Development of grammaticality and sentence complexity in monolingual Spanish-speaking children with specific language impairment: An exploratory study[1]

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Resum. Desenvolupament de la gramaticalitat i la complexitat de les oracions en nens monolingües de parla espanyola amb deficiències lingüístiques específiques: Un estudi exploratori. Aquest estudi inspecciona el desenvolupament de la gramaticalitat i la complexitat de les oracions en nens que parlen castellà amb trastorn específic del llenguatge (TEL). Quaranta set nens es van agrupar segons l'edat (4-5 i 6-7 anys) i els diagnòstics (TEL i desenvolupament típic del llenguatge, DTL). Les narracions orals dels nens es van analitzar tenint en compte la gramaticalitat i la complexitat de les oracions. Els resultats van mostrar que els nens amb TEL i DTL segueixen un patró de desenvolupament similar, tant en la gramaticalitat com en la

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complexitat de les oracions. Tanmateix, tot i que la complexitat de la frase dels nens amb TEL és similar a la complexitat de les frases dels nens amb DTL, els nens amb TEL són més poc programàtics que els nens amb TLD. Finalment, es va observar que la correlació entre oracions complexes i oracions no programàtiques evoluciona de manera diferent amb nens amb TEL i amb DTL.

Paraules clau: trastorn específic del llenguatge, gramaticalitat, complexitat semàntic, problemes morfosintàctics.

Abstract. Development of grammaticality and sentence complexity in monolingual Spanish-speaking children with specific language impairment: An exploratory study. This study inspects the development of grammaticality and sentence complexity in Spanish-speaking children with specific language impairment (SLI). Forty-seven children were grouped following age (4-5 and 6-7) and diagnostics (SLI and Typical Language Development, TLD). Children's oral narratives were analyzed considering grammaticality and sentence complexity. Results showed that children with SLI and TLD children follow a similar developmental pattern, both in grammaticality and sentence complexity. However, although the sentence complexity of children with SLI is similar to the sentence complexity of children with TLD, children with SLI are more ungrammatical than children with TLD. Finally, correlation between complex sentences and ungrammatical sentences was found to evolve differently when considering children with SLI and children with TLD.

Keywords: specific language impairment, grammaticality, syntactic complexity, morphosyntactic problems.

1. Introduction

Specific language impairment (SLI) denotes a developmental disorder (Tomblin, 2009) impacting spoken language in the absence of any auditory, cognitive, social, or neurological difficulties (Leonard, 2014). Children with SLI have troubles with oral language, usually both when speaking and when processing speech, which ultimately hinders their communication practices (Botting, 2014). One linguistic especially problematic dimension is morphosyntax (Bedore & Leonard, 1998; Leonard, Miller & Gerber, 1999). Morphosyntactic problems among children with SLI vary depending on the language they acquire (Leonard, 2014). Literature on Spanish-speaking children with SLI has mostly studied children who have acquired Spanish along with a second language (Hincapié, Giraldo, Castro, Lopera & Pineda, 2007). Studies focused on grammatical behavior conducted among monolingual Spanish-speaking children with SLI are sparse (Jackson-Maldonado & Maldonado, 2017) but confirm the developmental challenges posed by morphosyntax. For instance, Auza and Morgan (2013a) reported that children

with SLI produce articles significantly less often than their linguistic and chronological controls (for another related study on this subject, see Anderson & Souto, 2005). Bedore and Leonard (2001, 2005) found that children with SLI have troubles with clitic pronouns both when engaged in cloze tasks requiring filling in with pronouns and when engaged in spontaneous speech. Auza and Morgan (2013b) reported that children with SLI omit prepositions more frequently than their linguistic and chronological controls during retelling tasks.

Verbal inflection is another grammatical dimension that has been studied in the literature. Bedore and Leonard (2001) found that Spanish-speaking children with SLI perform lower than their chronological peers when using past tense and present tense in controlled tasks, even if their performance was similar to a control group matched by linguistic age. The same authors, however, reported no differences between children with SLI, chronological peers, and linguistic controls when observing spontaneous speech (Bedore & Leonard, 2005). Failure to mark tense on verbs has been explained by positing that children with SLI go through an extended optional infinitive stage, as it is in the case of the overuse of non-finite forms when an inflected form is actually required (Grinstead et al., 2013; Grinstead et al., 2014). Children with SLI are also challenged by inflections of mood, time, and person —particularly when irregular verbs are involved— and have problems with derived words (Buiza, Rodríguez-Parra, González-Sanchez & Adrián, 2016). Overall, however, Spanish-speaking children with SLI seem to be less troubled by verbal inflection than their English-speaking peers (Guasti, 2017). All of these morphosyntactic problems directly impact sentence grammaticality. Literature has shown that monolingual Spanish-speaking children with SLI produce more ungrammatical sentences than similarly aged children with Typical Language Development (TLD) (Coloma, Araya, Quezada, Pavez & Maggiolo, 2016; Jackson-Maldonado & Maldonado, 2017). Also, they tend to produce more ungrammatical sentences when engaged in storytelling than when engaged in conversations, with sentence complexity also playing a role in their ungrammaticality (Pavez, Coloma, Araya, Maggiolo & Peñaloza, 2015).

As for sentence-level syntactic complexity, studies suggest that children with SLI produce a similar number of complex sentences when compared to children with TLD (Coloma et al., 2016; Jackson-Maldonado & Maldonado, 2015). When considering paratactic relations (juxtaposed and coordinated clauses) and hypotactic relations (subordinated clauses), children with SLI have been reported to produce more paratactic relations than typical children, although the difference is not statistically significant (Alfaro, Crespo & Alvarado, 2016). Also, children with SLI seem to be less troubled by simple sentences than by coordinated sentences (Buiza et al., 2016). Acosta, Axpe and Moreno (2014) reported that children with SLI perform lower than control groups when producing complex sentences. Production-related problems seem to be more prevalent as sentence complexity increases; temporal, final, comparative, and relative constructions are particularly challenging (Buiza et al., 2016).

In sum, evidence suggests that monolingual Spanish-speaking children with SLI tend to be challenged by grammar. However, not much is known about how their grammar-related problems evolve over time (Barako Arndt & Schuele, 2012). Zwitserlood, van Weerdenburg, Verhoeven and Wijnenc (2015) conducted a longitudinal study with Dutch children in which they presented a fine-grained look at evolution of morphosyntactic accuracy and grammatical complexity, reporting different patterns of change depending on the dimensions observed. Barako Arndt and Schuele (2013) reviewed the literature on syntactic complexity and showed that findings point at an early emergence of complexity, with children with SLI lagging behind children with TLD both in terms of proficiency and pace of development. There is not much data available regarding monolingual Spanish-speaking children. One study by Pavez et al. (2015) reported that production of ungrammatical sentences decreases among children with TLD between four and six years old, while children with SLI produce similar rates of ungrammatical sentences when aged four and when aged six. The same happens with complexity, with children with TLD increasing the production of complex sentences by six years age and children with SLI remaining at the same level of production they attained when aged four. Still, the question about how grammaticality and sentence complexity evolves among monolingual Spanish-speaking children with SLI is rather underexplored. Because of this, the present study was conceived to explore how the production of grammatical sentences and sentence complexity evolves among monolingual Spanish-speaking children. Due to the lack of data regarding this question, the answer might contribute to improve our general understanding of the problem.

Two groups of children with SLI (aged 4-5 and 6-7) and two groups of children with TLD (also aged 4-5 and 6-7) were observed. Three questions drove this study: 1) are children with SLI aged 4-5 different from children with SLI aged 6-7 when considering sentence grammaticality and sentence complexity?; 2) are children with SLI different from their age-typical development peers on sentence grammaticality and sentence complexity?; 3) does the possible correlation between sentence complexity and ungrammaticality vary with age?

2. Method

2.1. Participants

Sample consisted of 47 children grouped by age range and diagnostics. Descriptives are provided in Table 1.

Since age-grouping was central for this study and since children with TLD were not matched by age with their peers with SLI, analyses were conducted to confirm that groups were indeed balanced. Thus, two t-tests were implemented considering months of age as the dependent variable and diagnostics as the independent variable. Results were $t(23)=1.11$, $p=0.28$ (4-5 age-range) and $t(23)=2.34$, $p=0.03$ (6-7 age-range), which

means that months of age for TLD children in 6-7 group were significantly higher than children with SLI's in the same range. To make sure that this difference did not involve a major bias in the established age-grouping, the impact of age expressed in months was compared against age-range by means of several regression tests. The rationale for this comparison was to determine whether months of age predicted ungrammaticality and/ or complexity differently. Two simple regression models were fitted with ungrammatical sentences as the outcome variable. The first model included age (expressed in months) as a continuous predictor. The second one's predictor was age-range (four-level grouping factor). Inspection of R^2 values for both models and p-values for coefficients showed that age impact was almost exactly the same whether expressed in months or age groups. The procedure was subsequently replicated adopting complex sentences as the outcome variable, overall values being very close to the ones previously observed. Possible covariant effects were inspected for age expressed in months, with no significant results. Therefore, statistical differences in months for 6-7 years of age were deemed as non-consequential inasmuch as months of age impact on selected outcome variables is almost exactly the same as age-range grouping. In this study, then, age effect was operationalized and observed as a grouping factor.

Table 1. Disaggregated sample descriptives

	n	Male	Female	Months	School
SLI (4-5)	12	6	6	54.25(3.7)	Language
TLD (4-5)	12	7	6	56.33(5.3)	Regular
SLI (6-7)	12	9	4	78.25(2.93)	Regular
TLD (6-7)	11	7	499	80.82(2.32)	Regular

The sample was drawn from 6 schools with integration programs (children with special needs supervised by specialist through a school-based program) and two language schools attended solely by children with SLI. SLI was diagnosed by a speech therapist meeting the requirements of the Decree 170/2010 of the Chilean Ministry of Education (Ministerio de Educación de Chile, 2010). Decree 170/2010 states that language must be assessed using standarized tests for diagnosing comprehension and/or production disorders. Tests focused on language production assess phonology, grammar and vocabulary. Scales focused on comprehension address grammar and vocabulary. For SLI to be diagnosed, the child must perform below norm in two subtests or more. A pedagogical assessment and a psycho-pedagogical evaluation must also be conducted. Auditory disorders are to be controlled, as well as any other disorder that might impact linguistic learning. Should a child be suspected to be intellectually disabled or undergoing emotional instability, a report by a psychologist must be obtained (Ministerio de Educación de Chile, 2010).

As for children with TLD, they were first selected by consulting a report by each child's teacher.

Once this first sample was gathered, all participants were screened for normal hearing following the ASHA international standards (American Speech-Language-Hearing Association, 2005). Auditory performance was screened for hearing impairment at 500, 1000, 2000, and 4000 Hz frequencies. Following ASHA guidelines, normal hearing intensities are located at or below 20 dB. Non-verbal cognitive skills, measured by the Raven's Progressive Matrices (Raven, 2005), were also defined as an inclusion criterion. Only children at or above the 25th percentile were included in the final sample.

Children complying with hearing and cognitive skills standards were assessed and grouped following the Allen Toronto's Exploratory Test of Spanish Grammar (Pavez, 2010). This test is the Chilean adaptation of the American 1973's Toronto test, normed for Spanish-speaking population in 1980. It provides norms valid for Chilean infant population. This test has been successfully used to distinguish Chilean children with SLI from children with TLD in a variety of studies (Pavez, Coloma, & Gonzalez, 2001; Pavez et al., 2015; Alfaro et al., 2016). The test comprises two sub-tests: grammatical expression and grammatical comprehension. Reliability was inspected by correlating test / retest scores. Pearson's correlation coefficients are r(59)=0.77 for the expressive subtest, and r(59)=0.83 for the receptive subtest. Items in this test address the following linguistic forms: sentences (affirmative, negative, and passive), pronouns (personal: clitics and non clitics, indefinite, demonstrative, relative, and interrogative), verbs (verb tense, third-person verbs, linking verbs), some prepositional locutions and adjectives (possessive and interrogative). Children's performance is classified as follows: impaired (≤ 10th percentile), descended (≥ 10th and < 25th percentiles), and typical (percentiles ≥ 25th). In this study, all children with SLI scored at impaired level. Therefore, they all had a grammatical deficit, whether expressive, comprehensive, or both. As for TLD children, they all scored within normal range. Children scoring at descended level were excluded from the final sample. Informed consent by parents or caregivers was obtained for all participants.

Thus, SLI was confirmed resorting to three sources. The first one was the speech therapist diagnostics meeting the requirements of the Decree 170/2010 of the Chilean Ministry of Education (Ministerio de Educación de Chile, 2010). The second one was normal performance on cognitive and hearing measures. The third one was low performance on grammar tests.

2.2. Materials and procedure

Children were summoned to an individual session and asked to complete a narrative discourse protocol —EDNA— (Pavez, Coloma & Maggiolo, 2008). This protocol involves listening to three narratives. Narratives must be read aloud by the examiner, not supported by any kind of visual clues. Subsequently, participants are asked to retell

each story (one at a time). Narratives were preferred over spontaneous conversation because children typically produce more complex syntactic structures in this genre (Gutiérrez-Clellen & Hofstetter, 1994; Pavez et al., 2001). Sessions were recorded and subsequently transcribed by trained speech therapists and linguists following the EDNA test's guidelines (Pavez et al., 2008). All transcribers were trained to correctly implement EDNA's criteria and guidelines when transcribing their narratives. After this training, they were asked to collectively transcribe one narrative, which was subsequently jointly analyzed and discussed. This process allowed transcribers to identify difference of opinion and divergence of criteria before actually transcribing the real narratives. Once this process was completed, narratives were finally assigned and transcribed.

Transcriptions were subsequently analyzed by two of the authors of this study to identify simple/complex and grammatical/ungrammatical sentences. First, a criterion determining the concept of sentence was defined. The adopted definition considered sentences as minimum units of predication consisting of a subject and a predicate (Bosque, 2010). Secondly, criteria were determined to establish complexity and ungrammaticality (see below). Transcribed narratives were then jointly analyzed. Whenever an ambiguous case emerged, criteria were debated and revised if necessary. Consensus between authors when identifying and counting simple/complex sentences was high (98.8%), as was consensus for grammatical/ungrammatical sentences (98%). Disagreement was resolved by mutual accord. Adopted criteria to classify the sentences produce by children were:

a. Sentence complexity: all sentences were classified as either simple or complex. Simple sentences included a single predicate nucleus and no subordinate clauses (e.g. *Ellos le pusieron una trampa* 'They placed a trap'). Complex sentences were defined as sentences comprising a subordinate clause (e.g. *El lobo se robó la estufa porque hacía frío* 'The wolf stole the heater because it was cold').

b. Sentence grammaticality: sentences were labeled as ungrammatical whenever any of their morphosyntactic elements did not comply with Spanish canonical syntactic organization or were morphosyntactically inaccurate (Zwitserlood et al., 2015). An example of such problems can be seen in the lack of verbal concordance in the Spanish sentence (e.g.*Los conejitos lo invitó a su casa* 'The bunnies [+ erroneous 3rd person singular inflection of *invite*] him home'. Note that Spanish errors are not fully translatable into English. Most frequent morphosyntactic errors involved articles, clitic pronouns, prepositions, and verb conjugation. Thus, the number of ungrammatical sentences can be considered a measure of morphosyntactic accuracy. The higher the number of ungrammatical sentences, the lower the level of morphosyntactic accuracy.

Studies in SLI have traditionally worked with the notions of simple/complex sentences and grammatical/ungrammatical sentences (Coloma et al., 2016; Jackson-Maldonado & Maldonado, 2017; Pavez et al., 2015; Zwitserlood et al., 2015).

3. Results

Data were analyzed and plotted with R statistical software (R Core Team, 2015; Wickham, 2009). Because children in all groups differed in the number of sentences generated when telling stories, the number of ungrammatical sentences was converted, for each child, into a percentage based on their total number of produced sentences. Consequently, higher percentages reflect higher overall ungrammaticality. The same conversion was performed on the raw number of complex sentences, with higher percentages reflecting a higher relative production of complex sentences. After these conversions, analyses were conducted to observe the impact of diagnostics and age-range on the production of a) ungrammatical sentences and b) complex sentences.

Figures 1 and 2 show means plots of groups' performance on ungrammatical sentences and sentence-complexity.
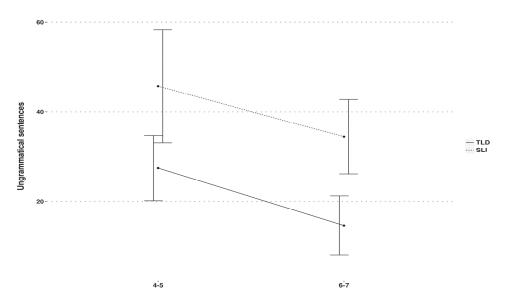

Figure 1. Means plot for ungrammatical sentences. Error bars represent 95% confidence intervals.

Plots suggest group differences in ungrammatical sentences, similar performances in sentence complexity, and no visible interactions. Because of limited sample size, subsequent analyses were based on multiple regressions, bootstrapping coefficients to provide a readily interpretable and more robust measure offsetting sample size limitations. The first step consisted of determining the relevance of including interaction terms in regression analyses. Based on the lack of significance and R^2 gain criteria, the decision

was made to not inspect interactions in any models. Table 2 shows results for two-predictor models on the two response variables of interest.
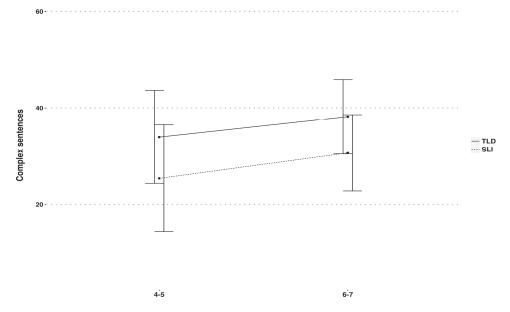

FIGURE 2. MEANS PLOT FOR SENTENCE COMPLEXITY. ERROR
BARS REPRESENT 95% CONFIDENCE INTERVALS.

TABLE 2. REGRESSION ANALYSIS RESULTS FOR UNGRAMMATICAL
SENTENCES AND COMPLEX SENTENCES[2]

	Non-grammatical sentences					Complex sentences				
	b	p	CI	R^2	f^2	b	p	CI	R^2	f^2
SLI/TLD	-19.02	<0.001	-11.56 -27.33	0.37	0.6	8.04	0.06	-0.44 15.66	0.06	0.06
Age-Range	-12.01	0.005	-20.46 -4.50			4.75	0.25	-3.55 12.51		

Results show that both SLI/TLD and age-range significantly predict the percentage of ungrammatical sentences produced by children in our sample. No significant results

2. Bootstrapped coefficients (95% CI) are provided for each predictor. Adjusted $R2$ are reported.

were observed for produced complex sentences. Adjusted R^2 for both models were considerably different (0.37 against 0.06), which further supports differences between response variables. Bootstrapped coefficients confirm these results. Non-zero intervals were observed only when predicting ungrammatical sentences. Because of this, follow-up analyses were conducted only on ungrammatical sentences. A dummy variable was constructed including the following levels: SLI 4-5, SLI 6-7, TLD 4-5, TLD 6-7. This variable allowed inspecting Tukey post-hoc pairwise contrasts controlling familywise error. To ease interpretation, reported results are based on group means. Results are shown in Table 3.

Pairwise contrasts suggest one highly ungrammatical group including children with SLI aged 4-5 (*a*), and a much less ungrammatical group including TLD children aged 6-7 (*c*). There is also an intermediate group *b* overlapping with *a* and *c*: with SLI aged 6-7 (*ab*) and TDL aged 4-5 (*bc*).

Table 3. Tukey's pairwise contrasts and groupings,
based on means from Anova test[3]

	Mean	Group
SLI 4-5	45.69	a
SLI 6-7	34.42	ab
TLD 4-5	27.41	bc
TLD 6-7	14.62	c

Finally, a Spearman rank correlation test was conducted for each group to observe the correlation between complex sentences and non- grammatical sentences. Results are presented in Table 4.

Coefficients show that the correlation between ungrammatical sentences and complex sentence production is positive and rather strong in the 4-5 age-ranges in both groups (above medium effect sizes, closer to large). In other words, when children produce complex sentences, these sentences tend to be also ungrammatical. In the 6-7 age-ranges, however, groups' coefficients differ both in magnitude and direction. The correlation is positive among children with SLI (although negligible). On the contrary, the correlation among children with TLD is not only rather meaningful given sample size, but also negative (coefficient reveals an almost medium effect size). Thus, children with SLI aged

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3. Significance and groupings are consistent with pairwise contrasts' coefficients from a Tukey post-hoc analysis conducted within a mixed-effect model. They were not reported here for simplicity.

6-7 produce complex sentences that can indistinctly be grammatical or ungrammatical (as suggested by the lack of correlation).

Table 4. Spearman rho coefficients for correlation between sentence ungrammaticality and complex-sentence-production, per group

	SLI	TLD
4-5	0.41	0.48
6-7	0.12	-0.26

4. Discussion

Results show that children with SLI are different from children with TLD in some respects and similar to them in others. As for our first question, children with SLI aged 4-5 are not statistically different from children with SLI aged 6-7 either on grammatical sentence production or complex sentence production. Complexity remained virtually unchanged in the observed age-ranges. This is consistent with the literature on linguistic development among Spanish-speaking children. Findings in this area suggest that children with TLD mostly produce grammatically simple sentences until aged 6 (Clemente, 2000; Codesido-García et al., 2012), even if some tokens of syntactic complexity may emerge at very early stages (Serrat, Sanz-Torrent & Bel, 2004). As for grammaticality, the lack of developmental change reveals that this problem does not recede with time. Two related transversal studies conducted with children aged 6 and 7 are consistent with this finding, inasmuch as Spanish-speaking monolingual children with SLI produce significantly more ungrammatical sentences than their TLD counterparts (Coloma et al., 2016; Jackson-Maldonado & Maldonado, 2017).

As for the question about possible differences between children with SLI and children with TLD in the observed age-ranges, results vary depending on the particular dimension considered. On sentence complexity, children with SLI are no different from children with TLD, regardless of age. Again, this may very well be attributed to the predominance of simple sentences for the observed developmental stages. Even if subordination may occur at this stage, children with SLI and TDL are far from having mastered it yet. Simple sentence predominance has been reported both for children with SLI and children with TLD in conversation and narrative discourse (Pavez et al., 2015).

Differences regarding produced ungrammatical sentences are consistent with the literature (Anderson & Souto, 2005; Bedore & Leonard, 2001; Bedore & Leonard, 2005; Coloma et al., 2016; Jackson-Maldonado & Maldonado, 2017; Morgan, Restrepo & Auza, 2013). Results suggest a descending progression. The highest level

of ungrammaticality was observed among children with SLI aged 4-5. An intermediate performance was attained by children with SLI aged 6-7 and children with TLD aged 4-5, while the lowest level of grammatical errors was observed among typical children aged 6-7. Alternatively, the point can be made that children with SLI are significantly more ungrammatical than children with TLD both at the 4-5 range and at the 6-7 range, and that even if in both diagnostics ungrammatical sentences decrease with age, this decrease is not significant.

Results regarding the final question about the possible correlation between sentence complexity and ungrammaticality show that variables are indeed correlated. Furthermore, correlation varies with age and is not the same in both groups studied. Children with SLI evolve from a strong initial positive correlation to a very mild positive one. This means that complex sentences by children with SLI aged 4-5 are very likely to also be ungrammatical. As they grow, this likelihood decreases but does not disappear. Complex-sentence construction therefore seems to be rather challenging for children with SLI. Children with TLD evolve from a strong initial positive correlation when aged 4-5 to a moderate negative correlation when aged 6-7. This means that even if they are very similar to children with SLI when aged 4-5, as they grow the complex sentences they produce are likely not to be ungrammatical. In other words, as children with TLD grow, their morphosyntactic accuracy increases. In summary, children with SLI and children with TLD seem to evolve differently over time, typical children being seemingly on their way to master both grammaticality and sentence complexity.

5. Conclusions

Children with SLI continue producing ungrammatical sentences with age. However, the developmental trend suggests a decrease among older children, even if statistically non-significant. As for complexity, observed age ranges showed virtually no differences, suggesting that no development involving this syntactic feature takes place within observed age-window. Finally, findings suggest that correlation patterns evolve differently when comparing children with SLI against children with TLD, with typical children evolving faster into morphosyntactic accuracy.

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