

A sociophonetic approach to the acquisition of Spanish rhotics in a bilingual community

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Abstract. This study explores Spanish-English bilingual children's acquisition of Spanish rhotics. The children's productions are compared to a group of Spanish-English bilingual adults who represent the Spanish spoken in the same community: Albuquerque, New Mexico. In their narrations of a wordless picture-book, both children and adults produce more non-canonical than canonical variants. Binary logistic regressions run on 817 rhotics produced by 21 children, ages 3-9-years-old, and 6 adults demonstrate that non-canonical variants, instead of canonical variants are more likely to occur as Spanish use increases and in word medial position. The results point towards the propagation of a working change in Spanish rhotics that sees both articulatory and sociolinguistic motivations. Implications for research on phonetic-phonological development are also discussed.

Keywords. child language; bilingualism; Spanish rhotics; language acquisition

1. Introduction. Previous research on phonetic-phonological development, like the acquisition of the Spanish rhotics /r/ and /r/, has measured and described bilingual children's acquisition paths from a prescriptive and monolingual baseline (Fabiano-Smith & Goldstein, 2010, Menke, 2018). However, bilingual children's sound patterns develop similarly to those of bilingual adults, instead of to those of monolingual adults (Menke, 2010). To shift the focus of acquisitional paths, the present study uses a combination of acoustic and impressionistic measures to understand the internal and external predictors of phonetic variation in Spanish rhotics among Spanish-English speaking children, and then to compare their behavior to that of adults in their community.

As a byproduct of describing bilingual children acquisition of their community's norms, the present study will contribute to bodies of phonetic research on the varieties of Spanish spoken in New Mexico (e.g., Brown, 2004; Van Buren, 2017; Vigil, 2018; among others) and on Spanish rhotics (Bradley & Willis, 2012; Henriksen, 2015). Specifically, we will add a detailed account of how language use and internal factors influence realizations of Spanish rhotics in Albuquerque, New Mexico¹. In other communities where Spanish and English are in contact, English use is found to correlate with non-canonical realizations but that canonical realizations are more likely in prosodically stressed syllables and word initial position (Henriksen, 2015; Waltermire & Valtierrez, 2017). Furthermore, we examine the distribution of canonical and non-canonical rhotics throughout these selected variables and the speech samples.

Our attention to these non-canonical variants is paramount to supporting a holistic and community-based approach to phonetic-phonological development. Work on acquisition of rhotics by Spanish-English speaking children has focused heavily on the child's mastery of

* We are grateful to Kelsey Treviño for her assistance with the interrater reliability and earlier versions of this manuscript. We thank Drs. Rich File-Muriel and Chris Koops for their guidance throughout the phonetic and statistical analyses, as well as the attendees at the 2022 LSA Annual meeting for their helpful questions and comments. Author: Sarah Lease, University of New Mexico (leases@unm.edu); Mariana Marchesi, University of New Mexico (mmarchesi@unm.edu).

¹ Albuquerque is towards the northern part of New Mexico, and speakers from Albuquerque have been considered in analyses of Northern New Mexican Spanish (see Torres Cacoullos & Ferreira, 2000).

canonical variants in order to determine developmental stages of acquisition and little attention has been given to ‘dialectal’ variants (Menke, 2018). Yet, research has shown that, from an early age, children mirror phonetic variants used by adults in their speech community, instead of prescriptive norms (Díaz-Campos, 2011; Smith & Durham, 2019). Furthermore, from studies on bilingual and monolingual adults (Bradley & Willis, 2012; Henriksen, 2015), it is clear that there is no specific realization that acquisitionists should select when measuring a child’s acquisition of a phonemic distinction between Spanish /r/ and /ɾ/. In order to accurately assess language acquisition, we must focus on community norms.

2. Literature review

2.1. AN OVERVIEW OF SPANISH RHOTICS. Spanish is traditionally characterized as having two rhotic segments, a tap /ɾ/ and a trill /r/. These rhotics are only contrastive in word-medial, intervocalic contexts: *pero* /'pe.ro/ ‘but’ vs. *perro* /'pe.ro/ ‘dog’ (Hualde, 2014). The prescriptive realization for /ɾ/ is a simple tap, [ɾ], which is produced with only one brief occlusion between the tongue apex and alveolar ridge (Hualde, 2014), as shown in Figure 1a. The prescriptive realization for /r/ is a voiced trill, [r], in which the tongue apex makes two or more occlusions against the alveolar ridge (Hualde, 2014), as shown in Figure 1b. The [r] is a complex sound, such that other voiceless, fricated, and approximant variants commonly result from online articulatory constraints (Ohala, 1983; Solé, 2002).

Despite this simplistic classification, it has been demonstrated that there is not a prototypical /r/ realization and synchronic variation in monolingual and bilingual varieties is attributed to a mixture of internal and external factors (Bradley & Willis, 2012; Melero, 2015; Henriksen, 2015; Vigil, 2018). Productions range from trills to pre-aspirated taps (Willis, 2007), approximant (Bradley & Willis, 2012; Henriksen, 2015) and fricated variants (Colantoni, 2006; Lastra & Martín Burtagueño, 2006; Vigil, 2018), as shown in Figures 1c and 1d.

Realizations of /ɾ/ also vary (Bradley & Willis, 2012; Henriksen, 2015). Spanish /ɾ/ is commonly realized as an approximant variant in monolingual and Spanish-English bilingual varieties of Spanish, most prominently in Mexican varieties of Spanish (Bradley & Willis, 2012; Henriksen, 2015). An approximant variant in a /ɾ/ context is shown in Figure 1e.

While there is an incredible range of rhotic productions, the duration of /ɾ/ is systematically shorter than that of /r/ (Bradley & Willis, 2012; Henriksen, 2015). While the average durations of these segments vary between speech communities (Melero, 2015), the tendency is still found in both adult (Bradley & Willis, 2012) and child (Menke, 2018) populations.

2.2. SPANISH RHOTICS IN NEW MEXICO. Documented variability in Spanish rhotics among Spanish speakers in New Mexico dates back to Espinosa’s (1909) detailed descriptions of a variety of Spanish spoken in Northern New Mexico and Southern Colorado, *Traditional New Mexican Spanish*. He documents canonical trills, approximant variants, voiced fricatives, as well as voiceless fricatives (see Figure 1). These variants are still abundant. Most recently, Vigil analyzed rhotic productions of 29 speakers of Traditional New Mexican Spanish from Taos, NM, and found that the fricated and approximant variants in /r/ contexts were most frequent in word-initial, stressed syllables. In word-medial, unstressed syllables the only other variant found with comparable frequency were trills. These non-trill variants were also most frequent among the youngest adults, aged 50-59. Contrasting the variability in /r/ contexts, there were no approximant variants in intervocalic /ɾ/ contexts.

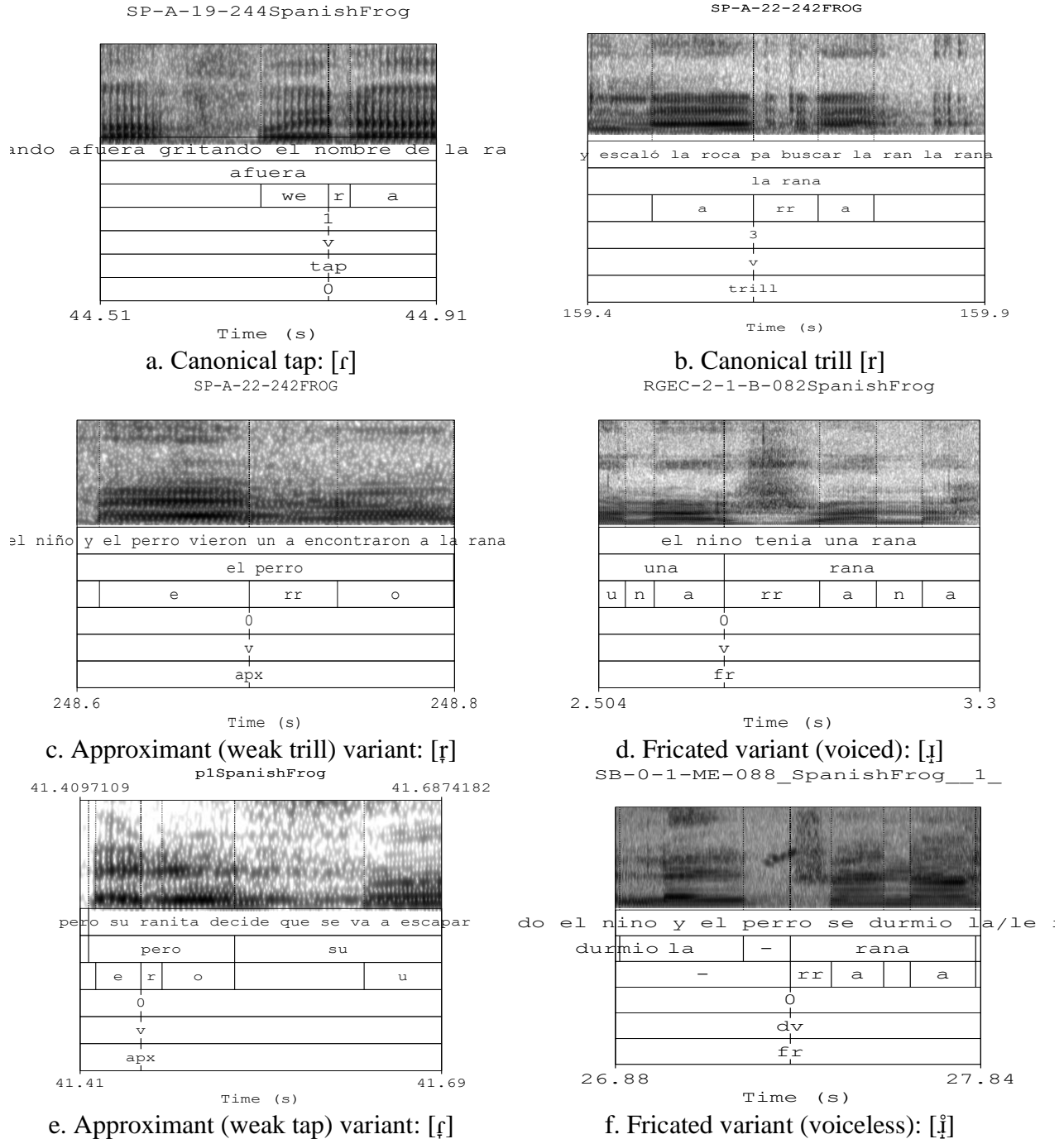


Figure 1. Variants of Spanish rhotics

In Southern New Mexico, the fricated and approximant realizations are not as common in /r/ context. Waltermire and Valtierrez (2017) examined 388 syllable-onset /r/ productions among 15 Spanish-English bilinguals, ages 24 to 74. The analysis centered on the likelihood of [r] and [ɹ] productions in /r/ contexts. Out of all internal predictors, only lexical stress was significant, and the trill variants were more likely to be produced in stressed syllables as opposed to the taps. In contrast, the sociolinguistic predictors returned more significant effects as canonical taps in /r/ contexts were most frequently produced by the younger speakers, speakers with at least one U.S.

born parent, and those with high English use. In the end, the authors suggest that younger speakers' increased English contact is neutralizing the difference between /r/ and /r/.

Together, these studies show that children who grow up speaking Spanish in New Mexico are exposed to a variety of Spanish rhotics in their input. Drawing on an exemplar-based model of lexical representation (Bybee, 2001; Bybee & Beckner, 2010), this relative infrequency of canonical variants to fricated and approximant variants is then expected lead to children's stronger representations of non-canonical variants in exemplars of words that include /r/ and /r/. The present study explores where these variants are more likely produced and who is most likely to produce each one.

2.3. THE ACQUISITION OF SPANISH RHOTICS. Most research on phonological acquisition finds that taps [r] are not frequently produced by children younger than 5-years-old, and that trills [r] are not common in children younger than ~ 6 y.o. (Fabiano-Smith & Goldstein, 2010). The rhotics' 'late-acquired' characterization stems from their articulatory complexity (Solé, 2002). In other studies that consider approximant, fricated, and trilled variants as /r/ target sounds, and approximant and tap variants as target sounds of /r/, rhotics are still characterized as 'late-acquired' (Keffala et al., 2020).

The simultaneous acquisition of English and Spanish has variable effects on the development of phonetic patterns. Some studies based on PCC-R and auditory analyses find that English proficiency does not predict Spanish developmental paths (Keffala et al., 2020), while others find that English use has an effect on the development of the minority language (Fabiano-Smith & Goldstein, 2010). However, these studies are all based on auditory, or impressionistic, analyses.

To the best of our knowledge, only Menke (2018) has carried out an acoustic analysis of rhotic realizations in Spanish-English bilingual children. School-aged children at a Spanish-English dual immersion school in San Antonio, Texas, completed picture sorting tasks by responding to simple questions about animals. From first grade, the children most often produced taps in /r/ contexts (63.4%), and these variants averaged 45.9ms in duration. Predictably, their productions of /r/ segments averaged 75.3ms but, in contrast with the high rates of taps productions, the first graders produced the 'target'-sound, [r], in only 15.9% of the tokens. The other common variants were taps (15.9%), alveolar approximants (18.2%), and 'other' sounds (29.4%). As [r], the 'target' sound, was not produced by the majority of children until 7th grade, the author suggests that increased English use delays the acquisition of Spanish phonology.

In contrast, monolingual Spanish speaking children's phonetic development is not held to this prescriptive standard. For instance, in a study of 34 monolingual Spanish-speaking Costa Rican children, aged 3 to 5;06, Vázquez Carranza (2011) found that the children produced fricated variants, one of the adult norms, in 45% of syllable-onset /r/. Trills only accounted for 2% of the tokens, and it was not the case that the oldest children articulated the most trills. This study, along with research on syllable-final /r/ deletion/lateralization in Venezuelan children, demonstrates that phonetic variability is conditioned by internal factors such as the phonetic context, and external factors such as age and families' socioeconomic status (Díaz-Campos, 2001). These factors are not highlighted in bilingual research. Moreover, children in both of these communities were also more likely to elide syllable-final /r/ in verbs and function words. In contrast, research on acquisition of phonetic variability in bilingual children has also not considered the importance of lexical effects.

The present study builds on this work by comparing the acoustic characteristics of rhotics produced by Spanish-English bilingual children and adults who have grown up in Albuquerque

and share similar family histories. In addition, it draws on variationist methods by considering the language-internal, social, and lexical factors that can predict variable rhotic production among children and adults from different regions.

2.4. RESEARCH QUESTIONS AND HYPOTHESES

RQ1: What rhotic variants do bilingual adults in Albuquerque, NM, produce frequently? And, what is the variants' distribution throughout lexical stress, word position, lexical frequency, and Spanish use variables?

RQ2: What rhotic variants do bilingual children in Albuquerque, NM, produce frequently? And, what is the variants' distribution throughout lexical stress, word position, lexical frequency, Spanish use, age, and grammatical category variables?

3. Methods

3.1. PARTICIPANTS. Data from 21 children, ages 3 to 8-years-old, growing up Albuquerque, New Mexico, was sampled for this study². The children's caregivers reported that Spanish was spoken in the child's home, and that they had no language/speech concerns for the child. Each caregiver filled out a language background questionnaire with 7 questions asking about the amount of ambient and direct Spanish input the child received and how much Spanish the child produced (see Shin et al., 2019, for the list of questions). Responses were assigned a score from 0 – *all English* to 4 – *all Spanish*, and the average score for all 7 questions was calculated for each child. Higher scores indicated more Spanish use and exposure, while lower scores represented more English exposure and use. All the children in the present study use a mix of Spanish and English at home ($M = 2.59$, $sd = 0.96$).

In addition to the children, 6 adults, ages 19–33, ($M = 24$) who reported spending the majority of their childhood and adulthood in Albuquerque were interviewed for this study. All adults reported acquiring Spanish in childhood and using Spanish daily either at home or in public spaces. Language use information was collected via the Bilingual Language Profile (Birdsong et al., 2012). One section of the BLP asks, on a scale of 0% to 100%, how much Spanish, English, and other languages the participant uses with family, friends, at work, doing math, and when talking to themselves. The adults' language use score was determined following the protocol for the BLP. The maximum score on this section is 50, and higher scores indicate more Spanish use, while lower ones less Spanish use. The adults here use a mix of Spanish and English ($M = 21.61$, $sd = 13.07$), with scores ranging from 12 to 45.

3.2. DATA COLLECTION, CODING, AND ANALYSIS. The participants narrated the wordless, picture-story book *Frog, Where Are You?* (Mayer, 1969). While this task is widely used to elicit Spanish rhotics with adults (i.e., Henriksen, 2015; Melero, 2015); this is the first study to analyze bilingual children's rhotic productions from the same story. Spanish rhotics in word-medial, intervocalic position (i.e., *perro* /'pe.ro/ 'dog' and *pero* /'pe.ro/ 'but') and word-initial position (i.e., *la rana* /la. 'ra.na/ 'the frog') were extracted. A total of 299 tokens (/r/: $n = 211$; /r/: $n = 88$) were extracted from the adult data, and 518 tokens (/r/: $n = 313$; /r/: $n = 206$) were produced by the children.

² The children's *Frog* narrations and background information were provided by Drs. Naomi Shin and Barbara Rodriguez. The adult data was provided by the Lobo Language Acquisition Lab at the University of New Mexico.

children under 5 years old produced the widest variety of /r/ variants (n = 212), as only 15% are fricated, 32% are approximant, and 18% are trilled variants. They also produce tap (6%) and English r (7%) variants. Finally, substitutions (22%) are significantly more common among the younger children than the older ones [$X^2(1) = 38.12, p < .001$]. The rates of production types are given in Figure 3.

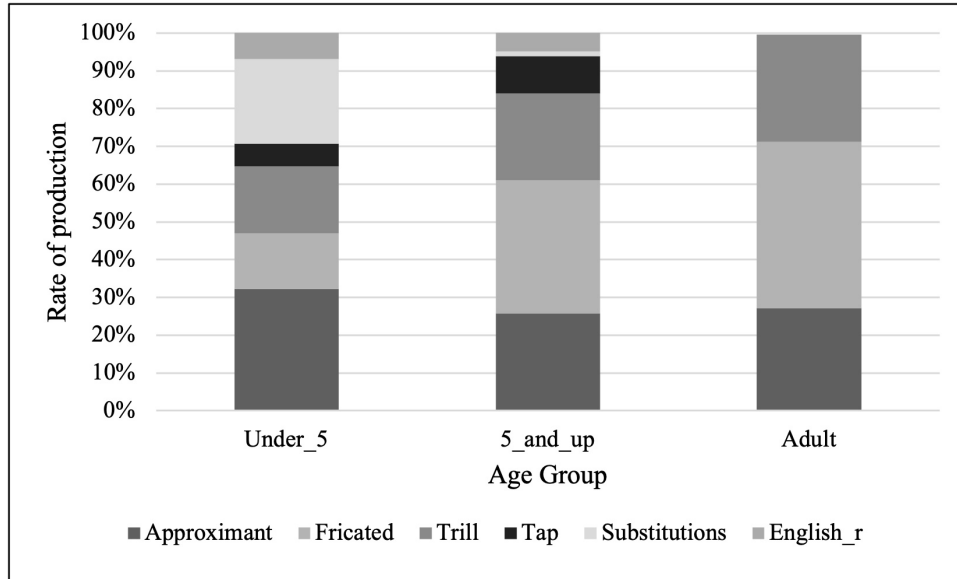


Figure 3. Rates of /r/ realization types by age group

The results for /r/ were more straightforward as speakers in each age group mostly produced approximant or tap variants. Of the adults' /r/ realizations, 53% are approximant and only 33% are tap variants. Occasionally, adults produced fricated (5%) and trilled (8%) variants. Once again, the children have more varied realizations, but they still follow the adults. Among children older than 5, approximant (41%) and tap (41%) variants are equally represented, and the next most frequent production type is substitutions (10%). The substitutions come from one child, age 5;1. The children under 5 realize /r/ most often as an approximant variant (54%), and they only produce taps in 20% of their tokens. Substitutions (13%) are, again, most frequent among the youngest children, but the difference between the rate of substitutions between the older and younger children is not significant [$X^2(1) = 0.41, p = .52$]. Fricated and English-r realizations account for the remaining 15% of their productions. The rates of production types are given in Figure 4.

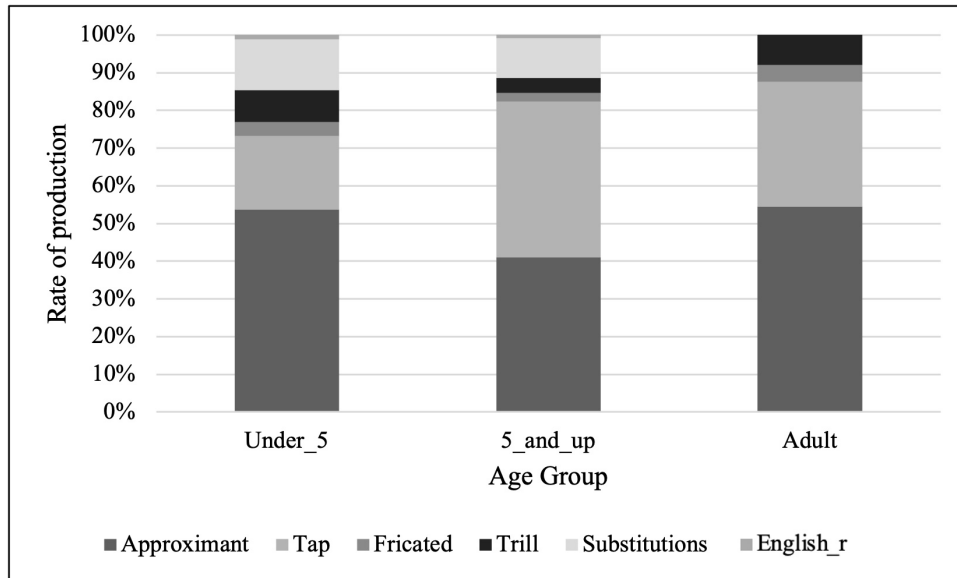


Figure 4. Rates of /r/ realization types by age group

4.2. BINOMIAL REGRESSIONS. We now turn to the results of the generalized mixed-effects models using the lme4 package (Bates et al., 2015) in RStudio (RStudio Team, 2020), that tabulated the likelihood of a specific variant over the other variants (i.e., ‘approximant’ vs. ‘not-approximant’) (Vigil, 2018). Separate analyses were run on the child and adult data sets. To recap, the internal, independent variables were duration of the following phone (proxy for lexical stress), the preceding phonetic context (vowel, sibilant, consonant/pause), word position (initial or medial), and lexical frequency (frequent or infrequent). The external variable in each model was Spanish use. Age group and grammatical category were only included in the children’s models. Individual speaker was included as a random effect. Table 1 summarizes the statistical models for the adults.

Model	Variable	<i>B</i>	<i>SE</i>	<i>t</i> -value	<i>p</i> -value
Adult /r/ predicting ‘canonical’					
	Intercept	0.009	0.59	0.02	.98
	Spanish use	-0.63	0.32	-1.95	.04 *
Not significant = Lexical stress, preceding phone, word position, lexical frequency.					
Adult /r/ predicting ‘fricated’					
	Intercept	-0.93	1.32	-0.70	.47
	Prec_phone-sibilant	3.15	1.38	2.27	.02 *
	Prec_phone-vowel	-0.21	1.19	-0.18	.87
Not significant = Lexical stress, word position, lexical frequency, Spanish use.					
-No significant effects for Adult /r/ predicting ‘approximant’					
-No significant effects for Adult /r/ predicting ‘canonical’ nor ‘approximant’					

Table 1. Generalized mixed-effects model results (adult data)

Most importantly, the model set to predict the likelihood of ‘canonical’ variants for adults’ /r/ realizations shows that canonical productions are significantly less likely as Spanish use

increases ($p = .04$). That is, instead of trills, the adults with higher Spanish use in this community produce more approximant and fricated variants than canonical ones. Figure 5 shows that as Spanish use increases the rate of ‘canonical’ productions tends to decrease.

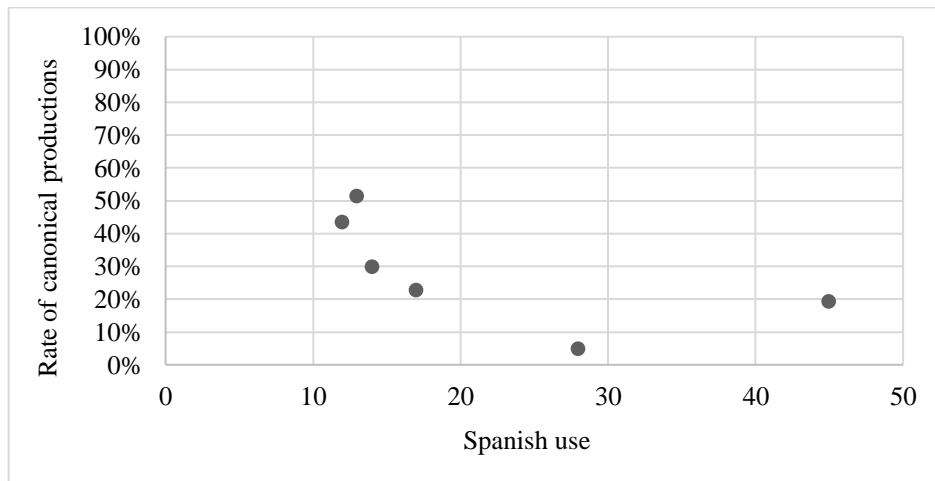


Figure 5. Rates of ‘canonical’ variants for /r/ realizations in adult data

In addition, the model set to predict the likelihood of ‘fricated’ variants for adults’ /r/ realizations shows that the fricated productions were significantly more likely after sibilants ($p = .02$). This is in line with past research examining post-sibilant rhotic production (Lastra & Martín Butragueño, 2006). Finally, none of the independent variables predicted the likelihood of approximant variants over other variants, nor did they have any significant effect on the models looking at adults’ /r/ realizations. The results for the children’s data (Table 2) were different.

Model	Variable	B	SE	t-value	p-value
Child /r/ predicting ‘approximant’					
	Intercept	-1.42	0.35	-4.00	< .001 *
	Position-medial	0.72	0.29	2.47	.01 *
Not significant = Lexical stress, preceding phone, lexical frequency, Spanish use, age group, word type.					
-No significant effects for Child /r/ predicting ‘canonical’ nor ‘fricated’					
Child /r/ predicting ‘canonical’					
	Intercept	-1.63	0.39	-4.11	< .001 *
	Age_group-5 and up	1.31	0.49	2.62	.008 *
Not significant = Lexical stress, preceding phone, word position, lexical frequency, Spanish use, word type.					
-No significant effects for Child /r/ predicting ‘approximant’					

Table 2. Generalized mixed-effects model results (child data)

Table 2 reports the outcomes of the statistical models for the children’s data. First, the model set to predict the likelihood of ‘approximant’ variants for children’s /r/ realizations found that these approximant productions were significantly likelier to occur in word medial than initial position ($p = .01$). In addition, the model set to predict the likelihood of ‘canonical’ variants for

children's /r/ realizations found that children aged 5 years and older were significantly more likely to produce canonical taps than the younger children ($p = .008$). This is evident back in Figure 4, where only 20% of the younger children's /r/ productions were 'canonical taps', and the rate of these variants doubled for the older children. Finally, none of the independent variables predicted the likelihood of canonical nor fricated /r/ realizations and, likewise, none of the independent variables predicted the likelihood of approximant /r/ realizations.

5. Discussion. The variability attested in Spanish rhotic productions by our speakers aligns with the synchronic variation documented throughout Spanish speaking communities. As demonstrated in Figures 2 and 3, Albuquerque Spanish-English bilinguals produce a mixture of trilled, approximant, and fricated variants. Two main findings here align with Menke's (2018) analysis of bilingual children in San Antonio, Texas. First, the present study finds substantial variability in children's productions. Second, relatively low rates of trill variants among the children are attested. Seeing that the bilingual adults in the research produce similarly low rates of these canonical trills (28%), and that these rates increase with Spanish use among the adults, it appears that bilingual children's exposure to English has not delayed their Spanish acquisition in any way. Instead, it seems that these children are following the speech patterns and distribution of variants of adults in their community. The children's low rate of canonical productions is a predictable consequence of low rates of canonical variants and stronger lexical representation of approximant and fricated variants from adults in their community (Bybee & Beckner, 2010).

The approximant and fricated variants have been mentioned in previous analysis of Spanish spoken in New Mexico (Espinosa, 1909; Vigil, 2018; Waltermire & Valtierrez, 2017), and the bifurcation into approximant and fricated /r/ variants and approximant and tap /r/ variants speaks to the dialect contact (in Albuquerque) between varieties of Traditional Northern New Mexican Spanish, where assibilated and tap variants are frequent (Vigil, 2018), and varieties of Spanish spoken in Mexico, where approximant variants are more common (Bradley & Willis, 2012). Historically, and when compared to the rest of Northern New Mexico, Albuquerque has attracted the largest immigrant population from Mexico due to the number of economic and professional opportunities (Bills & Vigil, 2008; Waltermire, 2020). Linguistic analyses find that Spanish speakers from Albuquerque (and Santa Fe), in contrast to speakers in other northern New Mexico places, speak with significantly more mexicanisms as well as pronunciations characteristic present in varieties of Mexican Spanish (Bills & Vigil, 2008; Waltermire, 2020). The differences between our findings and those of Vigil (2018) for speakers in Taos complement this perspective. More specifically, in Taos, 100% of speakers' intervocalic /r/ realizations are canonical taps, whereas over a third of Albuquerque speakers' productions are approximant variants instead. For /r/ realizations, Taos speakers produce more fricated and trilled variants and few approximants. In contrast, Albuquerque speakers produce more approximant and less fricated and trilled variants in the same context. The uptick in approximant variants among speakers in Albuquerque continues to demonstrate how the city's linguistic diversity differentiates its soundscape from the rest of Northern New Mexico.

The decrease in trilled variants suggests that adult and child speakers in Albuquerque are perpetuating a sound change from trilled to assibilated and approximant rhotic variants that are echoed throughout bilingual (Henriksen, 2015) and monolingual (Willis, 2007; Bradley & Willis, 2012; Melero, 2012; Lastra & Martín Butragueño, 2006) Spanish speaking communities. The motivations of this working change in Albuquerque are likely related to articulatory and sociolinguistic factors. First, usage-based theory postulates that sound changes are, at their base, articulatory motivated (Bybee, 2001). To this, laboratory work by Solé (2002) demonstrates that

voiced trills frequently reduce to approximant and fricated variants when the specific articulatory requirements are not met, since the resulting variants can occur with a wider range of airflow and oropharyngeal parameters. Solé (2002, p. 682) also points out that “diachronically, trills develop into fricatives”. With Spanish /r/, we are observing a substantive change from more to less articulatorily constrained productions. This change can be characterized as *lenition*, which characterizes sound changes where the phonetic result(s) require less articulatory precision (Hualde, 2014). In the past, lenition sound changes in Spanish have been more wide-spread in word-medial than initial position, especially when the segments occur in uniform environments that favor the reduced variant (Bybee, 2001; Hualde et al., 2012). The finding among the children that approximant variants are significantly more likely in intervocalic, word-medial position than initial position is in line with this research. We predict that, a larger data set from the adults would likely demonstrate this same pattern.

Findings also show that, despite children producing mostly approximant variants in intervocalic, word-medial position, they still maintain two rhotic categories. This phonetic context is where Spanish /r/ and /r̄/ are phonemically contrastive (Hualde, 2014), and for speakers to neutralize this phonemic contrast, they would need to realize these segments with similar durations (Bradley & Willis, 2012). In addition to collecting manner data for the tokens here analyzed, durational measurements were taken and normalized for speech rate. Interestingly, a *T*-test on the children’s approximant variants realized for intervocalic, word-medial /r/ ($n = 49$; $M = 81.87$ ms) and word medial /r̄/ ($n = 95$; $M = 57.59$ ms) demonstrates that children do maintain a durational difference between these phonemic contexts [$t(142) = 4.74$, $p < .001$]. In summary, while the working change represents a simplification in manner of production between the two rhotic categories, rhotic categories themselves are not merged.

Aside from articulatory factors, researchers have suggested that language contact between Spanish and English is a prominent motivator of the working change in Spanish rhotics: second-generation Spanish speakers who have grown up in the U.S. produce more approximant variants than first generation Spanish speakers who grew up in Mexico (Henriksen, 2015; Waltermire & Valtierrez, 2017). While the present study cannot provide commentary on generational effects, the results for Spanish use and the encountered productions offer another perspective on the sociolinguistic motivators of this working change. Here, it was found that as adults’ Spanish use increased canonical variants were significantly less likely. Given that (1) fricated variants are common among older Northern New Mexican Spanish speakers with little English use (Vigil, 2018), (2) that approximant and fricated variants are common among monolingual Spanish speakers in Mexico (Bradley & Willis, 2012; Lastra & Martín Butragueño, 2006), (3) and that the speakers with high Spanish use report that at least one of their parents grew up in one of these respective regions, the results suggest that the continued use of Spanish throughout generations helps perpetuate this working change.

Besides the mentioned factors, the research questions had centered on the explanatory power of lexical stress, lexical frequency and, for the children, grammatical category and age. Three of these variables never yielded significant results. First, lexical stress, operationalized as the duration of the following vowel, did not significantly predict variant production. This is contradictory to other research which finds lexical stress effects (Melero, 2015; Waltermire & Valtierrez, 2017). However, in past research lexical stress was coded from the prosodic pattern of the citation form, which cannot account for speech rate nor any other real time articulatory properties that may influence rhotic production (File-Muriel, 2009). Until further evidence is provided on continuous stress measures, the discrepancy between our findings and past research

is attributed to methodological decisions. The second variable that did not return a significant result was lexical frequency. It is important to keep in mind that lexical frequency measures are numerous (Erker, 2013), and a non-significant result in the present study does not discount that the lexical item's ratio frequency (Alba, 2008), type frequency (Bybee, 2010), or any culminating usage effects (Brown, 2005) may predict variable productions in Spanish rhotics. Seeing the explanatory abilities of frequency variables with other phonetic variables, it is worthy of further evaluation.

The third independent variable that yielded non-significant results was 'grammatical category'. Previous research on children's rhotic production had found that lateralized /-r/ was more likely in verbs than in other word types (Diaz-Campos, 2001; Vazquez-Carranza, 2012). The grammatical categories in the present study were noun, verb, and 'other'. The non-significant results may be due to a developmental stage when children use (phonetic) one variant categorically in one context and another variant for another one (Shin & Miller, 2021). In the present data, this developmental stage is evident in children's verbs and nouns. Specifically, two children produced all third person, plural preterit verbs with approximant variants. The verbal inflection on these forms is *-Vron* (i.e., *dijeron* 'they said', *buscaron* 'they looked'). These two children were not categorical in their approximant productions in other verb forms nor in nouns. Individual children also produced only approximant variants for one lexical item, like *perro* 'dog', but then categorically produced trill variants for other items like *roca* 'rock' and *ranita* 'little frog'. One older child's speech also represents this developmental stage, since they categorically produced trill variants with *rana* 'frog' and *ranita* 'little frog', but variably produced trill and approximant variants with *perro* 'dog'. Moreover, children's idiosyncratic behavior in this developmental stage partially explains why the grammatical category variable returned nonsignificant results. This patterning also suggests that children's acquisition of Spanish rhotics is incredibly nuanced and hard to capture in statistical models built from small data sets.

6. Conclusion. The findings of the present analysis have important implications for future work on acquisition of Spanish rhotics, especially for research conducted in bilingual communities. Importantly, we cannot continue to assess phonological development with a prescriptivist, production based, /r/-/r/ contrast. Instead, future research should consider the following two points.

The first necessary component for future work on acquisition of variable sound patterns, like Spanish rhotics, will be acoustic measurements. Given that the working sound change is more substantive than temporal, duration measurements can help to demonstrate how and when aspects of their phonology emerge. Above, the duration measure also showed that while Albuquerque children produced the same variant in both rhotic contexts, the contrast was not neutralized. The Albuquerque children's durational measurements are similar to those of age-equivalent bilingual children in San Antonio (Menke, 2018). This will show that even when children's realizations differ and 'target' sounds are not operationally defined in the same way, a similar path of acquisition with Spanish rhotics can be established with other phonetic correlates.

The second and most necessary component is a more holistic definition of 'target' sound. Specifically, we need to include a definition of 'target' sound that is based on the variety or varieties of Spanish that the children are acquiring. The definition should also acknowledge the widespread reduction of trilled variants and articulatory constraints. The operationalization of 'target' sounds based on the varieties of Spanish that children are acquiring have been used with percent consonant correct-revised (PCC-R) tests (Keffala et al., 2020), and the results are similar

with respect to the time when children produce these sounds. Augmenting the ‘target’ sound category also recognizes the hypothesis that children’s exposure to less frequent variants limits the lexical representation of these variants in memory and more than likely leads to a decrease their own production of these variants when compared to other productions more frequent in their environment (Bybee & Beckner, 2010). Thus, these operational definitions will still suggest that rhotics are complex and late acquired sounds but, more importantly, they will embrace rhotic variability in Spanish-English bilingual communities and detract from the traditionally used prescriptive baseline.

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