children from the LT1 in the NR group. Finnish children attend kindergarten from age 6, but formal schooling and reading instruction begin from age 7 when they enter the first grade. All children attended normal mainstream school.

## RESULTS

### DEVELOPMENTAL CHANGES OF THE GROUPS IN RECEPTIVE AND EXPRESSIVE LANGUAGE

The mean *z*-scores and standard deviations of the receptive and expressive composite measures derived at three time points (2.5, 3.5, and 5.5 years) are presented for the five groups in table I (see the means and standard deviations of primary scores of the language measures in the Appendix). In order to investigate the change of the relative differences of language skills from the

Table I. Language and Reading Outcome Scores by Groups.

	At-risk Group				No-risk Group					
	LT1 <sup>DRa)</sup> (n = 10)		LT2 <sup>b)</sup> (n = 12)		The remainder of the group (n = 85)		LT1 <sup>NRa)</sup> (n = 10)		The remainder of the group (n = 80)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2.5 Years										
Reynell receptive z-score	-0.18	0.39	-1.88	0.67	-0.08	1.05	-0.20	0.52	0.06	1.01
Mean expressive z-score	-1.31	0.17	-1.27	0.49	0.15	0.57	-1.63	0.46	0.28	0.58
3.5 Years										
Mean receptive z-score	-0.47	0.42	-1.07	0.47	-0.03	0.86	0.15	0.64	0.01	0.83
Mean expressive z-score	-0.79	0.59	-1.44	0.50	-0.29	0.86	-0.10	0.88	0.02	0.86
5.5 Years										
Mean receptive z-score	-0.44	0.33	-1.66	0.89	-0.22	0.97	-0.05	1.06	0.04	0.84
Mean expressive z-score	-0.55	0.70	-1.77	1.13	-0.28	0.89	0.01	0.96	-0.01	0.80
8 Years										
Mean reading (accuracy and speed)	-0.47	0.93	-0.79	1.20	-0.58	0.98	-0.18	1.16	0.04	0.64
Mean reading comprehension z-score	-0.36	0.88	-1.12	1.59	-0.06	1.13	-0.70	0.98	0.11	0.83
Mean spelling z-score	-0.57	1.16	-1.24	1.57	-0.39	1.09	-0.00	0.67	-0.02	0.90

Note:

a) LT1 = Late talkers1 (delayed in expressive language), DR = the dyslexic risk group, NR = the no-risk group

b) LT2 = Late talkers2 (delayed in receptive and expressive language), only in the DR group

control groups, a 3 (Age)  $\times$  5 (Group) repeated measures MANOVA was conducted using Pillai's Trace F-approximation as the criterion.

A 3 (Age)  $\times$  5 (Group) repeated measures MANOVA for receptive language development revealed a significant main effect for Age ( $F[2,183] = 3.04, p = .05$ ) and for Group ( $F[4,184] = 12.11, p = .000$ ), and a significant Age  $\times$  Group interaction ( $F[8,368] = 2.13, p = .032$ ). One-way ANOVAs were carried out on the language measures at each age point to compare the five groups. Follow-up LSD tests between the groups showed (see table II) that LT2<sup>DR</sup> achieved significantly lower receptive scores than all other groups through the language follow-up period; an only exception was a nonsignificant difference between the LT1 and the LT2 in the at-risk group at 3.5 years. As figure 1 shows, the interaction between Age and Group is seen in the differential change of the LT2 group that first approached the other two subgroups of the at-risk children at 3.5 years, but then departed back to a distance of 1.5 *SD* at the age of 5.5 years.

A 3 (Age)  $\times$  5 (Group) repeated measures MANOVA for expressive language development also revealed a significant main effect for the difference from controls related to Age ( $F[2,186] = 4.42, p = .013$ ) and for Group ( $F[4,187] = 20.87, p = .000$ ), and a significant Group  $\times$  Age interaction ( $F[8,374] = 9.32, p = .000$ ). ANOVA with follow-up LSD tests revealed that the LT2 group performed significantly less well than all other groups at 3.5 and 5.5 years (see table II). The only exception was a nonsignificant difference between LT1 and LT2 in the DR group at 3.5 years. Figure 2 shows that the LT2 group continued to be delayed in expressive language while the LT1s of both at-risk and control groups approached the mean level of the controls by 3.5 (NR) and 5.5 (DR).

As can be seen in table III, effect sizes using Cohen's (1988) "d" (mean of the remainder of the control group minus the mean of each other group divided by the *SD* for the remainder of the controls) were mostly very large for all language outcomes between the LT2 and the remainder group of the controls. Corresponding effect sizes were mainly at a medium level among the LT1<sup>DR</sup> and at a low level among the LT1<sup>NR</sup>.

#### OUTCOMES OF LITERACY SKILLS BY GROUPS

**Oral Reading.** A one-way ANOVA comparing the five groups showed significant differences ( $F[4,184] = 5.96, p = .000$ ) for reading outcome. Follow-up LSD tests revealed (see table II) that, for oral reading, the at-risk children with both receptive

**Table II. Group Differences in Receptive and Expressive Language and Reading /Spelling Outcomes.**

Measures	ANOVA	Follow-up Tests <sup>a)</sup>
2.5 Years		
Reynell receptive	F(4,184) = 10.40, p = .000	LT2 < all other groups
Mean expressive	F(4,189) = 56.44, p = .000	All late-talking groups < the remainders of both groups
3.5 Years		
Mean receptive	F(4,190) = 5.45, p = .000	LT2 < all other groups, except LT1 <sup>DR</sup>
Mean expressive	F(4,188) = 8.81, p = .000	LT2 < all other groups, except LT1 <sup>DR</sup>
5.5 Years		
Mean receptive	F(4,190) = 9.68, p = .000	LT2 < all other groups
Mean expressive	F(4,190) = 10.73, p = .000	LT2 < all other groups
8 Years		
Mean reading (accuracy and speed)	F(4,184) = 5.96, p = .000	LT2 < the remainder of the NR group Remainder of the DR group < that of the NR group
Mean reading comprehension	F(4,173) = 4.54, p = .002	LT2 < the remainders of both groups LT1 <sup>NR</sup> < the remainder of the NR group
Mean spelling	F(4,184) = 4.35, p = .002	LT2 < the remainders of both groups LT2 < LT1 <sup>NR</sup> Remainder of the DR group < that of the NR group

<sup>a)</sup>differences are significant at least at  $p < .05$

and expressive delays as toddlers and the at-risk children without language delays, both scored significantly lower than the control group children without language delay. As can be seen in table III, effect sizes were large (1.3) for comparison of the LT2 and the remainder of the controls, and for the comparison

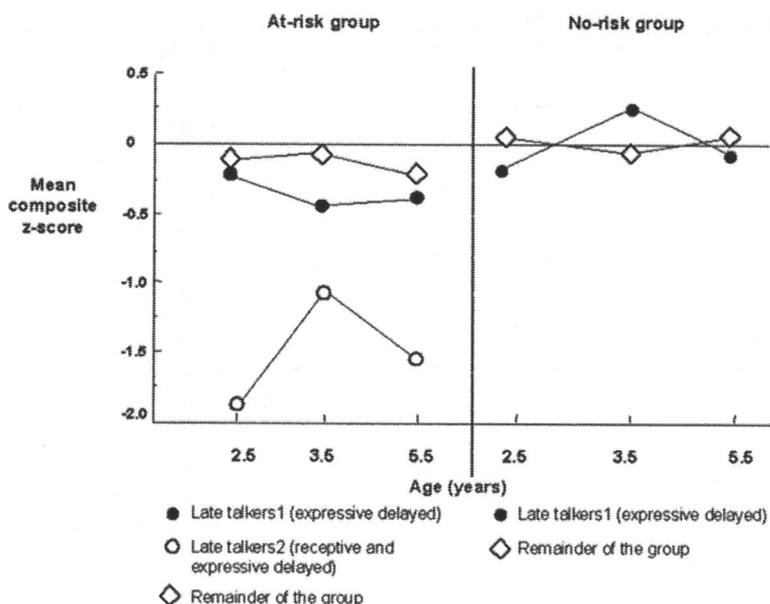


Figure 1. Development of receptive language skills by groups.

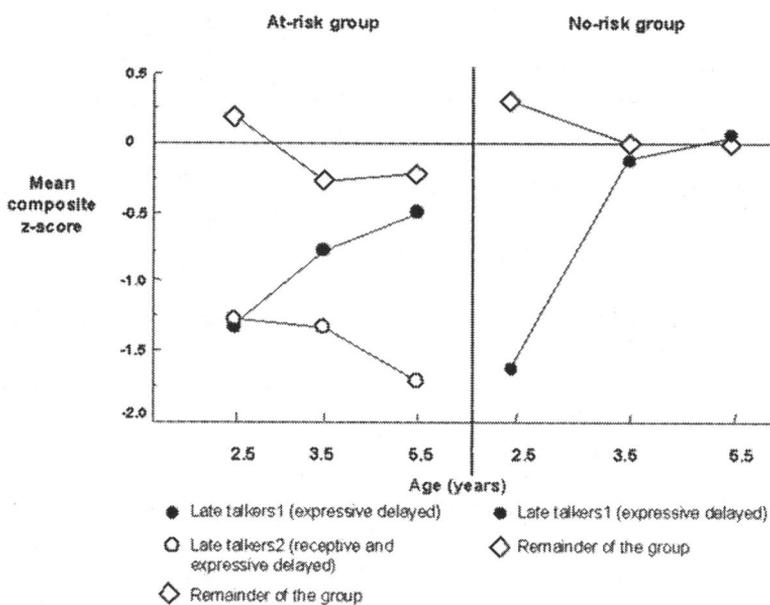


Figure 2. Development of expressive language skills by groups.

**Table III. Effect Sizes for Group Comparisons Between the Remainder of the No risk group and the Groups of Interests.**

Measures	Groups			
	LT1 <sup>DRa)</sup> "d"	LT2 <sup>b)</sup> "d"	The remainder of the DR group "d"	L1N <sup>Ra)</sup> "d"
2.5 Years				
Reynell receptive z-score	0.24	1.91	0.14	0.26
Mean expressive z-score	2.74	2.62	0.19	3.28
3.5 Years				
Mean receptive z-score	0.55	1.25	0.01	0.17
Mean expressive z-score	0.94	1.68	0.36	0.13
5.5 Years				
Mean receptive z-score	0.56	2.02	0.29	0.09
Mean expressive z-score	0.68	2.13	0.35	0.02
8 Years				
Mean reading z-score (accuracy and speed)	0.81	1.31	0.98	0.35
Mean reading comprehension z-score	0.57	1.48	0.20	0.98
Mean spelling z-score	0.62	1.36	0.42	0.01

Note:

<sup>a)</sup>LT1 = Late talkers1(delayed in expressive language), DR = the dyslexic risk group, NR = the no-risk group

<sup>b)</sup>LT2 = Late talkers2 (delayed in receptive and expressive language), only in the DR group

of the remainder of the at-risk group and that of the controls (0.98). It is noteworthy to observe that the remainder of the at-risk group was at least as delayed in oral reading as was the LT1 of the at-risk group (see figure 3). Although the latter was not significant by LSD, the effect size was, however, large (0.81).

**Reading Comprehension.** A one-way ANOVA showed a significant difference between the five groups ( $F[4,173] = 4.54, p = .002$ ) for reading comprehension (see figure 4). Follow-up LSD tests revealed that the LT2 scored significantly lower than did the remainder of both groups (see table II). However, the remainder of the DR and NR groups did not differ in reading comprehension in contrast to oral reading scores that were significantly lower among the at-risk remainder. Table III reveals that effect size for the LT2 was large ("d" was 1.5). An interesting finding was that the late talkers with expressive delay in the

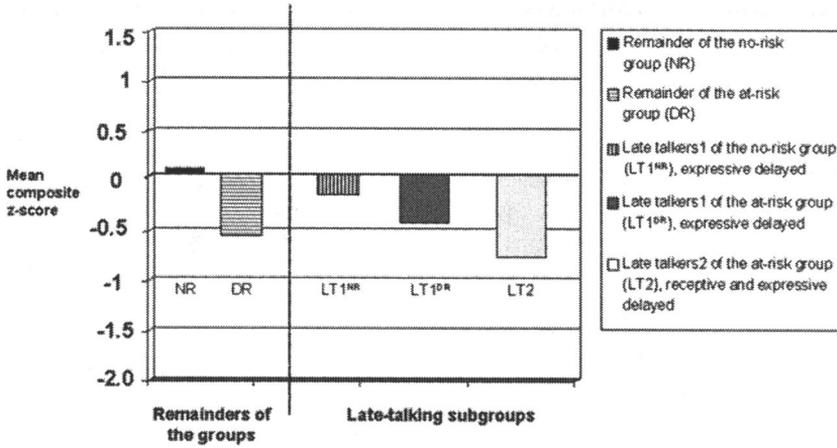


Figure 3. Reading accuracy and speed by groups at the end of the second grade.

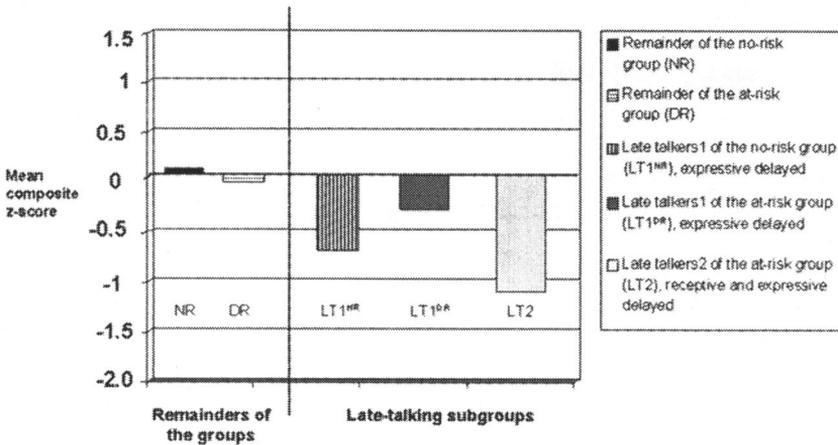


Figure 4. Reading comprehension by groups at the end of the second grade.

NR group differed also from their remainder on reading comprehension ("d" was close to 1).

**Spelling.** A one-way ANOVA showed significant differences among the five groups ( $F[4,184] = 4.35, p = .002$ ) for spelling outcome. The means of all DR subgroups were below the means of the controls in spelling (see figure 5); the follow-up LSD tests revealed significant differences between the LT2 and the remainder of both groups, as well as between LT2 and LT1<sup>NR</sup>. The remainder of the DR also differed from that of the NR group. The effect size was large (1.4) for the LT2, medium (0.62) for the LT1 of the at-risk group, and zero for the LT1 of the controls (see table III).

### CORRELATIONS BETWEEN LANGUAGE AND LITERACY SKILLS

Early receptive and expressive language skills correlated significantly with reading comprehension in the DR and NR groups at the end of the second grade (see table IV). In the DR group, a similar association was also found for spelling. The correlations between early language skills and oral reading were low, and only one coefficient reached significance in the DR group.

Oral reading, reading comprehension, and spelling outcomes were highly correlated ( $p = .000$ ) in the DR group. Corresponding associations were also found for the NR group. The only exception was the correlation between spelling and

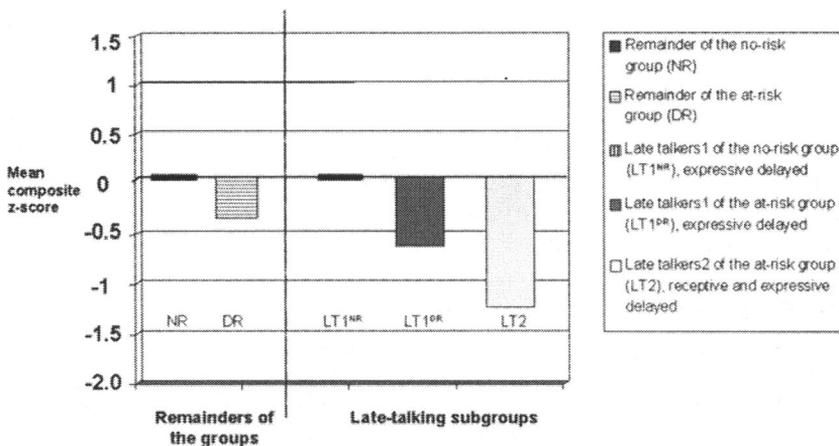


Figure 5. Spelling outcome by groups at the end of the second grade.

**Table IV. Correlations Between Language and Reading/Spelling Outcomes.**

	Oral Reading		Reading Comprehension		Spelling	
	At-risk Group	No-risk Group	At-risk Group	No-risk Group	At-risk Group	No-risk Group
2.5 Years						
Receptive z-score	.11	.16	.35***	.32**	.28**	.16
Mean expressive z-score	.13	.13	.33**	.35**	.31**	.14
3.5 Years						
Mean receptive z-score	.02	.10	.38***	.27*	.34**	.23*
Mean expressive z-score	.15	.16	.44***	.25*	.34**	.24*
5.5 Years						
Mean receptive z-score	.12	.21	.48***	.36***	.36***	.20
Mean expressive z-score	.25*	.12	.52***	.37***	.45***	.14

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

reading comprehension skills that was significantly lower ( $p < .01$ ) among the controls ( $r = 0.28$ ) compared to the at-risk children ( $r = 0.70$ ).

## DISCUSSION

The present study examined late-talking group status among the children with and without familial risk for dyslexia and its relation to subsequent language and reading/spelling outcomes. There are previous findings concerning the different pathways of vocabulary development, phonological and morphological ability, and orthographic skills between the ages of 1 and 6 years among offspring of dyslexic parents (Gallagher, Frith, & Snowling, 2000; Lyytinen et al., 2004; Lyytinen & Lyytinen, 2004; Pennington & Lefly, 2001) and children who later become dyslexic (Scarborough, 1990; Snowling et al., 2003). However, no previous study has examined whether late onset of talking is one of the early markers of reading difficulties among at-risk children, and what skill of the late talkers, if

any, is associated with failure to acquire reading skill at the expected time.

Dale et al. (2003) have asked how to distinguish transient from persistent language difficulties in young children. As far as subsequent language development of the late talkers is concerned, our findings revealed that late talking was a persistent language deficit among the at-risk group, especially among those late talkers who also had early receptive delay. The at-risk talkers with receptive and expressive delays (LT2) had the worst outcomes on all language measures.

The at-risk children with expressive but no receptive delay (LT1<sup>DR</sup>) had scores that were about half a *SD* lower than the typically developing controls on most measures. In contrast, late talkers of the control group (LT1<sup>NR</sup>) attained the mean scores of their age-mates' expressive language level already at 3.5 years, and maintained their age-appropriate position at 5.5 years. Previously, Lyytinen et al. (2001), Paul (2000), and Whitehurst and Fischel (1994), had presented similar recovery findings in language development. Late talking is a persistent risk factor for subsequent language development apparently only if it is associated with delay in receptive language.

Due to the full transparency of the orthography, most Finnish children easily acquire accurate reading skill during the first year of formal instruction (Lyytinen et al., 2006). The stage of assessing the outcomes at the end of the second grade, six years after the initial identification of the problem, is late enough to document an association with reading skill that should already be acquired to its full accuracy and substantial fluency. Children learning to read English, which is one of the most irregular orthographies, acquire the level of our participants later in age and grades (Seymour, Aro, & Erskine, 2003). Also, the specific challenges faced by early readers in their acquisition of reading may differ between these two different orthographies. We, however, believe that the present results are relatively directly comparable to English because the predictive relations to reading of the most extensively studied measures, viz, phonological skills and naming fluency (Lyytinen et al., in press), compare well with the results from research of learning to read English.

Our findings concerning reading acquisition showed that all late-talking subgroups performed below the expected level on oral reading and reading comprehension tasks at the end of the second school year. These results are consistent with the findings of Rescorla (2002, 2005) that slow onset of language is a

risk factor for subclinical weakness in language-related skills in the school years. The most remarkable persistent delay was found among late talkers with both receptive and expressive delay. Eight children (of 12) belonging to this subgroup had difficulties in literacy skills at the end of the second grade, the point in time when more than 95% of Finnish children are already accurate and relatively fluent readers. Four of these eight children had difficulties (at least  $-1.5$  SD below controls) in all three domains. One child had serious problems in oral reading, one in spelling, and two children in reading comprehension and milder difficulties in other domains. Only two of 12 children reached an expected level of reading skill. These findings support our hypothesis that late talking with a weakness of receptive skills is very often a persistent, across-the-board deficit that will be reflected in children's reading and spelling skills, as expected by Rescorla (2002) and Scarborough (2001). It is, however, important to note that the described children belonged to familial risk groups. Thus, this conclusion is valid only if this second criterion is met.

In order to have some understanding about the consequences of a parallel delay among children who do not have familial background of dyslexia, we examined data of the three toddlers who had a comparable delay in both an expressive and receptive language. They achieved as well as the remainders of the control group, expressive language at 5.5, but were still 0.5 SD below the mean level in receptive language. At the end of the second grade, the literacy skills of these toddlers did not differ from the means of the control children with expressive delay only, but two children of three were 1 SD or more below norm in reading comprehension, one also in oral reading, and none of them in spelling. Thus, the inspection of individual outcomes refers to ongoing delays. The small sample size, however, does not warrant any convincing conclusions.

In all, a delay comprising receptive language among all children led to reading problems. Toddlers whose delay was observed in expressive language only manifested some continuing weakness with large effect size in reading, especially in the at-risk group. Control children with mere expressive delay approached the level of their remainder group in reading skill. This finding suggests that early expressive language delay among children born to a parent with dyslexia means that their risk of facing reading problems at school age is more than the expected 40%–50% on the basis of the familial risk only.

An interesting finding was that the reading and spelling outcomes of the at-risk children who had no delays in language also failed to reach the level of controls. Correspondingly, our recent findings on developmental trajectories to dyslexia based on the further analysis of the JLD-data showed that a good start in early language skills may not ensure norm-level fluent reading for all children at the first and second grade. When all language measures were simultaneously analyzed, we (Lyytinen et al., in press) found three main routes to compromised reading acquisition. The most explicit routes were characterized by delays in either phonological awareness, naming fluency, or letter knowledge, problems that increased in severity with age. An unexpected finding was that some delayed readers had a good start in both expressive and receptive language with only one predictive antecedent: increasingly (relatively) delayed development of letter knowledge during the three years before school.

Our present results reveal that it is not necessarily mere expressive speech that is important to attend to when language skills show an early delay. The receptive side is worth special attention. This corresponds to the proposals made earlier by Rescorla (2002) and Whitehurst and Fischel (1994). Because comprehension taps all aspects of language including phonology, semantics, syntax, and pragmatics, it is reasonable to expect that these factors will influence comprehension of both spoken and written language (Nation, 2005), and possibly continue to do so also during later reading. However, the present evidence cues especially toward a connection between the familial risk for dyslexia and early receptive problems, a result compatible with earlier findings from the JLD data such as differences in the brain event-related responses to speech sounds between the infants with and without familial risk (Guttorm, Leppänen, Richardson, & Lyytinen, 2001; Leppänen et al. 2002), and atypicalities observed in the categorical perception among infants belonging to the at-risk group (Richardson et al., 2003).

The late-talking toddlers at familial risk for dyslexia who had a slow start in receptive and expressive language and a spectrum of continued delays in language and reading/spelling outcomes also differed from the other children in infancy in their motor development. Half of them also had at least a minor delay in gross and fine motor development (Viholainen, Ahonen, Cantell, Lyytinen, & Lyytinen, 2002). These findings motivate us to emphasize the value of detailed assessment of early delays if a child has a familial risk for language-related

problems. Simultaneously occurring delay in motor development stress furthers the need for intervention among these children.

It is widely assumed that intervention is more effective when provided earlier than later (Dale et al., 2003). We suggest, in agreement with Rescorla (2002), that it would be good to provide late talkers, and especially if they are at familial risk for dyslexia and do not have age-appropriate receptive skills, with extra exposure to games and play activities that may help to strengthen word retrieval, verbal memory, phonological discrimination, and grammatical processing. It is important to note, however, that many children who are at familial risk for dyslexia but do not show delays in early language, still face problems in reading and/or spelling. Not all of the approximately 40% of all children belonging to the at-risk group showed early language problems (Lyytinen et al., 2004; Lyytinen et al., in press). When a child is at familial risk for dyslexia, practically any lifetime expression of developmental delay, even if it is observable in letter knowledge only, refers to a substantially heightened requirement for strengthening pre-reading skills before school age in order to guarantee a good start in the child's reading career. The collaborative play situation with the parents and the staff of day care centers provides an essential resource for enhancing sophisticated forms of language skills already in early childhood (e.g., Levenstein, Levenstein, Shiminski, & Stolzberg, 1998; Lyytinen, Eklund, & Lyytinen, 2003; see McCardle, Scarborough, & Catts, 2001 for a review of further knowledge concerning early identification and prevention of reading disorder).

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APPENDIX

Means, Standard Deviations, and Group Differences for Primary Scores of Language Measures

Measures	At-risk Group				No-risk Group				F <sup>c)</sup>	p		
	LT1 <sup>a)</sup>		LT2 <sup>b)</sup>		The remainder of the group		The remainder of the group					
	Mean	SD	Mean	SD	Mean	SD	Mean	SD				
2 Years												
Vocabulary Production (CDI)	57.70	39.81	87.25	72.88	305.92	135.79	33.10	39.24	321.36	138.50	25.26	.000
Maximum Sentence Length (CDI)	2.10	1.12	2.70	1.47	5.67	2.24	1.63	1.30	6.47	2.67	20.06	.000
Bayley Expressive Score	1.40	1.95	3.18	3.52	10.32	3.51	1.10	2.33	10.97	2.89	50.62	.000
2.5 Years												
Reynell Receptive	36.50	2.27	26.75	3.86	37.07	6.07	36.40	2.99	37.91	5.83	10.40	.000
Reynell Expressive	28.50	2.84	24.08	5.23	36.05	5.00	22.60	8.47	35.87	4.55	34.02	.000
3.5 Years												
Peabody Picture Vocabulary Test	34.00	9.33	24.09	8.25	38.05	14.98	42.44	10.63	39.07	15.62	2.98	.021
Comprehension of Instruction	10.11	2.42	8.08	2.87	12.05	3.53	12.50	2.59	11.97	3.54	4.32	.002
Inflectional Morphology Test	10.78	7.90	7.83	3.97	14.04	8.45	17.87	8.71	16.59	8.01	2.92	.023
Boston Naming Test	15.00	3.23	10.82	3.03	18.54	5.52	18.90	5.38	20.42	5.87	8.81	.000

(continued)

Means, Standard Deviations, and Group Differences for Primary Scores of Language Measures (continued)

Measures	At-risk Group				No-risk Group				F <sup>c)</sup>	p		
	LT1 <sup>a)</sup>		LT2 <sup>b)</sup>		The remainder of the group		The remainder of the group					
	Mean	SD	Mean	SD	Mean	SD	Mean	SD				
5 Years												
Peabody Picture Vocabulary Test	57.10	19.41	36.91	16.62	71.73	24.59	79.10	24.13	75.04	21.58	8.04	.000
Inflectional Morphology Test	51.40	12.38	30.00	15.07	50.04	18.47	56.70	17.83	56.28	17.24	6.35	.000
5.5 Years												
Boston Naming Test	31.40	6.53	25.50	8.67	34.75	5.86	35.90	6.24	35.88	5.52	8.68	.000
Comprehension of Instruction	19.20	1.87	14.83	2.66	18.65	2.96	18.60	3.06	19.56	2.55	7.93	.000

Note: <sup>a)</sup>LT1 = Late talkers1 (expressive delayed), <sup>b)</sup>LT2 = Late talkers2 (receptive and expressive delayed); <sup>c)</sup>dfs vary between 4,167 and 4,189 due to missing data on the single measures