PATTERNS IN THE ACQUISITION OF THE SPANISH TRILL: A STUDY INVOLVING CHILDREN AGES 3;0 TO 5;6

Patrones en la adquisición de la vibrante multiple del español: Un estudio con niños y niñas entre los 3;0 y los 5;6 años de edad

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ABSTRACT

This study describes the substitution patterns of the trill found in naturalistic speech by 34 monolingual Spanish-speaking Costa Rican children between ages 3 and 5;6. In the 843 target-words identified, a total of six different phonetic realizations of the trill were found: a trill [ρ] (2% of the time), an assibilated rhotic [ρ◊] (45% of the time), a post alveolar affricate [ʤ] (9% of the time), a voiced labio-dental fricative [ϖ] (17% of the time), a voiced interdental fricative [ʌ] (9% of the time), and a lateral approximant [λ] (3% of the time). Interestingly, these phonetic realizations were not used consistently, as children relied on two or more phonetic realizations, regularly within a single session and to pronounce the same word. [ρ ◊] surfaced most likely as a result of the children's input, whereas [ϖ] and [ʌ], which are not part of the children's input, as well as the other phonetic realizations, surfaced most likely as approximations of the articulatorily very complex trill.

Key Words: phonetic substitution, Spanish trill, assibilation of rhotics, Costa Rican Spanish, acquisition of trills

RESUMEN

Este estudio describe los patrones de sustitución de la vibrante múltiple identificados en el lenguaje espontáneo de 34 niños y niñas costarricenses monolingües del español, con edades entre los 3;6 y 5;6 años. En las 843 palabras meta identificadas se encontró un total de seis realizaciones fonéticas de la vibrante múltiple: un sonido vibrante múltiple [ρ] (2% de las veces), una vibrante asibilada [ρ◊] (45% de las veces), una vibrante post-alveolar africada [ʤ] (9% de las veces), un sonido vibrante labio dental fricado [ϖ] (17% de las veces), un sonido vibrante africado ínter-dental [ʌ] (9% de las veces), y un sonido lateral aproximante fricativo [λ] (3% de las veces). Es interesante que esas realizaciones fonéticas no son utilizadas de manera consistente, por cuanto los niños y las niñas utilizan 2 o más realizaciones fonéticas de manera regular dentro de una misma sesión y para pronunciar una misma palabra. El sonido [ρ◊] emerge muy posiblemente como resultado del input al que están expuestos estos niños y niñas, mientras [ϖ] y [ʌ], las cuales no son parte del input, así como otras realizaciones fonéticas surgen posiblemente como aproximaciones de la muy compleja articulación de la vibrante múltiple.

Palabras Clave: sustitución fonética, vibrante múltiple del español, asibilación de róticas, español costarricense, adquisición de las róticas

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I. Introduction

The trill is a highly prominent sound in the Spanish language; although it is rare crosslinguistically (Widdison, 1998). It requires precise controlled gesture (Johnson, 2008; Ladefoged, 2001), and thus it is the last sound acquired by Spanish-speaking monolingual children; its full mastery is not obtained by the majority of children until after age 5 (e.g., Acevedo, 1993; Anderson & Smith, 1986; Jiménez, 1987). This difficulty frequently results in the need for clinical attention in the daily practice of speech therapy (Carballo & Mendoza, 2000; p. 588). In adult Spanish, the trill tends to undergo substitutions, all of which involve less complex articulatory effort (e.g., Agüero, 1962; Canfield, 1981; Bradley, 1998).

Although various studies have reported that the Spanish trill is a late acquisition phenomenon when compared to other consonant sounds, most such studies have been experimental in nature, based on children's ability to repeat or state small sets of words containing the target sound (e.g., Acevedo, 1993; Fabiano-Smith & Goldstein, 2010; Jiménez, 1987). That is, except for Gómez Fernández (2004), previous studies do not report on the process through which the trill is acquired (i.e., on possible substitution patterns).

This study describes the patterns in the phonetic realization of the trill identified in naturalistic speech by 34 monolingual Spanish-speaking Costa Rican children ages 3 to 5;6. In the 843 target words analyzed (i.e., words requiring a trill), a total of six different phonetic realizations of the trill were found, and they were not used consistently: i.e., the children alternated between two or more phonetic realizations of the trill. The multiple vibrant, [r], was found to be the least common phonetic realization of the trill, whereas the most common substitution was an assibilated rhotic [ρ◊], characteristic of the Spanish spoken by adults in the geographic area where the study was conducted.

Furthermore, the data revealed other phonetic realizations previously reported in the literature, namely [λ] and [ʤ], as well as phonetic realizations which have seldom been documented to replace the Spanish trill, specifically [ϖ] and [Δ].

In order to account for the difficulty in the production of the trill evidenced in this study, the proposal put forth here is that it results from the complexity involved in the articulation of this segment and due to Universal tendencies such as the Economy Principle, whereby children produce approximations that require less articulatory effort.

On the other hand, the fact that the data does not evidence full acquisition of the trill by these children confirms that [r] is indeed a truly marked phoneme cross-linguistically; as a result, its full mastery is delayed and there is a long process through which children substitute the trill for other sounds, even sounds that are not found in their input.

Finally, the fact that the most common substitution uncovered here involves an assibilated rhotic (also reported for adult Costa Rican Spanish) suggests that, given the complexity involved in articulating the trill, these children have an option in their input which involves less complex articulation and hence, they opt for delaying the consistent use of [r], even after they have developed the physical ability to produce it.

II. The complex articulation of the Spanish trill

The articulation of the Spanish trill involves complex, precise gesture, and highly restricted aerodynamic configuration (Johnson, 2008; Ladefoged, 2001). Specifically, "it requires that the tongue move up to contact the roof of the mouth at the alveolar ridge and then move back to the floor of the mouth with a closure that has extra-short duration" (Ladefoged, 2001; p. 150). Furthermore, as pointed out by Ladefoged and Maddison (1997), Solé (1999), and Johnson (2008), trills are the product of a restricted set of physical conditions which must be met before successfully producing it. Johnson adds that, "when these conditions are met, the production of the trill is likely inevitable" (p. 22). It is assumed that the first movement involved in the trill, namely, the rising of the tongue tip towards the alveolar ridge, is mostly a voluntary muscular gesture; at that point in the articulation process, the Bernoulli Effect plays an important role in sustaining the trill.

The Bernoulli Effect refers to the presence of low pressure where there is higher fluid flow (in this case air) and higher pressure where flow is slower. In trilling, pressure builds in the low flow region behind the tongue when it is in contact with the alveolar region. The pressure buildup created by tongue contact forces the tongue to separate from the alveolar ridge as air flows out at high speed. This results in a drop in pressure and creates a vacuum which the tongue is drawn back up to occupy once again, rising to make new contact with the alveolar ridge and beginning the cycle again (Johnson, 2008, p. 23). In other words, speakers appear to have little control over the production of the trill once air is set into motion.

Similarly, the Spanish trill involves anywhere from three to six contacts of the tongue tip against the alveolar ridge, depending on the phonetic context in which it occurs (e.g., word-initially or inter

vocalically; Hammond, 2001; Solé, 2002; Quilis, 1981). In fact, sonograms of trills produced by adult speakers show "successive trilled movements formed by periods of closure or silence (interruptions) and by periods of opening/aperture, in which formants are observed" (Carballo & Mendoza, 2000, p. 588).

Interestingly, most likely as a result of its complex articulation, the Spanish trill has undergone great adjustments across various Spanish dialects, resulting in completely different phonetic realizations. For example, an assibilated rhotic is said to have replaced the trill in some regions in Guatemala, Argentina, Cuba, Chile, Colombia, Panamá, Ecuador, Paraguay, Bolivia, Perú, Mexico, the United States, Spain (from Logroño to Zaragoza), and Costa Rica. That rhotic is defined as an alveolar tap or trill that is phonetically realized as a strident fricative (Agüero, 1962; Canfield, 1962 & 1981; Calvo Shadid & Portilla Chaves, 1998; Bradley, 1998; Berk-Seligson, 1984; Gaínza, 1976; Lipski, 1994; Quilis, 1999; Umaña, 1981; Sánchez Corrales, 1986; Vásquez Carranza, 2006; Widdison, 1998).

In contrast, a velarized rhotic has been reported to replace the trill in parts of Cuba, Puerto Rico, Panama, Mexico, and coastal Colombia and Venezuela (Canfield, 1962; Quilis, 1999; Widdison, 1998). Widdison (1998) accounts for such variation in the production of this sound by claiming that, a slight change in any of the parameters that involve the production of a trill (i.e., airflow, resistance, and body tension, and position of the tongue) "will lead to significant alteration in the quality of the sound produced" (p. 58). This same author claims that, "the complexity of the alveolar trill accounts for its relative obscurity in language systems much like other exotic sounds such as clicks" (Widdison, 1998; p. 58).

Given the complexity that appears to be involved in the articulation of a trill, difficulty in its acquisition by native speakers is anticipated in this study; in looking at different studies on the acquisition of Spanish consonants, this is in fact what has been revealed. Various studies show that the trill is normally the last sound to be acquired in Spanish, emerging at some point after age 4, and that its degree of accuracy varies significantly.

III. Studies on the acquisition of the Spanish trill by monolingual children

Various studies have reported on the acquisition of Spanish consonants, although some of them have referred to children under age 3 and hence, do not add detailed information regarding the acquisition of the trill, as is the case with Anderson and Smith (1986), Jara (1993), and Macken (1983).

Whereas Macken does not report any evidence of the trill in his data (involving a monolingual Mexican child aged 1;9 through 2;6), Jara reports a single instance in which the child in her study at age 1;0

replaced the trill in the word *carro* for a voiced labio-dental fricative [v] (this Costa Rican child's language development was studied from ages 0;6 to 3;0). Similarly, Anderson and Smith, in a study involving 6 two-year-old monolingual Puerto Rican children, report that the trill was part of the phonemes that constituted less than 4% of the total number of consonants identified in the children's spontaneous speech.

As far as I know, the first study to report on the acquisition of the trill *per se* as a late developmental phenomenon was Mason, Smith, and Hinshaw (1976; cited in Jiménez, 1987). The study was designed to validate their articulation test *Medida Española de Articulación* ('Spanish Meaure of Articulation') by applying it to 424 children of Mexican descent in California. These children ranged between 4 and 9 years in age, and the study revealed that the trill was mastered after age 5. Another study that later on showed that the trill is acquired after age 5 is Linares (1981; cited in Jiménez, 1987). That study involved 97 monolingual Spanish-speaking children from Chihuahua, Mexico, ages 3 to 6.

Despite these two studies, the author most frequently cited to argue for the late acquisition of the Spanish trill is Jiménez (1987). She tested the acquisition of Spanish phonemes in 120 monolingual children of Mexican descent ages 3 to 5;7 by means of a picture-naming task designed to determine the order of acquisition. The results were similar to those in Mason et *al*. (1976) and in Linares (1981), as the trill reportedly did not reach a 50% level of acquisition until age 4;7, whereas only 80% of the older group (i.e., the 5;7-year-olds) had acquired the trill. The children in that study were asked to name the items presented on picture cards, and only two of the items contained words with trills, namely *rey* ('king'; word-initially) and *burro* ('donkey'; inter-vocalically).

A similar study by Acevedo (1993) replicated Jiménez's findings in a group of 120 Mexican-American preschool children aged 3 to 5;11. The study aimed to test the production of 18 Spanish consonants and to determine if the findings reported in Jiménez could be found in a different group of Mexican children living in a different context. The stimuli used in this study were the same as those used in Jiménez (1987); i.e., only two of the target-words contained the trill. Overall, these children showed higher accuracy in using the trill than the children in Jiménez (1987). Specifically, at age 3 the children evidenced correct use of the initial trill in word-initial position in 60% of their productions and in inter-vocalic position in 55% of their productions, as compared to only 7% word-initially and 13% inter-vocalically in Jiménez' study at a comparable age. Similarly, the 4-year-olds in Acevedo evidenced a 75% correct production of the trill in word-initial position and an 85% correct production inter-vocalically, whereas in Jiménez, it was 40 and 45% respectively for that age group. Finally, the children in Acevedo's study used the trill correctly word-initially 90% of the time by age 5;6, whereas inter

vocalically, they used it correctly 100% of the time at that age (as compared to a 73 and an 80% respectively in the Jiménez' group).

In a different type of study, Carballo and Mendoza (2000) analyzed the temporal and acoustic characteristics of the trill in 5 groups of monolingual Spanish-speaking children in Granada, ranging in ages from 3;0 to 9;6. Six target words were used in the form of picture cards as stimuli, all word initially. The 45 participants were grouped as follows: each group consisted of 9 children, and the mean age for the first group was 4;85, the mean age for the second group was 4;78, for the third group, it was 4;46, for the fourth group, 7;70, and for the last group, 8;08. The results showed that in Groups 1 and 2, all subjects had a highly intelligible trill; i.e., they all pronounced the trill normally. This is somewhat surprising, given that these were the youngest children. The children in group 3, in contrast, evidenced low intelligibility of the trill, namely a rhotic similar to an intervocalic tap, despite having the same age range as those in Groups 1 and 2. Surprisingly, the children in Group 4 showed incorrect pronunciation of the trill, as they replaced the trill with another phoneme (unfortunately, the sounds that were used for the substitution evidenced here were not specified); this finding is unexpected, as well, given that these children were older than 7;0. Finally, the children in group 5, also aged 7 and older, revealed a normal enunciation of the trill. In this study, although the children in the first three groups (i.e., the younger children) produced the shortest trills, it is interesting that even the older groups showed difficulty in producing the trill (the authors clarify that none of the children in the study had been diagnosed as having speech problems). Carballo and Mendoza conclude that the incorrect pronunciation of the trill might result from tongue shape, which in some cases "is incompatible with the aerodynamic requirements for the trill" (p. 595).

Fabiano-Smith and Goldstein (2010) set out to establish early-, middle-, and late-developing sounds in a group of children which included 8 monolingual Spanish-speaking children with a mean age of 3;4; the children were from Queretaro, Mexico. By relying on photographs that elicited single word samples, the authors argued that the trill is indeed a late-acquisition phoneme. This study, however, was designed to establish whether the order of acquisition is the same for monolingual and bilingual English-Spanish children and hence, no specific details are provided regarding the acquisition of the trill.

Finally, a thesis conducted by Fernández Aragón, Gutiérrez Coto, Morgan Mora, Romero Zúñiga, and Zadwaski Wisniewski (1994) is, as far as I know, the only study to thoroughly report on the acquisition of the trill by a group of Costa Rican children. The study involved 78 children ranging in age

from 5;6 to 6;6, all diagnosed as having speech delay. Just like in most of the studies cited above, only two words were used to yield the Spanish trill, namely *ratón* 'mouse' (word-initial trill) and *perro* (intervocalic trill). Also similar to most other studies, the children were asked to name objects on picture cards; if they were unable to state the correct word, questions were asked to elicit it; as a last resort, repetition was used. The study revealed a 54% rate of error in the production of the trill inter-vocalically and a 29.5% rate of substitution (i.e., in 21 of the subjects). In that phonetic context, the trill tended to be substituted by either [δZ], [β], [δ], or [P] . Word-initially, a 26.9% of the productions were described as substitutions and a 16.6% as distortions (distortions were defined as sounds that were approximations or hard to identify). The most frequent substitution in this context was [δZ].

As far as I know, a single study has reported on the substitution patterns of the trill by native Spanish-speaking children based on *naturalistic* speech, namely Gómez Fernández (2004). His study involved children from Seville, ages 1 through 3. Between ages 1 and 1;5, few examples involving the trill were found, all of which involved substitutions for either [Δ], [B], or [λ]. Between ages 1;5 and 2, no examples of words containing trills were identified, whereas between ages 2 and 2;5, [ρ] was generally substituted with a tap or with [Δ], though some productions of the trill were reported. During the final stage, some omissions and substitutions were still reported, but at least syllable-initially, trills were mostly accurate.

In sum, although there is little doubt that the trill is acquired late as compared to other Spanish consonants, the age at which this sound is acquired is still uncertain, given that most studies have been based on children's naming or repetitions of *one* [emphasis added] target word containing the trill in each of the two possible contexts. In other words, these children may have been able to *use* the target sound in the words elicited, but may not necessarily have *acquired* the phoneme at the ages reported.

In order to more objectively argue for acquisition of a given linguistic component, we believe that multiple consistent occurrences of the target sound need to be identified in the speech of each child and therefore, more studies relying on naturalistic data which would contain multiple examples of the trill are called for. Such studies should describe the *process* through which this phoneme is acquired, because it is logical that from the onset of language development, children refer to words that contain trills, as such words are part of their daily lives (e.g., *carro* 'car', *perro* 'dog', *burro, rey*). As seen in the previous review, only two studies to date have described what children do instead of producing the so complex trill: Fernández Aragón et *al*. (1994) and Gómez Fernández (2004).

The present study was designed to firstly observe children's use, or lack thereof, of the Spanish trill in naturalistic conversations by a group of monolingual Costa Rican children between ages 3 and

5;6. Secondly, the study was designed to thoroughly describe the substitution process that is likely to take place regarding the trill phoneme, to observe whether the substitutions resemble those reported in Fernández Aragón et *al*. (1994) and in Gómez Fernández (2004), and to study if the patters of substitution used are consistent. Finally, given that the child's input generally influences his/her speech, the study aimed to examine the extent to which these children substitute the trill by an assibilated rhotic (a sound that involves less complexity regarding articulation), just like the adults in their input do.

IV. Subjects and Methodology

The process of acquisition of the Spanish trill was analyzed in natural speech produced by a group of 34 monolingual Spanish-speaking children between ages 3;0 and 5;6 (17 boys and 17 girls), all attending either public day care centers or pre-schools in the Western region of Costa Rica (namely in the Palmares, Zarcero, Naranjo, and San Ramon counties). As a requirement to participate in the study, the children had to be described by their teachers as not able to produce the trill consistently, this given that the main goal of the study was to analyze the process of acquisition of the trill. In addition, given the claim by Johnson (2008) that once the trill is acquired, few problems in its production should be expected, it would have been impossible to observe the substitutions of the trill in children who were already able to use it at will.

The children were audio-recorded on average four times in intervals of approximately two months between each recording; this in an effort to observe any changes in the process of the acquisition of the trill. The children were involved in play sessions with either the researcher alone or with the researcher and another child of comparable age, and sessions lasted from 20 to 45 minutes, depending on the children's willingness to stay engaged in the various play activities. For each session, play items such as toy animals, toy cars, puzzles, coloring books, and stuffed animals were used and, although the goal was to record the children's spontaneous speech, occasionally the researcher prompted the children to produce words containing the target sound, as sometimes they did not produce many within a single recording. For example, if a child was looking at picture books, the researcher would ask him/her to name pictures, and she would call attention to words that contained the trill in various contexts (e.g., a dog, a car).

Additionally, often times when a child seemed to be struggling to produce the trill, the researcher would pause and ask him/her to repeat the target word in an effort to determine whether the child was able to produce the sound accurately or whether he/she was using another sound to substitute for it. In general, as might be expected, some of the children were much more outgoing than others, and hence

some of the recordings included a lot more analyzable data (this fact was also pointed out in Gómez Fernández, 2004).

The sessions were then fully transcribed by either the researcher herself (an experienced linguist) or by a well-trained assistant. Once all the recordings had been typed in, both the researcher and her assistant listened to each recording and checked for reliability of the transcripts; when in doubt about what the child had actually said[i], the researcher and her assistant debated on the intelligibility of the target word(s) and decided whether they could be transcribed or whether they should not be counted for the analysis. The target words, i.e., all words requiring a trill, were carefully transcribed phonetically by using the International Phonetic Alphabet, and an effort was made to assure that the exact sound produced by the child in each example involving the target trill was transcribed. It is important to clarify, nonetheless, that the analysis is merely perceptual, as no advanced technological devices nor special software were used, given the lack of access to such technology on the part of the researcher. Once the data were fully transcribed, all substitutions of the trill per child per recording were entered into a grid in order to aid in the overall analysis and to establish any age, individual, and gender differences.

V. Analysis of the Data and Discussion

For the analysis, the subjects were divided into 6 age groups, three groups per gender, in an effort to observe possible differences across age groups and gender groups. The distribution of the subjects involved in the study is summarized in Table 1.

TABLE 1: Number of children in each age group according to gender.

# of BOYS			**# of GIRLS**		
GROUP 1	***GROUP 2***	***GROUP 3***	***GROUP A***	***GROUP B***	***GROUP C***
3 to 4 year-olds	*4 to 5 year-olds*	*5 to 5;6 year-olds*	*3 to 4 year-olds*	*4 to 5 year-olds*	*5 to 5;6 year-olds*
8	5	4	5	10	2[ii]

[i] This happened due to external noise mostly, as the recordings took place at any space available at the children's schools, and sometimes other events such as recess and such were taking place at the time of the recordings.

[ii] Recall that the number of children included in each age group depended on the availability, as the main requirement was that they did not evidence consistent use of the target sound.

The overall analysis yielded no major differences across the three age groups nor differences regarding the substitution patterns used by girls versus boys, as the six phonetic realizations of the trill reported in Table 2 bellow were identified in the boys as well as in the girls and across the three age groups. Nonetheless, the results are presented by gender and age group. Overall, a total of 843 words clearly requiring a trill were identified.

TABLE 2: Phonetic realizations of the trill across the 6 groups.

Phonetic realization of the trill	**trill [ρ]**	**assibilated rhotic [ρ◊]**	**voiced postalveolar affricate [ʤ]**	**voiced labio-dental fricative [ϖ]**	**voiced interdental fricative [ð]**	**lateral approximant [λ]**	**Total # examples**
Group 1 (8 boys)	0.40% N*=1	56.00% N=139	13.30% N=33	11.69% N=24	9.67% N=29	8.87% N=22	248
Group 2 (5 boys)	0.00% N=0	39.68% N=50	50.00% N=63	0.00% N=0	8.70% N=11	1.58% N=2	126
Group 3 (4 boys)	10.00% N=10	25.00% N=25	8.00% N=8	53.00% N=53	0.00% N=0	4.00% N=4	100
Group A (5 girls)	0.00% N=0	43.20% N=35	7.40% N=6	41.90% N=34	7.40% N=6	0.00% N=0	81
Group B (10 girls)	4.27% N=10	52.50% N=123	14.52% N=34	11.96% N=28	14.52% N=34	2.13% N=5	234
Group C (2 girls)	0.00% N=0	22.22% N=12	66.66% N=36	11.11% N=6	0.00% N=0	0.00% N=0	54
TOTAL examples	# 2.49% N=21	45.55% N=384	21.35% N=180	17.20% N=145	9.48% N=80	3.91% N=33	100% 843

*Note: here, N refers to the total number of examples for each phonetic realization of the trill.

From the information presented in Table 2, it is evident that the trill was almost never phonetically realized as such in the data analyzed, as only 2.49% of the total number of the examples retrieved was realized as [ρ]. In fact, in Group 3 a single boy produced the total number of examples reported in Table

2 above, whereas the remaining 11 trills were produced by 4 children, 1 child from Group 1 and 3 children from Group B. In other words, the trill was only phonetically realized as such by 5 of the 34 children, and these children did not necessarily belong to the older-age groups. Furthermore, the children who did produce the trill did not do so consistently, as they also used other phonetic realizations of the trill, sometimes to pronounce the same word and within the same recording (e.g., *perro* → [πΕρο / π ΕΔο], *rata* → [ρατ α / ϖατα], *rana* [ρανα / Δανα] 'frog', *carro* [καρο / καϖο]).

Interestingly, however, except for one child in Group 3 who substituted the trill for either an assibilated rhotic or for a lateral approximant [λ], the other 4 children who produced the trill only substituted it for an assibilated rhotic [ρ◊]. Recall that in the geographic area where this study took place, in adult speech the trill has been substituted by an assibilated rhotic, namely [ρ◊]. It is hence likely that four of these children had indeed acquired the trill at the time the study took place but that, just like adults do, they simply chose to substitute the trill for the less articulatorily complex segment [ρ◊].

Assibilation of the trill was indeed the most common substitution pattern identified in the data, as it occurred in 45.55% of all target words analyzed. In fact, only 3 of the children did not replace the trill with the assibilated rhotic (i.e., 91% of the subjects realized the trill as [ρ◊] at some point).

Regarding the voiced post-alveolar affricate, [ʤ], that phonetic realization of the trill was evidenced in 21.35% of the target words produced by the children in this study, as shown in Table 2 above. Just like with most other phonetic realizations of the trill, [ʤ] was normally used together with the other phonetic realizations reported, as only one child consistently substituted the trill for [ʤ]. The substitution of the trill for [ʤ] has been reported in Fernández Aragón et *al*. (1994), and this is the sound that most adults in Costa Rica allude to when imitating or making jokes about children's inability to produce the Spanish trill. Yet, in this study the assibilated rhotic [ρ◊] and not [ʤ] was generally used to substitute for the trill. Thus far, assibilation of the trill has not been reported as a substitution for the Spanish trill in child speech, although this implies that such realizations would only be found in the speech of those children whose input does involve the substitution of the trill for an assibilated rhotic.

It shall be point out here that was interesting to find two phonetic realizations of the trill which involve sounds that are not part of the phonetic inventory in the Spanish spoken throughout Costa Rica, namely the voiced labio-dental fricative [ϖ], which constituted 17.20% of the examples, and the voiced interdental fricative [Δ] , which was evidenced 9.48% of the time. Recall that Jara (1993) reported a single example of [ϖ] as a substitution for [ρ] in speech by a Costa Rican child. Regarding [Δ], this substitution pattern has been reported in children from Seville, Spanish dialect that does indeed contain

this voiced inter-dental phoneme. Although some researchers argue that [ð] is part of the Spanish phonetic inventory, authors such as Proctor (2009) point out that such a segment is not part of all Spanish dialects, as is the case with Costa Rican Spanish. Nonetheless, I argue that that these two phonetic realizations evidence these children's approximation to the dental voiced bilabial stop (i.e., a sound produced like a [b], but with the lower lip contacting the upper teeth, as in [v]) which is present in the adult Spanish spoken in Costa Rica[iii]; this is certainly a possibility, as pointed out to me at the XV Symposium on Spanish Linguistics at the University of Georgia where this study was presented in 2011.

Finally, a small percentage of the target words in the data contained a voiced lateral approximant [ʎ] instead of the required trill, namely 3.9% of the total target words. The tendency to substitute the trill for a lateral approximant in child Spanish has been reported in Yavas (2004), Barlow (2005; both cited in Proctor, 2009), and Gómez Fernández (2004). Here, of course, we could not refer to this substitution type as a tendency, as only a small percentage of the overall target words contained [ʎ].

In contrast, although Carballo and Mendoza (2000) and Fernández Aragón et *al.* (1994) report substitution of the trill for a tap, no instances of such examples were found in the data analyzed here. It is possible that this pattern is more characteristic of younger children and hence, we found no such evidence in our data. The same is true for omissions of the trill, which were not found in the data analyzed here, as these children always phonetically realized the target sound, wither as a trill as one of the substitutions reported above.

Overall, it is clear that these children evidenced difficulty in articulating the trill, most likely due to the complexity involved in sustaining the vibration required in this rhotic. Instead, they resort to other sounds, all of which are coincidentally voiced fricative sounds (except for the post-alveolar affricate which itself contains a fricative sound). The evidence is seen in that the children do not only tend to substitute the trill for various phonetic approximations, but that they do not consistently rely on a single substitution pattern but fluctuate back and forth across various approximations of the trill, sometimes within a single session and to pronounce the same word.

Furthermore, although there were intervals of approximately two months between each recording per child (i.e., eight months between the first and the last recording), no differences were observed in the substitution patterns of each child, suggesting that the acquisition of the trill is indeed a long *proces*s

[iii] This happened due to external noise mostly, as the recordings took place at any space available at the children's schools, and sometimes other events such as recess and such were taking place at the time of the recordings.

which takes at least several months before mastery is achieved, just as reported in Carballo and Mendoza (2000). A few of these Costa Rican children, once they were able to produce the trill accurately, tended to rely on the assibilated rhotic instead of producing the trill, most likely given the less articulatory effort involved in the latter. This fact does not support the argument by Johnson (2008) that once the trill is acquired, its consistent articulation is to be expected. I would argue that it is logical to evidence, even in the speech of young children, that there is a universal tendency to economize, which is exactly what occurs in the acquisition of the Spanish trill.

VI. Conclusions and Implications

This study was designed to determine the process through which Spanish-speaking children, specifically a group of 34 Costa Rican 3- to 5;6-year-old children, develop the trill. It was shown that the trill, as such, was rarely present in the children's spontaneous speech, as only 20 of the total 843 target words identified in the data contained trills. This contrasts with the findings in Jiménez (1987) and Acevedo (1993) who report higher percentages of accurate use of the trill by children of comparable chronological ages. Nonetheless, the data analyzed here consisted of naturalistic speech, as opposed to isolated words that were either imitated or repeated by the children in those two studies. Furthermore, recall that since this study was mainly designed to analyze the process of acquisition of the trill, the children included were specifically required to not have mastered the trill (as determined by the children's teachers).

Regarding the *process* of acquisition of the trill, six different phonetic realizations were identified. Furthermore, the trill was phonetically realized as some or even all of these six segments inconsistently, as some children realized the trill in three or more ways within a single session and to state the same word, except for a few cases where the substitution was consistently the assibilated rhotic.

Regarding the assibilated rhotic found in the majority of these children's words requiring a trill (i.e., 383 of the target-words), I adopt the account proposed by Recasens (1991), Widdison (1998) and Bradley (1998; 2005) who postulate that assibilation (in adults) results from normal physiological limitations in producing the highly complex trill; articulatory weakening is the end result in these phonetic contexts. Bradley (1998), for example, argues that whereas the trill requires complex precise gesture, the assibilated rhotic involves a reduced magnitude in tongue-tip gesture.

As for the fact that two of the phonetic realizations reported here involved segments that are not necessarily found in the children's input, namely [ϖ] and [ʌ], this suggests that, upon their straggle to

articulate the Spanish trill, children produce approximations, and these sometimes surface phonetically as sounds that might not be part of their input.

Another logical account for the difficulty in acquiring the Spanish trill evidenced through this study comes from the claim that there exist cross-linguistic generalizations which govern phonetic development and phonological processes in child language. Specifically, Jakobson (1968) postulated that there is a hierarchy regarding the order of acquisition of phonemes, and hence children are said to acquire unmarked phonemes (i.e., less complex and hence more common sounds cross-linguistically) earlier than more marked ones (i.e., more complex articulatorily and hence, more rare cross linguistically). The trill is certainly a highly marked phoneme cross-linguistically, as evidenced in its rarity across the world's languages as well as in its complex articulation. Young children appear to apply innate universal phonetic tendencies resulting from limitations in perception and production, and which are evidenced mostly *systematically* in sound changes or substitution patterns depending on various phonetic contexts. Although systematic use of a single segment to substitute for the trill cannot be argued for in this study, what is systematic is the fact that children have difficulty producing the trill, and that they rely on multiple approximations of the trill along the slow process that appears to be characteristic in the acquisition of the Spanish trill.

Overall, the substitutions reported here additionally appear to derive from the Economy Principle whereby according to Universal tendencies, children are likely to substitute complex phonemes for others that are less complex articulatorily[iv]. Nevertheless, the fact that these children do not evidence mastery in articulating the trill should not be interpreted as a sign of defective speech, as pointed out in Carballo and Mendoza (2000); instead, and as shown in the data analyzed here, it indicates that these children are in the process of acquiring the trill, and that the trill does indeed imply complex articulation. As a result, a lot of rehearsal and substations are involved before achieving full control of the Spanish trill.

For future studies, it would be interesting to observe whether the same patterns are observed in groups of monolingual Spanish-speaking children of comparable ages in different geographic contexts, including other contexts in Costa Rica, as assibilation of the trill is only characteristic of the Central Valley. I would predict that, in addition to children making use of less articulatorily complex sounds

[iv] This happened due to external noise mostly, as the recordings took place at any space available at the children's schools, and sometimes other events such as recess and such were taking place at the time of the recordings.

found in their input to replace the trill temporarily, they would rely on other phonetic realizations which might not even be part of their input, so long as they involve less articulatory effort.

VII. Reference List

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