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RECEPTIVE SKILLS OF HUNGARIAN CHILDREN WITH LATE LANGUAGE ONSET

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Late language emergence is diagnosed when language development trajectories are below age expectations and the delay cannot be explained by diagnosed disabilities or developmental delays in other cognitive or motor domains. The present study was motivated by the question whether a late onset of language emergence influences children's receptive skills when assessed at the later ages of 6 and 8. Fifty-two preschool children with a history of language onset at 3 years and another fifty-two schoolchildren with a history of language onset at 4 years were compared to fifty-two typically developing children. The children were matched on ages, articulation, and socio-economic status. Six subtests of the Hungarian standardized GMP test-package were used in individual assessment sessions. Children with language onset at 4 scored significantly below children with language onset at 3 irrespective of their chronological age, and all of the children with late language emergence performed below the level of the control subjects. The differences of receptive skills depending on language onset and the changes in children's performance at ages of 6 and 8 are discussed.

Keywords: late talkers, preschool and schoolchildren, receptive skills, individual differences

INTRODUCTION

Late language emergence is diagnosed when language development trajectories are below age expectations with no diagnosed disabilities or deve-

lopmental delays in other cognitive or motor domains (e.g., Zubrick et al., 2007; Desmarais et al., 2008; Rudolph & Leonard, 2016). There are other terms identifying children with late language onset and this developmental disorder, such as late talkers, late-talking children, late word producers, late word combiners, late language learners, specific expressive language delay, early developmental delay, late language emergence, expressive language delay, or developmental dysphasia, etc. (Tallal et al., 1991; Roos & Ellis Weismer, 2008; Perna & Loughan, 2013; Rudolph & Leonard, 2016). The prevalence of late language emergence in young children is reported to be 10–15% (Rescorla, 1989; Zubrick et al., 2007; Nouraey et al., 2021). Researchers' and clinicians' interest in this group of children began more than three decades ago with the seminal studies of Thal (1991), Paul (1991, 1992) and Rescorla (Rescorla & Merrin, 1998; Rescorla et al., 1997).

Studies have attempted to identify risk factors relevant to late language emergence (sociodemographic factors, maternal education, birth characteristics, family health and history, parenting and childcare, children's early behavior, etc.) and have investigated late talking children's language properties as well as the long-term outcomes (e.g., Campbell et al., 2003; Scheffner Hammer et al., 2017). Various predictive measures have been proposed for the identification of late talkers such as expressive vocabulary properties, lack of two-word combinations, MLU-number, percentage of intelligible utterances, receptive language (e.g., Rice et al., 2008; Perna & Loughan, 2013; Rescorla & Dale, 2013; Poll & Miller, 2013; Fischer, 2017; Farabolini et al., 2023). However, there is still little agreement about the criteria used to identify and classify children with late language onset. Late language emergence is a multifactorial disorder where no clear-cut reason or indication can be defined for all cases (e.g., Poll & Miller, 2013).

According to Scarborough (1990), 57% of late talkers showed delay after the onset of their language acquisition by one year. Forty four percent of late talkers showed delay at the age of 3 and 40% of them at the age of 4 (Dale et al., 2003). In other studies, delay in language development was shown in 71% of 4-year-olds (Rescorla et al., 2000) and in 92% of 5-year-old late talkers compared to typically developing children (Ellis Weismer, 2007). One hundred and twenty-eight children starting to speak at the age of 2 significantly underperformed from their age-matched controls, particularly in syntax, at the age of 7 (Rice et al., 2008). According to their findings, the prevalence of language disorders at age 7 was 20% for late talkers compared with 11% for controls.

The language performance of late talkers is below the age-required expectations which are reported by several studies (Gósy, 2002; Lyytinen et

al., 2005; Brooks & Kempe, 2014). For example, the delay of 8-year-old late talkers was demonstrated concerning all language skills analyzed, vocabulary, phonology, syntax, and sentence repetition (Paul et al., 1997; Rescorla, 2002). Comparing late talkers and typically developing children at the age of 10 significant differences were revealed in their reading skills and in mathematics (Perna & Loughan, 2013). 13-year-old late talkers showed delay in all analyzed fields of language development that were analyzed particularly in vocabulary, grammar, verbal memory and reading comprehension; however, they performed successfully in age-specific standard tests (Rescorla, 2005). Late talkers can show difficulties in sentence and nonword repetition (e.g., Ellis Weismer, 2007; Roos & Ellis Weismer, 2008), as well as in reading comprehension (Rescorla, 2005; Poll & Miller, 2013; Perna & Loughan, 2013).

Late talkers may show only expressive language delays (delayed vocabulary emergence and slow development of grammar and articulation) or there may be mixed expressive and receptive delays (language delay is demonstrated by both language comprehension and language production problems). Some children with late talking onset have been reported to show normal-range receptive language abilities while others had various levels of impairments in the same language skills. Consequently, Fisher (2017) emphasized the importance of accurately measuring receptive language when assessing and identifying late talkers.

There are late talking children who seem to catch up with their peers in various language skills between the ages of 3 and 5 demonstrating typical performance in various aspects of expressive and receptive language. These children were identified as late bloomers (Thal et al., 1991). Their scores, however, remain lower than those of children with a history of typical language development, particularly in language comprehension (Rescorla, 2000, 2002; Ellis Weismer, 2007). Many late bloomers still demonstrate atypical language development by late preschool and particularly at school age (e.g., Dale et al., 2003). Scarborough and Dobrich (1990) even use the term ‘delusory improvement’ for these cases. Perna and Loughan (2013) suggest that the late onset of language emergence remains a risk factor concerning the later language development and learning processes of children.

Studies on late language emergence focus mainly on speech production and far less on speech processing, speech perception and comprehension. The delayed development of receptive language is less conspicuous to the child’s family. Language emergence involves mapping form to meaning using underlying phonological information and the linguistic context (e.g., Pisoni

& Remez, 2005; Boets et al., 2007). Receptive speech processes are responsible for operations of both the lower levels of acoustic, phonetic and phonological patterns of speech and higher-level processing in terms of lexical access and comprehension. In the case of late language emergence, the receptive speech mechanism may develop atypically, resulting in various difficulties with any of the above processes. Late talkers may struggle considerably with both speech perception and verbal comprehension, but their difficulties may be less obviously apparent in everyday verbal communication. The question arises whether the late onset of language emergence still influences children's receptive skills when their language production skills are age-appropriate. There are a very few Hungarian studies concerning the late talkers' speech patterns (e.g., Gerebenné Várbíró, 1995; Gósy, 2002; Horváth, 2007), and no research has been conducted on speech processing performance of older Hungarian-speaking late talkers.

The purpose of this study was to investigate speech perception and comprehension processes of Hungarian-speaking preschool and schoolchildren whose language onset was delayed to either the age of 3 or the age of 4. Our target population consisted of children who had no additional developmental disorders in any motor or cognitive domain, like specific language impairment, attention deficit, hyperactivity disorder, intellectual/mental disability, autism spectrum disorder or learning disability (Miniscalco et al., 2006, Rudolph & Leonard, 2016; Perna & Loughan, 2013). We hypothesized that (i) children with language onset at 4 would show serious receptive impairments, (ii) children with language onset at 3 would show mild-to-moderate impairments, (iii) receptive language skills of late talkers would be significantly below those of typically developing children, and (iv) late-talking children would show different patterns in the severity of receptive language impairment depending on the tasks.

METHODOLOGY

Participants

Participants of this cross-sectional study included 156 monolingual Hungarian-speaking children divided into six experimental groups (see Table 1). Half of them were 6-year-old kindergarten pupils while the other half were 8-year-old second graders. The children were grouped by their language onset based on their parents' reports about the expressive vocabulary of their children and the existing two-word combinations at the ages of 3 and 4 as a main indicator to identify them as late talkers. According to parental reports,

all late talkers had a set of expressive words below 50 and failed to produce any two-word combinations at the ages of 3 and 4.

Two groups of children of both ages were late talkers while the third group of both ages served as controls. Twenty-six 6-year-old and twenty-six 8-year-old children had a history of language onset at 3 years. Another twenty-six 6-year-old and twenty-six 8-year-old children had a history of language onset at 4 years. Two groups of typically developing 6-year-old and 8-year-old children (with language onset between the ages of 12 and 18 months) formed the controls that matched on age, gender, and articulation skills (Table 1). A hearing screening was administered to each child before the data were collected. All of the children scored within normal hearing limits on a pure tone hearing screening that was administered bilaterally at 20 dB HL, using pure tones of 500, 1000, 2000, 4000, and 8000 Hz (measured in a sound-treated room). The cognitive functions of all children were within normal limits (using the same specific tests by speech pathologists), and they showed age-appropriate language production. All of the children in the control groups demonstrated age-appropriate articulation skills. The children's socio-economic status was similar. They came from working-class or middle-class backgrounds and attended regular public kindergarten (which is compulsory from the age of 3 in Hungary) or elementary school. All of the children with late language emergence had had access to typical speech-language therapy services and had undergone speech therapy for about 2-3 years.

Table 1. Number, age, gender and language onset of participants

Language onset	Participants: Late talkers and controls					
	6-year-olds			8-year-olds		
	mean age	age range	number of girls/boys	mean age	age range	number of girls/boys
at 3 years	6;4	6;1–6;7	5/21	8;4	8;2–8;7	5/21
at 4 years	6;5	6;3–6;8	5/21	8;5	8;3–8;9	5/21
typical onset	6;4	6;2–6;7	5/21	8;4	8;2–8;8	5/21

All children were examined on a test battery (developed for Hungarian), which assessed articulation and formulation of grammatical structures (Test for Language Proficiency and Test for the Examination of Articulation Disorders; Juhász, 1999). This study was approved by the Ethics Committee of the Hungarian Research Centre for Linguistics prior to its execution.

Materials

The materials used in this study comprised 6 tests taken from the Hungarian GMP standardized diagnostic tool for the evaluation of children's speech processing (Gósy, 2007). Data from 3 repetition tasks, a speech sound discrimination task, and a sentence and text comprehension task were analyzed. All stimuli were tape-recorded by a male speaker.

(i) Noisy sentence repetition test (referred to as NS): This assessment tool consisted of ten well-formed simple sentences (statements, questions, and commands) of various lengths containing 3 to 5 words, which corresponded to 7 to 12 syllables, e.g., *The lion is chasing the deer.* These sentences were masked by white noise (the signal-to-noise ratio was 4 dB on average). Sentences presented in noise offer an opportunity to obtain information about subject's receptive processing skills concerning acoustic cues of speech sounds. (ii) Fast sentence repetition test (FS): This measure consisted of 10 well-formed sentences. They were similar in length to those in the previous test but they had a complex morpho-syntactic structure, and they were artificially sped up by 1.5 times of their original speech tempo. The resulting average tempo of these sentences was 14 sounds/s. This repetition task was intended to check the children's accurate detection of rapid acoustic changes in speech. (iii) Nonsense word repetition test (NW): This test consisted of 10 nonsense words of varying length (between 5 and 12 speech sounds) that were consistent with Hungarian phonology and phonotactics. This test provided information particularly about the serial perception of speech sounds. (iv) Speech sound discrimination test (SSD): The test material consisted of 16 minimal pairs of nonwords (containing 3 to 5 speech sounds), e.g., *gev/bev* (the test also contained 7 identical nonword pairs). This test served to evaluate the children's ability to discriminate between speech sounds and will be referred to as the 'discrimination test'. (v) Sentence comprehension test (SC): Ten simple or complex sentences of varying length (between 5 and 11 words, and 12 and 19 syllables) were played to the children to evaluate their sentence comprehension ability. The sentences contained simple or complex morphological and syntactic structures. (vi) Text comprehension text (TC): A short (3.6-minute long) recorded story (about animals) was played to the children in order to assess their ability to comprehend a story.

Procedure

All children were tested individually by a certified speech-language pathologist in a quiet room. Sessions were conducted in the morning and lasted 20 minutes on average. Prior to administering the test, participants had

undergone a familiarization phase during which the tasks were explained. The participants were asked to immediately repeat the sentences and the nonwords that were played on speakers. Accurate repetition of the sentences by the participants meant preservation of the original word order and accurate production of all speech sounds. For nonwords, accurate repetition included preservation of the original order of speech sounds. Their task in the speech sound discrimination test was to judge whether the two nonword sound sequences were identical. Their 'yes' or 'no' answer was documented for each sound sequence pair, and the appropriate answers were averaged as a percentage correct for each child. In the sentence comprehension task, the children had to select the appropriate picture that corresponded to the meaning of the sentence they had heard. The selection of the picture was documented in each case as 'appropriate' or 'inappropriate' and the appropriate answers were averaged for each child in percentage. In the task of story comprehension, the children had to answer 10 questions concerning the contents of the story they had heard. The answers were judged by the first author as either 'appropriate' or 'inappropriate' based on the criteria written in the manual of the GMP diagnostic tool. The appropriate answers were averaged as a percentage correct for each child. The identification of the children's errors was made by both the first author and the speech therapist.

Statistical analysis

To investigate the hypotheses, we performed independent-samples *t*-test, one-way analysis of variance and Holm adjusted pairwise comparisons in all cases (R Core Team, 2024).

RESULTS

All typically developing children's scores were higher than those of late talkers (Table 2). The degrees of the differences seemed to be dependent on language acquisition onset, age and task. The majority of 6-year-old late talkers with language onset at 4 scored below those with language onset at 3 in all tests (Table 2). Similarly, the majority of 8-year-old late talkers with language onset at 4 underperformed those with language onset at 3 (Table 2).

Table 2. Performance of late talkers and typically developing peers in speech processing tests

Tests	data	Correct responses (%)					
		6-year-olds' language onset			8-year-olds' language onset		
		typical	at age 3	at age 4	typical	at age 3	at age 4
NS	mean	77.31	48.46	32.31	87.69	56.15	50.77
	SD	9.19	19.12	18.18	9.92	19.81	21.15
FS	mean	70.00	28.08	19.62	90.00	56.54	42.69
	SD	10.2	15.75	16.61	10.20	19.17	18.23
NW	mean	85.38	59.62	38.46	93.85	76.15	58.46
	SD	11.4	27.35	18.26	8.52	19.20	19.74
SSD	mean	84.69	55.46	47.19	94.45	80.41	60.65
	SD	7.49	30.35	24.53	7.45	10.80	27.15
SC	mean	94.62	76.54	60.38	92.31	88.46	73.08
	SD	7.61	14.68	15.62	6.52	11.20	20.55
TC	mean	85.00	59.62	28.08	93.08	76.92	59.23
	SD	9.9	27.35	21.17	8.84	20.93	26.22

Significant differences were found in almost all tests depending on the onset of language in both age groups (Table 3). No significant differences were found, however, between the two groups of late talkers depending on their language onset in fast sentence repetition (which yielded the poorest results with all late talkers) and in speech sound discrimination tests at the age of 6. There were two tasks, repetition of noisy sentences and sentence comprehension where no significant difference was found between the 8-year-old late talkers' groups.

Table 3. Statistical results depending on the three groups of 6- and 8-year-olds children with different language acquisition onset (LT = late talkers)

Tests	Statistical results			
	6-year-olds' three groups		8-year-olds' three groups	
	Univariate	Paired samples with Holm's correction	Univariate	Paired samples with Holm's correction
NS	$F(2,75) = 51.94$, $p < 0.001$	$p < 0.002$	$F(2,75) = 33.07$, $p < 0.001$	$p < 0.001$; for LT groups: $p = 0.348$
FS	$F(2,75) = 90.42$, $p < 0.001$	$p < 0.001$; for LT groups: $p = 0.065$	$F(2,75) = 57.39$, $p < 0.001$	$p < 0.002$
NW	$F(2,75) = 43.44$, $p < 0.001$	$p < 0.001$	$F(2,75) = 29.39$, $p < 0.001$	$p < 0.001$
TC	$F(2,75) = 49.02$, $p < 0.001$	$p < 0.001$	$F(2,75) = 18.57$, $p < 0.001$	$p < 0.001$
SC	$F(2,75) = 44.22$, $p < 0.001$	$p < 0.001$	$F(2,75) = 13.69$, $p < 0.001$	$p < 0.004$; for LT groups: $p = 0.137$
SSD	$F(2,75) = 19.18$, $p < 0.001$	$p < 0.001$; for LT groups: $p = 0.285$	$F(2,75) = 24.73$, $p < 0.001$	$p < 0.001$

We compared the participants' performance between the ages of 6 and 8 (Figure 1). In the case of children with language onset at the age of 3, no significant differences could be found depending on age in one test (NS: $t(50) = -1.42$, $p < 0.160$); though the 8-year-olds' score (on average) was numerically higher than that of the 6-year-olds. The older children performed significantly better in all the other tests (FS: $t(50) = -5.85$, $p < 0.001$, NW: $t(50) = -2.94$, $p = 0.005$, SSD: $t(50) = -3.95$, $p < 0.001$, SC: $t(50) = -3.29$, $p = 0.002$ TC: $t(50) = -2.56$, $p = 0.013$). In the case of children with language onset at the age of 4, all older children performed significantly better in all tests (NS: $t(50) = -3.38$, $p < 0.001$, FS: $t(50) = -4.77$, $p < 0.001$, NW: $t(50) = -3.79$, $p = 0.001$, SSD: $t(50) = -2.88$, $p = 0.047$, SC: $t(50) = -2.51$, $p = 0.015$ TC: $t(50) = -4.71$, $p = 0.001$). In the case of typically developing children, the older participants performed significantly better than the younger ones (NS: $t(50) = -3.92$, $p < 0.001$, FS: $t(50) = -7.07$, $p < 0.001$, NW: $t(50) = -3.03$, $p = 0.004$, SSD: $t(50) = -4.71$, $p < 0.001$, TC: $t(50) = -3.10$, $p = 0.003$) with the only exception of sentence comprehension (SC). Here, no significant difference could be obtained ($t(50) = 1.17$, $p = 0.246$).

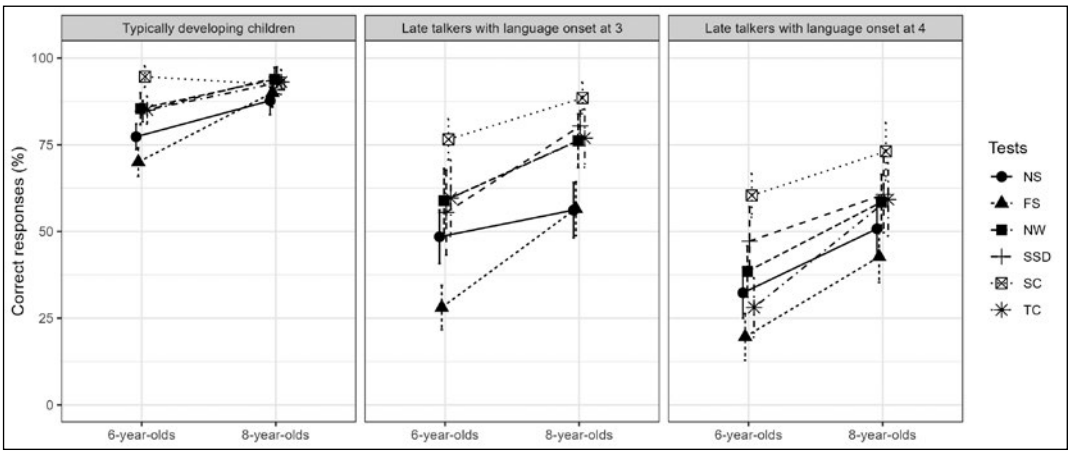

Figure 1. Performance of 6-year-olds and 8-year-olds depending on their language onset

The factor of task had a significant effect on the 6-year-olds' speech processing performance irrespective of their onset of language emergence (typical language onset: $F(5,150) = 20.52$, $p < 0.001$; language onset at 3: $F(5,150) = 13.04$, $p < 0.001$; language onset at 4: $F(5,150) = 14.72$, $p < 0.001$). The same significant results were obtained in the case of 8-year-olds $F(5,150) = 2.29$, $p < 0.048$; $F(5,150) = 15.04$, $p < 0.001$; $F(5,150) = 5.39$, $p < 0.001$, respectively). The figures support that the children performed differently in various receptive language tests.

CONCLUSIONS

Our data and the changes in scores between 6- and 8-year-old late talkers show that the patterns we gained are highly similar irrespective of age or the onset of language emergence. However, the scores were different depending on language onset. The later the language onset, the larger the receptive skill impairments later in childhood at ages 6 or 8.

Our hypothesis that children with language onset at 4 would show serious receptive impairments was supported by the data. The hypothesis that children with language onset at 3 would show mild-to-moderate impairments was not fully supported. The hypothesis that late talkers' receptive skills would be significantly below those of typically developing children was supported by the data. Our last hypothesis that late-talking children would show different patterns in the severity of receptive language impairment depending on the tasks could also be supported. All these findings can be explained in general by the fact that the contribution of diverse internal and external variables

to language development is far more complex when the onset of speech is delayed (Farabolini et al., 2023).

In general, late talkers achieved the best results in sentence comprehension and in speech sound discrimination tasks, followed by their performance in nonword repetition and in text comprehension. Their performance was the poorest, irrespective of language onset, in fast sentence repetition that needed complex morpho-phonological awareness and appropriate temporal processing to perform the test successfully (Tallal et al., 1991). For an explanation, we suggest that these tendencies correspond to the typical speech processing development of children. The more complex the receptive process, the more difficulties late talkers encounter.

At the age of 6, late talkers with different language onset showed similarly low scores in the repetition of fast sentences, and similarly moderate performance in the speech discrimination task. At the age of 8, the two groups of late talkers showed similar performance in the repetition of noisy sentences and in sentence comprehension. Their very similar performance in these tasks can be explained by the fact that children seemed to be accustomed to noisy surroundings and to listening to relatively short sentences frequently at school. The 6-year-olds showed a mild lag in sentence comprehension while 8-year-olds showed a mild lag both in speech sound discrimination and sentence comprehension. All children with late language onset had serious impairments in morpho-phonological processing and comprehension, foreboding and explaining difficulties in learning to read and write.

All typically developing children scored significantly higher than late talkers (Table 2). However, their performance is not steady across tasks, particularly in the case of 6-year-olds. In this age group, the difference between the best and poorest performance is more than 20%, on average while it is only about 7%, on average, in the case of 8-year-olds. These patterns show both developmental properties and also individual differences. Children with typical onset of language emergence did not show development between the ages of 6 and 8 in sentence comprehension, though their correct responses exceeded 90% at group level in the test already at the age of 6. Still, 8-year-olds showed several mistakes in the sentence comprehension task.

Analyzing the differences between the ages of 6 and 8, the increase of correct responses of the typically developing children was 9.06% (on average) while it was 17.8% (on average) in the case of children with language onset at 3 and 19.8% (on average) in the case of children with language onset at 4. Despite the improvement in late talkers' performance, they demonstrated remarkable delay comparing their performance to that of typically developing children. We suggest that it is impossible for all late talkers to catch up with

the typically developing children in the analyzed receptive language skills even by the age of 8. Apart from various similar findings (e.g., Paul, 1993; Dale et al., 2003; Poll & Miller, 2013; Roos & Ellis Weismer, 2008), brain imaging studies (e.g., Tallal et al., 1991; Gul et al., 2023) showed evidence for specific brain structures in late talkers. In the study of Preston and colleagues (2010) 174 elementary school children with early, on-time and late language onset showed that there were significant differences among children obtained by functional magnetic resonance imaging data during listening to and reading real words and pronounceable nonwords. These findings further support and explain the long-lasting effects of being a late talker.

The finding that children performed differently in various receptive language tests in all groups can be explained by both the characteristics of the typical development of receptive language and the effects of speech therapy in the case of late talkers, as well as the effects of teaching children to read and write in the case of all 8-year-olds.

The diagnosis and treatment of late talkers' language difficulties are at the interface between education, medicine and the allied professions, who may all adopt different approaches to interpret and manage them. Several studies concluded that late talkers' language abilities were critical to their academic success (e.g., Scheffner Hammer et al., 2017), particularly those who had receptive difficulties without any other motor or neurocognitive problems (Gósy, 2002; Lyytinen et al., 2005; Brooks & Kempe, 2014; Fisher, 2017). There are late talkers who seem to catch up on their delay when we evaluate their articulation, grammar or vocabulary size (e.g., Thal, 1991; Poll & Miller, 2013). Our findings showed that their seriously impaired receptive skills may be hidden for long years (Rescorla, 2002, 2005; Rescorla & Turner, 2015). Our findings indicate that (i) persistent difficulties with speech perception and comprehension exist beside the expected, age-relevant speech production, and (ii) children take different developmental pathways in language emergence from early childhood to school-age. Therefore, the receptive speech skills of both typically developing children and particularly late talkers should be systematically checked.

Our results highlight the need for therapy and for speech-language pathologists to be involved in improving late talkers' speech processing at school age, as well (e.g., Roos & Ellis Weismer, 2008). However, the problem is that not all late talkers are identified after entering school. We suggest that the onset of language emergence in first-graders should be checked through communication with parents, and late talkers should be thoroughly examined across various language fields.

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