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L3/Ln acquisition of the Mandarin onset voiced palatal approximant /j/ by Puerto Rican  
bilinguals

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802-09-1038

Monografía final de grado

Fecha de aprobación: 20 de mayo del 2024

Comité de monografía final:

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## **Abstract**

Puerto Ricans are part of a bilingual landscape of mostly native Spanish speakers who have had language contact with English. The present study examined the effect that Puerto Rican bilinguals' two language systems had on the acquisition of the onset voiced palatal approximant /j/ in Mandarin Chinese by means of a cross-sectional study involving reading tasks for Mandarin students from the UPR and acceptability judgment tests from a native speaker of Mandarin. The Cumulative-Enhancement Model (CEM) and the Typological Primacy Model (TPM) were put to the test because the participants were subject to cross-linguistic influence (CLI) from their first (L1) and second language (L2). There was potential to have negative transfer from the Spanish [+ obstruent] /j/ and positive transfer from the English [- obstruent] /j/ in the process of phonological acquisition through the reading of the <y> grapheme. Most participants were experienced L<sub>n</sub> language learners who had a slight language dominance towards their L1 according to their Bilingual Language Profile (BLP), but were, moreover, balanced bilinguals with a strong L2 system. Furthermore, there was not much negative transfer from their L1, and it was concluded that the TPM holds true in this context. However, there was inconclusive evidence regarding the CEM.

**Keywords:** Mandarin Chinese, Phonological Acquisition, Third Language Acquisition (TLA), Cross-linguistic influence (CLI), Cumulative Enhancement Model (CEM), Typological Primacy Model (TPM)

## Resumen

Los puertorriqueños son parte de un paisaje lingüístico en el cual la mayoría son nativohablantes del español que han tenido algún tipo de contacto con el inglés. Este estudio examinó el efecto que tuvieron los dos sistemas lingüísticos de puertorriqueños bilingües en la adquisición de la aproximante palatal sonora /j/ del chino mandarín, en posición del ataque silábico, por medio de un estudio transversal que involucraba tareas de lecturas para estudiantes de mandarín de la UPR y juicios de aceptabilidad de una nativohablante del mandarín. El Cumulative-Enhancement Model (CEM) y el Typological Primacy Model (TPM) se pusieron a prueba porque los participantes estaban sujetos a influencia interlingüística (CLI) de su primera (L1) y segunda lengua (L2). Había potencial de que hubiese transferencia negativa de la /j/ [+obstruyente] del español y transferencia positiva de la /j/ [-obstruyente] del inglés en el proceso de adquisición fonológica a través de la lectura del grafema <y>. La mayoría de los participantes eran aprendices de L2 con experiencia y tenían una leve dominancia hacia su L1 de acuerdo con el perfil lingüístico de hablantes bilingües (BLP). Por otra parte, estos eran bilingües balanceados con un fuerte sistema lingüístico de su L2. Por tal razón, no hubo mucha transferencia negativa de su L1. Por lo tanto, se concluyó que el TPM sí resultó sostenerse, pero hubo evidencia inconclusa en cuanto al CEM.

**Palabras clave:** chino mandarín, adquisición fonológica, adquisición del lenguaje, influencia interlingüística, Cumulative Enhancement Model (CEM), Typological Primacy Model (TPM)

## **1. Introduction**

### **1.1. Bilingualism in Puerto Rico**

According to Pousada (2017), the linguistic landscape of Puerto Rico (PR) is complicated due to a lack of efficient language planning. The government of PR has had a political relationship with the United States of America (US) ever since Spain yielded the territory after the Spanish-American war in 1898. Puerto Ricans received US citizenship in 1917, a year before the First World War ended. However, after PR was acquired by the US, English was pushed to be the language of instruction during the first fifty years of the PR-US relationship, even though the teachers and students' mother tongue was Spanish.

Torres González (2002) states that there were six language policies instituted between 1898 and 1949 in which English was forced to be the medium of instruction in the public school system of PR. From 1900 to 1903, the medium of instruction in elementary schools was Spanish while in high school, it was English. From 1903 to 1916, the language of instruction was English throughout all grade levels, K-12. From 1916-1934, the language of instruction was Spanish until the 4<sup>th</sup> grade, 5<sup>th</sup> grade was a year of language transition, and from 6<sup>th</sup> grade on, the medium of instruction was English. From 1934 to 1937, the language policy was brought back to the original policy that was in effect between 1900 and 1903. Then, from 1937 to 1942, yet again, they reverted to a previous language policy, the one that had been instituted between 1916 and 1934. Finally, the language policy in effect during the 1942-1949 era was that Spanish would be the language of instruction until the 6<sup>th</sup> grade and it would change to English from the 7<sup>th</sup> grade onward.

After the failed attempt to make English the main language in the public schools in PR, Spanish has mainly been the language of instruction and English has been taught as a subject in

itself. Nevertheless, both Pousada and Torres González would argue that the language planning and language policies that have taken place after 1949 have also not been successful in building a bilingual landscape in PR. However, what we can conclude from the history of bilingualism in PR is that Spanish has mainly been the first language of the students while English has been the second language that they have learned in school.

## **1.2. Third Language Acquisition**

Given that the linguistic landscape of PR is a context of language contact between English and Spanish, when speakers of this language community learn Mandarin Chinese in a formal setting, they are in a Third Language Acquisition (TLA) setting. There is an ongoing academic debate about whether TLA is different from Second Language Acquisition (SLA) and, thus, the field of TLA is arguably new. However, according to Rothman et al. (2013), TLA is different from SLA because the L3 learner has more previous linguistic experience in comparison to an L2 learner. Therefore, the L3 learner has access to more grammatical properties from their Universal Grammar (UG). Third language learners are experienced learners of a non-native system who have a different competence in comparison to L2 learners (Cenoz et al., 2001).

Because this is a young field of study, there are disagreements regarding the boundaries of its paradigm and theoretical framework. Nevertheless, according to Amaro et al. (2012), some of the major questions addressed in this field concern the classification of an L3 in adult acquisition when the learner is a simultaneous bilingual, a heritage speaker, or a learner of multiple foreign languages. Is a language system considered an L3 because of the chronological order of acquisition or does language proficiency play a role in the categorization of an L3? This

is an important question to consider in this particular research because some participants are college students who are learning or have learned more foreign languages.

There are different approaches to TLA, such as the sociolinguistic approach, the educational approach, and the psycholinguistic approach (Rothman et al., 2013). In this research paper, we approach TLA from the psycholinguistic perspective. Some of the major psycholinguistic models of TLA include the Cumulative-Enhancement Model (CEM), the L2 Status Factor Model, and the Typological Primacy Model (TPM) (Amaro et al., 2012). These models are part of an ongoing academic debate about the source of cross-linguistic influence (CLI) in TLA. According to Rothman et al. (2013), CLI from the L1 or L2 in TLA may be due to factors such as recency of use, L2 language proficiency, typological distance, psychoaffective factors, or the respective L1/L2 statuses. These models, the CEM and the TPM, will be discussed with more detail in sections 1.4 and 1.5 respectively. Nonetheless, what these models agree on is the concept of transfer, which will be further discussed in the next section (1.3).

### **1.3. Cross-linguistic influence**

The concept of cross-linguistic influence (CLI) is a widely studied phenomenon in the fields of SLA and TLA. Interference, as it was also usually named, was originally introduced by Robert Lado. According to Lado (1957), when someone learns a second language, they can transfer linguistic habits from their native language. When the linguistic traits are present in both languages, it is positive transfer, but when they are not shared by both languages, then it is negative transfer. However, this term has come to be in disuse in academic discourse during the past few decades.

According to Lightbown and Spada (2013), this might be because interference and contrastive analysis were linked to behaviorist theories of SLA. According to Saville-Troike

(2012), the field of linguistics shifted from that former behaviorist approach to a more cognitivist approach with the revolution of Chomsky's Transformational-Generative (TG) Grammar. There has been an ongoing debate on the nomenclature of the concepts of language transfer and interference. However, the term that has been growing in use is cross-linguistic influence. According to Odlin (2003), one of the biggest obstacles in the field of CLI is that it presumes some sort of movement and there has been no research that has clearly detailed the cognitive processing behind that movement.

Nevertheless, there have been psycholinguistic studies in CLI involving language contact between Sino-Tibetan languages and European languages. For example, Chen et al. (2007) conducted a study involving L1 Chinese/L2 English bilinguals and native speakers of English by monitoring their event-related potential (ERP) responses to stimuli of English verb agreement violations. Chinese is a language that lacks verb conjugation and inflection. Thus, the ERP responses from both groups of participants were different. Even though, language production varied and some of the bilinguals performed well in behavioral responses, some L2 speakers did violate the subject-verb agreement constraints of the English language, no matter how fluent or proficient they were. Based on the cognitive data retrieved from the ERPs from this study, one might be able to conclude that there is CLI in cognitive processing of a second language system.

In fact, according to McManus (2021), there is research that shows that CLI occurs in both directions, from L1 to L2 (progressive transfer) and vice versa (regressive transfer). Therefore, pertaining to the present study, in the process of studying CLI in L3/Ln Mandarin acquisition by Puerto Rican bilinguals, there might be some data that show CLI between the speakers' L1 and L2. It is possible that there is negative transfer from Puerto Ricans' L2 English onset voiced palatal approximant /j/ graphemic representation <y> in a reading task of their L1

Spanish onset voiced palatal fricative /j/. If the participants have a strong L2 system, it might influence their L1 articulation.

According to Brown and Amengual (2015), in a CLI study of phonological acquisition there was regressive transfer when encountering cognate words. They wanted to know whether cognates would affect the pronunciation of the Spanish onset voiced dental stop /d/ and its allophones in the spontaneous speech of Puerto Rican bilinguals. Another research question in this study concerns the duration of the mean voice onset time (VOT) of the Spanish onset voiceless dental stop /t/ in cognates. In this second experiment using elicited speech, they studied how Spanish-English heritage speakers performed in comparison to Spanish-Catalan speakers.

In the first experiment, they assumed that the Puerto Rican bilinguals would produce [d] more than [ð] and [Ø] in contrast to monolingual Puerto Ricans. In the second experiment, they believed that the heritage speakers would produce longer VOTs in onset /t/ cognates and the control group would have a shorter VOT that was closer to Spanish. The results showed that Puerto Rican bilinguals were less likely to produce allophones of the Spanish /d/ when the target lexical item was a cognate, in comparison to the monolingual counterparts. The results also show that the heritage speakers were more likely to produce the Spanish onset /t/ in cognates with a prolonged VOT that was closer to the aspirated English /t<sup>h</sup>/, in comparison to the other group.

#### **1.4. The Cumulative-Enhancement Model**

As mentioned before, one of the main psycholinguistic models of TLA is the Cumulative-Enhancement model. According to Flynn et al. (2004), the CEM proposes that all known languages play a role in the acquisition of a third or additional language. They researched the acquisition of L3 English by bilingual speakers of L1 Kazakh and L2 Russian. Their study compared the results with previous research done on L1 and L2 acquisition of three types of



restrictive relative clauses in English: lexically headed relative clauses with semantic content, lexically headed relative clauses without semantic content, and free relative clauses.

Previous L2 English acquisition research of these clauses by L1 speakers of Spanish and Japanese respectively concluded that in the native Spanish speakers, the free relative clauses did not precede the lexically headed relative clauses, in contrast to the native Japanese speakers. It was assumed that this was due to the fact that Japanese is a head-final language system while Spanish is a head-initial system. The Japanese learners of English were acquiring these structures for the first time just like L1 English speakers learn their relative clauses for the first time, i.e., the free relative clauses precede the lexically headed relative clauses.

On the other hand, the L3 English learners had a head-final L1 system and a head-initial L2 system and the free relative clauses did not precede the lexically headed clauses either, in the process of their acquisition of L3 English. Thus, it was concluded that their L1 Kazakh did not have a privileged role on their L3 acquisition, and their L2 Russian was an advantage to their acquisition of L3 English. This means that TLA is cumulative and previously learned languages do help in the process of acquiring an additional language. Up to that point, this was only an anecdotal and qualitative assertion made by multilinguals, but this study legitimized the CEM.

However, this study does not address order of acquisition. They point out that the successful CLI from L2 Russian to L3 English might be because Russian was the language system learned right before English. Thus, in the Bardel and Falk (2007) study, they put four CLI hypotheses to the test in the L3 acquisition of Swedish and Dutch syntax. The four hypotheses were: the non-transfer hypothesis, the L1 transfer hypothesis, the L2 transfer hypothesis, and the CEM. The non-transfer hypothesis assumes that there is no CLI. The L1 transfer hypothesis

assumes that there is L1 CLI primacy, while the L2 transfer hypothesis assumes that there is an L2 status factor. The CEM assumes that there is potential CLI from both the L1 and the L2.

The participants consisted of two heterogeneous groups. One group was made up of five female participants whose target language was Swedish. Their L1s included Dutch, English, and Hungarian while their L2s were English, German, and Dutch. The other group consisted of four participants (1 female) whose target language was Dutch or Swedish. Their L1s were Swedish, Italian, and Albanian while their L2s were English, German, and Dutch. The target structure was placement negation, which is post-verbal in the target languages under study.

The results favored the L2 transfer hypothesis, which brought forward the L2 status factor. As mentioned before, this was a concern that was addressed by Flynn et al. (2004). However, due to the heterogeneous nature of Bardel and Falk's (2007) participants and their bilingual profiles, the conclusions are questionable regarding their opposition to the CEM. Nevertheless, this research points out that the CEM asserts that previously learned languages can help in the acquisition of an additional language and that the more language systems that a foreign language learner knows, the easier it is for them to learn more, but it does not address the proximity in terms of language typology. Therefore, a new model was proposed as an extension to the CEM.

### **1.5. The Typological Primacy Model**

The Typological Primacy Model (TPM) proposed by Rothman (2011) states that the acquisition of a third or additional language will draw on the most typologically similar language from the learner's linguistic repertoire. Rothman researched the L3 acquisition of a Romance language by two groups of bilingual speakers, one group had a Romance language as their L1, and the other group had another Romance language as their L2. The first group consisted of L3

learners of Spanish with L1 Italian and L2 English. The second group was made up of L3 learners of Portuguese whose L1 was English and L2 was Spanish.

Rothman wanted to examine whether their CLI was restricted to their previously learned language (L2), or the most typologically similar language system, regardless of the order of acquisition. To accomplish this, the two groups of participants had to undergo two experiments. The first one consisted of a semantic interpretation task and the second one was a context-based collocation task. The target structure of both experiments were determiner phrases (DPs) with post-nominal and pre-nominal adjectives.

The results displayed that both groups were able to accomplish the tasks successfully due to their previously learned Romance languages. Thus, their CLI came from typological proximity and not from the order of acquisition of their respective L1s and L2s. However, as the study points out, the typological proximity is also based on the speaker's perception and awareness (psychotypology), and not necessarily on how similar the two language systems actually are. What it doesn't point out is that the TPM here seems to be based on general language typological proximity and not on specific linguistic traits. On the other hand, according to Rothman et al. (2013), some studies have concluded that CLI is a factor that can be applied to individual items or the entire system. In the case of L3/Ln Mandarin bilingual learners from Puerto Rico, their L1 and L2 are not similar, typologically or psychotypologically, to their target language in general, but they do have typological proximity in more specific domains of language and particular phonological and syntactic structures.

In a study by Villanueva (2011), the role of the linguistic proximity and the number of languages learned was researched in the acquisition of L3/L4 Spanish from speakers of L1French/L2English. The CLI from the participants' L1 and L2 on the acquisition of Spanish

syntax was examined by means of a grammatical judgment test (GJT). The GJT consisted of Spanish sentences with syntactic structures that were grammatical in some, none, or all of the speakers' linguistic repertoires. If the participants responded positively to the sentences that were not grammatical in the L3/L4 but were grammatical in the L1 or L2, it was attributed to negative transfer (-T). If they responded positively to the sentences that are grammatical in both the target language, the L3/L4, and one of the two known languages, the L1 or L2, it was attributed to positive transfer (+T). There were eight grammatical variant sentences and further conclusions on whether there was +T, -T, or no transfer at all.

The author believed that there would be more positive transfer from French to Spanish because they are typologically closer than are English and Spanish. She also assumed that the participants with an additional language, the Spanish L4 learners, would outperform the Spanish L3 learners because they had a broader linguistic repertoire and cumulative linguistic experience. The researcher's results favored the earlier research conducted on the TPM, but did not show any supporting evidence for the CEM model.

## **1.6. Phonology in Third Language Acquisition**

According to Rothman et al. (2013), L3 phonology is an understudied field, and it may be because most TLA research focuses on adult learners. During acquisition, Adult learners tend to perform better on grammatical and lexical items than on phonological ones. Therefore, most research usually focuses on morphology and syntax instead of phonology. As in other domains of language, the effects of CLI and the CEM/TPM debate is present in research regarding phonological acquisition of a third language. Recency of use, psychotypology, L2 proficiency, among other factors discussed before, can also be involved in L1/L2 phonological transfer in TLA.

According to Amaro et al. (2012), previous research shows an additive and facilitative effect of bilingualism in L3 phonology but focuses more on overall proficiency instead of specific linguistic experience. As for the role of the L1, prior research indicates that many L3 learners experience influence from their L1 accent and intonation patterns. Regarding the role of the L2, there is evidence of both positive and negative transfer in the acquisition of third language phonology. Various studies seem to show that there is not a privileged role of the L1 or L2 in L3 phonological acquisition. The research favors typological and psychotypological effects as driving factors of CLI in L3 phonology.

In Chen and Han (2019), the phonological acquisition of L3 Mandarin by native Cantonese speakers was studied. There were 24 participants from Hong Kong whose L2 was English. The pronunciation of frequent L2 and L3 phonological traits was analyzed. In addition, a questionnaire and an interview were conducted. The results showed that their perception was on par with their production. The research also favored the TPM.

On the other hand, Liu and Lin (2021) studied the L3 acquisition of Japanese and Russian stop consonants. The participants were 39 Chinese college students whose L1 was Mandarin and L2 was English. Identification tasks and reading tasks were used to investigate the perception and production of onset stop consonants. The results concluded that there was an agreement of perception and production of voiceless stops. However, the participants performed well in the perception of voiced stops, but struggled with their production.

Another research paper involving L3 phonological acquisition by Chen and Tian (2021) studied Cantonese L1 speakers of L2 Mandarin and L3 English. They examined the influence of language proficiency in the TLA of phonology. Reading aloud tasks, a questionnaire, and an interview were used for data collection. There was L1 influence found on both the L2 and L3

systems. The results also demonstrated evidence of L2 to L3 CLI and L2 to L1 regressive transfer. Typological distance was one of the factors involved, but they concluded that language proficiency was the driving factor to the CLI.

### **1.7. Phonological Acquisition through Reading**

Foreign language learning in adults sometimes takes place in a classroom, which involves formal training and instruction. Foreign language classroom instruction involves reading, literacy development, and orthographic input. Mathieu (2014) states that extralinguistic elements like written representations can also contribute to the learner's SLA experience. In fact, according to de Groot (2013), the process of reading will also activate sublexical memory units like phonological representations.

When speakers of a native language that is Indo-European are in the process of learning a foreign language that uses an unfamiliar orthography like Chinese characters, it is useful to use alphabetic representations to learn the new language (Mathieu, 2014). In fact, research shows that Chinese pinyin, the romanization of the Chinese logographic system, reinforces phonological acquisition of Mandarin as a foreign language (Guan et al., 2011). Therefore, to learn Mandarin as a foreign language, it is useful to learn phonology with the help of familiar graphemic representations.

However, in the case of Puerto Rican bilinguals, this learning process would lead to a competition of three language systems when acquiring Mandarin as an L3/Ln, based on what has been stated thus far. That seems to be the case when learning the onset voiced palatal approximant which is represented by the <y> grapheme in Chinese pinyin. In the process of articulation, the production of the onset voiced palatal approximant competes with the phonemic representations of the <y> grapheme in Spanish and English.

### 1.8. The sounds represented by <y> in Spanish, English, and Mandarin

In Chinese Mandarin, the voiced palatal approximant /j/ is represented by the <y> grapheme in the pinyin system (Lin, 2019). Pinyin(拼音) is a romanization system for Chinese characters developed by the linguist Zhou Youguang (周有光) and his colleagues around the 1950s (Wang, 2017). In fact, this alphabetic codification of syllables in Mandarin helps foreigners to learn Mandarin as a foreign language (Wang, 2017). The <y> is only written at the beginning of a syllable. In terms of graphemes, it is never present in the rhyme, nucleus or coda, of the Mandarin Chinese pinyin syllable structure. While the /j/ phoneme is not exclusively present as the onset of the syllable structure (Lin, 2019), the <y> grapheme is, in fact, exclusively an onset (see figure 1). Figure 1 shows all the possible syllables in Mandarin Chinese pinyin.

**Figure 1: Mandarin Pinyin Chart** ([Mandarin Pinyin Chart | East Asia Student](http://East Asia Student))

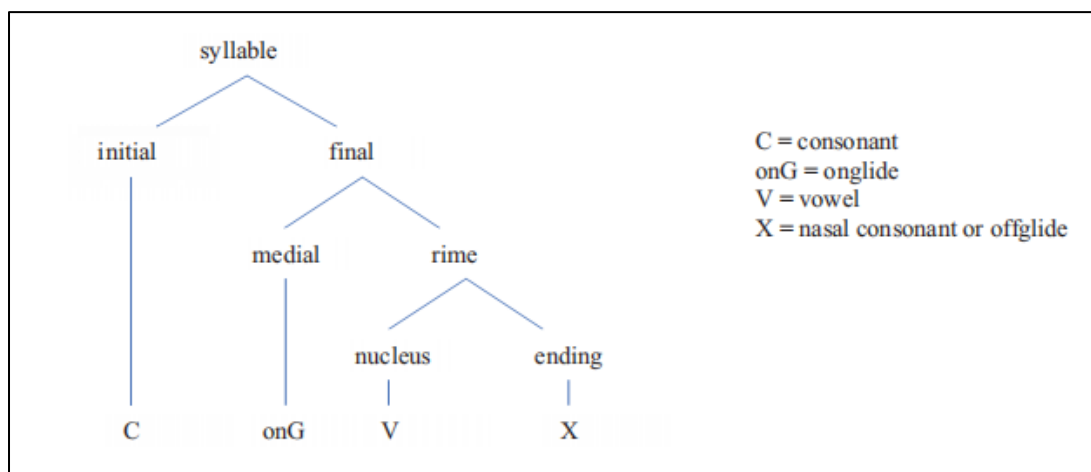
	a					o			e				i								u								ü									
	a	ai	ao	an	ang	o	ong	ou	e	ei	en	eng	er	er	yi	ia	iao	ie	iu	ian	iang	in	ing	long	u	ua	uo	ui	uai	uan	un	uang	ueng	ü	üe	üan	ün	
-	a	ai	ao	an	ang	o	ong	ou	e	ei	en	eng	er	er	yi	ia	iao	ie	iu	ian	iang <td>in</td> <td>ing</td> <td>long</td> <td>u</td> <td>ua</td> <td>uo</td> <td>ui</td> <td>uai</td> <td>uan</td> <td>un</td> <td>uang</td> <td>ueng</td> <td>ü</td> <td>üe</td> <td>üan</td> <td>ün</td>	in	ing	long	u	ua	uo	ui	uai	uan	un	uang	ueng	ü	üe	üan	ün	
b	ba	bai	bao	ban	bang	bo				bei	ben	beng		bi			bie		bian		bin	bing		bu														
p	pa	pai	pao	pan	pang	po			pou	pei	pen	peng		pi		piao	pie		pian		pin	ping		pu														
m	ma	mai	mao	man	mang	mo			mou	mei	men	meng		mi		miao	mie	miu	mian		min	ming		mu														
f	fa			fan	fang	fo			fou	fei	fen	feng												fu														
d	da	dai	dao	dan	dang	dong	dou	de	dei		deng		di	diao	die	dieu	dian				ding		du	duo	dui			duan	dun									
t	ta	tai	tao	tan	tang	tong	tou	te			teng		ti	tiao	tie		tian			ting		tu	tuo	tui			tuan	tun										
n	na	nai	nao	nan	nang	nong	nou	ne	nei	nen	neng		ni	niao	nie	niu	nian	niang	nin	ning		nu	nuo				nuan						nü	nüe				
l	la	lai	lao	lan	lang	long	lou	le	lei		leng		li	liao	lie	liu	lian	liang	lin	ling		lu	luo				luan	lun					lü	lüe				
z	za	zai	zao	zan	zang	zong	zou	ze	zei	zen	zeng		zi									zu	zuo	zui			zuan	zun										
c	ca	cai	cao	can	cang	cong	cou	ce		cen	ceng		ci									cu	cuo	cui			cuan	cun										
s	sa	sai	sao	san	sang	song	sou	se		sen	seng		si									su	suo	sui			suan	sun										
zh	zha	zhai	zhao	zhan	zhang	zhong	zhou	zhe	zhei	zhen	zheng		zhi									zhu	zhua	zhuo	zhui	zhuai	zhuan	zhun	zhuang									
ch	cha	chai	chao	chan	chang	chong	chou	che		chen	cheng		chi									chu	chua	chuo	chui	chuai	chuan	chun	chuang									
sh	sha	shai	shao	shan	shang		shou	she	shei	shen	sheng		shi									shu	shua	shuo	shui	shuai	shuan	shun	shuang									
r		rao	ran	rang		rong	rou	re		ren	reng		ri									ru	rua	ruo	rui		ruan	run										
j														ji	jia	jiao	jie	jiu	jian	jiang	jin	jing	jiong											ju	jue	juan	jun	
q														qi	qia	qiao	qie	qiu	qian	qiang	qin	qing	qiong											qu	que	quan	qun	
x														xi	xia	xiao	xie	xiu	xian	xiang	xin	xing	xiong											xu	xue	xuan	xun	
g	ga	gai	gao	gan	gang	gong	gou	ge	gei	gen	geng												gu	gua	guo	gui	guai	guan	gun	guang								
k	ka	kai	kao	kan	kang	kong	kou	ke	kei	ken	keng												ku	kua	kuo	kui	kuai	kuan	kun	kuang								
h	ha	hai	hao	han	hang	hong	hou	he	hei	hen	heng												hu	hua	huo	hui	huai	huan	hun	huang								

According to Lin (2019), the syllable structure in Mandarin, orthographically and phonologically, is generally broken down into initials and finals. Initials are made up of onset

consonants (See the first column of Figure 1). However, in Mandarin Chinese, the glides, /j/ and /w/, are classified as finals in the syllable structure because glides are also called semi-vowels or approximant consonants. Nevertheless, according to standard phonological practices, these would be reclassified as vowels rather than consonants, if they were part of the syllabic nucleus. In fact, the instructional book that is widely used in classrooms of Mandarin as a foreign language shows the high front unrounded vowel /i/ in place of /j/ and the high back rounded vowel /u/ instead of /w/ (Xún, 2019).

According to Lin (2019), the possible syllabic constructions of finals in Mandarin could consist of the onset glides, vowels, and a nasal or offset glide. This syllable structure can be expressed as CGV[NG] (See figure 2). Lin (2019) states that there are a total of 12 syllable types in Mandarin Chinese. However, diphthongs and triphthongs are not included as separate possible sounds in the nucleus V of this syllable structure. Therefore, there are more possible syllable types. There are no consonant clusters in the Mandarin syllable structure and the only consonants that could be present as codas are nasals and approximants, which are higher than most consonants in the sonority hierarchy.

**Figure 2: Mandarin Syllable Structure (Lin, 2019)**





On the other hand, in syllables where the vowel <u> follows the consonant <y> (<yu>, <yue>, <yuan>, and <yun>), it represents the voiced labio-palatal approximant /ɥ/ (Lin, 2019), or the high front rounded vowel /y/ (Xún, 2019). Neither of these sounds are part of the Spanish and English language systems. Therefore, under this classification, there would be no candidate for positive transfer from Puerto Rican's L1 and L2. However, according to Chen and Gussenhoven (2015), in Shanghainese, a dialect of Mandarin Chinese, [ɥ] is categorized as an allophone of /j/ because it only occurs before a rounded vowel. Chen and Gussenhoven (2015) do not specify if this contention is also applicable to standard Chinese, and Shanghainese is arguably typologically distant from it. Nevertheless, the IPA provides a diacritic <sup>w</sup> for the labialization of consonants, and thus [j<sup>w</sup>] is equivalent to [ɥ]. Furthermore, for the purpose of this study, <yu> will be considered as [j<sup>w</sup>y].

Conversely, according to Peña Arce (2015), the most common sound of the <y> grapheme in Puerto Rican Spanish is the voiced palatal fricative /j/. However, there are multiple realizations of the <ll> and <y> graphemes in the Spanish speaking world, including vocalic sounds as well as occlusive, fricative, affricate, and approximant consonant sounds (Quijada et al., 2023). In the Spanish language, the <y> grapheme can also represent the front high vowel /i/ and the <ll> grapheme can represent the /j/ phoneme or its allophones. There is an ongoing academic debate about the classification and geographic distribution of the sounds of <y> in Spanish. The debate mostly lies on the manner of articulation because most authors agree that it is voiced and palatal.

The Royal Spanish Academy (RAE) states that the phoneme that corresponds to the <y> grapheme is the voiced palatal fricative /j/ (Colantoni, 2012). However, according to Martínez Celdrán (2015), RAE is inconsistent in its classification of its allophones. In one page, they only

recognize an affricate [d͡j] and the voiced palatal plosive [j] variant, which are both conditioned by phonological context, but, in another page, they only recognize the affricate [d͡j] and the voiced palatal approximant [j]. He concludes that the most common articulation of the <y> grapheme is a palatal approximant. According to Quijada et al. (2023), an analysis of the Fonología del Español Contemporáneo (FEC) corpus shows that the articulation of /j/ in Spanish is very rare. The voiced palato-alveolar affricate [d͡ʒ] and the voiced palatal affricate [t͡ʃ] are other allophones that can also be found in previous literature (Colantoni, 2012; Martínez Celdrán, 2015; Quijada et al., 2023; Martínez-Celdrán, 2004).

In fact, according to Martínez-Celdrán (2004), the /j/ phoneme is not an actual fricative sound, but rather an approximant one. He states that both /j/ and /j/ are voiced palatal approximants, but /j/ is a semi-vowel and /j/ is an actual consonant. He describes /j/ as a central spirant consonant that can be rounded while /j/ is an unrounded semi-vowel. Given this characterization, we will further consider /j/ as [+obstruent] and /j/ as [-obstruent]. In other words, /j/ has more obstruction of airflow than /j/. Regarding the syllabic distribution of the sounds of <y> in Spanish, Martínez-Celdrán (2004) posits that [i] is only present in the nucleus of the syllable, [j] is never present as an onset, [j] is only present as an onset, and [t͡ʃ] appears after a pause, a nasal, or the lateral approximant /l/.

On the other hand, the <y> grapheme in English is also produced as the voiced palatal approximant /j/ (Zsiga, 2013). According to Kessler and Treiman (1997), the /j/ only occurs as the onset of a syllable or as part of a diphthong. The onset English <y> is classified as a semi-vowel and it is a consonant with one of the highest values in the sonority scale (O'Grady & Archibald, 2015). Because the onset English <y> is read as /j/, it is [-obstruent] in comparison to the reading of the Spanish <y> grapheme. Therefore, the phonological representation when

reading <y> in Chinese Mandarin is typologically closer to English than Spanish. This would entail that Puerto Rican L3/Ln Mandarin students have the potential of drawing positive transfer from their English language system or negative transfer from their Spanish language system.

**Table 1: The Sounds represented by <y>**

Language	Sounds of the onset <y>	Place of Articulation	Manner of Articulation	Obstruent vs. Sonorant
Mandarin Chinese	/j/ or [ɥ] or [jʷ]	palatal & labio-palatal	approximants	[- obstruent] [+ sonorant]
Puerto Rican Spanish	/j/ or [j̞] or [dʒ]	palatal & palato-alveolar	fricative & affricate	[+ obstruent] [- sonorant]
American English	/j/	palatal	approximant	[-obstruent] [+sonorant]

### 1.9. Chinese SLA & TLA

In the following literature review, it will be shown that this phenomenon has not been researched before in the field of foreign language acquisition of Mandarin Chinese. Among the research papers found and reviewed in this section, there are no previous studies in this particular context. According to Zhang (2021), the research conducted since the 1960s has focused more on Chinese SLA rather than Chinese pedagogy. The pedagogy research has mainly focused on beginners, and most of the studies have collected qualitative data. Additionally, studies about the teaching of phonology have mainly focused on the instruction of the four Mandarin tones. Mandarin is a tonal language in which one word or syllable could change its meaning depending on its intonation.

In Rodríguez-Fandiño and Tejada-Sánchez (2020), the phonological acquisition of L3 Mandarin by L1 Spanish/L2 English speakers was examined. Nevertheless, their target sounds were the retroflex consonants instead of the onset voiced palatal approximant and the participants were not Puerto Rican. Furthermore, this qualitative research was focused more on the pedagogical techniques to teach these retroflex initials and was not concerned with CLI from

the participants' L1 or L2. The study examined the use of explicit instruction and noticing to enhance the perception and production of these retroflex sounds. After a pedagogical intervention, the data were collected by means of oral production and listening comprehension tests, student feedback, a diary written by the researcher, an interview with the Mandarin instructor, and a focus group.

In Deng (2017), the acquisition of Mandarin as a second language by native Spanish speakers was examined. However, the participants did not speak Caribbean Spanish dialects as well as the previously reviewed paper and the study was concerned with the acquisition of syntax rather than phonological acquisition. She researched the acquisition of pro-drop parameters in both Spanish as an L2 and Mandarin Chinese as an L2. The data were collected by means of GJTs, interviews, photo and video descriptions, among other linguistic tasks. The results showed that there was CLI from the participants' L1s, even when they were in more advanced stages of their interlanguage development.

In Freundlich (2016), the acquisition of L3 Mandarin by L1 Polish and L1 Ukrainian speakers was investigated. This study was concerned with CLI, but the participants were not native Spanish speakers. The participants had English as their L2, and the language of instruction was English. The focus of this qualitative study was to examine the negative transfer from their L1 and L2. Data were obtained by means of observations during the classroom instruction of L3 Mandarin. The results showed that there was mostly phonological CLI from their L1 and grammatical CLI from their L2.

In Wu (2020), the acquisition of L2 Mandarin by English dominant heritage speakers and foreign language learners of L1 English was researched. This study also integrated CLI, but the target structures were referring expressions. Mandarin Chinese lacks definite and indefinite

articles as well as plural markers in nouns. Conversely, English does have articles and plural referents and it is not a pro-drop language. The data were collected from speech production of narratives, including those from control groups of native English speakers and native Mandarin speakers. The results displayed three types of CLI from L1 English in the L2 Mandarin narratives when introducing characters or maintaining reference to them.

In Chang (2018), L2 acquisition of Mandarin Chinese by L1 English speakers was studied. This paper did not consider CLI and the participants were not native Spanish speakers, but it studied the effects of orthography in Chinese SLA and it is concerned with phonological acquisition. The researcher wanted to know if tone marking, pinyin, and Chinese character radicals influenced the acquisition of the four tones of Mandarin Chinese. The data collection took place by means of a tone perception task and a tone production task. The results showed that the use of pinyin with diacritics was more facilitative in the acquisition of tones in comparison to the use of pinyin with tone numbers or characters without pinyin.

As mentioned before, these studies do not target the phonological acquisition of the voiced palatal approximant /j/. Some of them include CLI, TLA, phonological acquisition, the effects of orthography, and L1 Spanish speakers. However, none of them are developed in the context of Puerto Rican bilinguals and, the CEM as well as the TPM models of TLA are not put to the test. Throughout this literature review, no studies were found to have researched this phenomenon in this particular context. We now turn to a review of TLA research that has been completed in Puerto Rico.

### **1.10. TLA in Puerto Rico**

As for the previous research that has been conducted in the field of TLA in Puerto Rico, the following literature review will show that the subject matter of this paper has not been

addressed before. Just like in the previous section, this review of prior research did not find any studies of this phenomenon in the context of Puerto Rican bilinguals. One study was found regarding the L3/Ln acquisition of Mandarin in Puerto Rico and two papers were found about the TLA of French and Portuguese respectively. One of the studies focused on phonological acquisition while the rest focused on syntax and morphology. Two of the research papers had a more pedagogical approach in the debate of implicit vs. explicit instruction.

Pérez Burgos (2022) examined the acquisition of L3 Mandarin by Puerto Rican bilinguals. However, the target structure of this study was the acquisition of the adjectival predicate, that is, the acquisition of syntax rather than phonological acquisition. The study was concerned with CLI, the CEM, and the TPM. Nevertheless, the L1 and L2 shared the same possible patterns of grammatical structures, but the target language did not share those same patterns. Therefore, there was no real candidate for positive transfer. The research included three groups of participants: beginners, learners with more advanced proficiency, and native speakers as the control group. The data were collected by means of picture and question tasks and a fill-in-the-blank task. The results showed that the learners with a higher proficiency were less likely to have negative transfer from their L1 and L2 systems.

Conversely, in Dos Santos (2020), the phonological acquisition of an L3 by Puerto Ricans was studied but the target language was Portuguese. The target sounds were three fricative phonemes that are not part of the L1 system. Even though the study did not examine the L2 CLI, English was a candidate for positive transfer in the acquisition of the voiced alveolar fricative /z/ under study. However, the topic was approached from a pedagogical perspective and the major question was regarding the debate about the use of implicit or explicit instruction in the process of phonological acquisition of an unfamiliar sound in the learner's L1 system. The

participants of different levels of proficiency were divided into two groups: one that underwent implicit instruction and one that underwent explicit instruction. The data, collected through reading tasks and semi-structured interviews showed that the group where explicit instruction was used performed better in the production of these fricative sounds.

Likewise, in Beloucif (2017), the debate between implicit and explicit instruction in L3 acquisition was put to the test. The researcher examined the L3/Ln French acquisition of adverbial pronouns by Puerto Rican bilinguals. Some participants had L3 Italian or Portuguese in addition to L1 Spanish and L2 English. The study took CLI, the CEM, and the TPM into consideration. In this case, Italian was a candidate for positive transfer. The participants were divided into two groups, just like in Dos Santos (2020). The data, collected with a pre-test and a post-test, supported the CEM and TPM models, but did not yield any significantly conclusive evidence about the pedagogical debate.

In sum, this introduction and review of literature has not found any evidence of previous studies on the L3 Mandarin acquisition of /j/ in Puerto Rico. There has been research conducted about SLA and TLA of Mandarin. There have also been studies about TLA by Puerto Rican bilinguals. However, the acquisition of this particular phoneme in this context has not been examined and the CEM and TPM have not been put to the test regarding this matter. Therefore, in the following section, the need for this research is further justified.

### **1.11. Justification**

During research conducted by Ortega-Llebaria (1997), in an explanatory intelligibility test (EIT), there was a 27% deficit of the L2 English target sound /j/. The L1 Spanish participants, of which 30 were Puerto Ricans, produced the voiced palato-alveolar affricate /dz/ instead of the voiced palatal approximant /j/. Even though the severity of the deficit was not

high, the study reflects that there is, in fact, a confusion that occurs between these two sounds in Spanish speakers with English as a second language (ESL). The study also shows that this could lead to intelligibility problems in ESL Spanish speakers. In the case of L3 Mandarin Chinese production, this [+ obstruent] vs. [- obstruent] confusion could also lead to problems of intelligibility.

In a study conducted by Repiso-Puigdelliura et al. (2021), the L2 Spanish acquisition of the voiced palatal fricative /j/ was examined. The participants were heritage speakers whose majority language was English. The data were obtained through reading tasks and the purpose was to research the influence that orthography had on their pronunciation. They wanted to know if there was interference between the pronunciation of the <y> and <ll> graphemes in English and their pronunciation in Spanish. The results showed that, in fact, there was CLI from their majority language in the reading of their minority language, when the target grapheme was <y>.

Based on my own subjective observations as an ESL educator, there are Puerto Rican students from different ages who mispronounce the <y> grapheme in English by producing more consonant-like sounds that could be /j/ or its variants instead of /j/, both in free speech and in reading. In fact, in my experience as a teacher of Spanish as a foreign language, L1 English students sometimes struggle to make this Spanish/English <y> distinction. As an instructor of Mandarin as a foreign language, I have also noticed that L3/Ln Mandarin students who are Puerto Rican bilinguals have also exhibited difficulties when acquiring the onset voiced palatal approximant /j/. When reading syllables with the Mandarin Chinese pinyin initial <y>, they sometimes produce sounds that could be misinterpreted as their minimal pair initials with the <j> and <zh> graphemes. According to Xún (2019), the <zh> initial represents the voiceless retroflex sibilant affricate [tʂ] and the <j> represents the voiceless alveolo-palatal sibilant affricate [tɕ]. If



Puerto Rican bilinguals were to articulate any of these, this might lead to issues of intelligibility of their L3/Ln Mandarin.

According to Banegas and Cansoli (2019), “drawing upon the literature and our experience as teacher researchers, action research as methodology differs from other forms of inquiry in language education because it is context driven, practical, collaborative, cyclical, ecological, and transformative” (p. 179). In other words, based on the action research methodology, researchers who are also educators can recur to both academic literature and their own classroom experience to inquire about foreign language acquisition and instruction according to their practical context. For that reason, I have decided to include my own subjective observations as part of the justification of this research.

Given that the CLI negative transfer from Puerto Ricans’ L1 Spanish could potentially affect and influence their acquisition of L3/Ln Mandarin, the study of this linguistic phenomenon could lead to a further understanding on how to learn and teach Mandarin as a third language in Puerto Rico. Mandarin Chinese is the main language of China, and this country belongs to the emergent world economies known as BRICS. For Puerto Ricans to build good business relations with China, it would be advantageous to further enrich the education of Mandarin Chinese in Puerto Rico. However, if their articulation prevents their intelligibility, it would be difficult to build solid international relations with China. Given the fact that there is no documented research about this phenomenon, the need for this study is, thus, justified.

## **1.12. Objectives**

This study has four main objectives, stated below.

1. To investigate L1 and L2 Cross-Linguistic Influence on L3/Ln acquisition
  - 1.1. To study the influence of English language proficiency on L3/Ln Mandarin acquisition of the onset voiced palatal approximant /j/ in the articulation of Puerto Rican bilinguals by means of reading tasks
  - 1.2. To study the influence of Spanish language proficiency on L3/Ln Mandarin acquisition of the onset voiced palatal approximant /j/ in the articulation of Puerto Rican bilinguals by means of reading tasks
2. To study the effect that the amount of previously learned languages has on Ln acquisition
3. To study the effects of language typology on third language acquisition
4. To examine the effects of exposure to and language contact with the target language, Mandarin, on the accuracy of pronunciation
5. To examine the effect of the L1 and L2 recency of use in L3/Ln language acquisition

## **1.13. Research Questions**

Based on the study objectives, the following research questions are proposed.

1. Is there L1 and L2 Cross-Linguistic Influence on the L3/Ln Mandarin acquisition of the onset voiced palatal approximant /j/ in Puerto Rican bilinguals?
  - 1.1. Is there positive transfer from English in the L3/Ln Mandarin phonological acquisition of the onset voiced palatal approximant /j/?
  - 1.2. Is there negative transfer from Spanish in the L3/Ln Mandarin phonological acquisition of the onset voiced palatal approximant /j/?

2. Does the number of previously learned languages affect the acquisition of an additional language?
3. Does language typology influence third language acquisition?
4. What are the effects of language contact with and exposure to Mandarin on pronunciation accuracy?
5. Does L1 and L2 recency of use affect Cross-Linguistic Influence in L3/Ln language acquisition?

#### **1.14. Independent Variables**

This study will examine the effect that four independent variables have on reading pronunciation accuracy; these variables are:

1. English language proficiency level,
2. Amount of previously learned languages,
3. Time of language contact and exposure to Mandarin Chinese, and
4. L1 and L2 recency of use.

#### **1.15. Dependent Variables**

The effect that the independent variables have on the following two dependent variables will be examined:

1. General reading accuracy (native-like pronunciation).
2. Reading accuracy (native-like pronunciation) of the L3/Ln onset voiced palatal approximant /j/.

## **2. Methodology**

### **2.1. Participants**

#### **2.1.2. Demographic, Educational, and Language Learning Information**

This research was conducted with three groups of Mandarin students from two University of Puerto Rico campuses: Mayagüez Campus (UPRM, G1) and Río Piedras Campus (UPRRP, G2 and G3). The participants were college students who were sequential or simultaneous bilinguals of L1-Spanish and L2-English. The three groups of participants had varying levels of Mandarin Chinese experience and proficiency: G1, from UPRM, had basic proficiency, and G2 and G3, from UPRRP, had beginner and intermediate/advanced proficiency, respectively.

The six participants in G1 were first semester students from the basic Chinese course of the UPRM Mandarin curriculum. This group of participants included novice students of Mandarin Chinese who had less language contact, compared to the UPRRP students in G2 and G3. They had not finished their first semester and they met three times a week for 50 minutes with a professor for regular classes. They did not have language laboratory contact hours with another professor, as UPRRP students had, but they did use the same books that UPRRP students used to learn Mandarin. G1 had a balanced gender ratio with 50% female participants. The participants were 18-23 years old and had a heterogeneous pool of birthplaces. Five participants were studying Science and Engineering, and one participant was studying Business. Two participants were in their 1<sup>st</sup> year of undergraduate studies, three were in their 2<sup>nd</sup> year, and one was in their 5<sup>th</sup> year. They all started learning Spanish from birth and they all started learning English around or before their six years of age. Two participants reported being simultaneous bilinguals. None of the participants had started learning Mandarin before their UPRM courses. Three participants had learned one or two additional languages (Korean or ASL).

G2 consisted of eight participants who were second semester students from the basic intensive Chinese course of the UPRRP Mandarin program. During the first two semesters of this curricular sequence, the students meet five times a week for 50 minutes with a professor for regular classes and five times a week for 30 minutes with another professor for a language laboratory. All participants from G2 were females born in the San Juan metropolitan area of Puerto Rico, who were 19-22 years old. They were all students from the College of Humanities and 75% of them were majoring in the undergraduate program of Foreign Languages with a concentration on two modern languages. 50% of the participants from G2 were in their 2<sup>nd</sup> year of undergraduate studies. They all started learning Spanish from birth and they had a mean English language learning age of five years. One participant reported to be a simultaneous bilingual; 25% of them reported to have started learning Mandarin before their UPRRP courses. Only one of the eight participants had not learned an additional language other than Spanish, English, or Chinese. The rest of the participants had learned one or two additional languages (German, French, Portuguese, or Korean).

G3 was comprised of eight participants who had completed, at least, the third semester of Mandarin Chinese in the UPRRP Mandarin curriculum. G3 had one male and seven female participants who were 19-29 years old. They were all born in the north, San Juan adjacent, metropolitan area with two participants from Manatí. One participant was from the School of Communications and the rest were from the College of Humanities. One of the Humanities students was a graduate student from the Department of Spanish/English Translation. Seven participants were undergraduates in their 3<sup>rd</sup>-5<sup>th</sup> year and 75% of G3 was specializing in the two modern languages program. They all started learning Spanish from birth and they had a mean English language learning age of five years. Two participants reported being simultaneous

bilinguals. Three participants reported having started learning Mandarin before their UPRRP courses. The mean amount of time studying Mandarin in G3 was 3.4 years with a standard deviation of 1.4 years, a maximum of six years, and a minimum of 1.5 years. All participants had learned an additional language other than Spanish, English, or Chinese, particularly between one and three additional languages (German, French, Portuguese, Korean, Russian, Arab, Italian, Japanese, or ASL). G2 and G3 were somewhat homogeneous in their college educational background. Most participants were language learning specialists, they had learned various additional languages, and they had had daily language contact with Mandarin for over six months, unlike G1.

**Table 2: Demographic, Educational, and Language Learning Information**

<b>Group</b>	<b>Age</b>	<b>Gender</b>	<b>College Major</b>	<b>Spanish Language Status</b>	<b>Bilingual (L2 English) Status</b>	<b>Years of L3 Chinese Learning</b>	<b>Additional Languages Learned</b>
G1 (UPRM)	18-23	Female (50%)	Engineering (67%)	L1 (100%)	Sequential (67%)	0.5	0-2
G2 (UPRRP)	19-22	Female (100%)	Modern Languages (75%)	L1 (100%)	Sequential (88%)	1	0-2
G3 (UPRRP)	19-29	Female (88%)	Modern Languages (75%)	L1 (100%)	Sequential (75%)	1.5-6	1-3

### **2.1.2. Bilingual Language Profile**

In the entry questionnaire, after answering the demographic questions, the participants took a self-assessment test of their bilingual language history, language use, language attitudes, and language proficiency. These four components were used to determine each participant's Bilingual Language Profile (BLP). The BLP is an assessment developed by the Center for Open Educational Resources and Language Learning (COERLL) from University of Texas at Austin. The total score of the BLP adds up to 218 points per language. The English BLP is subtracted

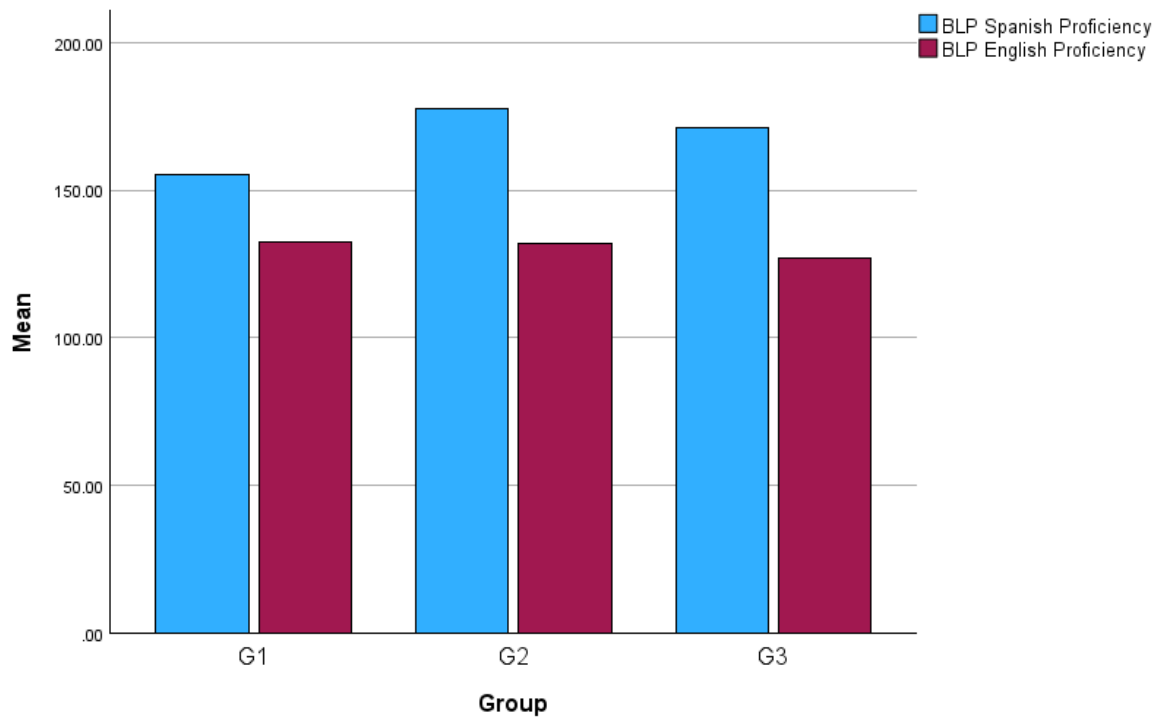
from the Spanish BLP to get a language dominance score between -218 and 218 points. The closer the score is to 0, the more balanced the bilingual participant is. A negative score entails English dominance while a positive score entails a Spanish dominance.

**Table 3: BLP Scores per Group**

	G1 (UPRM)			G2 (UPRRP)			G3 (UPRRP)		
	Spanish Proficiency	English Proficiency	Language Dominance	Spanish Proficiency	English Proficiency	Language Dominance	Spanish Proficiency	English Proficiency	Language Dominance
Mean	155	133	23	178	132	46	171	127	44
Standard deviation	19	19	32	17	21	30	17	31	41

G1 had an average Spanish BLP score of 155 with a standard deviation of 19 points and an average English BLP score of 133 with a standard deviation of 19 points. They had an average Language Dominance BLP score of 23 with a standard deviation of 32 points. G2 had an average Spanish BLP score of 178 with a standard deviation of 17 points and an average English BLP score of 132 with a standard deviation of 21 points. They had an average Language Dominance BLP score of 46 with a standard deviation of 30 points. G3 had an average Spanish BLP score of 171 with a standard deviation of 17 points and an average English BLP score of 127 with a standard deviation of 31 points. They had an average Language Dominance BLP score of 44 with a standard deviation of 41 points (See Table 3). Therefore, the three groups are balanced bilinguals with a similarly strong L2 English system and a slight inclination of language dominance towards their L1 Spanish. However, the participants in G1 are more balanced bilinguals, in comparison to the participants from G2 and G3.

**Figure 3: L1 Spanish and L2 English BLP Graph**



## 2.2. Instruments

The participants filled out two questionnaires: an entry questionnaire and an exit questionnaire. A demographic and linguistic profile questionnaire was provided at the beginning of the study (See Appendix 4.2.1). The participants answered questions about their personal information and a self-assessment of their Spanish/English bilingual profile. In the exit questionnaire, the participants were also asked about the language of instruction, explicit instruction, and how they learned the onset voiced palatal approximant /j/ (See Appendix 4.2.2). Both questionnaires were administered online through Google Forms.

The material used for the reading tasks of this study was a Power Point presentation with six lists of words, two in Spanish, two in English, and two in Mandarin Chinese pinyin.<sup>1</sup> When

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<sup>1</sup> Only the Mandarin Chinese pinyin word lists were analyzed in the present study. The Spanish and English word lists can be analyzed in follow-up studies for a more detailed analysis of CLI.



the participants were reading, there was one word per slide, some slides had instructions on it, and other slides had beginning/ending prompts. The corresponding Chinese characters were showed in the Mandarin reading tasks and neither the Mandarin pinyin list had tones, nor the Spanish list had accents written on the words. The document was showed to the participants on a tablet.

Each of the six lists had 28 disyllabic words (See Appendix 4.1); seven target words that started with the <y> grapheme and seven distractor words with each of the other three onset graphemes (<b>, <p>, and <r>). The words were placed in a random order, but no consecutive words started with the same letter. Each of the 14 possible onset <y> syllables in the Mandarin language were read once (see Tables 4 and 5). In the first list, S4 and S7 are syllables that start with <yu> and both are transcribed as [j<sup>w</sup>]. In the second list, S13 and S14 are also labialized palatal approximants because they are followed by a high front rounded vowel. The participants were audio recorded with a Marantz PMD660 digital audio recorder while reading the lists and texts out loud in the three languages.

**Table 4: Target words in the first Mandarin list**

<b>Target Syllable Code</b>	<b>Pinyin Transcription of Word</b>	<b>Word in Chinese Characters</b>	<b>Target Syllable IPA Transcription</b>	<b>English Translation of Word</b>
S1	ye cai	叶菜	/je/	vegetable/s
S2	yan jing	眼睛	/jen/	eye/s
S3	ya chi	牙齿	/ja/	tooth/teeth
S4	yu you	鱼油	[j <sup>w</sup> y]	fish oil
S5	you hua	油画	/jow/	oil painting
S6	yin hang	银行	/jin/	bank
S7	yuan gong	员工	[j <sup>w</sup> en]	staff

**Table 5: Target words in the second Mandarin list**

Target Syllable Code	Pinyin Transcription of Word	Word in Chinese Characters	Target Syllable IPA Transcription	English Translation of Word
S8	ying guo	英国	/jɪŋ/	England
S9	yong yi	泳衣	/jɔŋ/	swimsuit
S10	yao shi	钥匙	/jɑw/	key/s
S11	yi sheng	医生	/ji/	doctor
S12	yang rou	羊肉	/jaŋ/	lamb
S13	yun duo	云朵	[j <sup>w</sup> yn]	clouds
S14	yue liang	月亮	[j <sup>w</sup> ye]	moon

The pronunciation of the 14 target syllables was judged by means of an Acceptability Judgment Test (AJT; See Appendix 4.2.4). The syllables were clipped from the audio recordings of the participants' readings. Without seeing the target syllable, a native speaker first wrote down what they heard after each utterance. After seeing the target syllable, a 6-point Likert scale was provided, and the native speaker chose how accurate the utterance was, based on native speaker pronunciation. Then, for each syllable, the native speaker reported if there was a non-target pronunciation perceived in the initial or final sound, in both, or in neither. Even though describing it The AJT was administered as an online questionnaire in Google Forms.

G1 also read two additional Chinese texts that had 17 target words (1-3 syllables) with the target sounds in the first, second, and/or third syllable (See appendices 4.1.7 and 4.1.8). The two texts had their corresponding Chinese characters and the tone marks on top of the pinyin syllables. There were 29 types of Chinese words with the target sound (See Table 6). There were four types of words with two to three tokens (yòng, yǒu, yě, yīzhǐ), one type of word (yī) has five tokens with a suffix (yīzhǐ, yībān, yīgè, yībùfèn), and one type of word (yǒu) has another token with a prefix (méiyǒu). One type of word (yào) had a token with a prefix (yàoshi) and three tokens with a suffix (xiǎngyào, xūyào, zhòngyào). One type of word (yǒu) is a false cognate with

English (2<sup>nd</sup> person pronoun ‘you’) but its diphthong is pronounced differently. Six words start with the labialized approximant /j<sup>w</sup>/ (yǔyán, xīyǔ, yīnyuè, yùn, yuǎn, and fúwùyuán).

**Table 6: Target words in the Mandarin lists**

Text #1	Text #2
yǒu(2), yī, yīgè, yīzhǐ(2), yīngguó, nánpéngyǒu*, yào, yǔyán, yě, xīyǔ, yīnyuè*, yang, yā, yóuyǒng, yùn	yòng(2), yǒu/méiyǒu, yàoshi, xiǎngyào*, xūyào, zhòngyào*, yuǎn, jiànyì, yībān, yībùfèn, yīnggāi, yīnwèi, yǐjīng, yě, fúwùyuán

\*These target syllables are preceded by a nasal and have a higher potential of showing negative transfer from L1 Spanish.

Finally, a questionnaire for the Mandarin professors was administered online through Google Forms (See Appendix 4.2.3). It first asked them if Puerto Rican students sometimes have non-target pronunciations of the pronunciation of the <y> initial. Then, they were asked about the frequency of this non-target pronunciation (always, usually, sometimes, never) and when they encounter it (when reading, speaking...). Lastly, they were asked about the sound that was often heard and perceived by them when they encountered this non-target pronunciation.

### 2.3. Procedure

The students were recruited with the help of the Chinese professors. The participants were informed about the study during their Mandarin Chinese classes. Interested students were then contacted by the principal investigator through their institutional UPR email. Once they decided to participate, they were sent the Google Forms link with the authorization form and the entry questionnaire. After that, we met in person to complete the reading tasks. The reading task data from G1 was collected at the Carlos E. Chardon building in UPRM. The data from G1 and G2 was collected at the Linguistics Laboratory of the Luis Pales Matos building in UPRRP.

The participants were given instructions in Spanish about what they would do during the reading task. Before each text, they were prompted to read the text in the target language. They were informed of this during the Spanish explanation and instructions at the beginning. A green

image prompted them to start reading and swiping to the next word in the Power Point presentation and a red image prompted them to stop. The participants read the L1-Spanish list, the L2-English list, and the Mandarin pinyin list (i.e., their L3/Ln) in different sequences in order to counterbalance the effect of recency of use. They read the six texts in the following two sequences, L1>L2>L3/Ln and L2>L1>L3/Ln. Their reading was audio recorded and their reading time was monitored.

After all the participants had finished the reading task, they were sent the exit questionnaire. The target syllables were clipped from the recordings using Audacity and the audio clips were attached to the AJT. Then, the AJT was completed by the UPRRP Mandarin Chinese laboratory professor. After the AJT was administered, the three Chinese professors from UPRRP and the Chinese professor from UPRM were sent the professor questionnaire, which was completed online.

#### **2.4. Hypotheses**

The following hypotheses correspond to this study's objectives and research questions.

1. There will be CLI in the L3/Ln Mandarin phonological acquisition of the onset voiced palatal approximant /j/ when reading the <y> grapheme.

1.1. There will be more positive transfer, if the participants report a higher proficiency in their English BLP.

1.2. There will be more negative transfer, if the participants report a lower proficiency in their English BLP.

2. The results will favor the CEM and students who have learned more additional languages will outperform those who haven't.

3. Participants with a higher English BLP will have a higher reading accuracy of the <y> grapheme in Mandarin, supporting the TPM.
4. Time of language contact and exposure will have a positive effect on pronunciation accuracy of the <y> grapheme and the most accurate results on the articulation of the onset voiced palatal approximant /j/ in Mandarin Chinese will be from G3.
5. Spanish recency of use will produce more negative transfer and English recency of use will produce more positive transfer.

## **2.5. Data Analysis**

The audio clips were heard by a native Mandarin Chinese speaker to complete the AJT. The quantitative and qualitative data was stored for analysis. Then, the data from the AJT and questionnaires were processed with SPSS statistical software to analyze and display the results in figures and tables. To test the first and third hypotheses, a correlation was run between the English BLP scores and the amount of affricate utterances of <y> (<zh>/[tʂ] or <j>/[tɕ]) produced per participant, according to the AJT. To test the second hypothesis, a correlation was run between the number of languages learned per participant and the amount of affricate utterances produced per participant. To test the fourth hypothesis, a correlation was run between the three groups of participants and the amount of affricate utterances produced per participant. To test the fifth hypothesis, the amount of affricate utterances produced per participant were compared between the first and the second lists.

### 3. Results

#### 3.1. Reading Time Results

The participants in G1 generated a mean reading time of 160 seconds for both Mandarin lists with a standard deviation of 51.1 seconds, a maximum reading time of 255 seconds and a minimum reading time of 105 seconds. G2 had a very similar reading pace. It took an average of 160.6 seconds for the participants in G2 to read both lists with a standard deviation of 47.9 seconds. The slowest reading time was 255 seconds, while the fastest reading time was 110 seconds. G3 had a mean reading time of 134.4 seconds with a standard deviation of 30.1 seconds. The fastest participant took 105 seconds to read the two lists and the slowest participant took 185 seconds. Therefore, G3 had a faster reading pace than G1 and G2, which fits in well with their additional experience and proficiency with Mandarin Chinese (See Table 7).

**Table 7: Reading Time in Seconds**

	<b>Mean</b>	<b>Standard Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
<b>G1</b>	160	51.186	105	255
<b>G2</b>	160.63	47.916	110	255
<b>G3</b>	134.38	30.052	105	185
<b>Total:</b>	150.91	43.057	105	255

#### 3.2. Acceptability Judgment Test Results<sup>2</sup>

##### 3.2.1. Average Pronunciation Accuracy Results

This section starts with the results from G2 and G3 because the data from G1 was collected after getting these results. G1, the group of beginner proficiency students, was made because of the results that were obtained from G2 and G3. Therefore, these results are shown

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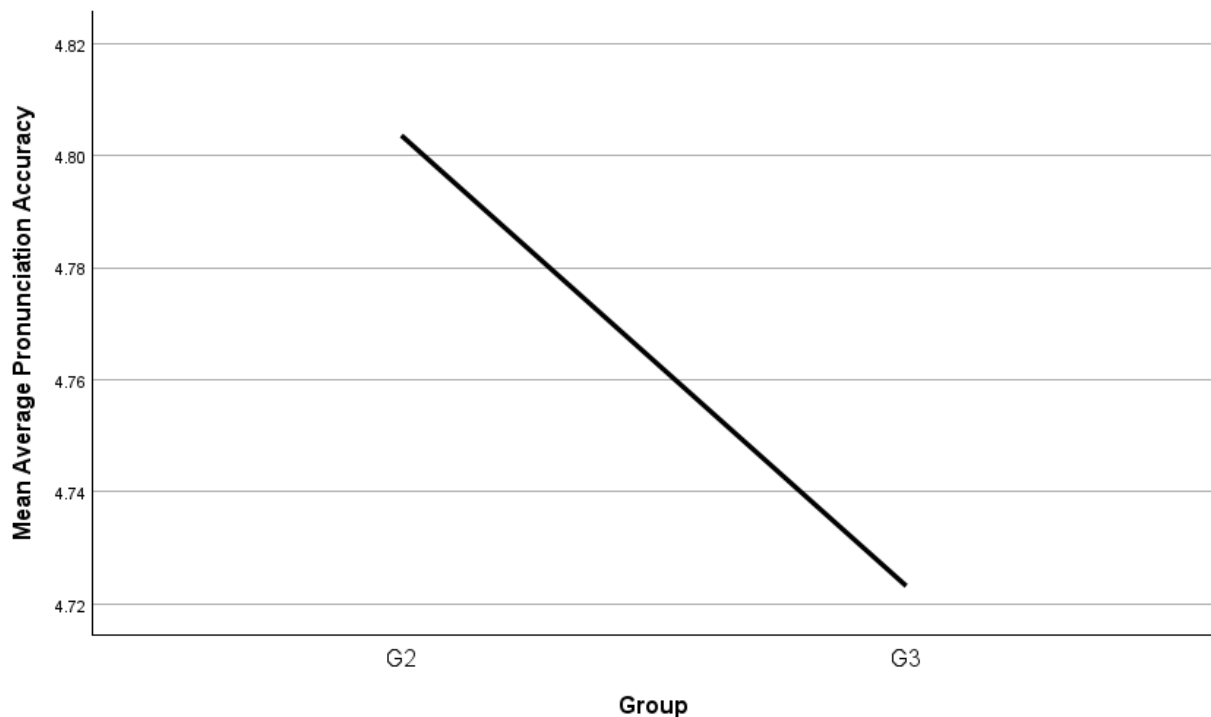
<sup>2</sup> As explained in section 1.8, there is debate regarding the pronunciation of <yu> in Mandarin Chinese. For the presentation of the results, we include <yu> together with the rest of the syllables starting with the <y> grapheme. However, we recognize that some researchers consider /q/ (<yu>) and /j/ (<y>) two distinct basic sounds in Chinese. As suggested by Dr. Meili Deng, before this study is published, the data should be regrouped to treat these two sounds separately. The analysis and discussion should then be redone with the sounds properly separated to ensure accurate findings and conclusions.

first and the results from G1 will be showed further on. Based on the 6-point Likert scale given to the native speaker for the AJT, the average pronunciation accuracy of the 14 Mandarin syllables for G2 was 4.80 points with a standard deviation of 0.78 points. G3 had an average pronunciation accuracy of 4.72 points with a standard deviation of 0.60 points. The total mean average pronunciation accuracy score for both groups was 4.76 with a standard deviation of 0.67 points (See Table 8). Therefore, the participants from G2 had a higher score than those from G3 (See Figure 4).

**Table 8: Average Pronunciation Accuracy for G2 and G3**

	Mean	Standard Deviation	Minimum	Maximum
<b>G2</b>	4.8036	.77756	3.71	5.93
<b>G3</b>	4.7232	.60300	3.71	5.79
<b>Total:</b>	4.7634	.67346	3.71	5.93

**Figure 4: Average Pronunciation Accuracy Graph**



To analyze the effects that recency of use has on the acquisition of the onset Mandarin /j/, the average pronunciation accuracy results are shown in two groups, according to the two lists of

the target syllables. The first Mandarin list was read after an English list and the second Mandarin list was read after a Spanish list. In the first list of words, only one syllable had a mean pronunciation accuracy score of <4 out of the 6 points from the provided 1-6 point Likert scale in the AJT of the utterances among the 16 participants from G2 and G3. S7 (yuan) had a mean pronunciation accuracy score of 2.69 with a standard deviation of 1.62 points. G2 had a mean of 3.00 with a standard deviation of 1.85 points while G3 had a mean of 2.38 points with a standard deviation of 1.41 (See Table 9).

**Table 9: Average Pronunciation Accuracy of the First List**

		<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>	<b>S6</b>	<b>S7</b>	<b>Total</b>
<b>G2</b>	Mean	4.13	4.38	6.00	3.75	5.13	3.88	3.00	4.32
	Standard Deviation	2.588	1.923	.000	1.581	1.642	1.959	1.852	1.649
<b>G3</b>	Mean	5.25	4.38	4.38	4.62	4.75	4.75	2.38	4.36
	Standard Deviation	1.389	1.408	2.264	2.264	1.832	1.282	1.408	1.692
<b>Total</b>	Mean	4.69	4.38	5.19	4.19	4.94	4.31	2.69	4.34
	Standard Deviation	2.089	1.628	1.759	1.940	1.692	1.662	1.621	1.77

Seven participants from G2 and G3 had non-target pronunciations of the initial in S7 and 12 participants had non-target productions of its final sound (See Table 10). In G2, three participants mispronounced the initial while five had issues with the final. Four participants from G3 mispronounced the initial sound of S7 and seven participants had non-target pronunciations of the final sound. G2 had four inaccurate uttered variants of S7: rang, ren, ruang, and yang (two instances). On the other hand, all participants from G3 pronounced S7 differently with seven variants (lun, rang, ruang, yan, yang, yun, and zhuang) and one accurate pronunciation.



**Table 10: Inaccurate S7 <yuan>/[j<sup>w</sup>ɛn] uttered variants in G2 and G3**

<b>Pinyin Transcription of Uttered Syllable</b>	<b>Perceived Problem in the Syllable Structure</b>	<b>Possible IPA Transcription of Uttered Syllable</b>	<b>Number of instances produced</b>	<b>Group where it was produced</b>	<b>Does it exist in Mandarin Chinese?</b>
rang	initial & final	[zɑŋ]	2	G2 & G3	yes
ren	initial & final	[zɛn]	1	G2	yes
ruang	initial & final	[zwaŋ]	2	G2 & G3	no
yang	final	[jaŋ]	3	G2 & G3	yes
lun	initial & final	[lwən]	1	G3	yes
yan	final	[jɛn]	1	G3	yes
yun	final	[j <sup>w</sup> yn]	1	G3	yes
zhuang	initial & final	[ʃwaŋ]	1	G3	yes

In the first list, G2 also had a mean pronunciation accuracy score of <4 in two other syllables: S4 (yu) and S6 (yin). S4 had a mean of 3.75 with a standard deviation of 1.58 and S6 had a mean of 3.88 and a standard deviation of 1.99. 75% of G2 had a non-target pronunciation of the final sound of S4 and 50% had non-target pronunciations of the final sound of S6. S4 had four inaccurate variant utterances and instances: yong, you, yue, and yun. S6 had three inaccurate variants: er, yo, and ying (three instances).

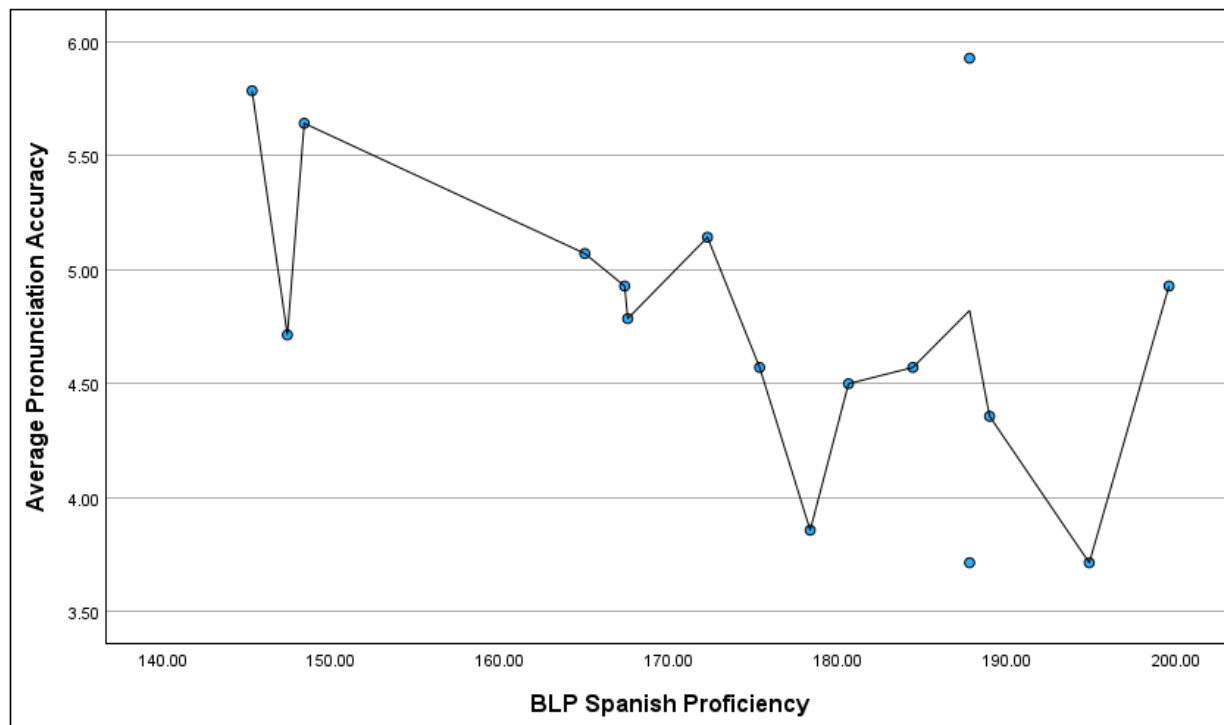
In the second list of words, there was only one syllable from G2 that had a score of <4. In G2, S8 (ying) had a mean average pronunciation accuracy score of 3.75 with a standard deviation of 1.75 points. For S8, one participant had issues with the pronunciation of the initial sound while six participants had issues pronouncing the final sound. There were two variants of S8: yin (three instances) and yong (two instances). In the second list, G3 had no syllables with a mean pronunciation accuracy score of <4 (See Table 11).

**Table 11: Average Pronunciation Accuracy of the First List**

		<b>S8</b>	<b>S9</b>	<b>S10</b>	<b>S11</b>	<b>S12</b>	<b>S13</b>	<b>S14</b>	<b>Total</b>
<b>G2</b>	Mean	3.75	5.50	6.00	5.88	5.50	4.62	5.75	5.29
	Standard Deviation	1.753	.756	.000	.354	1.069	1.847	.707	0.927
<b>G3</b>	Mean	4.75	5.00	5.38	5.50	5.50	4.75	4.75	5.09
	Standard Deviation	1.165	1.604	1.408	1.414	1.069	1.581	1.753	1.428
<b>Total</b>	Mean	4.25	5.25	5.69	5.69	5.50	4.69	5.25	5.19
	Standard Deviation	1.528	1.238	1.014	1.014	1.033	1.662	1.390	1.268

Statistical correlations were run between the Spanish BLP, the English BLP, and the language dominance BLP with the average pronunciation accuracy scores. The Spanish BLP correlation was the only one to generate statistical significance:  $r(14) = -0.503$ ,  $p = .047$ . The Spanish BLP score correlated negatively with the average pronunciation accuracy scores, as can be seen in Figure 5. However, after running a two-sample  $t$ -test of the average pronunciation accuracy for G2 and G3, the difference showed not to be statistically significant, with a two-sided  $p$ -value of .821. Nevertheless, this accuracy score takes the entirety of the syllable pronunciation into account; there is yet to examine in which part of the syllable structure the most non-target pronunciations occurred.

**Figure 5: BLP Spanish and Average Pronunciation Accuracy Correlation**



### **3.2.2. Onset, Rhyme, and Coda Problems in the Target Syllables read by G2 and G3**

A total of 224 target syllables were read by G2 and G3. The results of the AJT showed that only a total of 15 syllables (<7%) had a non-target pronunciation of the initial sound, i.e., the onset, among the 16 participants of G2 and G3. In G2, only 6% of the target syllables had non-target pronunciations of initials while 7% of the total syllables were reported to have this problem in G3. On the other hand, 73 syllables (<33%) had non-target pronunciations of the final sound, i.e., the rhyme or the coda. <35% of the target syllables read by G2 had this problem and 30% of these syllables had the same issue in G3. 12 of the total target syllables read by both groups (5%) had non-target pronunciations of both the initial and final sounds, meaning that they were entirely inaccurate. 148 syllables (66%) were reported to have no major issues of pronunciation in any of the parts of the syllable structure during the readings from G2 and G3.

### 3.2.3. Syllable Onset Non-Target Pronunciations

According to the AJTs, 56% of the participants from G2 and G3 produced an inaccurate onset consonant sound when reading the initial <y> syllables. Out of the total 15 syllables where initial non-target pronunciations arose, 12 syllables were produced with a consonant sound (See Table 12) and three were produced with a vowel sound (S6: er, S6: o, S8: ong). These 12 inaccurate consonant sounds account for 5% of the 224 target syllables uttered by the 16 participants. Six of these 12 inaccurate onset consonant sounds were produced with the retroflex approximant pinyin consonant <r> sound and three were produced with a stop consonant <d>, a liquid consonant <l>, and a nasal consonant <m> (S5: dou, S7: lun, S9: meng). Three of those 12 inaccurate consonant sounds were reported to sound like the affricate pinyin <j>/[tʃ] and <zh>/[tʂ] sounds in Mandarin Chinese (S1: jie, S7: zhuang, S14: jue).

**Table 12: Syllables where inaccurate onset consonant sounds were produced in G2 and G3**

Target Syllable	Pinyin Transcription of Target Syllable	IPA Transcription of Syllable	Pinyin Transcriptions of Utterances	Possible IPA Transcriptions of Utterances
S1	Ye	/je/	jie	[tʃeɪ]
S5	You	/jow/	dou	[tɒ]
S7	Yuan	[j <sup>w</sup> ɛn]	lun zhuang ruang ren rang	[lwən] [tʂwɑŋ] [zɥwɑŋ]* [zɛn] [zɑŋ]*
S9	Yong	/jɔŋ/	meng	[mɔŋ]
S12	Yang	/jaŋ/	rang	[zɑŋ]
S14	Yue	[j <sup>w</sup> ye]	jue	[tʃeɪ]

\* These syllables were produced by two different participants.

### 3.2.4. Onset Affricate <zh>/[tʂ] and <j>/[tʃ] Productions of /j/

The three onset affricate syllables that were produced account for 1% of the 224 target syllables uttered by G2 and G3. G2 had one instance of affricate consonant pronunciation. That accounts for <1% of the 112 target syllables uttered by G2. G3 produced two instances of

affricate consonant pronunciation. This accounts for <2% of the 112 target syllables uttered by G3. A two-sample t-test showed that the difference in pronunciation of affricate onset consonants between G2 and G3 was not statistically significant, with a two-sided P-value of .662.

Only 15 syllables from G1 were submitted to an AJT (See Table 13). These were syllables where the Spanish-like obstruent <y> was perceived by the principal investigator, a non-native Mandarin speaker. They were judged and heard as being <j> or <zh> in the Mandarin Chinese native speaker's AJT. However, G2 and G3 had only read the two lists. G1 read two additional Chinese Mandarin texts.

**Table 13: Syllables where onset affricate <y> sounds were produced by G1, G2, and G3**

Group	Reading Source	Pinyin Transcription of Target Syllable	IPA Transcription of Target Syllable	Pinyin Transcription of Utterances	Possible IPA Transcriptions of Utterances
G1	list	yue	[j <sup>w</sup> ye]	jue	[tɕye]
G1	list	yong	/jɔŋ/	zhong	[tʂɔŋ]
G1	list	yang	/jaŋ/	zhang	[tʂaŋ]
G1	text	ying	/jiŋ/	jin	[tɕiŋ]
G1	text	yao	/jaʊ/	jiao	[tɕjaʊ]
G1	text	yan	/jɛn/	zhang	[tʂaŋ]
G1	text	yin	/jin/	jin	[tɕiŋ]
G1	text	yue	[j <sup>w</sup> ye]	jue	[tɕye]
G1	text	ya	/ja/	jia	[tɕja]
G1	text	yuan	[j <sup>w</sup> ɛn]	jiong*	[tɕjɔŋ]
G1	text	ying	/jiŋ/	jun	[tɕyŋ]
G1	text	yi	/ji/	zhou	[tʂɔʊ]
G1	text	yao	/jaʊ/	jiao	[tɕjaʊ]
G1	text	yi	/ji/	ji	[tɕi]
G1	text	yao	/jaʊ/	zhao	[tʂaʊ]
G2	list	ye	/je/	jie	[tɕie]
G3	list	yuan	[j <sup>w</sup> ɛn]	zhuang	[tʂwaŋ]
G3	list	yue	[j <sup>w</sup> ye]	jue	[tɕye]

\* This syllable doesn't exist in Mandarin Chinese.

83% of the participants from G1 produced one of these obstruent affricate onset consonants during their reading of the lists and texts. Three of these syllables were taken from

the reading of the lists and the remaining 12 syllables were taken from the reading of the texts. Nine of those 12 syllables from the texts were uttered by one participant. 33% of the participants produced one of these affricate sounds during the reading of the two lists and 50% of them produced these consonant sounds while reading the two texts. Only one target syllable from the text that was followed by a nasal (yinyue) was perceived to be produced as an affricate sound.

Out of the 84 target syllables read by G1 in the lists, three syllables (<4%) were identified as having Spanish-like onset affricate consonants written as <j> or <zh> in Mandarin pinyin. On the other hand, 12 of the 222 target syllables (5%) from the readings were identified as having these onset initial sounds. That equals 15 out of 306 target syllables (5%) heard as affricate sounds during G1's readings of the lists and texts.

By only taking the list readings into account for a comparison with G2 and G3, this equals 6 syllables read as <j> or <zh> between the three groups. Out of the global amount of target syllables read in the two lists by the three groups (308), less than 1% had realizations of the onset affricate <y>. Only four participants (18%) of the 22 from G1, G2, and G3 uttered these onset obstruent consonants. However, after running an independent sample t-test to examine differences between G1 and G2 in the realizations of the onset affricate <y>, the results were not statistically significant, with a two-tailed P-value of 0.273. A two-sample t-test to examine differences between G2 and G3 in the realizations of the onset affricate <y> was not statistically significant either, with a two-sided P-value of .556.

### **3.2.5. Onset approximant <r>/[z] Productions of /j/ in G2 and G3**

The six onset <r> consonants produced by G2 and G3 account for <3% of the 224 target syllables uttered by them. G2 produced 50% of these approximant consonant sounds. Both groups had an equal amount of three consonants that sounded like the pinyin <r>. They both had

<3% of the 112 target <y> consonants per group. Five of these <r> consonants were produced when the target syllable was S7 (yuan) and one was produced when the target syllable was S12 (rang). Both target syllables have a nasal coda sound (/n/ and /ŋ/). An independent sample t-test was conducted to examine the difference between G2 and G3 for the approximant <r> realizations of <y>, and the result was not statistically significant, with a two-tailed P-value of 1.000.

### 3.2.6. Syllable Coda Non-Target Pronunciations in G2 and G3

According to the AJTs, 35 out of the 73 syllables that had non-target pronunciations in the final sound were syllables that end in /n/ or /ŋ/. 50% of the 14 target syllables ended in a nasal coda: S2, S6, S7, S8, S9, S12, and S13 (See Table 14). S6 (yin) and S8 (ying) are minimal pairs. That is 16% of the 224 target syllables uttered by the 16 participants in G2 and G3. 69% of the participants produced an inaccurate nasal coda sound. 75% of the participants from G2 encountered this non-target rproduction while 63% of G3 exhibited this phenomenon. Therefore, 31% of the total uttered 112 syllables ending in a nasal coda were produced inaccurately. G2 had 19 syllables with this problem (34%) while G3 had 16 (29%).

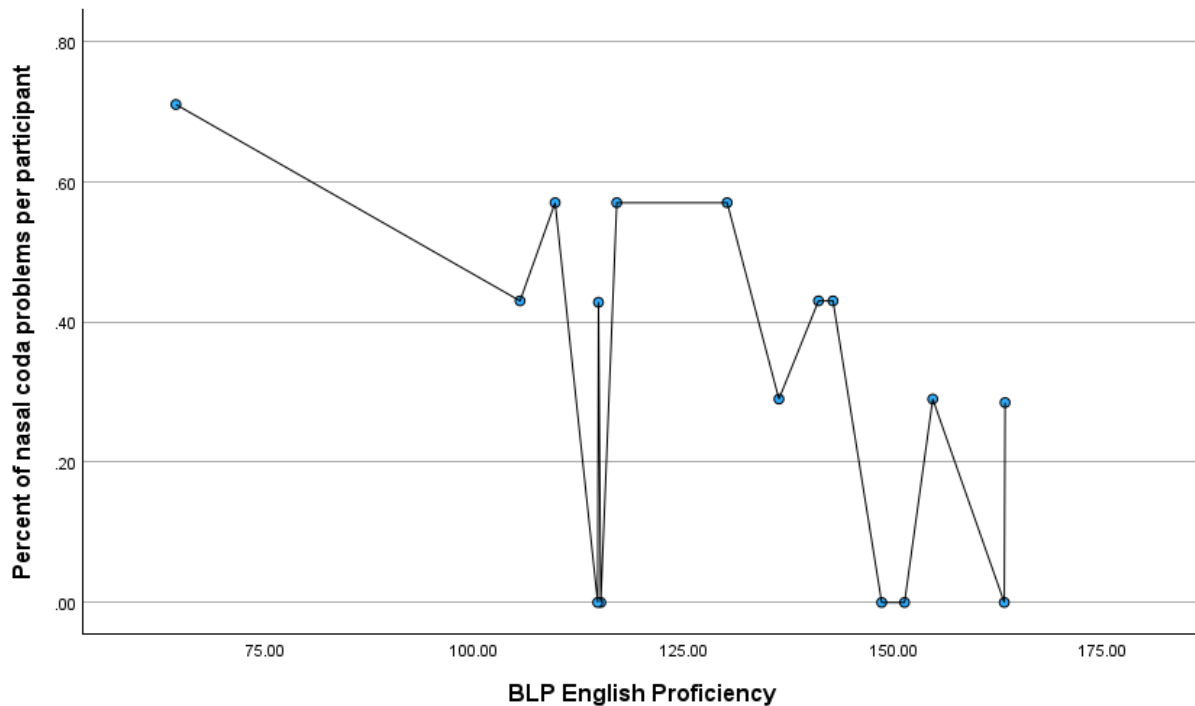
**Table 14: Syllables that have nasal codas /n/ and /ŋ/**

Target Syllables	Pinyin Transcription	IPA Transcription	Did the participants exhibit non-target productions of the nasal coda in this syllable?
S2	yan	/jɛn/	Yes
S6	yin	/jin/	Yes
S7	yuan	[j <sup>w</sup> ɛn]	Yes
S8	ying	/jiŋ/	Yes
S9	yong	/jɔŋ/	No
S12	yang	/jaŋ/	No
S13	yun	[j <sup>w</sup> yn]	Yes

Statistical correlations were run between the Spanish BLP, the English BLP, and the language dominance BLP along with the percent of nasal coda problems per participant. The

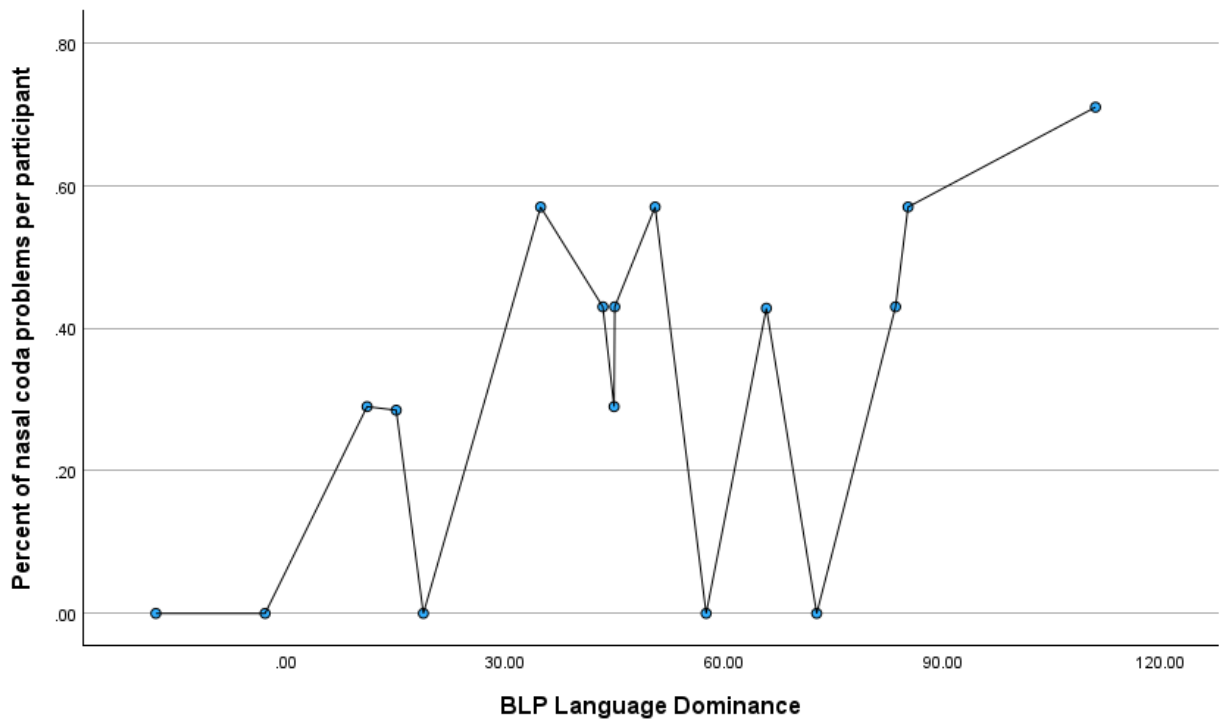
English BLP correlation was shown to have a statistical significance,  $r(14) = -0.539, p = .031$  (See Figure 6). Therefore, the English BLP score was negatively correlated with the participants' percent of nasal coda problems. The language dominance BLP correlation was also shown to have statistical significance; in this case, it was positively correlated with the participants' percent of nasal coda problems:  $r(14) = -0.582, p = .018$  (See Figure 7). A two-sample  $t$ -test showed that the difference between inaccurate nasal coda consonants produced by G2 and G3 was not statistically significant, with a two-sided P-value of 0.678.

**Figure 6: BLP English and Percent of Nasal Coda Problems Correlation**





**Figure 7: BLP Language Dominance and Percent of Nasal Coda Problems Correlation**



### **3.3. Exit Questionnaire Results**

15 of the 22 participants from G1, G2, and G3 filled out this questionnaire. The results from seven exit questionnaires showed that they learned the pronunciation of the Mandarin pinyin <y> grapheme by comparing it to the English pronunciation of <y>. Therefore, these participants had a metalinguistic awareness of their similarity. Four participants reported to have learned the pronunciation of this grapheme by relating it to the pronunciation of the Spanish vowel <i>. The results of this questionnaire also showed that both English and Spanish are used in the Mandarin Chinese courses of both universities.

### **3.4. Professor Questionnaire Results**

The three professors from UPRRP and the only professor from UPRM filled out this questionnaire. The results showed that all four professors agreed on the fact that Puerto Ricans

sometimes have problems (non-target pronunciations) when learning the initial <y> sound. All of them reported that Puerto Rican students encounter this problem at the initial stages of their interlanguage development, and when they express themselves orally. 75% of the professors reported that the students encounter this problem when reading or during dictation. The professors reported that the students' pronunciation of <y> sometimes sounds like the Spanish obstruent consonant or the Mandarin pinyin <j>, <r>, and <zh>.

#### **4. Discussion**

The results from the AJT for G2 and G3 showed that there were only three instances in which the [+ obstruent] Spanish-like affricate onset consonant sound occurred. Initially, these instances where the [+ obstruent] <y> was produced were not enough to analyze the quantitative data and support the hypotheses. For that reason, a third group with a lower proficiency and a lower frequency of language contact (G1) was included in the study, in order to see if CLI emerged in a more basic stage of L3/Ln acquisition. Nevertheless, after retrieving the data from G1 and running statistical analyses, few appeared to have statistical significance. The number of participants and [+ obstruent] affricate onset consonants were not sufficient to draw strong statistical conclusions. Thus, a questionnaire for the Mandarin Chinese professors was developed to further inquire about their qualitative observations of this linguistic phenomenon. In what follows, we will further discuss the findings and observations that were drawn from the results of this study.

Even though G2 and G3 did not present much evidence of negative transfer from their Spanish <y>, the results showed that there were some issues in the production of the onset voiced palatal approximant /j/ by Puerto Rican bilinguals from the three groups. There were 18 instances where the affricate pronunciation of <j> and <zh> was produced among the list

readings of all groups and the text readings by G1. In five of these instances, the target syllables started with the labialized voiced palatal approximant [j<sup>w</sup>]. Therefore, this might be because /ɥ/ and the high front rounded vowel /y/ are not candidates for positive transfer from the participants' L1 and L2 systems. However, this could be further examined to see if the participants' L3/Ln French or German had an influence on those who did have an accurate pronunciation of these target syllables.

There were also some instances where the approximant pronunciation of <r> was perceived to be produced by G2 and G3 in place of the onset voiced palatal approximant /j/. The Mandarin Chinese pinyin <r> has been transcribed to the IPA as the voiced retroflex sibilant fricative /ʐ/ (Lin, 2019) or as the voiced retroflex approximant /ɻ/ (Chen, 2024). In addition, there were a few other instances in which other vowel and consonant sounds were produced instead of the /j/. As a matter of fact, S7 (yuan) was the syllable with the lowest mean pronunciation accuracy score and the highest amount of inaccurate variant utterances. This target syllable begins with the labialized voiced palatal approximant, it had instances where the onset approximant <r> was produced by the participants, and it ends in a nasal coda.

In fact, there was negative transfer from the Spanish nasal coda /n/. In Spanish, the voiced velar nasal [ŋ] is an allophone of the voiced alveolar nasal /n/. However, in English and Mandarin Chinese, these two sounds are in contrastive distribution because they are phonologically distinct. In some dialects of the English language, there might be some language variation where these nasal codas wouldn't constitute a minimal pair. However, this non-distinction of these nasal codas, whether from the participants' L1 or L2, would imply negative transfer in their acquisition of their L3/Ln Mandarin Chinese.

Therefore, the first hypothesis turned out to be partially confirmed by the negative transfer of both the few affricate readings of <y> and the inaccurate minimal pair distinction of the nasal codas. There was indeed some CLI in the L3/Ln Mandarin Chinese phonological acquisition of the onset voiced palatal approximant /j/ when reading the <y> grapheme. The observations reported by the Mandarin Chinese professors also support this conclusion. However, the results were not sufficient to support hypotheses 1.1 and 1.2. Most participants were balanced bilinguals with a higher Spanish BLP and the correlations run between the BLP scores and AJT results did not show any favorable conclusions towards these hypotheses regarding the [+obstruent] affricate onset <y> realizations.

However, the Spanish BLP and average pronunciation accuracy correlation concluded that the higher a Spanish BLP was, the lower the average pronunciation accuracy was. The English BLP and the percent of non-target nasal codas correlation showed that the higher an English BLP was, the lower the percent was of nasal coda problems per participant, and its correlation with the language dominance BLP showed that the less balanced the participant is, in terms of their bilingualism, the higher the percent was of nasal coda minimal pair productions per participant. Only one syllable from G1's reading of the second text could have had negative transfer because of the influence from the post-nasal affricate realizations of <y> in Spanish.

Regarding the second hypothesis, the results did not show any conclusive evidence to deny or confirm the CEM. Students who had learned more additional languages did not show a tendency of higher performance than those who had none. There were only three students from G1 and one student from G2 who hadn't learned an additional language. No statistical significance was found after running correlations between the number of participants and the

amount of languages learned versus the average pronunciation accuracy scores, the amount of affricate onset <y> produced, and the amount of nasal coda non-target productions.

It could be argued that the third hypothesis was partially confirmed since, even though the participants had a Spanish BLP language dominance, they did have a high English BLP and were relatively balanced bilinguals. The fact that there weren't many instances where the [+obstruent] affricate onset consonant occurred might be because these participants are proficient English speakers. The exit questionnaire supports this claim with the participants reporting the knowledge they have about the phonological similarity between the English and Mandarin Chinese <y>. As a matter of fact, the students from G2 and G3 were heard speaking among themselves in both languages, their L1 and L2, during the process of recruiting participants and collecting data. Therefore, due to their strong English language system, it could be argued that the results favored the TPM.

The results from G2 and G3 were contrary to what was posited in the fourth hypothesis. The second semester students mostly outperformed the students that had taken four or more semesters of Mandarin Chinese. However, the *t*-test results showed the differences between the groups to not be statistically significant. On the other hand, the participants of G1, who hadn't finished their first semester yet, did produce more affricate onset consonant sounds. However, these participants read an additional two texts and those results are difficult to compare with the results from the first two groups. Thus, the time of language contact and exposure did not necessarily have a positive effect on pronunciation accuracy of the <y> grapheme and there are inconclusive results regarding the fourth hypothesis.

There was not enough evidence to confirm the fifth hypothesis. It could be argued that the recency of use did not affect CLI. The participants didn't show a higher pronunciation accuracy

during the reading of the first list, after reading the first English list, nor did they show a lower pronunciation accuracy during the reading of the second list, after reading the second Spanish list. In fact, the students from G2 and G3 were heard codeswitching during the process of recruiting participants and collecting data. They did orally report that it was challenging for them to change languages to read the three lists, but their performance showed that recency of use was not a driving factor to positive or negative transfer.

The average pronunciation accuracy and general good performance from the participants implies that college educated Puerto Ricans, from generation Y and Z, are generally balanced bilinguals that are successful in achieving phonological third language acquisition in adulthood. The results should also imply that both the UPRRP and UPRM Mandarin Chinese programs are effective in their pedagogy approaches and techniques in the teaching of Mandarin Chinese as a third language. However, this study did have its limitations, including the number of participants and the number of native-Chinese speakers willing and able to perform the AJTs. Further research should be conducted with more participants and judges.

In the future, the production of the affricate onset <y> consonants should be studied with the reading of texts, as was done with G1, to see if there is a higher rate of negative transfer. Research including open-ended conversations in Mandarin Chinese by Puerto Rican learners could also show more conclusive data about the variables that affect CLI. The data from future studies like these should be analyzed with PRAAT, and phonological assimilation in their Mandarin Chinese production should be compared to the speakers' L1 and L2. Furthermore, the acquisition of the onset voiced palatal approximant /j/ could be studied in and compared with L2 and L3 language acquisition by different populations of native Spanish speakers.

Other further research could be conducted regarding the acquisition of nasal codas in Mandarin Chinese by Puerto Rican speakers. Phonological research could be conducted concerning the retroflex <r> realizations of <y> in Puerto Ricans' speech. In fact, the reading of the distractor syllables starting with <r> in Mandarin might have had some negative transfer because the production of the Spanish voiced alveolar trill was heard sometimes instead. In addition, some progressive and regressive transfer was observed in the readings of the Spanish and English lists. Therefore, the CLI between Puerto Rican's L1 and L2 language systems should also be further explored.

## **5. Conclusion**

The present study set out to investigate L1 and L2 CLI on L3/Ln acquisition by Puerto Rican Bilinguals, and to study the influence of language contact and recency of use in the acquisition of the onset Mandarin /j/. In turn, the TPM and CEM were put to the test in this particular context. In conclusion, some CLI was observed from the [+obstruent] Spanish <y> during the L3/Ln Mandarin Chinese acquisition of the voiced palatal approximant /j/ by Puerto Rican bilinguals. However, the sample of participants and [+obstruent] instances were not sufficient to fully analyze the driving factors influencing this linguistic phenomenon. Nevertheless, some other negative transfer was shown in the language production of the L3 Mandarin Chinese nasal codas (/n/ and /ŋ/) by Puerto Rican bilinguals. The results were inconclusive concerning the CEM. In turn, the strong English language proficiency shown by the participants and the general phonetic performance accuracy displayed by them should serve as evidence to confirm the TPM. Conversely, the results were inconclusive regarding the influence that time of exposure and language contact with the target language has on CLI and the L3/Ln Mandarin Chinese acquisition of the voiced palatal approximant /j/ by Puerto Rican bilinguals.

Finally, the recency of use was not influential in the L3/Ln Mandarin Chinese pronunciation of the voiced palatal approximant /j/ by Puerto Rican bilinguals. This study represents an important first step towards the examination of L3/Ln Mandarin Chinese phonological acquisition, together with the influence of CLI in this acquisition process. It makes methodological contributions with the development of study materials, as well as theoretical contributions that inform the debate surrounding the TPM and the CEM. Moreover, it opens doors for data and participant reorganization, as well as further statistical analyses to arrive at more specific conclusions.



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## 4. Appendix

### 4.1. Reading Tasks:

#### 4.1.1. English Reading Task 1 (ERT1)

razors	baking	posting
yardage	yippy	yorker
being	raining	booking
ready	biting	popping
youthful	petrol	rivals
parrots	rivers	puppies
bonus	yapping	busy
yellow	beauty	yearly
rubbing	pillow	
packing	rockets	

#### 4.1.2. English Reading Task 2 (ERT2)

pencil	running	pitty
rusty	buddy	yawning
betting	pending	reply
yelling	yourself	powder
ringing	babies	backing
boarding	picking	yearning
yanking	rabbits	pulling
busting	yummy	remote
papers	robots	
younger	bitter	

#### 4.1.3. Spanish Reading Task 1 (SRT1)

barbas	yeguas	yunque
puentes	pollos	ratas
yesos	rural	boton
retos	yolas	restos
peleas	billar	pinos
bajos	rabos	buhos
yernos	peste	yugo
rival	yates	buscar
beber	rodar	
partes	pilar	

#### 4.1.4. Spanish Reading Task 2 (SRT2)

yervas	rasgos	yacer
puercos	burros	puertas
rotos	yucas	balon
palas	pintar	ricos
bolsas	bizco	bellos
rizos	pactos	yardas
yuntas	yodos	rocas
besos	peces	botas
rubio	rentas	
yendo	potros	

#### 4.1.5 Chinese Reading Task 1 (CRT1)

rengran 仍然	rongyi 容易	rangdao 嚷道
pinguo 苹果	paobu 跑步	pinyin 拼音
baozi 包子	banfa 办法	bianhua 变化
yecai 叶菜	yachi 牙齿	yinhang 银行
rizi 日子	runnian 闰年	pianzi 骗子
bomu 伯母	putao 葡萄	ruguo 如果
penzi 盆子	yuyou 鱼油	beizi 杯子
yanjing 眼睛	bangzhu 帮助	yuangong 员工
ruogan 若干	panzi 盘子	
binli 宾利	youhua 油画	

#### 4.1.6 Chinese Reading Task 2 (CRT2)

bingxiang 冰箱	pizi 皮子	paidui 排队
yingguo 英国	bufen 部分	yunduo 云朵
pohuai 破坏	ruanjian 软件	benlai 本来
ranhou 然后	yisheng 医生	piehao 撇号
yongyi 泳衣	pangbian 旁边	yueliang 月亮
reshui 热水	bizi 鼻子	renshi 认识
bashi 八十	yangrou 羊肉	peigen 培根
ruidian 瑞典	baise 白色	raogu 挠骨
pashan 爬山	rougan 肉干	
yaoshi 钥匙	bieren 别人	



#### 4.1.7 Chinese Reading Task 3 (CRT3)

你好！ 我叫林娜。 他是大为。 他今年十五岁。 我比他大一岁。 他来自英国。

Nǐ hǎo! Wǒ jiào línà. Tā shì dàwéi. Tā jīnnián shíwǔ suì. Wǒ bǐ tā dà yī<sup>1</sup> suì. Tā láizì yīngguó<sup>2</sup>.

我是美国人。 他是我的男朋友。 我们要学习中文。

Wǒ shì měiguóren. Tā shì wǒde nán péngyǒu<sup>3</sup>. Wǒmen yào<sup>4</sup> xuéxí zhōngwén.

我们对语言感兴趣。 我们也会说西语。 他喜欢音乐。

Wǒmen duì yǔyán<sup>5</sup> gǎnxìngqù. Wǒmen yě<sup>6</sup> huì shuō xīyǔ<sup>7</sup>. Tā xǐhuān yīnyuè<sup>8</sup>.

我喜欢动物。 我最爱的是羊。 我有一只狗和一只鸭。

Wǒ xǐhuān dòngwù. Wǒ zuìàide shì yáng<sup>9</sup>. Wǒ yǒu<sup>10</sup> yīzhī<sup>11</sup> gǒu hé yīzhī<sup>12</sup> yā<sup>13</sup>.

它们是我的宠物。 他的爱好是跳舞但是我的是游泳。

Tāmen shì wǒde chǒngwù. Tāde àihào shì tiàowǔ dànshì wǒde shì yóuyǒng<sup>14</sup>.

他是一个很好的舞者。 下个月他有比赛。 祝他好运！

Tā shì yīgè<sup>15</sup> hěn hǎode wǔzhě. Xiàgè yuè tā yǒu<sup>16</sup> bǐsài. Zhù tā hǎo yùn<sup>17</sup>!

#### English Translation:

Hello! My name is Lina. He is David. He is fifteen years old. I am one year older than him. He is from England. I am American. He is my boyfriend. We want to learn Chinese. We are interested in languages. We also speak Spanish. He likes music. I like animals. My favorite is the sheep. I have a dog and a duck. They are my pets. His hobby is dancing but mine is swimming. He is a very good dancer. He has a game next month. Good luck to him!

#### 4.1.8 Chinese Reading Task 4 (CRT4)

上个月他们开了个新的中餐厅。 离这里不远。

Shànggè yuè tāmen kāile gè xīnde zhōng cāntīng. Lí zhèlǐ bù yuǎn<sup>1</sup>.

你想要去吗？ 我还没去。 我建议下个周五去。

Nǐ xiǎngyào<sup>2</sup> qù ma? Wǒ hái méi qù. Wǒ jiànyì<sup>3</sup> xiàgè zhōuwǔ qù.

我听说过周五的环境一般很好玩。 你知道怎么用筷子吗？

Wǒ tīngshuōguò zhōuwǔde huánjìng yībān<sup>4</sup> hěn hǎowán. Nǐ zhīdào zěnmeyòng<sup>5</sup> kuàizi ma?

去中餐厅的时候大家应该试试因为筷子是中华文化的一部分。

Qù zhōng cāntīngde shíhòu dàjiā yīnggāi<sup>6</sup> shìshì yīnwèi<sup>7</sup> kuàizi shì zhōng wénhuàde yībùfèn<sup>8</sup>

要是你已经知道怎么用，没有问题。 但是如果太难的话，  
Yàoshi<sup>9</sup> nǐ yǐjīng<sup>10</sup> zhīdào zěnmeyòng<sup>11</sup>, méiyǒu<sup>12</sup> wèntí. Dànshì rúguǒ tài nán dehuà,

你也能告诉服务员你需要勺子。 最重要是吃好了。  
nǐ yě<sup>13</sup> néng gàosù fúwùyuán<sup>14</sup> nǐ xūyào<sup>15</sup> sháozi. Zuì zhòngyào<sup>16</sup> shì chī hǎole.

你下个周五有时间吗？

Nǐ xiàgè zhōuwǔ yǒu<sup>17</sup> shíjiān ma?

### **English Translation:**

Last month they opened a new Chinese restaurant. It's not far from here. Do you want to go? I haven't gone yet. I recommend going next Friday. I've heard that the ambiance on Fridays is usually good. Do you know how to use chopsticks? When you go to a Chinese restaurant, you should try it because chopsticks are part of Chinese culture. If you already know how to use it, no problem. But if it's too hard, you can also tell the waiter you need a spoon. The most important thing is to eat well. Do you have time next Friday?

## **4.2. Questionnaires**

### **4.2.1. Demographic and Linguistic Profile Entry Questionnaire**

Link: <https://forms.gle/Rd3YHwpNCfmDoRAn8>

### **4.2.2. Exit Questionnaire**

Link: <https://forms.gle/4LhaVQcRRgwXNakN6>

### **4.2.3. Questionnaire for the Professors**

Link: <https://forms.gle/7U3awUVuszvq7GKQA>

### **4.2.4. Acceptability Judgement Test Template**

Link: <https://forms.gle/8yKspu61NzpAX2Fs5>