



Revista de Filología y Lingüística de la Universidad de Costa Rica

Publicación Semestral, EISSN: 2215-2628

Volumen 51 - 1

Enero 2025 - Junio 2025

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Hernández, J. E. (2025). Acquisition of The Tap-Trill-Lateral Contrast by Speakers of L1 Cantonese-L2 Spanish. *Revista de Filología y Lingüística de la Universidad de Costa Rica*, 51(1), e63517.



Doi: <https://doi.org/10.15517/rfl.v51i1.63517>
URL: <https://revistas.ucr.ac.cr/index.php/filyling/index>

Acquisition of The Tap-Trill-Lateral Contrast by Speakers of L1 Cantonese-L2 Spanish

Adquisición del contraste vibrante simple-múltiple entre hablantes del cantonés L1-español L2

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DOI: <https://doi.org/10.15517/rfl.v51i1.63517>

Recepción: 04-09-24

Aprobación: 24-06-24

ABSTRACT

In the present study an assessment of the on-target and off-target production of liquids (laterals and rhotics) is undertaken in a corpus of second language (L2) Spanish. The Chinese-origin participants have immigrated to Mexicali, Mexico where they have acquired L2 Spanish in a natural setting. As a major aim, a quantitative analysis of the data is performed to determine the production of on-target and off-target articulations in lateral, tap, trill, and syllable-coda rhotic. Internal and external factors are considered in the analysis; for example, liquid production in syllable onset, coda and consonant clusters was considered. The data were subjected to two variable rule analyses to determine factors that favored off-target articulations. Type of liquid sound, phonotactic context, education in Mexico, number of years in Mexico, and the Chinese varieties spoken all were determined significant in the production of off-target articulations. The naturalistic Spanish L2 data confirm a wide-ranging phonological diversity that was overwhelmingly produced in line with target language patterns. The production of on-target and off-target articulations was constrained by the articulatory ease and difficulty that participants face.

Keywords: natural acquisition; liquid articulation; lateralization; rhotacism; L2 Spanish.

RESUMEN

El presente estudio se lleva a cabo mediante un análisis de la producción de líquidas (laterales y róticas) acertadas y fallidas en un corpus del español como segunda lengua (L2). Los participantes de origen chino han emigrado a Mexicali, México, donde han adquirido el español L2 en un contexto natural. Como objetivo principal, se lleva a cabo un análisis cuantitativo de los datos, para determinar la producción de las articulaciones líquidas acertadas y fallidas en las laterales, vibrantes simples, múltiples y róticas en coda silábico. En el análisis, se consideraron factores internos y externos: por ejemplo, se examinó la producción de sonidos líquidos en ataque silábico y en grupos consonánticos. Se sometió el cotejo de los datos a dos análisis multivariados para determinar los factores que favorecen las articulaciones fallidas. El tipo de sonido líquido, el contexto fonotáctico, la educación en México, número de años en México y las variedades conocidas fueron señaladas como significativas en la producción de las articulaciones fallidas. Los datos naturales del español L2 confirmaron una diversidad fonológica producida en su mayoría dentro de los parámetros de los patrones de la lengua meta. La producción de las articulaciones acertadas y fallidas se rigió por la facilidad y dificultad articulatoria que enfrentaron los participantes.

Palabras clave: adquisición natural; articulación de líquidas; lateralización; rotacismo; español L2.

1. Introduction

This study presents an analysis of liquid articulation, i.e. rhotics and laterals, in the Spanish as a second language (L2) of Chinese-origin participants in Mexicali, Mexico. A corpus of naturally occurring speech is used to determine the degree to which the participants acquire the liquid sound system in their L2. Second Language Acquisition (SLA) is an unstable process characterized by the production of non-target-like articulations, such as the pronunciation of laterals in place of rhotics in phonological contexts not attested in first language (L1) speech: *horita* ‘now’ > ‘ho[**l**]ita, *futuro* ‘future’ > futu[**l**]o. I assume that SLA is rule-governed, rather than haphazard in nature (Labov, 1972, 1994, 2001); and I also assume that phonological production in SLA is as systematic as in L1 speech (Preston, 1989; White, 2003, p. 19; Young, 1988). The pressing question is how sensible is on-target and off-target articulation to internal and external factors constraining production in SLA (Bayley, 1996, 2005; Cao & Rius-Escudé, 2021; Dickerson, 1974, 1975; Geeslin, 2011; Geeslin & Gudmestad, 2011, 2010; Liu et al., 2020)? With this question in mind, I consider the effect of internal and external factors, as predictors of on-target and off-target articulations, in the production of liquids in the L2 Spanish of Chinese origin participants. The acquisition of the rhotic-lateral contrast represents an acquisition challenge for Chinese-origin L2 learners of different languages. Their acquisition of the rhotic-lateral contrast has been documented in languages such as L2 Spanish for Mandarin L1 learners (Patience, 2018; Patience & Quian, 2022), L2 Spanish for Japanese L1 learners (Fernández Mata, 2012, p. 194), L2 Italian for Mandarin L1 learners (Feng & Grazia Busà 2022), L2 Portuguese for Mandarin L1 learners (Zhou & Rato, 2023), and L2 Russian for Mandarin L1 learners.

Lateralization of rhotics has been attested in the speech of Chinese students acquiring Spanish as a foreign language in classroom settings (Cortés Moreno, 2014, p. 177). Lateralization of rhotics has also been confirmed in natural or untutored contact situations where Chinese immigrants acquire Spanish outside the classroom (Clements, 2009, p. 141; Figueroa Arencibia, 2008), and it also occurs in textual representations of the L2 Spanish spoken by Chinese coolies, indentured laborers, in late 19th century Cuba and Peru (Clements, 2009, p. 116; Lipski, 1999, p. 219; Walicek, 2007, p. 305). In fact, Lipski (1999) notes that “the most common single instance of ‘Chinese’ Spanish [in literary sources] is the massive conversion of /r/ to [l] in all positions” (p. 219). Stereotypical representations of the L2 Spanish of Chinese-origin speakers in film, music, and literature, often resort to lateralization as a distinguishing trait, pointing to the marked status of lateralization. In (1), one of the second-generation, Chinese-origin participants in this study commented on the lateralization of rhotics; and he addressed the difficulties that first generation speakers experience in their production.

(1) Entrevistador: ¿Cómo habla un— español, una persona que habla una lengua china?

Entrevistado: Pues, mire, para empezar, la, la pronunciación de la ‘erre’ es lo más difícil. Como en el dialecto cantonés no existe ninguna pronunciación similar a la ‘ere’ o ‘erre’.

‘Interviewer: How does a— the Spanish of a Chinese-speaking person sound?

Interviewee: Well, you see to begin, the, the pronunciation of the ‘r’ is the most difficult because there is no similar pronunciation to ‘r’ [tap] or ‘rr’ [trill] in the Cantonese dialect.’

Lateralization has been key in shaping perceptions of Chinese L2 Spanish, and the present data offers an excellent opportunity to analyze the process in a context of natural acquisition.

In assessing the extent to which L2 speakers master target-like phonological production, investigators have examined cases of complementary distribution where two or more possible realizations of a single phoneme alternate, according to voice, point, or mode of articulation (Flege et al., 1996). A pivotal issue is how well L2 speakers acquire target-like distribution patterns? Researchers have also looked at the distribution of two or more non-contrastive articulations produced in the same phonological environment (Geeslin & Gudmestad, 2011; Nagy et al., 1996). Distribution of this sort is dependent on social or stylistic factors, and on phonotactic constraints. Off-target articulations occur in SLA. For example, participants in the present study produce rhotic lateralization in syllable coda (*aeropuerto* ‘airport’ > a[l]opue[l]to), onset (*rojo* ‘red’ > [l]ojo), and consonant clusters (*sobrina* ‘niece’ > sob[l]ina), but L1 Spanish speakers in Mexicali do not lateralize rhotics in any phonological context. Alternation of liquids cannot be attributed to any one of the phonological processes mentioned above; rather, the Cantonese participants producing a liquid may aim to approximate their L2 speech to target-like articulations that have no articulatory or phonotactic equivalent in their L1, leading to unattested neutralization in the target language. In a study of the acquisition of the contrast of the sounds /l/, /r/ y /r/ in the L2 Spanish of Japanese learners, Fernández Mata (2012) comments on the concept of interference and notes that

the ANJ [native student of the Japanese language] decomposes and produces the sounding consonants of Spanish by applying the Japanese phonological system, that is, that of his native language. Although from childhood to adolescence it is L2, it is quite easy to acquire the phonological system of one, the truth is that after puberty «the “bottleneck” mechanism begins to “calcify” and the ability to auditorily recognize the features is lost. distinctive of the allophonic variants, all of which are heard as phonemes typical of the LM (mother tongue). (pp. 5-6)

Interference in rhotic and lateral production can be quantified to determine the degree to which learners tend to distinguish between sound systems of the L2 and the distinctive features of their L1. Empirical quantification of interference can also establish the factors that govern production. Cross linguistic interference may explain off-target articulations to some extent because Cantonese has no rhotics in its phonological inventory. The neutralization of liquids in L2 can be credited to the absence of rhotics in the participants’ L1, even though, off-target alternation in L2 production may be the result of factors beyond cross linguistic pressures (Romaine, 2003). The present analysis explores the effect that linguistic and extra-linguistic factors have in the acquisition of on-target and off-target articulation of liquids in naturally-occurring speech through a detailed account of on-target and off-target liquid production in the L2 Spanish of Chinese-origin participants who have learned their L2 outside of a classroom setting.

2. Liquid sounds in Spanish, Cantonese, and Mandarin

Some L1 varieties of Spanish neutralize the lateral and rhotic distinction in syllable-coda through lateralization and rhotacism, i.e. producing a lateral as a rhotic (*escuela* ‘school’ > *escue[r]a*). The two processes have been widely studied in the varieties of Spain and Latin America (Bero, 2022; Dearstyne, 2021; Proctor, 2009; Silvestre Llamas, 2020). Lateralization and rhotacism do not occur in northern Mexican varieties. Spanish L1 speakers in Mexicali do not neutralize liquids in syllable-coda, nor in any position; in fact, neutralization of liquids in syllable-onset is not characteristic of any variety of Spanish. In contrast, the participants in our study produce lateralization and rhotacism in syllable-coda (lat. *restaurante* ‘restaurant’ > [l]esto[l]ante; rhot. *igual* ‘same’ > igua[R]), syllable-onset (lat. *ropa* ‘clothing’ > [l]opa; rhot. *familia* ‘family’ > fami[r]ia), and in consonant clusters (lat. *trabajo* ‘work’ > t[l]abajo; rhot. *clase* ‘class’ c[r]ase).

The Cantonese language does not have taps or trills in its phonological inventory; it has a lateral that is produced exclusively in syllable-onset (Bauer & Benedict, 1997, pp. 16-17; Matthews & Yip, 1994, p. 13). Lateral production in Cantonese has more phonotactic restrictions than in Spanish, where laterals can occur in syllable-onset and coda and in consonant clusters. The three Spanish liquid phonemes differ in their mode of articulation. The lateral is produced when the tip of the tongue comes in contact with the mid alveolar ridge, prompting the air current to escape through the sides of the oral cavity, while the rhotics are produced by vibrations in the alveolar ridge (one for tap and two or more for trill) (Martínez Celdrán & Fernández Planas, 2007, p. 14). Cantonese shares several phonological similarities with Mandarin. The two are tonal languages, and both languages have a more restricted syllable structure than Spanish (Ramsey, 1987, p. 41). As a result, consonant clusters are non-existent and only a restricted set of phonemes are possible in syllable-coda position, i.e., voiceless occlusive and nasal for Cantonese (Li & Thompson, 1987, p. 816) and nasals for Mandarin (see also Bauer & Benedict, 1997, pp. 16-17; Matthews & Yip, 1994, p. 13). Mandarin does have a lateral sound—much like the alveolar in Spanish and Cantonese—that occurs in syllable-onset, but taps and trills are absent. In addition, a retroflex much like the English sound in *red* [ɹ] can occur in syllable onset and coda (Li & Thompson, 1987, p. 816; Ramsey, 1987, p. 44). Table 1 shows the liquids in Cantonese, Mandarin, and Spanish, as well as differences in the syllable structure.

Table 1.
Phonological/phonetic system of liquids in Cantonese, Mandarin, and Spanish

	Cantonese ^a	Mandarin ^b	Spanish ^c
<u>Lateral:</u>			
Syllable onset /l-/	+	+	+
Syllable coda /-l/	-	-	+
Consonant clusters C + [l]	-	-	+
<u>Tap:</u>			
Syllable onset, word initial /r-/	-	-	-
Syllable onset, word medial /-r-/	-	-	+
Consonant clusters C + [r]	-	-	+
<u>Trill:</u>			
Syllable onset, word initial /r-/	-	-	+
Syllable onset, word medial /-r-/	-	-	+
Consonant clusters C + [r]	-	-	-
<u>Syllable coda rhotic:</u>			
Syllable coda [-R]	-	-	+
<u>Retroflex:</u>			
Syllable onset, word initial /ɽ-/	-	+	-
Syllable coda [-ɽ]	-	+	-

^a Bauer & Benedict (1997, pp. 16-17); Matthews & Yip (1994, p. 19); Ramsey (1987, pp. 100-101). ^b Li & Thompson (1987, p. 816); Ramsey (1987, p. 44). ^c Hualde et al. (2010, p. 81)

The differences summarized above make the Spanish L2 liquid system of the Chinese-origin participants susceptible to interference, and thus, more likely for Cantonese bilinguals to neutralize liquids in their L2. Target-like articulations are attested in native registers, as in *[r]egalamos* ‘we offer a gift’, *va[r]iedad* ‘variety’, *t[r]abajo* ‘work’, *mejo[R]* ‘better’, *pe[l]ícu[l]a* ‘movie’ and *a[l]guna* ‘some’; non-target-like articulations are not attested in L1 speech, as in *[l]estau[l]ante* ‘restaurant’, *p[l]ime[l]o* ‘first’, *pasa[l]* ‘to pass’, *po[r]que* ‘because’, *mejó[Ø]* ‘better’, *Mesica[r]I* ‘Mexicali’, and *hab[r]an* ‘they talk’.

Neutralization of liquids in L2 is prone to stimuli from multiple internal and external sources, but in the participant’ L2 Spanish, the complexity involved in the articulation of liquids—and above all taps and trills— not attested in Cantonese and Mandarin is a likely influence on their on-target and off-target articulation. Even among children acquiring Spanish as an L1, rhotic sounds are acquired rather late, and in early stages of acquisition speakers may even go through a period of alternation, in which rhotics are often substituted by other sounds (Anderson & Smith, 1987, p. 67; Goldstein, 1999; Maez, 1985, pp. 16-18). The evidence from L2 acquisition situations confirms that the contrastive distinction of liquid sounds is uncommon and unstable (see also Lipski, 1998, p. 307; 2005, p. 218; Ortiz López, 2011, 2010). The neutralization of the liquid distinction in L2 suggests that speakers perceive a single liquid phoneme or archiphoneme articulated as a lateral or as a rhotic or some other possibility.

Three liquids are distinguished: lateral [l] in all its phonotactic possibilities, syllable onset, coda, and consonant cluster; trill [r], in syllable onset, and consonant cluster; tap [ɾ], in syllable onset, and consonant cluster; and syllable-coda rhotic [-R]. The first three enjoy a phonemic distinction, as exemplified in the following contrastive pairs, *pelo* ['pe-lo] 'hair', *perro* ['pe-ro] 'dog', and *pero* ['pe-ro] 'but'. The sole lateral sound has a wide distribution, appearing in syllable onset and coda and in consonant clusters, but the rhotics show a more complex complementary distribution. Hualde et al. (2010, p. 81) sum up the distribution of the liquid sounds in Spanish as follows: 1) trill and tap rhotics contrast in intervocalic position: *carro* ['ka-ro] 'car', *caro* ['ka-ro] 'expensive'; 2) only trill can occur in word initial position and in word medial after a consonant in a previous syllable (C—r: *sonrisa* [son-'ri-sa] 'smile', *alrededor* [al-re-ðe-'ðor] 'around', *israelita* [iz-ra-e-'li-ta] 'Israeli'); 3) only tap can occur in a consonant cluster, i.e. in word medial position after a consonant (—Cr; *primo* ['pri-mo] 'cousin', *brazo* ['bra-so] 'arm', *tres* [tres] 'three', *dragón* [dra-'ʝon] 'dragon', *cruz* [krus] 'cross', *gramo* ['gra-mo] 'gram', *frío* ['fri-o] 'cold'). In syllable-coda contexts, the contrastive function of rhotics experiences complete neutralization: *honor* [o-'noR] 'honor'; *carne* ['kaR-ne] 'meat'; thus, hampering all efforts to group these with tap or trill exclusively. In sociolinguistic analyses of syllable-coda neutralization, the syllable-coda rhotic has been treated as a sociolinguistic variable.

3. The Present Study

The present study has three objectives. First, it looks at the L2 Spanish of Cantonese-speaking participants living in Mexico. Studies undertaken in SLA have focused on the acquisition of L2 English speakers of distinct linguistic backgrounds or on the L2 acquisition of diverse languages (e.g. Spanish or French) by L1 speakers of English, mainly in a predominantly English-speaking environment. Participants in the present study are acquiring L2 Spanish in a predominantly Spanish-speaking environment. Second, it uses Spanish L2 data acquired in a natural environment in a well-defined speech-community, as opposed to data acquired through an experimental approach from participants acquiring their L2 in a classroom environment. Third, it makes use of a sociolinguistic approach to determine the external and internal factors that constrain on-target and off-target liquid production in the participant's L2 Spanish. The quantitative analysis of the participant's L2 Spanish liquid production can provide a better understanding of the wide-ranging on-target and off-target liquid articulations of liquid sound articulation in L2 speech, and it can shed light on the linguistic and social constraints that regulate production of liquid sounds in the participant's L2 Spanish.

4. Data and Methods

All instances of the on-target and off-target lateral, tap, trill, and syllable-coda rhotic articulations were extracted from thirty-minute speech samples from twelve one-hour long interviews. The on-target and off-target articulations were coded for phonological environment and external factors. A series of quantitative analyses were conducted to examine the distribution of the on-target and off-target articulations in the Spanish L2 data, the production of the liquid sounds (lateral, tap, trill, and syllable-

coda rhotic), and the influence of the phonological environment on the on-target and off-target articulations. Finally, a series of multivariate analyses, using GoldVarb X (Sankoff et al., 2005), were conducted to determine the type of internal and external factors that contribute to the distribution of the on-target and off-target articulations in L2 speech. The use of a multivariate analysis can establish the direct influence and strength of each of the factors within those factorial groups selected as significant. Two internal factors were considered (the type of liquid and the phonological environment), as well as six external factors (education in Mexico, years living in Mexico, number of Chinese varieties spoken, sex, age, and age of arrival). All the participants in this study are L1 speakers of Cantonese, a Chinese language spoken in the southern regions of Guangxi and Guangdong; it is the main Chinese language spoken in the cities of Guangzhou, Hong Kong, and Macau. Cantonese is not mutually intelligible with Mandarin (Duanmu, 2007, p. 1; Ramsey, 1987, p. 6; Matthews & Yip, 1994, p. ix-x).

The data used in this study was collected in Mexicali, Baja California, a city on the Mexican side of the California-Mexico border. The Chinese-speaking community in Mexicali is relatively small — considering the overall population in the region — but it is an extremely tight-knit community with a long historical presence in the city (Chao Romero, 2010; Velázquez Morales, 2001). The author of this study collected close to 18 hours of semi-directed, sociolinguistic interviews. Throughout the interviews, participants talked about recurrent topics, such as growing up in China, arriving and establishing themselves in Mexicali, adapting to life in Mexicali, and comparing labor experiences in China and in their new place of residency. The participants in the study were contacted mainly through the help of members of two Chinese associations in the area. The interviews were conducted among the members of two local Chinese associations and among workers of the Chinese restaurants in and around the local Chinatown or *Chinesca*. Only 12 interviews, those of the participants born in China, were used for this study.

The 12 participants considered in the analysis (8 males and 4 females) came to Mexico long after they had acquired Cantonese as an L1. The youngest participant was 13 years old at the age of arrival and the oldest one was 34. All participants produced on-target and off-target liquid articulations (lateral, tap, trill, and syllable-coda rhotic) in their L2 Spanish, and in the three phonotactic contexts under consideration (syllable onset and coda and consonant clusters). All participants claimed Cantonese as their L1, and some also claimed a working knowledge of L2 Mandarin, mainly as a result of formal education in China. None of the participants were competent in English, despite living in a border city. All participants were 18 years old or older at the time of the interview, and only those who had lived in Mexicali for five years or more were interviewed. Participants worked alongside other speakers of Cantonese in Chinese restaurants or businesses that cater mainly to Spanish-speaking costumers; L1 Spanish-speaking co-workers were also common in some of the businesses. As a result, participants in this study had received considerable input from Spanish L1 speaker. All of our participants learned their L2 in a natural setting, mostly from interacting with Spanish L1 speakers in the area, and participants used Spanish on a daily basis. All participants lived and worked alongside other Cantonese speakers, but in their workplace, they dealt with Spanish-speaking co-workers and costumers on a regular basis. Table 2 summarizes the socio-demographic profiles of the participants.

Table 2.
Participants' Socio-Demographic Profiles

Participant	Sex	Age	Age of Arrival	Years in Mexicali	Knowledge of Mandarin	Education in Mexico
EA	m	78	24	54	√	√
AU	m	75	26	49	√	√
AZ	m	63	31	32	-	-
CZ	m	62	34	28	-	-
SE	f	51	23	28	-	-
LI	f	46	20	26	-	-
ML	m	38	26	12	√	-
YX	f	35	25	10	-	-
JO	f	27	20	7	√	-
JA	m	22	15	7	√	√
TA	m	20	15	5	√	√
TO	m	18	13	5	√	√

5. The Quantitative Analyses

This section investigates quantitatively how liquid sounds were produced in L2 Spanish. Table 3 shows the overall distribution of on-target and off-target liquid production in the L2 Spanish data. The on-target column measures the rate of felicitous articulations; these articulations are verified in the local Spanish L1 registers, as in *[r]egalamos* ‘we offer a gift’, *va[r]iedad* ‘variety’, *t[r]abajo* ‘work’, *mejo[R]* ‘better’, *pe[l]ícu[l]a* ‘movie’ and *a[l]guna* ‘some’; the second one accounts for infelicitous articulations, as in *[l]estau[l]ante* ‘restaurant’, *p[l]ime[l]o* ‘first’, *pasa[l]* ‘to pass’, *po[r]que* ‘because’, *mejó[Ø]* ‘better’, *Mesica[r]i* ‘Mexicali’, and *hab[r]an* ‘they talk’.

Table 3.
Distribution of “on-target” and “off-target” liquid articulations in participants’ L2 Spanish

On-Target	Liquid Articulations		Off-Target	
	%	N		%
84.2 %		1,898	15.8 %	356

Overall, 84.2 % of all liquid articulations were uttered in line with Spanish L1 patterns, while off-target production accounted for 15.8 % of all occurrences. The results may suggest that the effect of the off-target liquid articulations tends to be more prominently perceived in the collective mind of Spanish-speaking monolinguals and of Chinese-origin bilinguals, as indicated by the emphasis on lateralization in Chinese L2 Spanish representations. The higher rates of on-target liquid articulations in Chinese L2 Spanish stands out when the results are compared to analyses of rhotics undertaken in other cases of

Spanish L2 acquisition, often showing lower rates of on-target liquid production (Face, 2006; Rafat, 2008).

Two social factors may be affecting on-target liquid production in the participants' L2 Spanish. The amount of exposure to the target language may be the most important one, possibly pointing to a key characteristic of naturally acquired L2 speech. In the case of Chinese-origin participants in Mexicali, the amount of contact with speakers of the target language far surpasses the exposure time common to most classroom settings. Direct or indirect pressure from the negative evaluation of the off-target variants in the social sphere may also weigh in on participants to produce the on-target variants. Most of the off-target articulations seem to neutralize the distinct, contrastive character of the liquid sounds, a process typical of some Spanish L1 varieties, but restricted to syllable-coda environments. The neutralization of liquid sounds brings about extremely salient off-target phonological articulations in the participants' L2 Spanish.

Table 4.
Distribution of “on-target” and “off-target” liquid articulations in participants' L2 Spanish

Realization	Liquid Sounds									
	Lateral		Tap		Syllable-coda Rhotic		Trill		Totals	
	%	N	%	N	%	N	%	N	%	N
<u>On-Target:</u>	91.1 %	804	82.1 %	669	78.3 %	372	65.4 %	53	84.2 %	1,898
<u>Off-Target:</u>										
Lateral			15.6 %	127	6.1 %	29	27.2 %	22	7.8 %	175
Deletion	0.9 %	8	1.7 %	14	10.3 %	49	-	-	3.3 %	74
Tap	7.9 %	70					-	-	3.1 %	70
Retroflex	0.1 %	1	0.6 %	5	5.3 %	25	7.4 %	6	1.6 %	37

Note. The difference in the distribution of on/off target articulations for Lateral and Tap is significant, as determined by a Chi square test: $X^2 = 29.65$, $p = 0.0000$; also significant is the difference in the proportion for Lateral and Syllable-coda: $X^2 = 43.18$, $p = 0.0000$; for Lateral and Trill: $X^2 = 49.36$, $p = 0.0000$; for Tap and Syllable-coda: $X^2 = 2.74$, $p = 0.0980$; for Tap and Trill: $X^2 = 13.06$, $p = 0.0003$; for Syllable-coda and Trill: $X^2 = 6.38$, $p = 0.0116$.

As shown in Table 4, the L2 data presents high diversity in liquid production. High diversity of liquid articulations seems to be a hallmark of liquid sound production in Spanish SLA and in early Spanish L1 acquisition. Evidence from studies of L1 acquisition among Spanish-speaking children also shows diversity in the different developmental stages, where tap is often produced as [l, Ø] and trill as [d, l, n, r, j, Ø] (Anderson & Smith, 1987, p. 67; Maez, 1985, pp. 16-18). Studies of the SLA of rhotics among L1 speakers of different languages show the same diversity in rhotic production. In a study of intervocalic rhotic pronunciation among adult English L1 learners of L2 Spanish, Face (2006) shows that rhotic production is tied to a range of possibilities of articulations. The English-speaking learners of

L2 Spanish articulated rhotic sounds as a glide, trill, deletion, lateral, retroflex, and tap. In fact, the L2 Spanish of the English L1 speaking learners and of the participants in our study share the same phonological off-target articulations. Lateralization of rhotics as an off-target articulation by the English-speaking learners was marginal; retroflexion (voiced, alveolar approximant) had the most extensive rate of occurrence of any off-target articulation. The on-target articulations of all four liquid sounds were always articulated at higher rates than their off-target counterparts. In the participants' L2 Spanish, the on-target rates differed for each of the liquid sounds considered. The quantitative analyses show that participants are more likely to produce on-target articulations.

Participants produced higher rates of on-target articulations of the lateral sound. These results mirror those found by Feng & Grazia Busà (2022, p. 224) in a perception and production experiment to study the acquisition of the lateral and rhotic contrast in Italian among Mandarin speaking students majoring in the language. Overall, first year students had a 92 % lateral and 13 % rhotic production accuracy, compared to an 85 % lateral and 47 % production accuracy for second year students, and 75 % lateral and 62 % production accuracy for third year students. The rate of accurate production of lateral remained high, yet it decreased with time of exposure, while that of rhotics decreased.

In the production of the Spanish L2 lateral, the on-target articulations were produced more vigorously, even though, as a general tendency, the rates of on-target articulations were higher than those of off-target ones. The high rates of on-target articulations suggests that laterals presented the least articulatory problem for speakers; this seems to imply as well that phonotactics inherent to the L1 impact phonological patterns in the participants' L2 Spanish. For this particular case, a viable explanation can be found in the fact that Cantonese has an (l)+V parallel structure. The low rates of rhotacism, in comparison to much higher rates of lateralization for rhotics, suggests that cognitively speakers were more inclined to replace a rhotic with a lateral than the opposite situation. The quantitative analysis seems to indicate that syllable-onset rhotacism is less likely to occur as an off-target variant because Cantonese L1 constraints preclude the production of rhotic sounds in any phonological environment. In the participants L2 Spanish, the Cantonese rhotic-less constraint may be particularly felt in word-initial position, where a trill sound—that with the highest rates of off-target occurrences—is the norm in Spanish L1 registers. The high rates of on-target, syllable-onset laterals may be additionally reinforced by the high rate of on-target high-frequency monosyllabic articles and accusative and dative pronouns, such as *la* 'the, fem. sing.'; *las* 'the, fem. pl.', which bare a 99.1 % on-target retention rate. While the high rate of on-target realizations was likely influenced by the presence of a lateral sound in Cantonese in syllable-onset contexts, the low rates of deletion of /l/ in syllable-onset position are probably due to the fact that /l/ deletion is not a widespread process in Spanish L1 monolingual varieties.

The production of rhotic sounds shows a higher rate of off-target articulations. Lateralization of rhotics, the most frequent off-target articulation, results in greater saliency in L2 speech, and in terms of phonotactic structures, it is more in line with Cantonese L1 phonotactic configurations because Cantonese does not have tap and trill sounds in its phonological inventory. The high rates of rhotic lateralization suggest that—by adhering to L1 patterns—participants seemed to solve the absence of taps and trills. The high rates of lateralization of rhotic sounds are also suggestive of greater levels of

complexity in rhotic articulation. In contrast to the lateral sound, the rate of tap on-target articulations decreased considerably. The drop in accurate articulations may be indicative of the increase in the degree of difficulty faced by speakers in tap sound production. Despite the increase in off-target articulations, overall, participants of L2 Spanish fared better in their production of on-target rhotic articulations than American students in a short story reading task. In this study, Face (2006, p. 52) looked at the production of intervocalic rhotics in two groups of L1 speakers of American English, studying L2 Spanish at the university level. His two focus groups, intermediate level students and advanced level students in the Spanish major/minor, produced a 48.5 % and 78.7 % rate of on-target tap articulations and 5.1 % and 26.6 % of on-target trill articulations, compared to 82.1 % for tap and 65.4 % for trill in the participants' L2 Spanish. These results may be suggestive of the difference between primarily classroom-centered and a more naturalistic acquisition. Nonetheless, while the rates of on-target production differed in the three groups compared, the distributional patterns remained the same among the beginning and advanced American students of Spanish and the Chinese-origin participants in this study. The participants showed higher rates of on-target tap production in all cases, again suggesting that they faced a bigger challenge in the production of trill sounds.

Speaker production of on-target articulations continued to decrease to 78.3 % in syllable-coda rhotic. Variationist studies have long-established that this phonological context is conducive to the neutralization of liquid sounds in many L1 varieties of Spanish. Structurally, Cantonese and Spanish favor open syllabification, often achieved in Spanish through processes of consonantal deletion and epenthesis, two tendencies also confirmed in the participants' L2 Spanish. Finally, the highest rate of off-target articulations in the participants' L2 Spanish was confirmed in their attempts to produce a trill articulation. No doubt, the lower rate of on-target articulations suggests that this is the sound that presents the greatest articulatory challenge for the participants.

Table 5.
Distribution of “off-target” liquid articulations in participants’ L2 Spanish

Realization	<u>Liquids</u>									
	Lateral		Tap		Syllable-coda Rhotic		Trill		Totals	
	%	N	%	N	%	N	%	N	%	N
<u>Off-Target:</u>										
Lateral			87.0 %	127	28.1 %	29	78.6 %	22	49.8 %	175
Deletion	10.1 %	8	9.6 %	14	47.6 %	49	-	-	20.8 %	74
Tap	88.6 %	70					-	-	19.7 %	70
Retroflex	1.3 %	1	3.4 %	5	24.3 %	25	21.4 %	6	10.4 %	37

Table 5 shows the distribution of off-target articulations analyzed in the participants L2 Spanish. Results show that in L2 liquid production all sounds have more than one potential articulation and that

the rate of production in each sound increases or decreases, accordingly, as discussed earlier. In off-target lateral production, tap is the most common off-target articulation, while deletion and retroflex have lower rates of occurrence. The trill articulation was not a possibility, confirming the close association between lateral and tap sounds. In the quantitative analysis, rhotacism has the highest off-target tap occurrence rate, the highest rate among failed lateral articulations; deletion reached 10.1 %; and the retroflexed articulation reached 1.3 %. The retroflex sound is the only off-target articulation that is not part of the Spanish and Cantonese L1 phonological repertoires inventories. Perhaps, due to the marked tendency to maintain syllable-onset laterals in Cantonese and Spanish L1 registers, deletion in syllable-coda environments primarily involves the simplification of the syllabic structure of the type $C[l]V \rightarrow CV$ (*pro-ble-ma* ‘problem’ > *pθo-bθe-ma*) and $(C)V[l] \rightarrow (C)V$ (*bol-sa* ‘purse’ > *boθ-sa*), while rhotacism (*ca-ble* > *ca-b[r]e*) involves some degree of hypercorrection. The quantitative evidence in Table 5 partly explains why in contrast to lateralization, rhotacism does not emerge in imitations of Chinese L2 Spanish. The low incidence of rhotacism in stereotypical depictions is likely due to the fact that lateralization is so prevalent in the articulation of the three other sounds in the participants’ L2 Spanish. In the data, rhotacism only accounts for 19.7 % of all off-target occurrences, but lateralization accounts for 49.8 % of all off-target occurrences. The higher rates of lateralized rhotics and the high rate of use of those lateralized forms may conceive a deep-seated mental representation in L1 Spanish speakers. The total distributions in Table 5 are suggestive of the relative articulatory and phonotactic complexity faced by speakers in the production of each liquid sound. Similar challenges are faced by L1 speakers in their acquisition process, studies of L1 acquisition of Spanish liquids consistently show that laterals are acquired earlier and more accurately than rhotics, and that, in the acquisition of rhotics, tap sounds are acquired earlier than trill (Acevedo, 1993, p. 12; Anderson & Smith, 1987, p. 63; Maez, 1985).

In the off-target production of taps, lateralization obtains the highest off-target articulation rate (87.0 %), deletion reaches 9.6 %, and retroflexion 3.4 %. In the off-target production of syllable-coda rhotic, deletion reaches the highest rate among the off-target articulations, 47.6 %; lateralization reaches 28.1 %; and retroflex reaches 24.3 %. Syllable-coda rhotics appear in a phonological environment that is prone to consonantal weakening in L1 Spanish varieties. In addition, phonological changes in Cantonese—and in Mandarin—are more likely to occur in syllable onset position (Ding, 2010, p. 203; Matthews & Yip, 1994, p. 29). Thus, in syllable-coda, speakers resort to deletion in higher rates, a process that eventually leads to syllabic simplification. Even when the syllabic structure of Cantonese accepts closed syllables in (p, t, k, m, n, ŋ), the exclusion of liquids from closed syllables—and above all, the absence of taps and trills from its phonological inventories—may lead participants to delete syllable-coda rhotics; the result is an open syllabic structure, rather than in a closed one. Simplification involves the deletion of a non-existent sound in Cantonese to avoid a non-existent phonotactic combination in Cantonese: $CV[R] \rightarrow CV$ (*¿Por qué?* ‘Why?’ > *¿Poθ qué?*, *Baja Ca-li-for-nia* > *Ba-ja Ca-li-foθ-nia*). The modification may be explained by the influence of Cantonese syllable structure. After deletion, the more complex CVC pattern is simplified to CV, an open syllable pattern. Lateralization and retroflexion of syllable-coda rhotics suggests that speakers are attempting to comply with articulatory expectations. The rate of the off-target retroflex articulation was much higher here than

with any other sound; but despite the fact that the retroflex articulation occurs only sporadically and in allophonic distribution in Mandarin, speakers may perceive that a retroflex articulation is closer cognitively to a rhotic sound than to a lateralized articulation.

In a study by So & Dodd (1995, p. 482), Cantonese-speaking children acquired their lateral sound around the age of 3 and a half years old, while Zhu & Dodd (2000, p. 20) report that Mandarin-speaking-children in their study did so around the age of 4 years old. Analyses of speech development in Spanish-speaking children suggest that lateral sounds are among the first sounds to be acquired and that trill sounds are one of the last. Acevedo (1993) reports that 3-year-old Mexican American school-age children in the Lower Río Grande Valley of Texas show a 100 % on-target production of lateral sounds, 90 % of tap sounds, and 58 % of trill sounds. By age 5:6, on-target production of tap and trill sounds reached 95 %, meaning that it seems to take Spanish-speaking children in South Texas close to three more years to produce trills in comparable on-target rates as taps. Similar results are put forward by Maez (1985, p. 23); his analysis showed that at 21 months of age the Mexican American children learning Spanish as an L1 had 100 % accuracy in their production of the lateral sound. Mastery of the tap sounds came around the 24 months period at 100 % accuracy. However, at the same 24-month stage, trill sounds reached only 9.5 % accuracy. These results are somewhat echoed in studies of L2 Spanish acquisition (Olsen, 2012). Face (2006, p. 52) explored rhotic production among English-speaking learners of L2 Spanish. In his study, learners of beginning L2 Spanish produced the on-target tap at a rate of 51.5 % and trill at 5.1 %, while advanced L2 Spanish learners produced the on-target tap at a rate of 78.7 % and trill at 26.6 %. Trill sounds caused more articulatory problems. Learners produced lower on-target rates in trill articulation; but in the two cases, learners were able to increase their levels of on-target articulation with time and exposure, as evidenced by higher on-target rates among advanced learners. In looking at trill production among L1 Farsi speakers of L2 Spanish, Rafat (2008) finds that these speakers produced a 0 % on-target rate in word initial position and in post-consonantal position, evidencing the high level of difficulty involved in producing trills among L1 Farsi speakers of L2 Spanish, as well.

In off-target trill articulations, participants lateralized at a rate of 78.6 %, registering one of the highest rates in off-target occurrences. The high rates of lateralization that occurred in rhotic sound production are indicative of the articulatory challenge faced by Spanish L2 speakers producing a new sound in a new phonological environment. The overall production of rhotic sounds caused serious articulatory problems to participants; but, in comparison to the tap sound, the rate of off-target occurrences was higher in the production of a trill sound. The trill sound is the most complex articulation tackled by the participants. The trill sound also resisted deletion strongly; speakers were not prone to delete word-initial or syllable-onset trills. Retroflexion had a rate of 21.4 %. The high rate of trill retroflexion suggests that participants perceive retroflexion somewhat closer to a trill than to a tap sound, perhaps suggestive of the importance of L2 transfer during third language acquisition.

There is another phonological trait of Cantonese that may explain why syllable-onset rhotics — and trill sounds in particular— resist deletion and the substitution of trill by tap in favor of lateralization. Matthews and Yip (1994, p. 29) and Ding (2010, p. 203) note that most phonological changes in Cantonese, a highly monosyllabic language, are prone to occur at syllable onset. In addition, Matthews

and Yip (1994, p. 16) and Cheng et al. (2022) note that word-initial (n) is often pronounced in some varieties of Cantonese as an (l) by younger speakers, and by older speakers in less formal speech registers. Thus *néih* ‘you’ is produced as [l]éih, *nìhn* ‘year’ as [l]ìhn. Innovation is representative of a change in progress in some varieties of Cantonese. Apparently, the process is so advanced and it has been around for several decades that in some varieties word-initial /n/ is reserved primarily for use in formal registers, such as singing and reading (Matthews & Yip, 1994, p. 29). The tendency to lateralize word-initial /n/ is present in the participants L2 Spanish, as in *no* ‘no’ → [l]o, *necesario* ‘necessary’ → [l]ecesario. The inference can be made that because some Chinese L2 speakers are already prone to lateralize syllable-onset nasals in their L1, the transfer to lateralize rhotics in their L2 Spanish is a deeply-rooted plausibility. In their attempts to aim as closely as possible to L1 models, the participants seem to disregard in part the rhotic / lateral distinction, a fact that leads us to infer that cognitively these speakers recognize an all-encompassing liquid category that accounts for all the on-target and off-target articulations produced.

5.1 Phonological Environment

Table 6 shows the distribution of on-target and off-target liquid production by phonological environment. The on-target articulations were produced at higher rates than their off-target counterparts in every phonological environment. Relevant tendencies emerge, once the different sounds and their phonological environments are considered. In word initial context, the lateral showed a strong resistance to produce off-target variants. In this environment, 93 % of the off-target occurrences were due to rhotacism. The high on-target rates confirm that Cantonese L1 structures may account for the strong maintenance of laterals in word-initial contexts. Neither language is inclined to reduce (l) in this phonological environment, a trait that carries over to L2 speech.

A similar trend was found by He (2001). In his study of the production of English /l/ by L1 speakers of Mandarin, He (2001) found that speakers had no problem producing the syllable onset /l/; most speaker production errors occurred in syllable coda position where off-target rates were extremely high. In the present study, participants produced high on-target rates of laterals in syllable-coda at the end of words. There is a substantial reduction in on-target rates in syllable-coda, in word medial contexts, even though this is a context with a lower frequency of occurrence. Overall, on-target production of syllable-coda laterals in the participants’ L2 Spanish contrasts with has been found for L1 Mandarin speakers learning L2 English. He (2014) shows that Mandarin-speakers learning L2 English (eight in Beijing and eight in Canada) produced low rates of on-target articulations of syllable coda laterals in four different phonological environments: 1.25 % after /t/, 8.9 % after /tʃ/, 0.0 % after /d/, and 0.0 % after /dʒ/. Participants in his study rely on deletion, the most frequent strategy, and also on vocalization and retroflexion. In the L2 Spanish data, participants’ production of syllable-onset /l/ in word-medial contexts shows a lower rate of on-target articulations, 80.8 %. The participants seem to follow more universal tendencies.

In this phonological environment, languages such as Japanese and Korean treat the intervocalic tap articulation, as in *escue[r]a* ‘school’, as an allophone of /l/. In syllable-onset in word-medial contexts,

95 % of all off-target occurrences were due to rhotacism. In consonant clusters, /l/ reveals a high decrease in on-target production. In this phonological context, /l/ reached one of the highest off-target rates. Such a high rate suggests that this phonological environment poses a high cognitive challenge for speakers, even though such complexity is more than likely due to a high level of confusion, in turn leading to hypercorrection of the type C[l]V → C[r]V. In this phonological environment, 93 % of all off-target occurrences were due to rhotacism (*empleados* ‘employees’ > *emp[r]eados*). The rate of off-target occurrences is higher in clusters of the C[r]V type than of the C[l]V type, an outcome that contradicts the prevalent stereotypical notion that lateralization is the only process operating in liquid sound production in L2 Spanish.

Table 6.

Distribution of “on-target” and “off-target” liquid production in participants’ L2 Spanish by phonological environment

Liquid Variable Phonological Context	<u>Liquid Production</u>			
	On-Target %	N	Off-Target %	N
<u>Lateral:</u>				
Syllable onset - word initial <i>[l]ibro</i> ‘book’	99.1 %	342	0.9 %	3
Syllable coda - word final <i>difci[l]</i> ‘easy’	98.3 %	176	1.7 %	3
Syllable coda - word medial <i>adu[l]to</i> ‘adult’	90.2 %	37	9.8 %	4
Syllable onset - word medial <i>sale</i> ‘he/she/it leaves’	80.8 %	168	19.2 %	40
Consonant cluster <i>p[l]átano</i> ‘banana’	73.6 %	81	26.4 %	29
<u>Tap:</u>				
Consonant cluster <i>f[r]ío</i> ‘cold’	83.8 %	269	16.2 %	52
Syllable onset - word medial <i>interesa</i> ‘it interests him’	81.0 %	400	19.0 %	94
<u>Syllable-coda Rhotic:</u>				
Syllable coda - word medial <i>fo[R]ma</i> ‘shape’	81.9 %	158	18.1 %	35
Syllable coda - word final <i>seño[R]</i> ‘sir, mister’	75.9 %	214	24.1 %	68
<u>Trill:</u>				
Syllable onset - word medial <i>a[r]iba</i> ‘upstairs’	68.4 %	13	31.6 %	6
Syllable onset - word initial <i>[r]espeto</i> ‘respect’	64.5 %	40	35.5 %	22

The two possible phonological contexts in tap production show comparable off-target rates. In consonant clusters, lateralization (*compra* ‘he/she buys’ > *comp[l]a*) accounted for 71 % of all occurrences, and deletion (*primero* ‘first’ > *pøimero*) for 23 %; in syllable-onset, word medial position, lateralization (*arroz* ‘rice’ > *a[l]oz*) accounted for 96 % of all off-target articulations and retroflexion

(*arroz* ‘rice’ > *a[r]oz*) for the remaining 4 %. Consonant cluster contexts trigger different results in lateral and tap articulation. Rate is one way in which the two sounds differ, but the higher rates of off-target articulations in lateral, rather than in tap cluster production, is surprising. Cognitively, speakers face two main Cantonese L1 restrictions in tap cluster production: absence of consonant clusters and of rhotic articulations. In lateral consonant cluster contexts, speakers only face one Cantonese L1 restriction: absence of consonant clusters. The fact that speakers produced higher rates of rhotics in the latter context suggests that Spanish L1 constraints sometimes have a stronger effect on L2 configuration. Using data from a perception and production task, Feng & Grazia Busà (2022) revealed that participants showed greater accuracy in lateral over tap production. In addition, due largely to L1 phonotactic rules, the /l/ onset accuracy was acquired before /l/ coda, while /r/ coda accuracy was acquired before /r/ onset.

Syllable-coda rhotic showed higher rates of off-target occurrences than lateral in similar contexts. It may be that more complex syllabic structures, i.e. those that involve consonant clusters or closed syllables, take longer to be acquired. In word medial context, syllable-coda rhotic revealed a slightly higher rate of on-target occurrences than in word-final. Rates of off-target variants showed the following distribution in word-final context: 54 % deletion (*cuidar* ‘to take care of’ > *cuidáØ*), 33 % lateralization (*estudiar* ‘to study’ > *estudia[l]*), and 13 % retroflexion (*por qué* ‘why’ > *po[r] qué*). The rate for deletion is higher here than in any other phonological environment. In line with Cantonese L1 configurations, deletion simplifies the syllabic structure and helps participants avoid a rhotic articulation. Reduction of syllable-coda rhotic in word-final contexts is additionally reinforced by similar trends in Spanish L1 varieties, thus showing that participants seem to arrive at solutions that may account for L2 input, though not in the same way as the phonological tendencies in monolingual speech. In the case of deletion, the difference may be one of frequency because deletion seems to be a more widespread option in L2 than in L1 registers. Thus, speakers may tend to simplify consonant-final structures, as in CV(C), because these configurations may be perceived as more marked than a CV structure (*cui-dar* > *cui-dáØ*). This constraint operates to maintain the preferred universal canonical syllable structure in the two languages. In word medial contexts, the distribution is as follows: 33 % deletion (*fuerza* ‘force’ > *fueØza*), 18 % lateralization (*carne* ‘meat’ > *ca[l]ne*), and 49 % retroflexion (*porque* ‘because’ > *po[r]que*). While the rate of deletion remains high, retroflexion is the articulation with the highest rate in this context. Retroflexion involves a sincere effort to comply with L2 articulatory restrictions, as speakers strive to produce the sound that in their mind is cognitively closer to a rhotic.

In syllable-onset position, the trill sound showed the highest rate of off-target production for all the liquid sounds in any phonological context. The high rate of off-target production of the trill sound was previously credited to its articulatory complexity. Here, the somewhat uniformed rates of on-target production suggest parallel levels of complexity faced by speakers of L2 Spanish in the two contexts compared. The trill sound proved highly resistant to syllable-onset deletion. Only two off-target variants were possible: lateralization (*tierra* ‘land, country’ > *tie[l]a*) accounted for 93 % of all occurrences in syllable-coda contexts, and retroflexion (*resto* ‘rest’ > *[r]esto*) for 7 %. Retroflexion is clearly an option closely associated with the trill sound, but one for the most part accessible to L2 speakers of Mandarin. Retroflexion shows a nice middle ground negotiation between a lateral and a rhotic. We can also see

that, compared to the tap sound, the on-target, syllable-onset trill sound in word medial position diminished by more than 10 %. Dissimilar rates of on-target articulation in analogous contexts only serve to accentuate the challenge that the participants face when they try to generate a trill sound. The analysis up to this point supports the notion that speech production in the participants' L2 Spanish is systematic and that liquid off-target production is not hap hazardous.

5.2 Multivariate Analysis: Internal Factors

In this section, the liquid system is subjected to two multivariate analyses that test the internal and external factors that seem to promote the production of off-target articulations in the participants' L2 Spanish.

Table 7.

Results of the Variable Rule Analysis of the contribution of internal factors selected as significant to the selection of off-target over on-target articulation of liquids

	Prob.	%	N
Liquid Variable			
Trill	0.87	34.6 %	28
Syllable coda	0.81	21.8 %	103
Tap	0.39	17.9 %	146
Lateral	0.37	8.9 %	79
	Range 50		
Phonological Context			
Syllable onset - word medial <i>arroz</i> 'rice' > a[ʀ]oz	0.72	19.3 %	140
Consonant cluster <i>frontera</i> 'border' fθontera	0.71	18.8 %	81
Syllable coda - word medial <i>abierto</i> 'open' > abie[ʀ]ta	0.32	15.9 %	39
Syllable coda - word final <i>igual</i> 'same' > igua[R]	0.26	15.8 %	71
Syllable onset - word initial <i>ropa</i> 'clothing' > [l]opa	0.23	6.4 %	25
	Range 47		

Table 7 shows the results of the variable rule analysis of the contribution of internal factors selected as significant in the production of off-target over on-target liquid articulations in the participant' L2 Spanish. The two internal factors considered, type of liquid sound and phonological environment, were significant predictors of the distribution of liquid on-target and off-target articulations. Type of liquid exerts only a slightly stronger constraint on the choice of off-target articulations than phonological context with a range value of 50 and 47 respectively.

The probability that a trill and a syllable-coda rhotic are produced as an off-target articulation is high at 0.87 and 0.81. These findings confirm statistically that speakers find it difficult to articulate a

trill; thus, they resort to lateralization and retroflexion as articulation strategies. To the participants, the trill sound seems to be the most complex articulation attempted. As far as the syllable-coda rhotic, results seem to back the claim that it appears in a phonological environment that is optimal for consonantal change and weakening in Spanish. Thus, in syllable-coda, the speakers resort to deletion at higher rates, a process that eventually leads to syllabic simplification. The tendency to simplify the syllable structure in L2 speech involves the deletion of a non-existent sound in Cantonese, a tap or trill-like rhotic, and the avoidance of an unacceptable Cantonese consonantal combination, a rhotic or a lateral in a closed syllable. As it can be observed in Table 7, off-target articulations were disfavored in tap and lateral production.

Phonological context also contributed a statistical significance to the choice of an off-target articulation. Off-target liquid production was strongly favored in syllable-onset word medial and in consonant clusters at 0.72 and 0.71 respectively. In the data, off-target articulations in syllable-onset, word medial contexts affected laterals (with a 19.2 % off-target rate), as in *escue[r]a* (*escuela*) ‘school’ and *abue[r]a* (*abuela*) ‘grandmother’; tap (19.0 %), as in *pa[l]a* (*para*) ‘for’ and *ba[l]ato* (*barato*) ‘inexpensive’, and trill (31.6 %), as in *tie[l]a* (*tierra*) ‘land’ and *[l]opa* (*ropa*) ‘clothes’. Off-target articulations in consonant cluster contexts affected laterals (26.4 %), as in *g[l]ande* (*grande*) ‘big’ and *p[Ø]ocedimento* (*procedimiento*) ‘procedure’, and tap (16.2 %), as in *c[r]ase* (*clase*) ‘class’ and *prob[Ø]ema* (*problema*) ‘problem’. As a whole, lateral seems to have an influential role in determining the relative weight of the particular phonological contexts. Notice that syllable-onset, word medial and consonant cluster were the two contexts that showed the highest rate of off-target articulations for lateral in Table 6, 19.2 % and 26.4 % respectively. Inversely, the high rate of lateral on-target syllable-onset, word initial articulations (99.1 %) is probably decisive in determining the weak probability exerted by this context.

5.3 Multivariate Analysis: External Factors

Table 8 shows the results of the variable rule analysis of the contribution of external factors selected as significant in the production of off-target over on-target liquids in Chinese L2 Spanish. Three external factors were considered: education in Mexico, years living in Mexico, and the number of Chinese varieties spoken. Sex, age, and age of arrival were consistently selected as non-significant in previous analyses; thus, these factors were excluded in the present analysis, even though a brief discussion of their effect on the variation is offered. Education in Mexico, years living in Mexico, and the number of Chinese varieties spoken did exert a statistically significant effect on the distribution of liquid articulations. Education in Mexico exerts a slightly stronger constraint on the choice of off-target variants than years in Mexico and Chinese varieties spoken with a range value of 55, 52 and 30 respectively.

Table 8.

Results of the Variable Rule Analysis of the contribution of external factors selected as significant to the selection of off-target over on-target articulation of liquids

		Prob.	%	N
Education in Mexico				
	None	0.66	20.1 %	267
	Secondary +	0.28	9.1 %	89
		Range 55		
Years in Mexico				
	9-	0.72	19.1 %	73
	10-29	0.54	17.9 %	193
	30+	0.35	11.4 %	90
		Range 52		
Chinese varieties known				
	Cantonese	0.55	20.2 %	154
	Mandarin L2	0.40	13.6 %	202
		Range 30		

Abundant literature on the subject has pointed out the benefits of second language instruction, which seems to occur at a faster rate than L2 learning in cases of naturalistic acquisition (Doughty, 2003, p. 262). The multivariate analysis shows that the acquisition tendencies among the speakers of L2 Spanish point in that direction. In the participants' L2 Spanish data, the off-target articulations were strongly favored by a lack of education in Mexico at 0.66 and were disfavored by the *secundaria* or above group at 0.28. Speakers that did not have access to formal education in Mexico generated higher rates of off-target liquid articulation, while those with secondary education or more produced lower rates. Upon their arrival in the Mexicali area, most of the younger arrivals go through part of *secundaria* or *preparatoria*, the Mexican equivalent for middle and high school. These Chinese-origin students are mainstreamed early on in the Mexican education system. None of them have access to conventional second language acquisition courses. Instead, the student participants covered the common subjects prescribed by the nation-wide curriculum of the Mexican education system in Spanish. The education factor as considered in this study differs from what is commonly the focal point in other acquisition studies. In classroom-centered environments, investigators often focus on the acquisition of particular features in task-oriented, collection strategies among students enrolled in formal, target language instructed courses. The L2 Spanish spoken by the student participants is for the most part learned in formal L2 classroom instruction. Outside of the educational spaces, student participants tend to make use of their L1 among themselves; they reserve the use of their L2 Spanish to communicate with L1 speakers. The situation described here is one in which the L2 is acquired naturally in the target language community under a situation of intense language contact, resulting in intense and prolonged levels of exposure to the target language.

Studies have proposed that higher levels of L2 acquisition are intimately attached to the systematic use of the target language and to the amount of exposure in it. In situations of social L2

acquisition, exposure to the target language and use of it are embodied partly in the length of residency of the participants in the target language community. The present study illustrates this well. The positive effect of the number of years living in the area of contact is corroborated by the multivariate analysis. The off-target articulations were strongly favored by participants who have lived nine years or less in Mexico, at 0.72. Having lived in Mexico from 10 to 29 years moderately favored the production of off-target articulations, at 0.54, while the off-target articulations were disfavored by those that have lived for 30 years or more in the country, at 0.35. The rates of off-target liquid sound production among the participants decreased with time, but the decrease was higher among speakers with a residency span of 30 years or more in the area of study. The off-target production showed a slight percent difference between the two groups with the shortest length of residency in the area, but in terms of statistical probabilities, the chances of producing off-target articulations show a moderate decrease. By contrast, speakers living in the Mexicali area for 30 years or more produced off-target liquid articulations at a much lower rate, suggesting that longer exposure to the target language leads to less off-target articulation. Prolonged language use and exposure seems to have an effect on off-target liquid articulation only after the participants have resided in Mexico for 30 years or more. This is when the increase in on-target production seems to take off.

Differences in the linguistic abilities of the participants turned out interesting results. Off-target liquid articulation was moderately favored among those speakers that only speak Cantonese (0.55), and disfavored among those that speak Cantonese and Mandarin (0.40). The quantitative distribution of liquid sound production showed that those participants that spoke Mandarin as an L2, in addition to their L1 Cantonese, produced lower rates of off-target liquid articulations, compared to those that do not speak Mandarin. Despite the fact that the lower rates of off-target liquid sound production among the Cantonese / Mandarin speakers represented only a small difference from the Cantonese only speakers, their linguistic abilities did have a significant impact on liquid production. Nonetheless, this distribution may be difficult to explain. Exposure to classroom-oriented L2 learning may play a role in boosting on-target rates among the Mandarin-speaking participants. These participants have higher levels of education in China, meaning that in learning Mandarin as an L2 —for the most part— they have experienced a previous process of instructed L2 acquisition in their native country. In addition, the possibility that their bilingual abilities result in a cognitive advantage when acquiring Spanish as a third language and in producing on-target liquid sounds, in comparison to the Cantonese monolinguals, must be mentioned, since multilingual speakers may have more extensive phonetic repertoires and more cognitive resources at their disposal.

The effect of sex and age on the variation of the off-target and on-target liquid articulations was not as clear as that of the previous social factors. The analysis of the L2 data showed that male speakers produced off-target liquid articulations at a slightly lower rate (15.6 %) than female speakers (16.4 %). The lack of a significant quantitative distinction between the sexes suggests that liquid sound production is not a typical stylistic variable with a clear-cut social significance assigned to any one particular variant in the sociolinguistic sense. Instead, social significance —if any— comes from a genuine ability to accurately articulate liquid sounds in considerable on-target rates, rather than from the ability to maneuver articulations that are sensible to stylistic differences in speech. What the quantitative results

seem to indicate is that males and females at comparable stages of acquisition will produce similar rates of on-target liquid sounds. Quantitative similarities in the rates of on-target and off-target liquid production between the sexes can be explained by the fact that the sex of the speakers is an ascribed trait; and as such, sex differences are not directly tied to heightened articulatory abilities that—if obtained at all—occur over time as speakers advance in their acquisition of the language.

The age of the speaker at the time of the interview did not turn out significantly different rates of on-target and off-target liquid articulations. Speakers 50 years or older produced off-target articulations at a slightly lower rate (15.0 %) than younger speakers (16.4 %), but once again, the small difference between the two is not a significant predictor of higher rates of production of one articulation over the other. Studies that analyze age differences in community-specific settings interpret balanced rates of variant distribution as suggestive of situations that support the conditions for a more stable variation, while divergent rates of variant production are often interpreted as an allusion to a linguistic change in progress, particularly when the variation that ensues confirms the increase in use of a prestigious or an innovative variant among the younger age groups. Age arrival did not yield a significant effect on the production of liquid sound articulation. The lack of significance is understandable if we consider that participants are not reacting to a given social meaning assigned to the different articulations. Results reveal that the on-target and off-target articulation in the participants' L2 Spanish is not sensitive to age differences.

6. Conclusion

The application of a quantitative analysis contributes to our understanding of the SLA process in the L2 Spanish of our Chinese-origin participants. By accounting for the on-target and the off-target articulations in their L2 Spanish, it has been established that production errors are systematic and that their manifestation in L2 speech is tied to structural, phonotactic, and social factors. For instance, the phonological context in which each articulation was produced seemed to contribute to the relative frequency of on-target and off-target articulations. A higher occurrence of a particular on-target and off-target articulation in the production of each liquid sound goes in tandem with the phonotactic characteristics of the context in which it is articulated, pointing to the importance of new and old articulatory output in L2 speech. A lesser proportion of on-target articulations seemed to point to greater structural divergence between L1 and L2; those sounds produced in phonological contexts more in line with structural patterns present in the L1 confirmed higher rates of on-target production in L2. Nonetheless, more detailed analyses are needed to determine the contribution of factors, such as previous or posterior sound, stress, and frequency to the on-target and off-target distribution in L2 speech.

In addition, it was established that social factors, such as access to education in Mexico, years in the place of L2 acquisition, and linguistic ability are important predictors of L2 articulation. In analyzing the social factors of the participants, it was suggested that a major difference between classroom centered and naturally acquired L2 speech was the amount of time available to master a particular sound. Longer periods of time and more intense levels of exposure seem to be the case in natural

acquisition, as opposed to classroom centered, which —as reported in prior studies— seems to occur at a faster pace, often from one level of study to another (Face, 2006; Geeslin & Gudmestad, 2010). In comparing the L2 Spanish of advanced, English-speaking learners to that of L1 speakers, Geeslin & Gudmestad (2010) found that the distribution of subject expression, copula contrast, mood distinction, past-time reference, and future time in L2 mirrored that in the target language. The differences found involved only some minor discrepancies in the rates of the factors examined. In their study of the L2 French of English speakers in Montreal, Nagy et al. (1996) pointed out that L1 interference or transfer do not seem to be the determinant in the acquisition of variable phonology. Rather, social factors, such as the amount of French exposure in formal and informal settings and the level of French competence proved more influential in shaping the patterns of variation in L2 speakers. In general, speakers with higher levels of competence in French and with more exposure to the local variety produced rates more in line with the patterns of L1 speakers in the area. Thus, higher rates of on-target variants among the Chinese-origin participants suggest that constant exposure to input and continued opportunities for output in the target language are important contributors in mastering on-target liquid sound articulations.

The present analysis has shed some light on the way that phonological competence is acquired in a situation of natural L2 acquisition. The production of on-target and off-target articulations was clearly constrained by the ease and difficulty faced by speakers in the articulation of each of the four liquid sounds. Laterals were produced on-target at higher rates, followed by taps, rhotics, and finally trills, suggesting greater to lesser ease of articulation. The quantitative analysis showed that liquid production is a highly unstable process with each sound showing two or more off-target possibilities, in addition to the on-target production. Participants seemed to follow universal trends in their production of liquids in their L2 Spanish, such as high deletion rates in syllable-coda contexts, simplification in consonant clusters, hypercorrection in hazy contexts in lateral production, and the use of a retroflex sound from their previously learned language. The rates of the off-target variants, in general, matched acquisition patterns attested in learners acquiring Spanish as an L2.

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