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Phonological Problems in Spanish-Speaking Children

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Abstract

Phonological development in some children does not follow the typical trajectory. This may affect their communication processes. The primary aim of this chapter is to characterize the phonological development of Spanish-speaking children with phonological problems. The characterization is based on the Theory of Natural Phonology, which poses that children with phonological problems produce phonologically simplified words resulting from the application of strategies known as phonological simplification processes. Phonological development implies the progressive elimination of these strategies. It has been observed that children with phonological problems produce phonologically simplified words until advanced age. This chapter focuses on studies involving Chilean children with phonological problems, in an attempt to characterize their phonological performance. Overall, the point can be made that Chilean children with phonological problems have a trajectory of phonological development of their own, with phonological simplification processes equally affecting syllable structure and word structure. Also, these processes tend to consistently decrease with age at a steady rate. Once 5 years of age, however, processes tend to become more persistent and decrease becomes slower. They are also prone to have problems both with the phonological representation of words and lexical comprehension. Finally, they seem to be challenged by phonological awareness and grammar.

Keywords: phonology, development, Spanish-speaking children, impairments

1. Introduction

Children with phonological alterations have problems when uttering words (they omit elements, alter syllables, substitute phonemes, etc.), difficulties that cannot be explained by

articulatory disorders. These children's productions are hardly intelligible, similar to younger peers'. This lack of intelligibility makes communication difficult; these productions are usually associated to problems in language development.

This chapter reviews a series of studies on phonological problems (PP) in Spanish-speaking children, specifically Chilean monolingual children. The studies are based on the Theory of Natural Phonology (TNP). The primary aim of these studies is to contribute to the characterization of the phonological development in Spanish-speaking children with PP. This might provide valuable insights to understand the phonological challenges faced by these children. It may be considered as a glimpse into an impairment which has not been studied in depth among Chilean children. Conclusions can be useful in two ways. First, they can help better understand the problem in general and, consequently, improve related therapeutic interventions. Second, characterizing this particular group of children might be of use to compare Chilean children with Spanish-speaking children from other countries to determine both commonalities and differences. Studying phonological performance in children with phonological problems (PP), however, necessarily requires research on normal development, which also relies on the model used to study PP.

The chapter is organized in four sections: (a) review of phonological development from the point of view of the Theory of Natural Phonology, which advances the progressive elimination of the strategies used by children to produce phonologically simplified words; (b) phonological development in Spanish-speaking children. In this section, studies on the progressive elimination of simplification strategies in typically developing Spanish-speaking children are presented; (c) phonological problems in Spanish-speaking children. This section focuses on phonological development in children with phonological problems; finally, section (d) Phonological awareness in Spanish-speaking children with phonological problems.

2. Phonological development from the theory of natural phonology

The study of phonological development is a complex task that requires explaining the discrepancies in linguistic production between adults and children, establishing phonological development patterns in infants and determining the basic unit (phoneme or word) that will be deemed important in the future [1, 2].

The complexity of this topic generates many different perspectives that seek to capture it accurately. Some have focused on the sequence of the appearance of phoneme and the features that they characterize (behavioral and structuralist theories). Other approaches, like the Theory of Natural Phonology, focus on the acquisition of phonology of the word. Still, when discussing the psychological reality and the explanatory power of their postulates phonology [3], one must recognize its usefulness in describing the relationship between adult and infantile productions to better understand the phonological difficulties for young people and to design programs for intervention [1, 3].

Theory of Natural Phonology (TNP) states that a child possesses a phonological representation of a word that is equal to that of an adult, even though they produce the word with errors. A child hears a word from an adult, processes it, and then reproduces it in a phonologically simplified manner. The simplification of the word consists that the child applies strategies, known as the Phonological Simplification Processes (PSP), which are mental operations that constitute an innate system. Another way to understand the PSP is as error patterns commonly found in children language outputs [3] that modify phonological representations of words. PSP facilitate the linguistic production of children [4]. Additionally, it has been suggested that the simplifications can occur in the word, in the syllable or in the phoneme. At the word level, one could find the assimilations and alterations in the number of syllables in the word. In contrast, the reduction of the consonant group and the omission of the coda are processes that affect the syllable. The substitutions correspond to the phoneme level [5]. From another perspective, PSP are classified as systemic or structural. They are considered systemic when they affect the system of phonological oppositions, as it occurs in substitution processes. Contrastingly, they are structural processes when they simplify the word or syllable structure and when phonemes are assimilated inside words [6, 7].

In the proposal of TNP, a distinction is built between the three types of PSP: those related to the structure of the syllable and the word, those from substitution and those from assimilation. The PSP related to the structure of the syllable and the word are procedures in which the child reduces its syllables to “consonant (C) + vowel (V),” a basic structure [8] that most commonly occurs in the Spanish language [9]. This simplification can suppress codas (/pata_lón/ for “pantalón,” pant), reducing consonant groups (/páto for “plato,” plate) and diphthongs (/áto/ for “auto,” car), among other strategies. As well, this tends to simplify the word structure, reducing them to the sequence CV + CV. This occurs, for example, when the amount of syllables of a word is reduced by the omission of unstressed syllables (/_pósa/ for “mariposa,” butterfly).

The PSP of assimilation consist of replacing phonemes to make them similar or identical to other phonemes present in the model word or in the word produced by the child (/núna/ for “luna,” moon). The PSP of substitution is a strategy that change phoneme groups for members from another groups (fricatives for stop /kiráfa/ for “jirafa,” giraffe) or for a phoneme within the same group (liquid together /pélo/ for “perro,” dog) [10]. **Table 1** summarizes relevant PSP (**Table 1**).

According to TNP, the phonological development implies the progressive elimination of the PSP until the child achieves word production like that of an adult. Certainly, the decrease in PSP occurs alongside the acquisition of the system of phonemes. As well, studies about PSP suggest that PSP are strategies that children use, especially at the period of lexical explosion around 18 to 20 months. The increase in new words demands finer phonological representations that allow children to distinguish similar words [11, 12]. Therefore, phonological development is favored because of the lexical increase that contributes to a permanent reorganization of the phonological representation of the words for children [13].

PSP	Definition	Examples
Structure of the syllable and the word		
1. Consonant-group reduction	1. Omission of /l/ o /r/ of a homosyllabic consonant group	1. /p_áto/ for /pláto/ (plate) /t_en / for /tren/ (train)
2. Diphthong reduction	2. Omission of a diphthong vowel	2. /á_to/ for /áuto/ (car)
3. Coda suppression.	3. Omission of consonantal phoneme at the end of syllable	3. /pa_talón/ for /pantalón/ (pant)
4. Coalescence	4. Merging of two adjacent phonemes originating a different consonantal phoneme	4. /kén/ for /tren/ (train)
5. Omission of unstressed elements	5. Omission of unstressed syllables or any of the phonemes that constitute it	5. /pósa/ for /mariposa/(butterfly)
6. Addition of phonemes or syllables	6. Addition of phonemes or syllables	6. /níndio / for /indio/ (Indian) /kaperutusita/ for /kaperusita/ (Little Red Riding Hood)
7. Inversion of phonemes or syllables	7. Two phonemes or syllables switch their position	7. /uáto/ for /áuto/ (car) /tenéfolo/ for /teléfono/ (phone)
Assimilation		
1. Identical	1. A phoneme becomes identical to another one in a word	1. bubánda/ for /bufánda/ (scarf)
2. Labial	2. A phoneme becomes similar to a labial phoneme (/p/, /b/, /m/) or a labiodental (/f/) phoneme	2. /plátamo/ for /plátano/ (banana)
3. Dental	3. A phoneme becomes similar to a dental phoneme (/t/, /d/, /s/)	3. /madípósa/ for /maripósa/ (butterfly)
4. Velar	4. A phoneme becomes similar to a velar phoneme (/k/, /g/, /x/, /o/, /u/)	4. /guáfánda/ for /bufánda/ (scarf)
5. Nasal	5. An oral phoneme becomes similar to a nasal phoneme (/m/, /n/)	5. /anfómbra/ for /a/fómbra/) (carpet)
6. Syllabic	6. A syllable becomes identical to another one within a word	6. /lilikóptero/ for /elikóptero/ (helicopter)
Substitution		
1. Posteriorization	1. A phoneme articulated in anterior areas is replaced by another one articulated in posterior areas	1. /ekifísio/ for /edifício/ (building)
2. Frontalization	2. A phoneme articulated in posterior areas is replaced by another one articulated in anterior areas	2. /buánte/ for /guánte/ (glove)
3. Stopping	3. A fricative phoneme is replaced by an occlusive or affricated phoneme (similar articulation zones)	3. /póka/ for /fóka/ (seal)
4. Fricativization	4. An occlusive or affricated phoneme is replaced by a fricative (similar articulation zones)	4. /marifósa/ for /maripósa/ (butterfly)

PSP	Definition	Examples
5. Semiconsonantization of liquid phonemes	5. A liquid phoneme (/l/, /r/) is replaced by yod (j) or wau (w)	5. /tjen/ for /tren/ (train)
6. Within-category liquid substitution	6. A liquid phoneme is replaced by a different liquid phoneme	6. /kape/usita/ for /kaperusita/ (Little Red Riding Hood)

Table 1. Most frequent phonological simplification processes.

In the following section, we will explore phonological development in Spanish-speaking children within the context of the TNP. Specifically, this section will discuss a study undertaken with children in Chile.

3. Phonological development in Spanish-speaking children

Phonological development has been widely studied in children who speak English with no preexisting language problems and in children with linguistic difficulties [3, 8, 14, 15]. In Spanish, studies on this topic are scarce. The ones that exist have explored descriptions of the acquisition of phoneme at different age ranges in Mexican children between 3 and 6 years old by using denomination tasks [16] and in Spanish children between 3 and 7 years old by word repetition tasks [17].

In addition to the acquisition of phonemes, phonological development based on the TNP has been studied in different groups of Spanish-speaking children [4, 7, 18–24].

In Spanish children between 3 and 6 years old, researchers have corroborated that the PSP disappear as age increases and that the PSP are less frequent around 6 years of age [7, 18, 20]. As well, it has been noted that variability of PSP decreases in spontaneous speech in Spanish children between 3 and 5 years old as age increases [4].

In Argentinean children between 2 and 5 years old, it was found that the decrease in PSP occurs specifically between 4 and 4 years and 6 months old. In addition, it was found that the more frequent types of PSP are related to syllable and word structure [24].

The previous results have permitted researches to note the decrease in PSP along with age, which agrees with the proposal of the TNP. However, there are few studies in the Spanish language that detail gradual decreases in the different types of PSP in distinct age ranges, like what occurred in the studies by Bosch with Spanish children [7] and the studies by Storti with Argentinean children [24].

A study performed with Chilean children between the ages of 3:0 and 6:11 years old is presented in more detail. The principle research questions were: Do PSP decrease as age increases? How do PSP decrease in different age ranges? [25]. Different age ranges were 3:0 to 3:11 years old (90 children, 41 girls and 49 boys); 4:0 to 4:11 years (90 children, 45 girls and 45 boys); 5:0 to 5:11 years (90 children, 45 girls and 45 boys); 6:0 to 6:11 years (90 children, 45 girls

and 45 boys). The PSP were elicited in 37 words used to complete sentences through deferred imitation. The words presented distinct levels of phonological complexity, which are different amounts of syllables, accentuation and syllabic complexity.

The results obtained from statistical analysis demonstrated that the use of PSP significantly reduced between 3 and 6 years old, corroborating previous evidence [7, 24]. Additionally, it established a negative correlation between this correlation and age, or that with age one uses less processes. PSP decrease by almost half when they move from each age range to another.

As well, it determined that the distinct types of PSP were eliminated in different ways at the ages studied.

The PSP related to syllable and word structure are the most frequent in all of the groups and significantly decrease in each subsequent age group. In other words, they appear as foundational processes in phonological development through which one begins to gradually incorporate distinct syllable structures in words of high syllable count between the ages of 3 and 6.

The PSP of assimilation, in contrasts, are significantly more common in children aged 3 years old, which agrees with the results found in Argentinean children where these processes were the most commonly employed in children between 2:5 and 3:0 years old [24]. This also coincides with the phonological profile presented by Bosch [19] for Spanish children aged 3:0 years old in which the presence of assimilations was considered normal while they began to decrease noticeably at 4:0 years old until they no longer appeared in children between 5:0 and 6:0 years old. This idea implies that the assimilation of phonemes is an early strategy to simplify the emission of words in early-stage phonological development.

As for the PSP of substitution, it warns that children 5:0 years old used them scarcely, like children 6:0-year olds. This type of processing is related to the construction of the phonological system. For this reason, it is feasible that between 5 and 6 years old the use of PSP of substitution is so infrequent that these children already possess an almost complete phoneme system only missing some of the more rhotic phonemes [7, 16, 26].

Additionally, socioeconomic status was relevant in the phonological development of Chilean children in this study. It coincides with what was already suggested in previous studies, that differences in economics groups in the use of PSP can affect word emission and master of phonemes [3, 27]. Upon studying socioeconomic level in each age range, it was observed that the difference between children from middle-low class backgrounds and middle-high class backgrounds always maintained itself for children between 3 and 6 years old. This corroborates that belonging to a certain socioeconomic class clearly influences the phonological development in a way that favors children from more upper class backgrounds. This fact expands and affirms the previous assumption that Chilean children aged 3 years old from higher socioeconomic backgrounds employ less PSP than children from a lower socioeconomic background, in particular in processes related to syllable and word structure [28].

In summary, the studies of Spanish-speaking children demonstrate that the PSP decrease as age increases. Additionally, they warn that the more common PSP are related to syllable and word structure and that they can be understood as foundational PSP in phonological development.

PSP of assimilation, it could affirm that they are very common in younger children and that they tend to disappear around age 4. Finally, the PSP of substitution are almost eliminated between the ages of 5 and 6.

The TNP can also be utilized to explain the phonological problems that generally arise in children. They point to language development not much different from that of an even younger child, even if that child can articulate the phonemes well. This can be attributed to the fact that some children conserve the PSP even when they should no longer exist. These children present a problem known in the speech pathology world as phonological problem [8, 2, 26].

In the following section, we will explore the phonological disorders in Spanish-speaking children from the perspective of the TNP.

4. Phonological problems in Spanish-speaking children

Phonological development, considering the elimination of PSP with age, remains unclear for children with phonological problems (PP) and has few studies relating to the matter, especially in the Spanish language. Certainly, the PP is a complex topic since it affects factors in a different way. Regardless, children have difficulty in the emission of words that cannot be explained by problems with phoneme articulation. For this reason, a child can produce /la nuna/ for “la luna” (moon), adequately emitting the phoneme /l/ only once. This problem is clearly demonstrated through an increase in the amount of syllables and the phonological complexity of a word, therefore suggesting that it is not surprising that polysyllables presented a unique challenge. The problems with phonological emission of a word also appear in the varied production of the same word. For example, a child, while telling a story, may say the word “entonces” (so) so like /entóne/; /tónse/ o /intóse/.

In this section, we will present various studies performed with Spanish-speaking children with PP centered on their use of PSP. Specifically, we will illustrate in detail studies of Chilean children.

A study of PSP in Catalan and Spanish-speaking children between 3:0 and 4:0 years old with specific language impairment (SLI) observed changes in their phonological profile [29]. The most significant PSP at 3 years old were syllable omissions, especially when compared against a control group of the same age. In contrast, the same children at 4:0 years old more commonly used the PSP associated with the reduction in consonant sequences and the omissions of consonants (equally in the onset as in the syllabic coda), in addition to an absence of the multiple rhotic phoneme /r/. In this sense, the PSP at 3:0 years old involve the word level, whereas those at 4:0 years old affect the syllabic level and begin to appear at the phoneme level. This suggests a tendency in development to advance from the word toward the syllable to finalize the phoneme system.

A different study performed with Spanish-speaking children in Puerto Rico with PP between the ages of 3:0 and 4:0 demonstrated, at each age group, PSP with a percentage of occurrences exceeding 10%. In the 3:0–3:11 years old group, these processes were cluster reduction

(/plato/ /páto/, plate), stopping (/frío/ /pío/, cold), liquid simplification (/pláto/ /pwáto/, plate), and initial consonant deletion. In the 4:0–4:11 years old group, they used the same process without initial consonant deletion. In the same way, they suggested that to diagnose a suspected PP in Spanish-speaking children, speech-language pathologists can look at three specific markers: (1) the use of initial consonant deletion, (2) a moderate percentage-of-occurrence of liquid simplification and stopping, and/or (3) a high percentage-of-occurrence for cluster reduction [21].

Following, it presents studies with monolingual, Spanish-speaking Chilean children with PP. First, it approached the phonological development of these children by characterizing their emission of PSP in distinct age ranges. Later, it supplemented their understanding of the PP through a study on the production of polysyllables and a different study on the phonological representation of a word.

Studies of children were performed by eliciting the PSP through the test to evaluate processes of phonological simplification, revised version, known as the TEPROSIF-R [10]. This instrument evaluates PSP in Spanish-speakers between 3 and 6 years old. It was used in the studies to be described here. First, it will present the test and later we will explore the studies.

The TEPROSIF-R consists of 37 words of a different length, stress and syllabic complexity that facilitate the issuance of PSP. Deferred imitation is supported with flashcards. Showing the child a picture on the top of a sheet, the child is told, for example, “Look, here is a duck and now look here (pointing to the picture on the bottom of the page): On the water there is a... (and the child is expected to complete the sentence with the target word).” The child’s responses are recorded and then phonologically transcribed in a log sheet, where the PSP issued in each word are identified and each assigned 1 point each. The total score is interpreted according to the norms corresponding to their age.

The test was administered to 620 children between 3:0 and 6:0 years old, grouped in four age ranges: 3:0–3:11, $n = 137$ (67 girls and 70 boys), 4:0–4:11, $n = 182$ (82 girls and 100 boys), 5:0–5:11, $n = 157$ (79 girls and 78 boys), 6:0–6:11, $n = 144$ (70 girls and 74 boys). The participants were identified by three social classes: lower-middle class children (31% of the sample), middle-class children (30% of the sample), and upper-middle class children (39% of the sample). In addition, participants were selected from five regions in Chile.

The statistical analysis found that, first, there is significant correlation between the score of the TEPROSIF and the age of the child ($r = -0.64$, $p.000$, the index is negative because a much younger age corresponds to a greater number of PSP). Second, it discriminates between different age ranges (ANOVA and Tuckey). It also discriminates between children with typical language development (TLD) and children with specific language impairment, SLI (Mann Whitney). Finally, it presents a high level of reliability (Alpha Cronbach 0.90).

An initial study was performed with Spanish-speaking Chilean children 4:0-year-olds with SLI. The research question posed was: Do 4:0-year-old children with SLI emit PSP similarly to 4:0-year-old children with Typical Language Development (TLD) or are they more like 3:0-year-old children with TLD? [30].

It worked with 21 children 4:0-year olds with SLI and two groups of children with TLD, one group of 4:0-year-olds ($n = 90$) and another group of 3:0-year-olds ($n = 90$). Each child was evaluated with the TEPROSIF-R.

The analysis of the results found that 4:0-year olds with SLI had significantly more PSP than 4:0 and 3:0-year-old children with TLD, a difference that was observed in all three types of PSP (according to ANOVA and Tuckey).

As well, it was noted that 4:0-year olds with SLI used the PSP differently than 3:0 and 4:0-year-old children with TLD. A large percentage of children with SLI use PSP, which are rarely used by children with TLD. This is to say, these children not only have more PSP but use processes that are less used by children with TLD.

The wide usage of less common PSP by children with SLI is seen especially in the use of the following processes:

- a. Processes related to syllable and word structure: the addition of phonemes or syllables (/plátano/ /plántano, banana), coalescence (/tren/ /ken/, train) and metathesis (/bufánda/ /fubánda/, scarf)
- b. Assimilation processes: velar (/bufánda/ /gufánda, scarf), nasal (/alfómbra/ /anfómbra/, carpet); labial (/plátano/ /plátamo/, banana)
- c. Substitution processes coda aspiration (/dúlse/ /dúhse/, candy) and substitution of liquid phonemes for non-liquid phonemes (/xáula/ /xáuba/, birdcage)

Therefore, 4:0-year-old children with SLI present a distinct profile from similarly aged or younger children with TLD. These problems specifically arise with structural process (syllable and word structure and assimilation). In this respect, it is remarkable that the assimilation PSP exist in 4:0-year-old children with SLI, something that does not occur in 4:0-year olds with TLD.

In a different study, we approached how children with PP at ages 4:0, 5:0 and 6:0 manage PSP [31]. The research questions were as follows: Does the use of PSP in children with PP change between the ages of 4:0 and 6:0? If they do change, how do these changes reveal themselves?

This study worked with a group of 34 children distributed in three age ranges: 4:0 years ($n = 12$); 5:0 years ($n = 11$) and 6:0 years ($n = 11$). All the children presented PP and their performances in the TEPROSIF-R were poor. Comparing the quantity of PSP from the groups with ANOVA, the results showed that: (a) 4:0-year-old children with PP present significantly more PSP than the 5:0 and 6:0-year-old children, (b) 5:0 and 6:0-year-old children with PP do not differ in the number of PSP.

A qualitative analysis of the evidence revealed that the 4:0-year-old children with PP use certain PSP related to syllable structure (omission of the coda: /pantalón/ /pa_talón/, pant); reduction of the diphthong (puénte/ /pénte/, bridge); reduction of the consonant group (tren/ /ten/, train);

and coalescence (/tren/ /ken/, train). As well, PSP that affected word structure were observed, specifically in the omission of pretonic syllable (/mariposa/ ma_pósa/, butterfly).

In contrast, the 5:0 years old used significantly less PSP in relation to the 4:0 years old. This implies a higher phonological development, even though their performance levels are still considerably low. Additionally, they demonstrated better control of syllable structure with codas and diphthongs. Regardless, the reduction of consonant groups and coalescence remained with no significant changes. No observable progress was made in the control of word structure whereas the omission of non-tonic syllable remained stable.

Finally, the 6:0 years old did not demonstrate any significant changes in phonological development in comparison to the 5:0 year olds. Consequently, their phonological characteristics were very similar to the 5:0-year olds. It is also notable that the reduction of the diphthong originally observed at 4:0-years old persisted.

This shows that the elimination of simplification processes in children with PP occurs between 3:0 and 5:0 years old, but it slows down between 5:0 and 6:0 years old where no significant changes were observed in the study. This could indicate that phonological development somehow stalls in these later stages and that PP tends to be more persistent.

Notably, children's development is most visible in their progressive suppression of processes affecting syllable structure and word. This suppression, however, becomes slower once around 5 years of age.

PSP of substitution, which are linked to the management of the phonological system, do not differ in the three age groups studied here. In respect to the PSP of assimilation, which usually are considered structural [5, 6, 7, 32], there as well were no observable differences. If one emphasizes that the assimilations serve to harmonize the phonemes in a word, it could signal that the PSP most related with the phonemes maintain themselves with no relevant changes.

In this manner, children with PP probably improve their control at a structural level better than they do at the phoneme level at around 5:0 years old, as compared to children under 4:0 years old.

The fact that children with PP conserve the simplifications that affect word structure, specifically the omission of pretonic syllable, can relate to their difficulties with polysyllabic words. Another study with 4:0-year-old Spanish-speaking Chilean children with PP attempted to explore the capacity of use of polysyllables, or words with three or more syllables [33]. The principles research questions in this study were as follows: How is the emission of polysyllabic words in 4:0 years old children with PP? How do they perform in relation to the quantity of syllables and rhythmic structure of the word organized based on the tonic syllable?

The study was performed with 36 children from 4:0 to 4:11 years old separated into two groups, one consisting of children with PP ($n = 18$) and one of children with TLD ($n = 18$). Each child was asked to say, through deferred imitation and with the support of drawings, the following polysyllabic words from the TEPROSIF-R. These words were presented orally by the examiner in this sequence: mariposa (butterfly), bicicleta (bicycle), helicóptero (helicopter), teléfono (phone), Caperucita (Little Red Riding Hood), refrigerador (fridge) y edificio (building).

The words have different syllable counts and distinct rhythmic structures. The rhythmic structure was described identifying the syllables with a number according to the accenting in the word. The tonic syllable, the most intense, longest, and the highest in tone, was identified as a3. The initial unstressed syllable, with a secondary accent, was identified as a2. Finally, the rests that precede and follow a tonic syllable were labeled a1. In this way, four words presented the rhythmic structure 2131 (*mariposa*, *edificio*, *dinosaurio*, *bicicleta*) and the rest followed the sequences 2311 (*teléfono*), 21131 (*Caperucita*), 21113 (*refrigerador*) y 21311 (*helicóptero*). Consequently, the rhythmic structures of most of the words were different.

The statistical comparison of the words emitted correctly by both groups of children corroborated that children with PP present significantly fewer correct responses. This was demonstrated in their difficulties to emit polysyllabic words.

In respect to the individual performance of each child, 55.5% of the children with PP did not correctly emit any of the polysyllables and only two children achieved the maximum performance for the group, correctly emitting four words (out of a total of seven). In contrast, in the control group 55.4% of the participants correctly produced five or more polysyllables, with one child correctly producing all seven words with no errors.

Their incorrect responses were also analyzed to consider their capacity of use over syllable quantity and accented syllables.

The most common error in children with PP was the alteration of syllable quantity in polysyllabic words. As well, some children incorrectly produced words by conserving the tonic syllable. Finally, a less frequent error consists of children wrongly uttering a particular word, although accent and rhythmic structure are correct (/misiséta/ por /bisikléta/ "bicicleta", bicycle). The children with TLD, in contrast, demonstrated different behavior, often committing the same errors but in similar frequencies. Additionally, they produced much fewer errors than children with PP.

The most common errors in children with PP correspond to alteration in the quantity of syllables and are predominantly reductions in the length of the polysyllable. In order to obtain more precise information for this performance, the average of the syllables used were calculated. It finds that in words longer than four syllables children did an average of 3.4 syllables, while in five syllable words the average was 3.5. This is to say, the length of their emissions consistently maintained itself around three syllables. The simplifications used to achieve such length were diverse and depended on each word. For example, in the word "mariposa," there was a tendency to use a diphthong to omit the onset of the accented syllable (/meliósa;/ /miniósa/) along with the omission of unstressed syllables or some of their elements, like with the word *Caperucita* (/kaperusíta/, pronounced as /pusíta/ or /kausíta/).

In reference to the rhythmic structure of a word, it was suggested that with a word like "mariposa," with the structure 2131, subjects reduced the word to /meliósa/ or /miniósa/ with the structure 231. Something similar occurred in *Caperucita* (21131), which was emitted as /kausíta/ (231) or /pusíta/ (231). This suggests a metric structure of three syllables with a rhythmic pattern of 231.

In contrast, children with TLD, when they committed errors with four syllable polysyllabic words, used an average of 3.9 syllables and 4.6 syllables for five syllable words. They used a closer number of syllables to the original polysyllabic word.

In summary, children with PP commit significantly more errors in the production of polysyllables, tend to reduce the quantity of syllables in the word and conserve the tonic syllable. Their simplifications demonstrate a strategy that fundamentally supports the tonic syllable, an important element in the rhythmic structure of the word. Regardless, they are unable to emit the word in all its length, and tend to produce around three syllables, where they have eliminated elements. This suggests a depleted phonological representation that makes this type of task even more complex.

The previous studies on the topic focused on the production of words in children with PP. It is clear that these children have problems with word emission, but it remains unclear if this implies difficulty with the internal phonological representation of a word (that one cannot infer certainty through errors production of words). A different study was performed with Chilean children to explore the phonological representation of words through *receptive tasks* that did not require verbal responses [34].

The phonological representation can be understood as a system of superimposed strata, each one with information of a distinct nature (according to the proposal by Ref. [35]). Therefore, in the process of codification (where lexical-syntactical representation serves as the entrance point for a word), the phonological representation arises to recuperate the metric and rhythmic structure of the word, thereby identifying the sequence of accented and unaccented syllables in the word.

The research questions posed in this study were as follows: Is this performance in phonological representation in children with PP similar or different than in children with TLD? Is the phonological representation related to the emission of PSP and to the lexical comprehension of children with PP?

The study was performed with 30 Spanish-speaking Chilean children between the ages of 4:0 and 4:11. In total, 15 of these children had PP and 15 had TLD.

The phonological representation was evaluated with an instrument specifically designed for this study. It measures the identification of phonological representation in a word alluded to in picture reference. There were 36 color drawing that represented 12 words of three syllables or more. The words were modified according to Claseen's proposal [36] and the child was presented with each word three separate times during the evaluation: one time without modification (hipopótamo, hippopotamus; zapatilla, sports shoes); one time modified with the tonic syllable (hipopétamo, zapalla); and one time modified with the pretonic syllable (hipepótamo, zatílla). The syllable modifications occurred in the omission of a syllable (like in zapa_lla, in which the "ti" is omitted) or in the substitution of a vowel (like in hipopétamo, in which the /e/ is substituted for /o/).

The stimuli were recorded in a soundproof booth using the program Praat. The children were presented with the stimuli through headphones in which they were told they would hear a

person that “did not know how to speak very well and needed help knowing when they made mistakes.” The child was instructed to identify if the stimulus he/she heard was well or poorly emitted by responding with a smiley face or a sad face.

The emissions of PSP were evaluated with the TEPROSIF-R and the lexical comprehension with the vocabulary test in images (TEVI-R [37]). This test evaluated the level of passive vocabulary comprehension in Spanish-speaking subjects between the ages of 2:6 and 19:11. It resembles the Peabody Picture Vocabulary Test, but differs in the way that it does not establish any correlation with the intelligence coefficient. The examiner orally presents a child with a word telling the child, “We are going to play, look at these drawings (4), I’m going to say a word and you point to the drawing for that word.”

Upon comparing the statistical performance of both groups of these children, it was noted that children with PP performed significantly worse than children with TLD in phonological representation and lexical comprehension. As well, they emitted significantly more PSP than children with TLD, which is in line with their phonological problem. Additionally, the correlation analysis revealed that children with PP did not demonstrate a correlation with any of the evaluated aspects. Essentially, phonological representation, lexical comprehension, and the production of PSP are not related. Contrastingly, the children with TLD demonstrated significant correlations between these three aspects.

In conclusion, the children with PP present a decreased ability in phonological representation and lexical comprehension in addition to their increased use of PSP. However, there is no relationship between these three aspects. This fact demonstrates that they have a decreased linguistic system and that the aspects that are related in children with TLD appear to be dissociated in children with PP.

In summary, previous studies suggest that, consistent with TNP, Spanish-speaking children with PP are more prone to produce PSP than children with TLD. Moreover, not only they produce more PSP than children with TLD in their same age-level but also produce more PSP than younger typical children.

Their performance corresponds to a distinct profile, suggesting that even though they use the same PSP as children with TLD, children with PP tend to use, with increased frequency, the less commonly used processes. Their increased difficulty is heightened with the structural PSP (those related to syllable, word, and assimilation structure). Researchers observed significant phonological development specifically between the ages of 4 and 5, while during the ages of 5 and 6 they observed less pronounced changes, which could imply that the phonological problem of word organization is persistent. Additionally, it especially corroborates the difficulty of words with three syllables or more, since in these words children with PP tend to decrease the quantity of syllables and conserve the tonic syllable. Finally, it was observed that children with PP also demonstrate problems with the phonological representation of a word and a decreased performance in lexical comprehension. Even though these aspects are associated in children with TLD, they are not correlated in children with PP. This fact also shows that children with PP present a unique phonological profile.

Studies discussed were performed with Spanish-speaking Chilean children. Therefore, results cannot be readily generalized to other populations. However, since they were all conducted within the same theoretical framework, they are an interesting body of work that helps both characterizing Chilean children in detail and providing empirical results for future comparisons. Research on children from other Spanish-speaking communities might benefit from the reference points provided by literature reviewed here.

The verification that children with PP also present difficulties with phonological representation of a word suggests that these children probably demonstrate lower performance in phonological awareness. In the following section, we will explore the theme of phonological awareness in children with PP through two studies performed with Chilean children.

5. Phonological awareness in Spanish-speaking children with phonological problems

Phonological awareness is a metalinguistic ability that enables speakers to manipulate and explicitly identify the syllables and phonemes in a word [38]. The development of this ability plays a fundamental role in decoding letter patterns in words, which in turn, is essential in the development of reading skills [39].

Two types of phonological awareness have been identified: awareness of the syllable and awareness of the phoneme. Firstly, during the preschool period, awareness of the syllable is developed. Then, in the school period, awareness of the phoneme is built together with the development of reading skills.

The development of phonological awareness requires that children have an analytic and differential representation that enable them manipulate and identify syllables and phonemes. Therefore, it is possible to propose that children with PP also have difficulties with phonological awareness. However, findings are not conclusive [40–42].

It has been observed that children with PP show poorer performance than typically developing children in phonological awareness. Despite this, they show better performance in this metalinguistic ability when compared to children with PP who also have language difficulties [40]. It has been also reported that phonological perception and vocabulary can predict children's performance in phonological awareness. However, phoneme articulation does not affect phonological awareness [42]. Likewise, preschool children with severe PP do not show difficulties with phonological awareness [41]. In the following section, two studies performed with preschool Chilean children with PP and SLI are presented [43, 44].

The first study [43] aimed to answer the following question: Is there a relationship between phonological problems and phonological awareness? For this study, 24 preschool children with SLI and PP (aged 4:2 on average) and 26 preschool children with TLD (aged 4:4 on average) were recruited. Phonological performance was evaluated with the TEPROSIF-R [10].

Children with SLI and PP had a poor performance in the test, that is to say, they produced more PSP than expected for their age. Children with TLD, conversely, perform according

to their age. Phonological awareness was evaluated with *Prueba Destinada para Evaluar Habilidades Metalingüísticas de tipo Fonológico* (PDEHMF) [45]. This test evaluates, mainly, phonological awareness at the syllable level, thus its subtests focus on the evaluation of syllabic awareness. Each subtest has eight items and provides an example to ensure comprehension of the task. The first four subtests aim to measure syllabic awareness and the fifth test evaluates the grapheme-phoneme associations. The final subtest deals with phonological awareness at the phoneme level. Pearson's r test was used to determine if there was a relationship between these variables. The results obtained showed that there is no correlation between the number of PSP and phonological awareness either in preschool children with SLI or children with TLD. Therefore, the number of Phonological Simplification Processes that children produce is not related with their metaphonological abilities.

This result supports previous findings that state that phonological problems do not necessarily affect these metaphonological abilities [40, 41, 46, 47]. This also corroborates the finding that some children without PP show difficulties in phonological awareness [47, 48].

Normal phonological awareness develops considering other linguistic and cognitive factors. It is argued that vocabulary and working memory play an essential role in its development. For this reason, vocabulary expansion is an important factor since it implies a lexical reorganization that requires a more precise and analytical phonological representation of the word [41]. Working memory, on the other hand, is also relevant to the development of phonological as carrying out phonological awareness tasks requires that acoustic information be processed in its central executive component [49].

In conclusion, the study shows that there is no relationship between phonological performance and phonological awareness. This suggests that a normal phonological development does not ensure a satisfactory performance in this metalinguistic ability. It seems that the development of phonological awareness also requires such other factors as vocabulary and working memory.

The second study aimed to deepen the findings reported in the previous study [44]. For this reason, the following research question was posed: Do children with PP and grammatical difficulties are more likely to have poor phonological awareness skills than children with PP?

A total of 25 preschool children with SLI were recruited for the study: 14 children with PP and 11 children with PP and grammatical difficulties (aged 5:4 on average) and 59 preschool children with TLD (aged 5:5 on average). The phonological ability was evaluated as done in the previous study. Thus, TEPROSIF-R [10] was used to evaluate PP and PDEHMF [45] to measure phonological awareness. Grammatical difficulties were evaluated with the *Test Exploratorio de Gramática Española de A. Toronto* (TEGE) [50]. This test has two subtests: one to measure receptive skills and the other to measure expressive skills. Each subtest has 23 items that evaluate the following aspects: sentences (affirmative, negative and passive), pronouns (personal, interrogative, demonstrative, indefinite and relative), verbs (tense and 3rd person), and adjectives (possessive and interrogative). Student's t test was used to compare the performance of children with SLI and children with TLD. The same statistical treatment was used to compare the performance of children with SLI and PP with that of

children with SLI, PP, and grammatical difficulties. The results obtained showed that children with SLI had a lower performance in phonological awareness than children with TLD. Children with SLI and PP demonstrated a better performance in this metalinguistic ability than children with SLI, PP, and grammatical difficulties. These findings are consistent with evidence from a previous study that suggest that children with PP show better performance in this metalinguistic ability when compared with children with PP and who also have other language problems [40].

Even though the results obtained indicate that phonological problems do not determine the performance in phonological awareness, it was observed that children with decreased performance in phonological awareness produced a greater number of PSP at syllable level. This type of PSP could imply an important alteration in the phonological representation, due to the fact that it modifies the syllable structure and/or the number of syllables in a word. Thus, it might be supposed that children who produce this type of PSP show a phonological representation that is insufficiently precise and undifferentiated. This suggests that children with PP who produce a great number of PSP related with the syllable could show difficulties with phonological awareness.

In summary, results suggest that children with PP are less likely to have poor performance in phonological awareness. However, when children with PP also have grammatical difficulties, it is possible that phonological awareness be affected.

The two studies above suggest that in children with PP, understood as the production of a great number of PSP, no relationship between phonological performance and phonological awareness can be found. On the other hand, when children show phonological problems and grammatical difficulties, a lower performance in phonological awareness has been observed. Finally, findings suggest that children that produce a great number of PSP at the syllable level tend to have a poorer performance in phonological awareness.

6. Conclusions

Reviewed studies were all conducted within the Theory of Natural Phonology framework. Consequently, they provide a valuable point of view when describing children with PP, especially when considering that there are indeed other studies conducted within the same theoretical framework in other populations

Firstly, it has been demonstrated that phonological development in typically developing Spanish-speaking children, particularly, Chilean children, implies the elimination of the Phonological Simplification Processes as they get older. This supports the Theory of Natural Phonology.

As for phonological development in Spanish-speaking children with phonological problems, it is possible to conclude that these children:

- a. produce phonologically simplified words until advanced age as compared to children with typical language development, that is to say, they frequently produce phonologically simplified words until 6 years of age. They also produced more phonologically simplified words as compared to younger typically developing children (chronological age).
- b. show their own developmental trajectory of phonological development. Children with phonological disorders and typically developing children produce the same types of phonological simplification processes. However, some Phonological Simplification Processes are produced more frequently by children with phonological disorders than typically developing children.
- c. show more difficulties with structural process (syllable and word structure). This is also observed in typically developing children. These processes have a central role in phonological development.
- d. produce a fewer number of phonological simplification processes between 4:0 and 5:0 years of age. However, between 5:0 and 6:11 years of age the number of Phonological Simplification Processes remains numerically the same. Phonological development seems to slower down between 5:0 and 6:11 years of age. This is not observed in typically developing children, as the elimination of the phonological simplification processes in these children occurs more rapidly and usually between 3:0 and 6:0 years of age.
- e. show severe phonological difficulties in producing words with three or more syllables. Children with phonological disorders produce words in which some syllables are omitted, whereas the tonic syllable remains stable. Patterns commonly found in these children include elements with three syllables.
- f. present a decreased ability in phonological representation and lexical comprehension. However, no significant statistical correlation was found between these difficulties.
- g. no correlation was found between phonological awareness and phonological performance. Children with phonological problems show difficulties with phonological awareness when they have grammatical problems or when they produce a high number of Phonological Simplification Processes that equally affects syllable structure as it does word structure.

The conclusions above contribute to gain deeper understanding of phonological development in Spanish-speaking children with phonological problems, in particular, Chilean children. However, it is important to highlight the fact that these conclusions are drawn from studies carried out based on a specific theoretical perspective; thus, other issues concerning phonological development and disorders may not be covered.

Finally, phonological disorders found in the production of words can be related to other difficulties for instance phonological representations and phonological awareness. It is also interesting to mention that phonological disorders also occur together with grammatical and lexical problems. Future research should, therefore concentrate on this relationship in Spanish-speaking children.

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