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Reading Comprehension in Children With Specific Language Impairment: An Exploratory Study of Linguistic and Decoding Skills

Comprensión Lectora en Niños con Trastorno Específico del Lenguaje: Un Estudio Exploratorio de Habilidades Lingüísticas y de Decodificación

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The present study explored the relationship between linguistic and decoding skills in children with specific language impairment (SLI), inquiring whether reading comprehension is associated with linguistic or decoding skills in these children. Non-probability sampling was used. The sample consisted of 19 first grade Chilean students from 6 middle-low socioeconomic status schools in Santiago, Chile. They were 6 years old on average: 10 children with SLI (7 male) and 9 who displayed typical development (6 male). Participants were assessed on linguistic measures (mean length of utterance [MLU] and narrative), decoding, and reading comprehension. Descriptive analyses showed that the children with SLI exhibited difficulties in reading comprehension and decoding. Using Fisher's exact test, it was found that the children with SLI and low reading comprehension performed more poorly than the control group in narrative comprehension, narrative production, and MLU. This association was not observed between reading comprehension and decoding skills. The results suggest that linguistic abilities play a major role in the reading comprehension of children with SLI.

Keywords: SLI, reading, comprehension, language, decoding

El presente trabajo exploró la relación entre habilidades lingüísticas y decodificación en niños con trastorno específico de lenguaje (TEL), preguntándose si la comprensión lectora se asocia a las habilidades lingüísticas o a la decodificación en estos niños. La muestra fue no probabilística por conveniencia y estuvo compuesta por 19 estudiantes de 1º básico de 6 colegios de nivel socioeconómico medio-bajo de Santiago, Chile. Su promedio de edad fue 6 años: 10 niños con TEL (7 hombres) y 9 con desarrollo típico (6 hombres). Se evaluaron habilidades lingüísticas (promedio de longitud del enunciado y narración), decodificación y comprensión lectora. Los análisis descriptivos mostraron que los niños con TEL exhibían problemas en decodificación y en comprensión lectora. Utilizando la prueba exacta de Fisher, se encontró que los escolares con TEL y disminuida comprensión lectora mostraron desempeños menores que el grupo control en comprensión narrativa, producción narrativa y promedio de longitud del enunciado. Esta relación no se observó entre comprensión lectora y decodificación. Los resultados sugieren que las habilidades lingüísticas juegan un rol central en la comprensión lectora de los niños con TEL.

Palabras clave: TEL, lectura, comprensión, lenguaje, decodificación

Specific language impairment (SLI) is a deficit in children's language abilities without an underlying neurological or cognitive cause (Rice et al., 2010). Children with SLI may struggle in one or several areas: phonology, vocabulary, grammar, narrative, and pragmatics (Sanz-Torrent, Andreu, Badia, & Serra, 2010), showing a heterogeneous linguistic profile (Parisse & Maillart, 2009). In addition, there is extensive evidence showing that children with SLI may experience reading difficulties (Bishop & Adams, 1990; Ricketts, 2011; Snowling, Bishop, & Stothard, 2000).

Grammar is particularly affected in children with SLI (Leonard, Miller, & Gerber, 1999). Hence, it could be useful as a clinical marker for making diagnosis (Conti-Ramsden, 2003). One of the most frequently used

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measures to assess syntax is the mean length of utterance (MLU), which consists of the number of words or morphemes per utterance of a language sample (Rice et al., 2010). The MLU has been associated with reading skills since that of children with SLI at age four and a half is a strong and consistent predictor of later reading accuracy and reading comprehension (Bishop & Adams, 1990).

The ability to narrate stories implies both the mastering of complex language skills and pragmatic knowledge. In order to perform adequately, children need to understand causal and temporal relations between the events, grasp the local and global structure of the text, and have some knowledge about the elements of a story (Hughes, McGillivray, & Schmidek, 1997; Pavez, Coloma, & Maggiolo, 2008). It is also well documented that the quality of narrative comprehension (NC) and narrative production (NP) is associated with reading comprehension performance in children with SLI (Hughes et al., 1997; Vandewalle, Boets, Boons, Ghesquière, & Zink, 2012).

The simple view of reading (SVR) could be a useful framework to understand reading performance in children with SLI. The SVR claims that reading comprehension is the product of decoding and language comprehension, suggesting that a child needs to master both skills to fully comprehend a text (Hoover & Gough, 1990). In addition, decoding and reading comprehension are based on distinct skills: phonological abilities constitute the foundation of decoding, whereas language skills at both lower (i.e., vocabulary and grammar) and higher level (i.e., narrative knowledge, inference making, and comprehension monitoring) are the foundations of reading comprehension (Oakhill & Cain, 2012). Using the SVR to explain the reading problems of children with SLI suggests that their classic reading profile is determined by phonological, semantic, and grammatical limitations. The phonological difficulties might affect decoding skills, whereas the semantic and grammatical ones might impact comprehension (Bishop & Snowling, 2004).

Consistent with this classic profile of children with SLI, Sanz-Torrent et al. (2010) found that children with SLI showed low performance in both reading comprehension and decoding skills. However, other studies have shown that children with SLI could be divided in two groups: children with reading comprehension difficulties only and children with decoding difficulties but without reading comprehension difficulties (Kelso, Fletcher & Lee, 2007). In line with Kelso et al. (2007), Bishop, McDonald, Bird, and Hayiou-Thomas (2009) found that some children with SLI have reading comprehension difficulties but are good at decoding. Thus, the role of decoding in the reading comprehension of children with SLI is still not clear. Since decoding and reading comprehension are founded on different skills, a possible explanation could be that linguistic skills could be affecting the reading comprehension of the children with SLI who show typical decoding abilities.

Hence, the present study aimed to provide information regarding the role of linguistic skills and decoding in the reading comprehension of children with SLI. Specifically, we sought to establish to what extent the low reading comprehension of children with SLI is associated with linguistic abilities, on the one hand, and decoding skills, on the other.

Method

Participants

Two groups of children participated in this study: 10 children with SLI (7 male) and nine typically developing children (6 male) matched by age. The mean age of the group with SLI was 78 months ($SD = 2.9$). The mean age of the typically developing group was 81 months ($SD = 2.3$). All the children were in first grade, and the control group students were selected from the same classes of the children with SLI. We studied this year group because children are starting their formal reading training on. All the children that met the criteria explained below were included in the sample.

Using a non-probabilistic convenience sampling, we recruited children from six medium-low socioeconomic status (SES) schools of Santiago, Chile, that had integration programs for children with special educational needs and that agreed to collaborate in the study. Four of the schools were public (10 children; 5 with SLI), and the other two were private with vouchers (9 children; 5 with SLI). The private schools with vouchers represent a shared funding system. In Chile, school type is closely related to SES (Bellei, 2007). The Chilean Ministry of Education classifies schools in five SES groups according to the average years of schooling of the parents and the average family income. Our public schools belonged to groups A and B, which means that parents have an average of 8 and 10 years of schooling, respectively, ($SD = 1$) and an average monthly family income between US$ 285 and US$ 420. The private schools with vouchers included in our study belonged

to group C. Group C has parents with an average of 12 years of education (*SD* = 1) and an average monthly income equivalent to about US$ 643.

All participants were monolingual Spanish-speaking children. In addition, all children showed nonverbal IQs within the normal range (> 25 percentile) on the Raven's Coloured Progressive Matrices (Raven, 2005) and did not show hearing impairment (audiometry ≥ 20 dB; American Speech-Language-Hearing Association, 2005). Children in the group with SLI were previously diagnosed as having SLI by the speech-language therapist at their respective school. This diagnostic was carried out according to Chilean norms; more specifically, children need to show low performance in two tests that are standardized in Chile, together with a physical and psycho-educational exam (Chile, Ministerio de Educación, 2010).

Given that grammar is a clinical marker for identifying SLI (Conti-Ramsden, 2003), in addition to the given diagnosis, we re-assessed all children with SLI to confirm the low performance in grammar, using the Exploratory Test of Spanish Grammar by A. Toronto (Pavez, 2010). We selected children with expressive and/or comprehensive deficit (< percentile 10) for the group with SLI. We included children who scored above the 25th percentile in the control group. Through a clinical observation, the speech-language therapist from the school confirmed that children in the control group showed typical development in terms of language skills.

Regarding the small sample size, it is important to note that the strict diagnosis criteria of SLI often make it difficult to use big samples, thus, many studies of children with this disorder have a limited number of participants (e.g., Acosta, Moreno, & Axpe, 2012; Anderson & Souto, 2005; Contemori & Garraffa, 2010; Domsch et al., 2012; Marinellie, 2004).

Measures

Mean Length Utterance (MLU). The MLU was obtained from a language sample. In order to determine topics of interest for children aged six years old, we carried out a pilot study. Some of the topics we selected were: cartoon of interest, recreational activities at home, and school activities. To obtain the sample, a trained examiner was first familiarized with the aforementioned topics. Then, the examiner started a conversation with the child following some directions: using a conversational tone, promoting expansions during the conversations, avoiding close-ended questions, among others.

The conversation was recorded and later transcribed by two trained assistants. We analyzed each conversation starting from the 21st utterance. We calculated the inter-rater reliability for the number of utterances and number of words in four conversations, yielding a 95% of agreement between coders. Discrepancies were solved through discussion.

We calculated the MLU score taking into account the average number of words per utterance. We did not code reformulations, repetitions, false starts, or interjections.

Narrative skills. We used the Test for Evaluating Narrative Development by Pavez et al. (2008; Evaluación del Discurso Narrativo [EDNA] in Spanish), which is validated in Chile, in order to assess children's NC and NP. Children's responses were recorded and transcribed by trained assistants following the test criteria. The analyses of NC and NP were conducted by one of the researchers following the criteria of the test.

The test has two subtests:

Narrative production subtest. We asked children to retell three stories previously read by the examiner. For each transcript the following categories were identified and scored: setting and initiating event, episode, and ending. Each category received 1 point, except for the episode, which received 2 points. There was no maximum score for this task, as children could include as many episodes as they wanted (Cronbach's α = 0.84).

Narrative comprehension subtest. The task required that children answer a set of 20 literal and nine inferential questions about the same stories used in the NP subtest. The first story included six literal questions, whereas the second and third stories included seven questions of this type. All the stories considered three inferential questions. Literal questions received 1 point, while inferential ones received 2. The task has a maximum score of 38 points (Cronbach's α = 0.77).

Reading. We examined decoding and reading comprehension through the standardized test known as Prueba de Complejidad Progresiva de Lectura (Himmel & Infante, 2007). The analyses were conducted by one of the authors following the criteria set for each test.

Decoding subtest. In the decoding task, we asked children to read aloud letters, syllables, words and pseudo-words. Each item received 1 point with a maximum of 75 points (Cronbach's $\alpha = 0.97$).

Reading comprehension subtest. To test reading comprehension children carried out two tasks. First, they were presented with a sentence (from a set of 10) that they had to read and then match up to a picture from a choice of three pictures. In the second task children had to read two narrative texts silently and then answer multiple-choice questions about them. There were a total of 22 items and each correct response received 1 point (Cronbach's $\alpha = 0.88$).

We classified children in all target variables into the following categories: difficulties and typical development, as shown in Table 1.

Table 1
Classification Criteria According to Test Performance

Classification	Tests raw scores				
	MLU[a]	NC[b]	NP[b]	Decoding[b]	Reading comprehension[b]
Difficulties	≤ 4.38	0-24	0-11	0-57	0-13
Typical development	≥ 4.57	25-38	≥12	58-75	14-22

[a] MLU performance was defined according to age equivalent scores proposed by Rice et al. (2010): Difficulties correspond to performance of children aged up to 5 years old.
Typical development correspond to performance of children aged 6 or more.
[b] Typical development: ≥ 25 percentile.

Procedure

The principals of the schools and parents were invited to participate in the study and had to sign a consent form that was previously approved by the Human Research Ethics Committee of Universidad de Chile' Faculty of Medicine. Ethical clearance was obtained in July 2009. In addition, each child was individually asked by a teacher if he/she would like to take part in a language activity. They were told that participation was voluntary and that they could stop their participation at any time without any consequences. We included in the study only children who agreed to participate.

A speech-language therapist assessed each child individually in a quiet room of the school. There were four sessions of approximately 20 minutes each. These evaluated auditory skills, grammar and non-verbal IQ, narrative skills and MLU, decoding, and reading comprehension. At the end of the study, only general results were informed to the speech-language therapist (or equivalent) in charge of the integration project.

Analysis Plan

The data of the two groups (SLI and typical) are described and compared. Then, all performances are analyzed qualitatively by looking at the frequency of low performance in each variable in both groups. Finally, the association between reading comprehension ability and language and decoding performance is tested using Fisher's exact test. Considering the small sample size, we carried out four 2 (typical and low reading comprehension) x 2 (typical and low performance in MLU, narrative, and decoding) Fisher's exact tests to test whether children with SLI and low reading comprehension also showed low linguistic and decoding skills.

Results

We show the descriptive statistics for MLU, narrative skills (NC and NP), decoding, and reading comprehension in Table 2. The scores indicated that all measures were within the normal range. None of the measures suffered from floor or ceiling effects and the score ranges were reasonable, so we conducted all the subsequent analyses using the raw data.

Table 2
Means, Standard Deviations, and Range of Scores for MLU, Narrative Skills, Decoding, and Reading Comprehension of Children

Variable	SLI (n = 10)		Control group (n = 9)		t	p	95% CI	d
	M (SD)	Range	*M (SD)*	Range				
MLU	4.76 (1.41)	3 - 7.4	6.85 (1.83)	3 - 9.86	-2.80	0.012	[-3.66, -0.52]	1.28
NC	22.50 (7.40)	13 - 36	28.67 (4.27)	19 - 32	-2.19	0.043	[-12.10, -0.23]	1.00
NP[a]	9.83 (3.22)	4 - 15	11.28 (2.17)	7.75 - 14.5	-1.13	0.272		
Decoding	44.00 (24.77)	0 - 75	70.56 (7.37)	52 - 75	-3.09	0.007	[-44.70, -8.40]	1.41
Reading comprehension	10.50 (7.89)	0 - 21	19.11 (2.80)	15 - 23	-3.10	0.007	[-14.48, -2.74]	1.42

[a] There is no maximum score.

According to the criteria we present in Table 1, most children showed difficulties in reading comprehension and decoding (60% and 70%, respectively). In contrast, all the children in the control group showed typical development in both reading measures.

In Figure 1 we show the distribution of the linguistic and decoding performance of children with SLI and both with and without reading comprehension difficulties. In our sample, most of the children with SLI and compromised reading comprehension showed impaired linguistic and decoding skills. On the other hand, children with SLI with typical reading comprehension showed no deficit in MLU and mild to medium difficulties in narrative skills and decoding.

Results revealed a direct relation between performance in reading comprehension and linguistic skills. More specifically, children with SLI showing low reading comprehension were more likely to also show low MLU (p = 0.048), poor NC (p = 0.033), and poor NP (p = 0.033). However, we did not find a significant association between low reading comprehension and low decoding (p = 0.500) in our sample of children with SLI.

Discussion

The results show variations in the reading comprehension performance of children with SLI but not in typically developing children, who were all within the normal range. Our main finding is that linguistic skills in children with SLI were associated with reading comprehension performance, whilst decoding was not.

In line with the heterogeneous profile of children with SLI, we found that not all of them showed low performance in linguistic skills. We also found that not all children with SLI showed low reading comprehension and/or decoding skills, which is not surprising, as it has been previously documented in the literature (Bishop & Adams, 1990; Catts, Fey, Tomblin, & Zhang, 2002). One alternative to explain the variability in the reading ability of children with SLI could be their different linguistic skills performance. In our study, most children with SLI and low reading comprehension also showed low linguistic skills at the sentence and discourse level (MLU and narrative), whereas children with typical reading comprehension showed difficulties at the discourse level (narrative skills), but not at the sentence level (MLU).

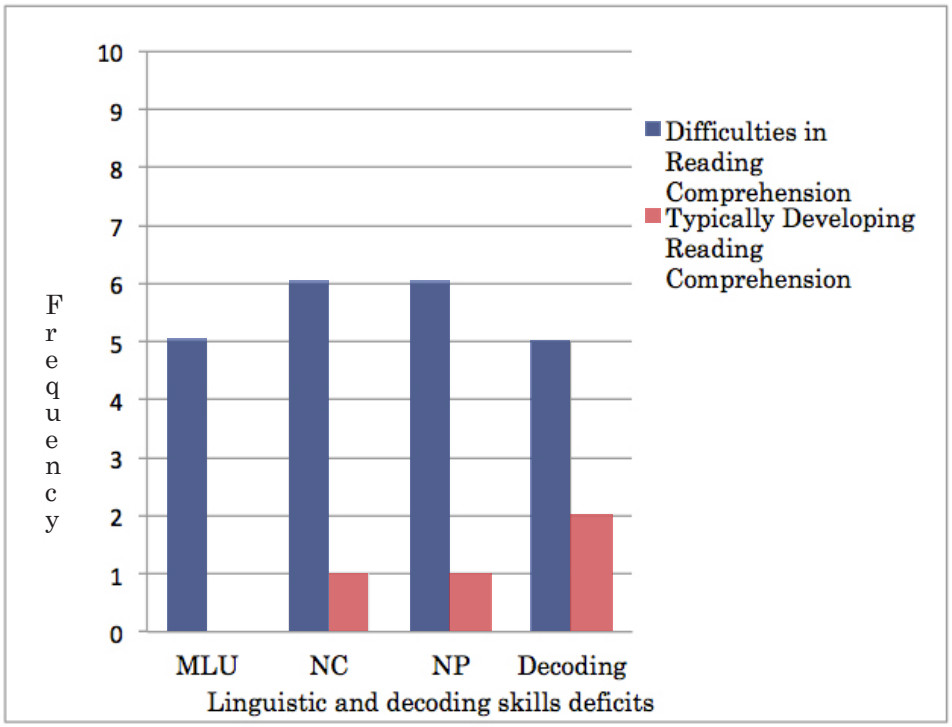

Figure 1. Reading comprehension in children with SLI. Frequency of children with SLI showing difficulties and typical development in reading comprehension that show deficit in MLU, NC, NP, and decoding.

This finding suggests that if children exhibit difficulties at both the discourse and the sentence level, they are more likely to have impaired reading comprehension skills. However, the fact that some of the children who showed difficulties with narrative measures performed well at the sentential level implies that they have an unimpaired building block at least at the lower level of oral language. That would explain why their reading comprehension was not affected. This is also consistent with the reading comprehension measures we used in this study, which included two tasks, one mostly assessing sentence comprehension and another assessing narrative comprehension. In addition, children with SLI and reading comprehension difficulties showed more linguistic abilities in the lower range (MLU, NP and NC), a result that is consistent with Catts et al. (2002), who found that the severity of linguistic skills impairment was related to reading comprehension performance in children with SLI. In addition, we found that most children with SLI showed low decoding and reading comprehension, which is consistent with the classic SLI profile proposed by Bishop and Snowling (2004).

The main objective of this study was to inquire whether an association exists between reading comprehension performance and linguistic skills, and decoding. Regarding linguistic abilities, our findings showed that MLU was related to reading comprehension, which is consistent with previous findings (Bishop & Adams, 1990). However, it is not yet clear why the MLU could be related to the ability to grasp the meaning of a written text. It is known that sentence-level grammatical knowledge constitutes a building block to develop higher language comprehension (Oakhill, Cain, & Bryant, 2003), because it is necessary to process units of meaning at different levels, in this case, sentence level, to build a mental model (Perfetti, Landi, & Oakhill, 2005). Thus, the MLU as a proxy measure could be accounting for the syntactic knowledge that is necessary for children's comprehension.

Narrative skills were also observed to be related to reading comprehension. This finding was expected, given that the ability to produce and comprehend a story requires many of the skills that are also necessary to understand written texts, like the mastery of oral language skills and memory, as well as the ability to construct meaning and integrate events in a coherent representation (Oakhill & Cain, 2012).

The relation we found between linguistic skills and reading comprehension confirms the effect of linguistic deficits on reading performance in children with SLI. More specifically, it highlights the key role of syntactic and narrative abilities in reading comprehension.

We did not find an association between decoding and reading comprehension. This finding is in line with other studies that report an unequal performance in decoding and reading comprehension skills in children with SLI (Bishop et al., 2009; Kelso et al., 2007). Of note is that in our sample most children with SLI and reading comprehension difficulties also showed low decoding performance, which would fall within a classical SLI profile with deficits in decoding and reading comprehension (Bishop & Snowling, 2004). The lack of a significant association between decoding and reading comprehension may be better explained by the variability in the children with SLI and typical reading comprehension: half of them showed low decoding while the other half displayed typical decoding. Thus, in this group decoding is not consistently associated with typical comprehension. In other words, appropriate reading comprehension in children with SLI cannot be attributed only to decoding, whereas low reading comprehension could be related to decoding and linguistic skills.

In sum, our study suggests that the influence of linguistic skills (MLU and narrative) on reading comprehension in children with SLI goes beyond decoding.

One limitation of our study is that we recruited only 10 children with SLI. As we have already mentioned, SLI is a heterogeneous disorder and, therefore, one that is difficult to properly diagnose. In the current study, we re-assessed children using additional criteria to consider them as having SLI. That is, they were required to show that their auditory acuity and nonverbal skills were within the normal range, whereas their grammar skills needed to be at a lower typical range. This re-assessment procedure reduced the original sample. The small sample size resulted in limited statistical power; consequently, the type of statistical analysis we used did not allow us to reach definitive conclusions. Post hoc power analyses showed that a sample of 30 individuals per group would be needed to obtain the appropriate power (0.8). In spite of this, we believe that the results show a tendency that is worthwhile attending to in future investigations.

Another potential limitation relates to the use of MLU as a linguistic measure. Despite the fact that MLU is widely used in the field, it is just a proxy measure of syntactic skills. It is limited as it only considers utterance production. Future work should include more fine-grained measures of syntactic skills in order to disentangle what aspects of syntactic knowledge actually underpin comprehension skills.

Further research might try to explain the relation between linguistic skills and reading comprehension in children with SLI, studying some cognitive aspects that could be sustaining this relation. For example, memory could be mediating the relation between narrative abilities and reading comprehension. There is evidence of a direct correlation between narrative skills and working memory in children with SLI (Duinmeijer, de Jong, & Scheper, 2012; Wellman et al., 2011). Thus, by controlling the influence of working memory on language tasks, a different picture might appear that could inform the current findings in a more comprehensive way.

Finally, our preliminary findings suggest that it is important to conduct systematic work on linguistic skills—grammar and narrative—in children with SLI. This means creating developmentally appropriate activities that gradually increase in complexity. Teaching activities should combine the sentence and discourse levels to promote the integrated learning of these aspects.

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