

THE THIRD LANGUAGE IMITATION OF SPANISH RHOTIC-LATERAL CONTRAST BY AKAN-ENGLISH BILINGUAL CHILDREN AND ADULTS: THE EFFECT OF FIRST LANGUAGE TRANSFER, ORTHOGRAPHY, AND AGE OF ACQUISITION

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Abstract: *This study explores the third language imitation of the Spanish rhotic-lateral contrast by Akan-English bilingual children and adults. Specifically, it examines this phenomenon, with respect to (i) first language transfer in the imitation of the Spanish rhotic-lateral contrast, (ii) the effect of orthographic input on the imitation of the rhotic-lateral contrast in Spanish as a third language, and (iii) the effect of age of acquisition with the inclusion of a comparison between children and adults. Whereas rhotics and laterals are contrastive in most varieties of Spanish and English, they are in free variation in Akan (Guerini, 2018). The participants in this study consisted of 20 Akan-English bilinguals between the ages of 8-10yrs and 18-55. The conditions included an imitation task with auditory input only and another with orthographic input. The results showed evidence of L1 transfer, a positive effect of orthography, and a better performance of children. This study has important implications as it provides data from an understudied population in the field of L2/L3 speech learning.*

Keywords: third language imitation; first language transfer; Spanish; English; rhotics; laterals; Akan; phonetic imitation; age of acquisition; orthography.



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1 Introduction

With about 81 living languages and a population of approximately 30 million people, Ghana, like many other countries, is multilingual. English is the official language of the country due to British colonial history in the region and is the language associated with social prestige, power, and has a privileged place in the nation's communication landscape (Guerini, 2018). Akan is considered a major lingua franca and is the first language to about 41% of the population. The Akan language is a member of the Kwa sub-group falling under the larger Niger-Congo language family and is mainly spoken in Southern Ghana and some parts of Côte d'Ivoire (Dolphyne, 1988; Abakah, 2016). Akan consists of two major dialects: Twi and Fante, with the former consisting of the Asante and Akuapem dialects (Dolphyne, 1988). Akan has many dialects, but only the Asante, Akuapem, and Fante dialects are widely known and have gained 'literary status' (Appah, 2003). In the educational domain, English remains as the main language of instruction. Furthermore, Ghana has a close proximity to many Francophone countries. Therefore, French is taught as an elective course from primary school all the way to university, further adding to the linguistic landscape of the country.

Few studies (e.g., Dako, 2000; Adjave, 2005; Ngula, 2011; Kpogo & Gathercole, 2019) have tackled Akan phonological transfer in first (L1) and second language (L2) speech. For instance, Kpogo & Gathercole (2019) investigated the production of English interdental fricatives by Akan-English bilinguals in a native English-speaking environment. The expectation was that voiced /ð/ and voiceless /θ/ interdental fricatives would pose difficulties for Akan-English bilinguals since they do not exist in the Akan phonological inventory. The results supported initial predictions in that the target sounds were substituted with the phonemes (/t/, /d/, /f/) which already existed in Akan. However, little is known regarding the imitation of rhotics and laterals by Akan speakers, specifically in the context of third language acquisition (L3) at its initial stages. By initial stages here we mean at the onset of acquiring an L3 before the learner has had any exposure to a given language. In this case, the given language we are referring to is Spanish.

Whereas rhotics and laterals are contrastive in most varieties of Spanish and English, (e.g., <play> /pleɪ/ vs. <pray> /preɪ/) they are in free variation in Akan (e.g., <to call> /frɛ/ or /flɛ/) (Dolphyne, 1988). Even though this free variation of rhotics (e.g., [r] <sere> 'laugh') and laterals (e.g., [l] <akwalaa> 'child') occurs among speakers of Akan, its influence in the acquisition of another language has received little attention in the literature. Furthermore, the limited literature currently available on this topic has reported slightly different variations for the phonetic environments in which the production of rhotics and laterals tend to occur in the language. Abakah (2004) suggests that speakers of the Asante Twi and Fante dialects use /l/ and /r/ interchangeably, while Guerini (2018) argues that /d/, /r/, and /l/ are phonemes that are regarded as free variants only in certain dialects of Akan. Abakah (2016) supports this claim by providing evidence that /l/ occurs in word-initial (e.g., /lotoo/ 'filthy tooth'), word-medial (e.g., /sɔrɪ/ /sɔlɪ/ 'get up'), and word-final positions (e.g., /ehul/ 'foam'). Abakah (2016) further claims that this realization seems to only occur in free variation with /r/ but not with /d/ in word-final positions. Furthermore, the trill does not seem to be used among speakers of any of the main varieties of Akan (Abakah, 2016). Therefore, one of the main aims of the present investigation is to contextualize the areas where /r/ and /l/ exist in free variation in Akan and if/how this free variation is transferred in the imitation of an L3.

Previous research on the acquisition of rhotics and laterals have demonstrated the difficulty that learners face when acquiring them (e.g., Face, 2005; Waltmunson, 2005; Colantoni & Steele, 2008; Johnson, 2008; Olsen, 2012). Furthermore, prior studies indicate that many learners initially produce the English [ɹ] in place of both the tap and the trill in languages where

this rhotic contrast exists (Waltmunson, 2005; Olsen, 2012; Patience, 2018). Additionally, Ortí Mateu (1990) and Patience (2018) have shown that L1 Mandarin learners of Spanish have difficulty perceiving and producing the Spanish rhotic-lateral contrast, resulting in non-target lateral substitutions in place of the tap (Patience, 2018). Patience and Qian (2022) also showed that Mandarin-English-speaking L3 learners of Spanish had difficulty producing the Spanish tap and trill.

The effect of orthography is another question that is addressed in this study (see Bassetti, 2008; Chih, 2013; Rafat, 2015; Hayes-Harb & Cheng, 2016; Rafat, 2016; Bassetti 2017; Bassetti, Mairano, Materson & Cerni, 2020). While some studies have found positive effects of orthography in L2 acquisition, other studies have underscored its negative influence. For instance, Erdener & Burnham (2005) examined the effect of exposure to different auditory, orthographic, and visual input cues on L2 production by adults' L1 orthographies with differing degrees of transparency. The results showed there was a significant facilitative effect for the orthographic condition in comparison to the auditory-only condition. Contrasting these findings, Bassetti (2008) observed orthography to result in a decreased performance where learners tended to overgeneralize grammatical rules due to orthographic transparency.

Finally, age of acquisition is another factor addressed in this study as we analyze the different patterns of acquisition of rhotics and laterals between children and adults. A key tenant in examining the effect of age of acquisition is the Critical Period Hypothesis (CPH) which postulates that it is easy to learn a language before the age of puberty, and the ability for learners to attain a native-like competence in the language is quite high (Paradis, 2004; Nikolov & Djigunovic, 2006). However, the CPH also states that this native-like attainment is much more difficult for learners acquiring a language after the onset of puberty (Paradis, 2004). To address these issues and gaps in the literature, the present study investigates the relative degree of first language (L1) transfer in the imitation of the Spanish rhotic-lateral contrast among Akan speakers and the potential effects of age of acquisition and orthographic input. Our study contributes to documenting the linguistic behavior of an understudied population and its findings are of relevance to the field of L2/L3 speech learning. As noted by Wang & Nance (2023), previous L3 speech learning studies have mostly focused on adults. Consequently, the research questions that form part of this study are as follows:

1. Can native Akan-English bilinguals who are also naïve Spanish learners produce /l/ and /r/ accurately in Spanish?
2. Does orthography play a role in the acquisition of the rhotic-lateral contrast in Spanish?
3. Is there a relationship between age and the production of the rhotic-lateral contrast among Akan-English bilinguals who are naïve speakers of Spanish?

2 Hypotheses

Based on the previous literature available, the following hypotheses will be tested:

H1: Based on Guerini (2018), native Akan speakers with L2 English are expected to transfer the phonological distribution into the production of the rhotic-lateral contrast in both English and Spanish.

H2: As predicted by Bassetti, Mairano, Materson & Cerni (2020) and Hayes-Harb & Cheng (2016), orthography will have a positive effect on the production of the rhotic-lateral contrast in Spanish.

H3: Following Paradis (2004), it is expected that children will produce rhotics, specifically the Spanish trill, more accurately than the adult participants.

3. The Experiment

3.1 Participants

A total of twenty Akan-English bilinguals participated in this study. Specifically, there were two age groups: 10 children between the ages of 8 and 10 (4 females, 6 males) and 10 adults between the ages of 18 and 55 (8 females, 2 males). All the children were enrolled in primary school, whereas the adults participants were enrolled or had completed a university-level education. The participants had no visual, speech, or cognitive impairments. All participants were native Akan speakers who spoke a variety of the Twi dialect which mainly included Asante Twi or Fante. Since none of the participants reported they could speak or had knowledge of Spanish, they were all considered to be naïve speakers of Spanish. This was corroborated by administering a standardized language background questionnaire to all participants, which will be further described in Section 3.3. Some of the participants reported they had a low proficiency in French since the French language is taught in most primary schools. However, this was not a concern to us since the phonetic realization of the rhotic-lateral contrast is different in French in comparison to Spanish. Participants were vetted prior to participating in the study. Any individuals who did not fall into one of the age groups examined or spoke languages other than Akan or English were excluded from the study. A low proficiency in French was acceptable, as previously mentioned.

3.2 Stimuli

The stimuli for this study consisted of a total of 36 English words, 42 Spanish words, and 31 words in Akan, in addition to 19 distractors. The uneven number of words tested per language is due to differences in their lexicon, as we selected real, commonly used words containing specific sounds in a specified environment. The target segments analyzed in the study included the Spanish tap [r], trill [r] and lateral [l] and the English lateral [l] and approximant [ɹ]. The stimuli were randomized, and a distractor word was included for every 5 target words. The stimuli were controlled for position (i.e., word-initial, word medial/intervocalic, and word-final position) and stress, with stress falling on the first syllable. Some examples of Spanish words used in this study were <perro> /pero/ ‘dog’ (trill [r]), <pelo> /pelo/ ‘hair’ (lateral [l]), and <caro> /caro/ ‘expensive’ (tap [r]).

3.3 Study Tasks and Procedure

The study consisted of three tasks: (1) an auditory imitation task (conducted in Spanish and English), (2) an auditory-orthography imitation task (conducted in Spanish and English), and (3) a picture-naming task (conducted in Akan). For tasks 1 and 2 participants were presented with the stimuli on a computer screen and they heard a recording of a native Spanish or English speaker producing the stimuli. The participants were then instructed to repeat back/imitate the word they heard after a pause of 7 seconds where they had to count down from 7 backwards before repeating the word. The only difference between tasks 1 and 2 was that in task 2, the participants would have the audio provided alongside the written word on the screen. In task 3, the participants were presented with pictures and were asked to name them in Akan. Given the scope of this paper, only the results of tasks 1 and 2 will be reported.

In addition to these three tasks, the participants completed a Language Background Experience and Proficiency Questionnaire (LEAP-Q) at the end of the trials. The LEAP-Q developed by Marian, Blumenfeld & Kaushanskaya (2007) allows for the collection of a

participant's language background according to several categories such as language dominance, order of acquisition, use, and exposure to a given language, among other factors. All participants performed the three tasks first in Spanish and then in English. Since the participants were naïve speakers of Spanish, the experiment was firstly conducted in Spanish to avoid potential articulatory fatigue occurring later in the experiment. All tasks were presented to the participants in the same order. Each participant was seated in front of a laptop screen in a quiet room for the duration of the experiment to limit any distractions while completing the study tasks. Prior to experimentation, participants were vetted verbally. This vetting process was done by asking participants several questions regarding their language background (e.g., age of acquisition, language use, etc.) to further confirm eligibility. The data from informal portion of the experiment was collected separately from the date of the other study tasks.

3.4 Data Processing and Analysis

A total of 4,364 tokens were coded and included for subsequent analysis. The participants' productions of the target segments for each language were manually inspected in Praat by two trained individuals and labeled based on their acoustic and perceptual properties. The equipment used to record the participants was an M-Audio Micro-track 24/96 professional two-channel mobile digital recorder and a lavalier unidirectional microphone. The recordings were made at a sampling rate of 44.2 kHz and a quantization rate of 16 bits. The audio files containing the extracted tokens were downsampled at 22.1 kHz and saved in wave format. For the Spanish /ɾ/ specifically, the productions were characterized as either a tap or trill. The trill contains multiple openings and closures, therefore productions with more than one closure on the spectrogram were coded as trills. Figures 1-5 below illustrate distinct spectrograms that show the difference between an English lateral (Figure 1), an English rhotic (Figure 2), a Spanish lateral (Figure 3), a Spanish tap (Figure 4) and a Spanish trill (Figure 5). Below each Figure is a caption specifying the word being produced in each spectrogram. The differences are as expected, with the laterals being characterized by the presence of antiformants and the tap exhibiting the shortest duration. The English rhotic is characterized by lowered F3, while the Spanish trill displays multiple closures (4 present in the token included, most visible on the bottom of the spectrogram in Figure 5). After this categorization, accuracy rates were computed for each segment, representing the percentage of time a given target was realized as the segment it was intended to be (out of the total number of productions of that given phoneme). This was done separately for each participant, following a series of univariate ANOVAs that were conducted with the data.

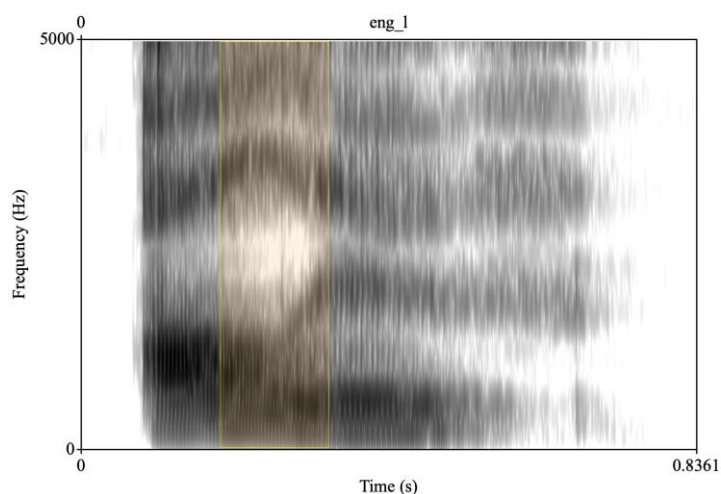


Figure 1: A spectrogram showing the English lateral produced in the word *olive*. The lateral [l] portion is highlighted.

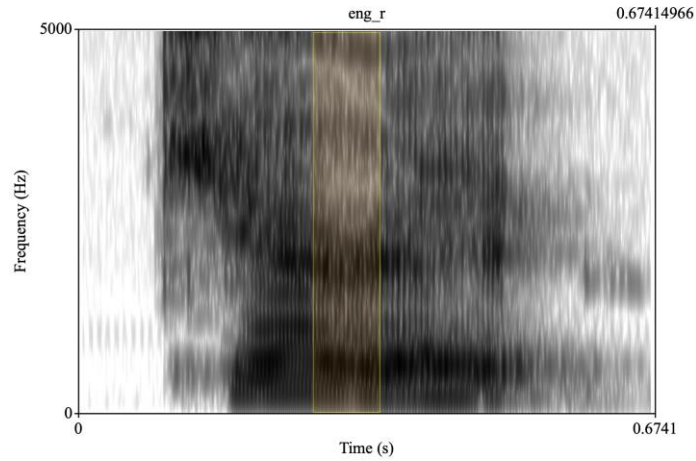


Figure 2: A spectrogram showing the English rhotic produced in the word *carrot*. The approximant [ɹ] portion is highlighted.

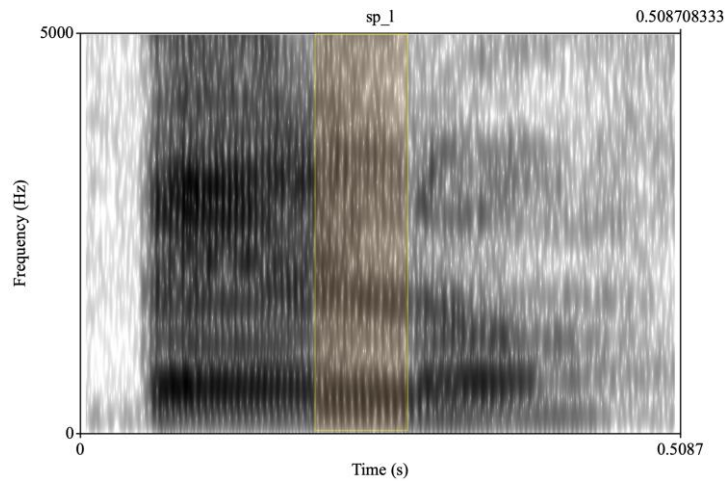


Figure 3: A spectrogram showing the Spanish lateral produced in the word *pelo*, meaning ‘hair’. The lateral [l] portion is highlighted.

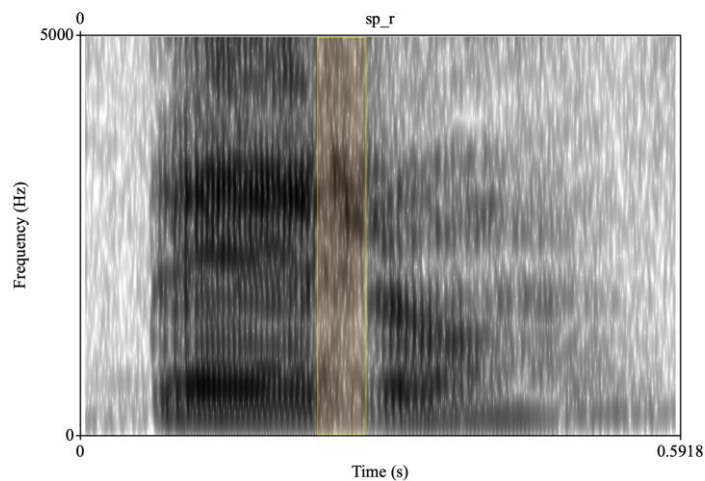


Figure 4: A spectrogram showing the Spanish tap produced in the word *pero*, meaning ‘but’. The tap [ɾ] portion is highlighted.

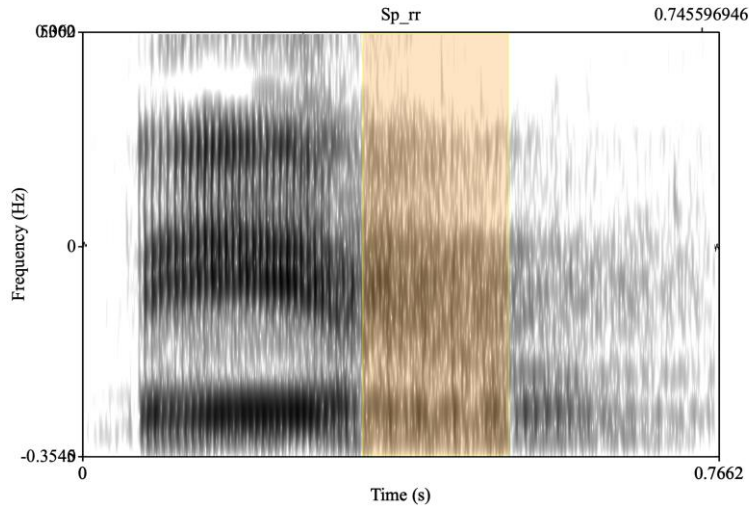


Figure 5: A spectrogram showing the Spanish rhotic produced in the word *perro*, meaning “dog”. The trill [r] portion is highlighted.

4 Results

In this section, we provide the results from the three tasks, in relation to the research questions and hypotheses mentioned previously. Firstly, the general performance of how Akan-English bilinguals performed overall will be discussed. This is followed by a discussion of the effect of several variables on the production of Spanish rhotics and laterals. These variables include transfer, age of acquisition, and word position, which are directly related to our research questions and main research objectives.

4.1 General Performance of Akan-English Bilinguals

Figure 6 shows the average accuracy scores of Akan-English child and adult bilinguals in both English and Spanish. Here, it is apparent that both groups performed better in English than they did in Spanish with children performing significantly better than adults in Spanish. The interaction of these factors (Group x Language) was found to be significant in a univariate ANOVA, $F(1,4260) = 5.528, p < .05$. There was no significant difference in the performance of both groups in English.

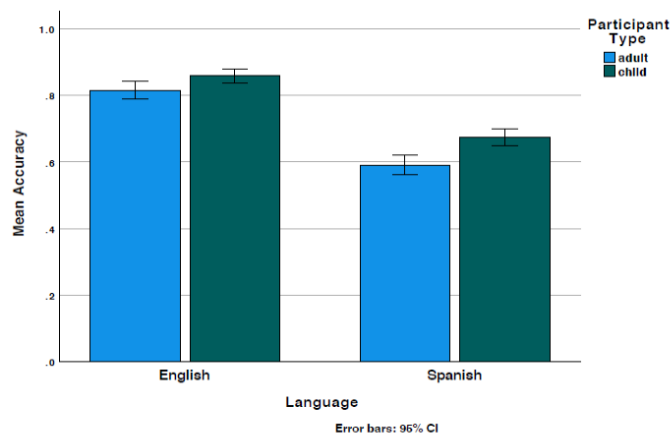


Figure 6: The mean accuracy of performance in both English and Spanish.

Additionally, the English approximant [ɹ] was produced correctly about 95% of the time, similar to the production of the English lateral [l]. For Spanish, the lateral [l] was produced correctly with an accuracy rate of about 85%, followed by the tap at about 75%, and the trill at rate of about 55% by both groups. Due to increased articulatory complexity, the trill tends to be a difficult sound for most L2 learners of Spanish (e.g., Face, 2005; Waltmunson, 2005; Colantoni & Steele, 2008; Johnson, 2008; Olsen, 2012); therefore, the results of the Akan-English bilinguals are not surprising, but this will be further expanded upon in the discussion.

4.2 The Effect of Transfer of Free Variation of [r] and [l] in Akan into Spanish

The results obtained for the realization of /r/ and /l/ indicate that other types of non-target segments were also occasionally produced (e.g., stop-liquid clusters [dr], combination sounds [ɔr], etc.). Additionally, while most of the productions for the lateral [l] were correct, substitution of the [l] with the approximant /ɹ/ was also noted. Similarly, the greatest frequency of substitution recorded for the English lateral [l] by child participants was the approximant /ɹ/. These results suggest that there is transfer from participants' L1-Akan where [l] and [r] can be used interchangeably to their L2-English. The adult participants produced both the Spanish lateral and the tap less accurately. Please refer to the Appendix (Tables 1-8). These tables provide the descriptive results for the adult and child participants in both English and Spanish across audio and audio + orthography task conditions. The trill production consisted of several substitutions with the majority being the approximant /ɹ/, followed by the tap /r/, and the aspirated /h/. Please refer to Tables 9 and 10 in the Appendix for the total number of categories and frequencies of the production of the rhotic-lateral contrast in both English and Spanish. The child participants also had a low score for the lateral. The tap realizations included some substitutions with the majority being the approximant /ɹ/, followed by the lateral, and then the trill /r/. Children also substituted the trill /r/ for the tap /r/ which was the majority, the approximant /ɹ/, /h/, and combination sounds such as [ɔr].

4.3 The Effect of Age on Production

When the accuracy scores of both groups' productions of the target segments in Spanish (tap [r], trill [r] and [l]) and English (lateral [l], approximant [ɹ]) were compared in a post-hoc analysis with Bonferroni correction, children performed significantly better than adults in the production of the English approximant [ɹ]. This is illustrated in Figure 7. There was no significant difference between the two groups on the production of the English lateral [l]. In the case of the Spanish lateral [l], a significant difference was found between children and adults with children performing better than adults. Again, children did better in both the production of the tap and trill even though there was no significant difference. Both groups performed poorly overall in the production of the trill.

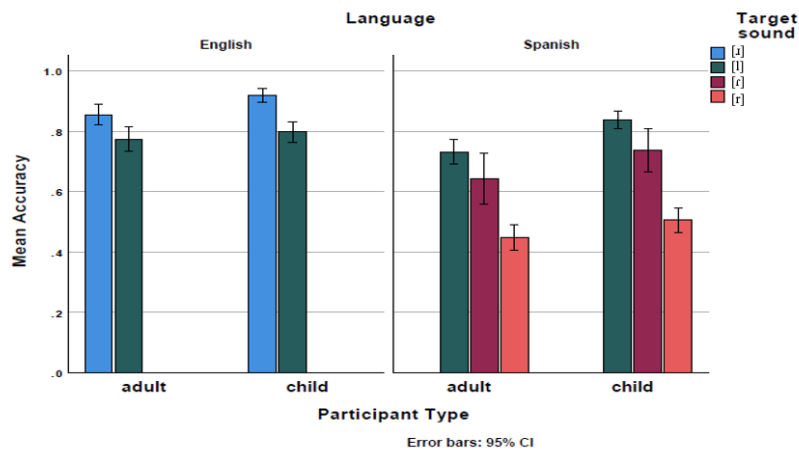


Figure 7: Accuracy rates adults and children for each target sound in Spanish and English.

4.4 The Effect of Orthography on Production

As explained in the methodology section, the experimental procedure included an audio only block and audio + orthography block. In the former block, the participants heard only the audio, and, in the latter, the audio and orthographic cues were presented simultaneously to the participants for each stimulus. Figures 8 and 9 show the mean accuracy rate of the target sound from both the audio and audio + orthography segments. Specifically, Figure 8 compares the accuracy rates of child and adult participants in the audio and audio + orthography task, while Figure 9 breaks down the accuracy scores for each language individually (Spanish and English). Overall, both groups performed significantly better in the audio + orthography block in both English and Spanish in comparison to the audio-only block, $F(1, 4260) = 175.555, p < .001$, although the mean accuracy rate for English (audio + orthography) was higher than that of Spanish. These results suggest that the presence of orthography improves the overall rate of accuracy among the participants.

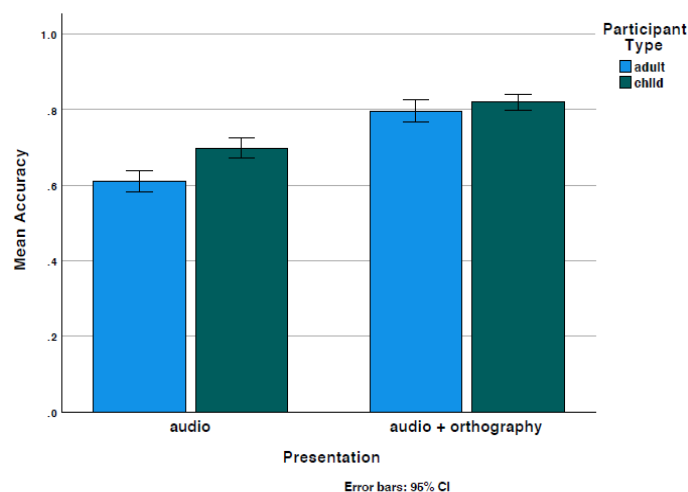


Figure 8: Mean accuracy rates of child and adult participants in the audio and audio + orthography blocks.

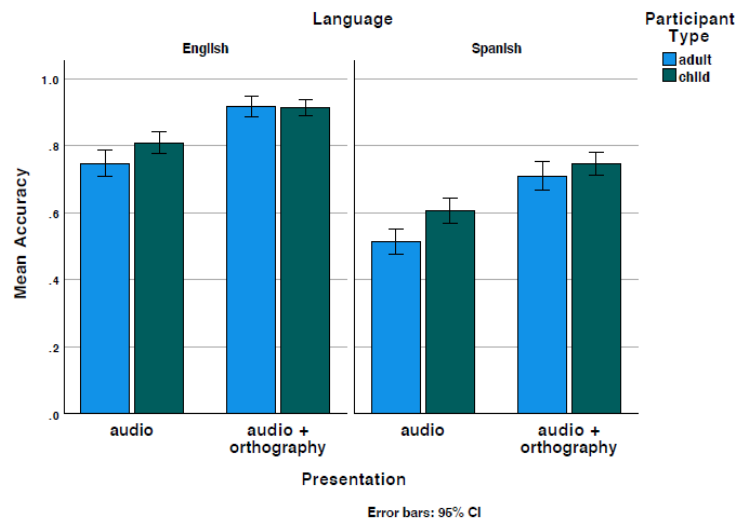


Figure 9: Mean accuracy rates for child and adult participants in audio and audio + orthography blocks for English and Spanish separately.

4.5 The Effect of Word Position

Word position was another significant factor in this study, $F(2,4260) = 282.032, p < .001$. Post-hoc tests were conducted to examine the results for the effect of word position within each sentence. Word position was another significant factor in this study, $F(2, 4260) = 282.032, p < .001$. Figure 10 shows that performance was generally better for English words in all word positions, namely, word-initial, word-medial, and word-final, as compared to Spanish. Performance in Spanish word-final position for both groups was found to be worse than the other word positions. A significant difference was found in the Spanish word-medial position between adult and child participants with the latter performing significantly better than the former. The interaction of these factors was found to be significant, $F(1, 4260) = 5.126, p < .05$.

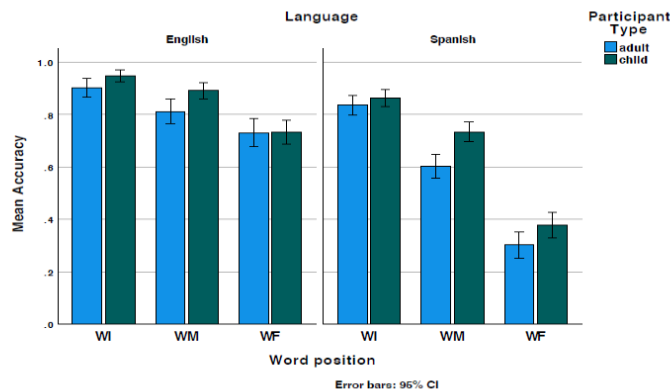


Figure 10: Mean accuracy scores for word-initial (WI), word-medial (WM), and word-final (WF) positions.

5 Discussion

As a brief reminder, it was firstly predicted that native L1 Akan-L2 English speakers would transfer the pattern of free variation affecting the production of laterals and rhotics in their native language to English and Spanish. Second, it was hypothesized that orthography would positively interfere with production. Finally, it was predicted that the children would produce rhotics,

specifically the Spanish trill, more accurately than the adult participants. All three hypotheses we formulated were supported by the results obtained in this study.

Our findings support Hypothesis 1 in that transfer of the variable production from the participants' native language (i.e., Akan) was observed in their productions of the rhotic-lateral contrast in both English and Spanish. More specifically, the participants at times substituted the approximant [ɹ] with the lateral [l] and vice versa (e.g., <police> /porice/), as they would in Akan. There was also evidence of Spanish tap and trill production as a lateral (e.g., <caro> /calo/ 'expensive'). The greatest frequency of the English lateral [l] substitution occurred with the approximant /ɹ/, followed by [l] substitution with the tap. This is a novel contribution as fewer studies have focused on examining the transfer of variable phenomena in both the L2 and L3 literature.

One explanation as to why we see our participants patterning in this manner is because Akan speakers are more familiar with the approximant [ɹ] as it occurs in most dialects of Akan, with the trill also occurring in the Akuapem dialect. Data collected from the LEAP-Q questionnaire showed that the known languages of the participants were Akan and English. Since French is taught in some schools, some of the participants reported knowledge of basic French. None of the participants reported that they spoke any other local language apart from Twi and its dialects. Therefore, other languages were not considered in the analysis. However, due to the multilingual nature of Accra, there is a minor possibility of influence from other languages such as Ga (the main language of the locals of Accra) in addition to other non-Akan languages.

Regarding the tap, it must also be mentioned that participants mostly produced the approximant [ɹ] as a substitute for the tap [ɾ]. This was expected as a case of L1 transfer since this sound exists in Akan. Moreover, since the tap is not present in the Akan phonemic inventory, participants tended to map the tap onto the approximant as substitute. Regarding the trill, which tends to be a difficult sound for most L2 learners of Spanish to produce in general, it was expected that it would also be particularly difficult for Akan-English bilinguals, even more so than the tap. We consider imitation to be an important factor in the very early stages of speech acquisition, thus indicating it may be a powerful tool in speech development, especially for hard-to-acquire sounds.

Regarding Hypothesis 2, participants were found to perform better in the audio + orthography task in comparison to the audio-only task, indicating that the presence of orthography improves the rate of production accuracy. These results are consistent with prior studies that found a positive effect for orthography (e.g., Erdener & Burnham, 2005; Waltmunson, 2005), but contradicts studies such as Hayes-Harb & Cheng (2016) and Rafat (2016), which did not find a positive effect for orthographic input. As demonstrated in the Results section, however, we see that the production of our participants' rhotic-lateral contrast in English and Spanish improved with orthographic input, indicating that orthography could play a beneficial role in the acquisition of a language during the initial stages, especially for sounds that are harder to produce.

Finally, Hypothesis 3 was also found to be supported, in that children were observed to perform better than adults in the production of English and Spanish rhotics and laterals. Specifically, the children outperformed the adults with respect to trill production. This result supports the CPH (Paradis, 2004) which claims that language acquisition is available to young children, but is limited in older adolescents and adults, as demonstrated by the children (8-10yrs) performing better than the adults (18-55) in the present study. This claim is also supported by previous literature (e.g., Nikolov & Djigunovic, 2006, Scovel, 1988) but contradicts Flege, Frieda & Nozawa (1997) and Yeni-Komshian (2000) which challenge the view that ultimate success in pronouncing an L2 is determined solely by an individual's state of neurological development at the time of first exposure to the L2.

6 Conclusions & Future Work

This study investigated the production of English and Spanish rhotics and laterals at the very onset of L3 acquisition. Our findings confirmed that crosslinguistic transfer was observed among Akan-English bilinguals who are naïve speakers of Spanish. Akan speakers substituted /l/ for /r/ and vice versa, which is a phenomenon that occurs in free variation in Akan. Additionally, being presented with orthographic input had a positive effect on production. Lastly, children outperformed adults which supports the CPH. To date, very little is known about the influence of transfer and the effect of orthography at the very onset of acquisition or in imitation contexts. Therefore, our study contributed to this growing body of knowledge. We also provide descriptive data from an understudied population, namely, Akan-English bilinguals who are naïve speakers of Spanish to the field of L2/L3 speech learning. Moreover, there are very few L3 speech learning studies on bilingual children. Future research in multilingual phonetic and phonological development should aim to focus more on the role of social factors such as education and gender in the imitation of an L3 or additional language. This is especially relevant in studies examining novel language pairings, such as the present study, to determine which factors most prominently effect phonetic and phonological development at the initial stages of acquisition.

Ethics Statement: Ethics approval was obtained for the study from Western University’s Non-Medical Research Ethics Board and all participants were given a letter of information and a consent form to sign prior to participating in the study.

APPENDIX

Table 1: Overall mean scores for English rhotic-lateral contrast, audio only task (adults).

Total		
WF	l	0.56
	r	0.78
	Total	0.67
WI	l	0.79
	r	0.89
	Total	0.84
WM	l	0.80
	r	0.66
	Total	0.73
Total	l	0.71
	r	0.78
	Total	0.75

Table 2: Overall mean scores for English rhotic-lateral contrast, audio + orthography task (adults).

Total		
WF	l	0.66

	r	1.00
	Total	0.83
WI	l	0.98
	r	1.00
	Total	0.99
WM	l	0.95
	r	0.91
	Total	0.93
Total	l	0.86
	r	0.97
	Total	0.92

Table 3: Overall mean scores for English rhotic-lateral contrast, audio only task (children).

Total		
WF	l	0.43
	r	0.91
	Total	0.67
WI	l	0.87
	r	0.95
	Total	0.91
WM	l	0.91
	r	0.78
	Total	0.84
Total	l	0.74
	r	0.88
	Total	0.81

Table 4: Overall mean scores for English rhotic-lateral contrast, audio + orthography task (children).

Total		
WF	l	0.62
	r	1.00
	Total	0.80
WI	l	0.98
	r	1.00
	Total	0.99

WM	l	1.00
	r	0.90
	Total	0.95
Total	l	0.86
	r	0.97
	Total	0.91

Table 5: Overall mean scores for Spanish rhotic-lateral contrast, audio only task (adults).

Total		
WF	l	0.31
	r	0.11
	Total	0.21
WI	l	0.91
	r	0.66
	Total	0.77
WM	l	0.74
	r	0.51
		0.33
	Total	0.53
Total	l	0.66
	r	0.43
		0.33
	Total	0.51

Table 6: Overall mean scores for Spanish rhotic-lateral contrast, audio + orthography task (adults).

Total		
WF	l	0.67
	r	0.22
	Total	0.44
WI	l	0.97
	r	0.92
	Total	0.94
WM	l	0.89
	r	0.87
		0.41

	Total	0.72
Total	l	0.84
	r	0.67
		0.41
	Total	0.71

Table 7: Overall mean scores for Spanish rhotic-lateral contrast, audio only task (children).

Total		
WF	l	0.47
	r	0.09
	Total	0.28
WI	l	0.94
	r	0.70
	Total	0.81
WM	l	0.90
	r	0.66
		0.45
	Total	0.67
Total	l	0.77
	r	0.49
		0.45
	Total	0.61

Table 8: Overall mean scores for Spanish rhotic-lateral contrast, audio + orthography task (children).

Total		
WF	l	0.80
	r	0.14
	Total	0.47
WI	l	0.97
	r	0.88
	Total	0.92
WM	l	0.95
	r	0.81
		0.64
	Total	0.80

Total	l	0.91
	r	0.62
		0.64
	Total	0.75

Table 9: Total number of categories and their frequencies for English productions of rhotics and laterals.

Count														
		Sound produced												Total
		kl	d	ew	l	m	n	o	r	re	uo	w		
Grapheme	l	18	1	2	33	746	8	1	96	50	0	3	2	960
	r	49	0	2	0	11	4	3	3	872	1	0	16	961
Total		67	1	4	33	757	12	4	99	922	1	3	18	1921

Language = English

Table 10: Total number of categories and their frequencies for Spanish productions of rhotics and laterals.

Count														
		Sound produced												Total
		h	aa	ɹ	b	br	k	tʃ	kr	l	lio			
Grapheme	l	43	0	0	0	0	0	0	0	883	12	1059		
	r	10 1	0	13 1	46	3	4	0	1	2	0	1071		
	rr	12	2	0	16	4	0	1	0	0	0	351		
Total		15 6	2	13 1	62	7	4	1	1	2	883	12	2481	

Language = Spanish

Note: For this table in particular, other productions were observed, however, only a few are reported for consistency and to demonstrate the overall pattern of productions.

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