Revisiting the Effect of Speech Style on L2 Acquisition of Spanish Voiceless Stops

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Abstract

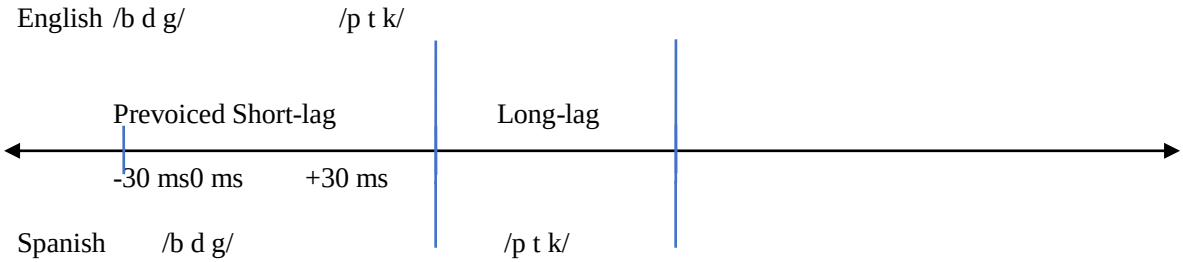
This study investigates the effect of speech style on second language (L2) Spanish learners' acquisition of voiceless stop /p t k/ consonants. Nine L1 English-speaking L2 Spanish learners enrolled in a third-year composition and conversation course for Spanish majors and minors at a university in the United States participated in the present study. Participants first completed a formal reading task followed by a more informal conversational task. Tokens of target sounds on both tasks appeared in absolute initial (i.e., following a pause), word-initial intervocalic, and word-internal intervocalic positions to examine whether utterance/word position affects learners' overall production of Spanish voiceless stops. Acoustic analysis in Praat revealed that learners generally produced shorter overall voice onset times (VOTs) on the more formal reading task than the more informal conversational task, and they produced word-initial /p t k/ with significantly longer VOTs than word-internal /p t k/. ANOVA results showed an interaction between speech style and phoneme, indicating that the effect of speech style on learners' mean VOT depends on the individual target voiceless stop consonant.

Keywords: L2 Spanish, voice onset time, voiceless stop consonants, speech style

1. Introduction

Although the phonological inventories of both English and Spanish contain voiceless stop /p t k/ consonants, which together with their voiced counterparts /b d g/ are the most common sounds among the world's languages (Ladefoged, 2001; Ladefoged&Maddieson, 1996), acquisition of Spanish voiceless stops poses a challenge to first language (L1) English-speaking second language (L2) learners because the phonetic implementation of these sounds in English and Spanish is different. The primary phonetic difference between English and Spanish voiceless stops concerns voice onset time (VOT), which is the interval between the release of the stop closure and the beginning of vocal fold vibration in the following vowel. Voiceless stops in English are produced with aspiration, leading to a longer amount of time that elapses between the release of the stop closure and the onset of voicing in the following vowel and thus to longer VOT values. Since voicing in the following vowel typically begins between 58 and 90 milliseconds (ms) after the release of the closure, English voiceless stops are described as being produced with long-lag VOT (Flege, 1982; Flege&Eefting, 1986; Lisker& Abramson, 1964). On the other hand, voiceless stops in Spanish are unaspirated, leading to a shorter amount of time that elapses between the release of the stop closure and the beginning of vocal fold vibration in the following vowel and consequently to shorter VOT values. Since voicing in the following vowel typically starts between 0 and 30 msafter the release of the closure, Spanish voiceless stops are described as being produced with short-lag VOT (Casteñada Vicente, 1986; Flege&Eefting, 1986; Lisker& Abramson, 1964; Rosner et al., 2000; Williams, 1977). Given the acoustic difference – long-lag voicing in English and short-lag voicing in Spanish – associated with the same class of sounds, L1 English-speaking L2 Spanish learners must learn to shorten their VOT of /p t k/ in Spanish. However, short-lag voicing is not new to L1 English speakers, as voiced stops in English are produced with short-lag VOT (Zampini, 2014, 2019). The overlap in VOT values between English voiced stops and Spanish voiceless stops is illustrated in Figure 1.

Figure 1: Representation of VOT differences between Spanish and English stops (adapted from Zampini, Clarke, & Green, 2000)



L2 acquisition of Spanish voiceless stop consonants by L1 English speakers has been investigated quite extensively, with research focusing on the relationship between learners' productive and perceptive abilities (Kissling, 2013; Reeder, 1998; Zampini, 1998), longitudinal development of Spanish VOT (Nagle, 2017), ultimate attainment of Spanish VOT (Face & Menke, 2020), and the effect of extralinguistic factors, such as explicit pronunciation instruction (Camus, 2019; Elliott, 1997; González-Bueno, 1997a; González López & Counselman, 2013; Kissling, 2013; Lord, 2005; Olson, 2019, 2021), context of learning (Díaz-Campos, 2004, 2006; Díaz-Campos & Lazar, 2003), and speech style (Díaz-Campos, 2006; Elliott, 1997) on acquisition. However, not all of these topics have received equal attention. Perception studies in particular have lagged behind production studies and the question of ultimate attainment of Spanish VOT has only recently begun to be examined. In addition, among studies that have investigated the effect of extralinguistic factors on L2 acquisition of Spanish voiceless stops, explicit pronunciation instruction is the factor that has received the most attention, with context of learning and speech style receiving considerably less attention. Elliott (1997) and Díaz-Campos (2006) are the only studies to date to empirically examine the effect of speech style on L1 English-speaking L2 Spanish learners' acquisition of voiceless stops, finding different effects of speech style on learners' production of these sounds. In addition, since these previous studies examined the effect of speech style in combination with another extralinguistic factor (explicit pronunciation instruction in the case of Elliott (1997) and context of learning in the case of Díaz-Campos (2006)), the effect of speech style alone on L2 learners' acquisition of Spanish voiceless stops is unknown. Speech style is of particular interest to the present study because previous studies have documented its effect on production of different Spanish sounds by a variety of speakers, including L1, heritage, and L2.For example, Harmegnies and Poch-Olivé (1992) and Martín Butragueño et al. (2008)found variation in vowel production across speech styles in L1 Spanish, while Rao (2014) found an effect of speech style on heritage speakers' production of Spanish /b/ and Ronquest (2016) found an effect of speech style on heritage speakers' production of Spanish vowels. In L2 Spanish, speech style has been found to impact learners' production of[b β ð γ] (Zampini, 1994), intervocalic voiced approximants (Díaz-Campos, 2006), syllable-final laterals (Díaz-Campos, 2006), and the palatal nasal (Díaz-Campos, 2006) in addition to voiceless stops (Díaz-Campos, 2006; Elliott, 1997). The present study aims to shed further light on the effect of speech style on L2 acquisition of Spanish /p t k/ by isolating it as the sole extralinguistic factor under investigation.

2. Literature Review

2.1 Speech Style and Major's (1986) Ontogeny Model and (2001) Ontogeny Phylogeny Model

It has long been recognized in sociolinguistic (e.g., Eckert & Rickford, 2001; Labov, 1972) and second language acquisition (e.g., Tarone, 1979, 1982, 1983) research that style affects speech production. In sociolinguistic research (e.g., Eckert & Rickford, 2001; Labov, 1972), style is defined by attention paid to speech. This definition later influenced how the notion of style would be conceptualized in second language acquisition research. Based on Labov's (1972) definition of style, Tarone (1979, 1982, 1983) observed that L2 learners' production varies along a continuum of speech styles defined by the amount of attention paid to speech. Specifically, Tarone proposed that learners' production accuracy increases and transfer phenomena decrease as learners move toward more careful or formal stylesof speech where greater attention is paid to speech, such as a reading task.

Expanding on Tarone's (1979, 1982, 1983) work, the interaction between style and accuracy was further developed in Major's (1986) Ontogeny Model (OM) and (2001) Ontogeny Phylogeny Model (OPM). The OM describes the interaction between transfer processes, which involve applying pre-existing knowledge of linguistic structures and rules from the first language (L1), and developmental processes (language universals) in second language acquisition. Specifically, Major's (1986) OM posits that second language acquisition is a dynamic process in which transfer

decreases over time, while developmental processes increase and then decrease. Therefore, according to this model, only one of the two processes, transfer or developmental, predominates at a given time.Major's (2001) OPM, which is a revision of his earlier OM, similarly describes and makes explicit claims about the interaction between transfer and language universals, but it also specifies the role of L2 in the acquisition process. Specifically, Major's (2001) OPM states that L2 increases, L1 transfer decreases, and developmental processes (universals) increase and then decrease. In other words, as the L2 system develops there is less L1 transfer but a greater reliance on language universals, which subsequently decreases as the L2 system continues developing. The OPM therefore addresses the interrelationship between L1, L2, and U in second language acquisition, and importantly, makes claims about interlanguage development in relation to chronology, style, similarity, and markedness, which the OM did not. Of the four corollaries (Chronological, Stylistic, Similarity, and Markedness) of Major's OPM, the Stylistic Corollary is the most relevant to the present study and thus, the results of this study will be discussed within the context of this corollary.

The Stylistic Corollary of the OPM claims that there is less influence of transfer and greater accuracy as learners move toward more careful or formal styles of speech, such as that produced during a reading task, because as style becomes more formal, the speaker increasingly pays more attention to form. In contrast, in running/casual speech, learners often revert to L1 patterns, making foreign accent more noticeable (Major, 2001). Based on the Stylistic Corollary of the OPM, it is hypothesized that L2 learners in the present study will produce Spanish voiceless stops with shorter, and hence more target-like, VOTs on a more formal reading task than an informal conversational task.

2.2 Previous Studies on Speech Style in Spanish Phonology

The impact of speech style on production of Spanish vowels and consonants has been documented in a broad population of speakers. Despite having different experiences with the language, speech style has been found to affect L1 Spanish speakers', heritage Spanish speakers', and L2 Spanish learners' production of different sound classes in Spanish. In L1 Peninsular Spanish, Harmegnies and Poch-Olivé (1992) found greater vowel centralization in spontaneous speech than laboratory speech and greater clarity between vowel categories in laboratory speech than spontaneous speech. In L1 Mexican Spanish, Martín Butragueño et al. (2008) similarly found greater vowel centralization in spontaneous speech than laboratory speech and greater clarity between vowel categories in laboratory speech than spontaneous speech. Ronquest (2016) documented the effect of speech style on heritage speakers' production of Spanish vowels, finding a general trend of vowel space expansion in controlled speech and, in accordance with Harmegnies and Poch-Olivé (1992) and Martín Butragueño et al. (2008), centralization in spontaneous speech. Ronquest also found that duration of the lowest vowels /a/ and /o/ increased as speech style became more controlled. Focusing on heritage Spanish speakers' production of intervocalic /b/, Rao (2014) found decreases in target-like pure approximant productions and increases instop productions on a reading task compared to a picture description task.

The effect of style on speech production reported in L1 Spanish and heritage Spanish extends to L2 Spanish, as previous studieshave documented an effect of speech style on L2 Spanish learners' production of several sound classes. Zampini (1994) found that second- and fourth-semester L2 Spanish learners produced [b β ð γ] less accurately on a formal reading task than an informal conversational task because of L1 transfer from English due to the negative influence of orthography.On the reading task, learners in Zampini's study pronounced [b] and [β] as a voiced labiodental fricative [v], as in English, in Spanish words containing orthographic "v". In a more recent study, Díaz-Campos (2006) found that students between the second and third semesters of instruction produced intervocalic voiced approximants, syllable-final laterals, and the palatal nasal more accurately on an informal conversational task than a formal reading task. With respect to the effect of speech style on L1 English-speaking L2 Spanish learners' acquisition of voiceless stops, Elliott (1997) found that intermediate learners who received explicit phonetics instruction produced Spanish /p t k/ more accurately on three formal tasks (word repetition, sentence repetition, and word reading) than on a less formal picture description task. However, in contrast to Elliott (1997),Díaz-Campos (2006) found that both at home (AH) and study abroad (SA) learners favored more target-like production of Spanish /p t k/ in a conversational style, with SA learners producing more target-like variants in the conversational style than AH learners. Both groups, AH and SA learners alike, equally disfavored target-like variants of Spanish /p t k/ on the formal reading task. Díaz-Campos (2006) attributes these findings to the fact that SA students have more contact with L1 Spanish speakers in different daily life situations, so their production is more likely to improve in informal contexts. Indeed, Díaz-Campos and Lazar (2003) found that students who used Spanish outside of the classroom more regularly in informal situations favored target-like variants of voiceless stops.

While the findings from previous studies examining stylistic variation in monolingual and bilingual speech provide evidence that Spanish vowels and several classes of consonants produced by L1 speakers, heritage speakers, and L2 learners vary systematically based on style, it is not yet clear how L2 Spanish learners' production of voiceless stops varies based on style since Elliott (1997) and Díaz-Campos (2006) found different effects of speech style on learners' production of these sounds. The effect of speech style alone on L2 learners' acquisition of Spanish voiceless stops is unknown because previous studies investigated the effect of speech style in combination with another extralinguistic factor. Therefore, the present study aims to shed further light on the effect of speech style on L2 acquisition of Spanish /p t k/ by isolating it as the sole extralinguistic factor under investigation.

2.3 Linguistic Variables and Spanish VOT

Studies on VOT in L1 Spanish have found that VOT production varies according to place of articulation, asL1 speakers across dialects produce the voiceless velar stop /k/ with longer VOTs than the voiceless bilabial stop /p/ and voiceless dental stop /t/(Lisker& Abramson, 1964; Michnowicz & Carpenter, 2013; Rosner et al., 2000; Williams, 1977).Most previous studies found that /p/ is produced with the shortest VOT (Lisker & Abramson, 1964;Michnowicz& Carpenter, 2013;Williams, 1977), while Rosner et al. (2000) found that /t/ (14.05 ms) is produced with a slightly shorter VOT than /p/ (15.5 ms) in Castilian Spanish. However, all these previous studies on VOT in L1 Spanish found that of the voiceless stops, /k/ is produced with the longest VOT. Given these place of articulation effects on VOT in L1 Spanish, place of articulation is included as a linguistic variable in the present study.

Since utterance and word position have been shown to affect VOT production by L1 Spanish (Michnowicz & Carpenter, 2013) and L2 Spanish (Face & Menke, 2020) speakers, these linguistic variables are also included in the present study. Michnowicz and Carpenter (2013) found that L1 speakers of Yucatan Spanish produced voiceless stops with longer VOTs in word-initial and in utterance-initial positions than in word-medial and utterance-medial positions, respectively. More recently, Face and Menke (2020) reported that long-time native English-speaking residents of Spain who began learning Spanish as an L2 after the age of six produced voiceless stops with significantly longer VOTs in utterance-initial position than in word-medial position. Following Face and Menke (2020) and to facilitate comparison of data by the same participants across tasks, the present study examines L2 learners' acquisition of Spanish voiceless stops in absolute initial (i.e., following a pause), word-initial intervocalic, and word-internal intervocalic positions.

In addition to utterance and word position, stress is another contextual variable that has received some attention in recent years. However, few studies have investigated the effect of stress on VOT production specifically in L1 and L2 Spanish, finding no significant difference in VOT production in stressed and unstressed syllables (Face & Menke, 2020; Simonet et al., 2014). Because previous L1 and L2 studies of Spanish VOT found that stress does not significantly affect VOT production, it is not considered in the present study.

2.4 Research Questions

Motivated by the information presented in prior sections, the present study addresses the following research questions:

1. How does speech style (formal/informal) affect L1 English-speaking L2 Spanish learners' acquisition of voiceless stop /p t k/ consonants?Do L1 English-speaking L2 Spanish learners produce Spanish /p t k/ with shorter VOTs on a moreformalreadingtask ormore informal conversational task?
2. Does utterance/word position affect L1 English-speaking L2 Spanish learners' overall production of voiceless stop /p t k/ consonants?

3. Methodology

3.1 Participants

Nine L1 English-speaking L2 Spanish learners enrolled in a third-year composition and conversation course for Spanish majors and minors at a university in the Midwestern United States participated in the present study. Similar to the participants in Olson (2014, 2019, 2021), all of the L2 Spanish learners in the present study placed into the third-year course via a standardized placement exam or successful completion of the preceding first- and second-year sequence of language courses, ensuring similar proficiency levels. The Spanish course in which students were enrolled at the time of the study met two times per week for three hours and 50 minutes each week. This course and previous courses in which study participants were enrolled did not address Spanish pronunciation.

Self-reported biographical data, summarized in Table 1, were obtained from learners through a questionnaire adapted from Kissling (2013), which included questions about previous and current L2 study. As reported in Table 1, L2 Spanish learners' age ranged from 18 to 20 years, with a mean of 18.7. Study participants reported similar prior

experience with Spanish, as all had studied the language for four years in high school and had completed, on average, 6.2 years of L2 Spanish study. Finally, study participants were also similar with respect to time spent abroad, as they either had not spent any or little time abroad. Moreover, those students who had spent time abroad, traveled for leisure rather than for language study. Complete learner background characteristics are provided in Table 1.

Table 1: L2 Spanish learners' background characteristics

Learner	Age	Gender	Years of L2 Study Completed	TimeSpent Abroad(In weeks)
1	19	Female	6	2
2	18	Female	4.5	0
3	19	Male	13	4
4	20	Male	7	3
5	18	Female	5	4
6	19	Female	5	2
7	19	Female	5	1.5
8	18	Female	5.5	0
9	18	Female	4.5	0

In addition, an L1 Spanish speaker from Lima, Peru also participated in the study to provide a basis of comparison for the L2 learners' data. The L1 Spanish-speaking participant is a Spanish professor, with a Ph.D. in Spanish literature, at a different university than the one L2 Spanish learners were attending. He is 38 years old and has lived in the United States for 13 years. These self-reported biographical datawere obtained from the L1 Spanish speaker through a questionnaire adapted from Kissling (2013). No participants, the L1 Spanish speaker or L2 Spanish learners, had formal knowledge of linguistics or Spanish phonetics and phonology. All participants were naïve as to the purpose of the study.

3.2 Materials and Tasks

To investigate the effect of speech style on L1 English-speaking L2 Spanish learners' acquisition of voiceless stop /p t k/ consonants, participants performed two production tasks of differing formality similar to Elliott (1997) and Díaz-Campos (2006). According to Zampini (1994), "formal tasks used to investigate variation in L2 pronunciation include the reading of word lists or paragraphs, while conversations and spontaneous speech typify more informal tasks" (p. 472).Participants first completed the formal task in which they read aloud, at a normal pace, a one-page passage about urbanization in Latin America taken from the textbook, *Tradición y Cambio*, used in the Spanish course in which students were enrolled at the time of the study. Students had not previously read this passage and were therefore unfamiliar with it. A passagerather than a word list was used for the formal reading task because as Face and Menke (2009) state, "it allows subjects to immerse themselves in a coherent text, which is less devoid of meaning than a list of words" (p. 42). After completing the formal reading task, each L2 learner engaged in a 10- to 15-minute conversation in Spanish with the researcher. Conversation topics included the student's field of study, family, hobbies, and daily routine, among others.

The L1 Spanish-speaking participant performed the same tasks in the same order as the L2 Spanish learners. Each participant met individually with the researcher in a quiet office. All participant productions were audio-recorded using a Marantz professional solid state recorder PMD660 and head-mounted microphone.

3.3 Data Analysis

Tokens of voiceless stops /p t k/ were taken from throughout the passage and the same tokens were analyzed for each participant. Twenty tokens of each voiceless stop were identified in the text for analysis, meaning that 60 tokens per participant were analyzed for a total of 600 stop tokens from the reading task (60 tokens x 10 participants = 600). However, 28 tokens of /p t k/, produced by L2 Spanish learners, were eliminated from the passage reading analysis because they either lacked a stop burst, which made it difficult to measure VOT, or because the learner did not produce the target word. Eliminated tokens were distributed as follows: twenty-five /p/, one /t/, and two /k/. After removing these tokens, a total of 512 tokens of /p t k/ were analyzed from L2 learners' readings. All sixty tokens identified for analysis in the L1 Spanish speaker's passage reading were included.

Twenty tokens of each voiceless stop were extracted from each conversation and analyzed, meaning that 60 tokens per participant were analyzed for a total of 600 stop tokens from the conversational task (60 tokens x 10 participants = 600). However, to make for an equal comparison, 28 tokens of /p t k/, divided the same way as the tokens eliminated from the L2 reading data, were excluded from the L2 conversational data. All sixty tokens identified for analysis in the L1 Spanish speaker's conversation were included. A total of 1,024 (512 from the passage readings + 512 from the conversations) L2 learner productions of /p t k/ were analyzed between the two tasks, while a total of 120 (60 from the passage reading + 60 from the conversation) L1 Spanish productions of /p t k/ were analyzed.

Working with both scripted (i.e., passage reading) and spontaneous speech (i.e., informal conversation) data presents challenges, as scripted speech yields a finite data set across participants, while spontaneous speech data is likely to be more varied since it is not possible to control participants' productions. However, there are, of course, also methodological advantages to including both data sources in an analysis, as scripted speech provides more uniform data across participants and spontaneous speech data are more authentic. Despite the aforementioned challenges of working with scripted and spontaneous speech data, every attempt was made to balance tokens of voiceless stops across the linguistic factors under consideration in the present study: place of articulation (bilabial, dental, velar) and word position (absolute initial, word initial, word internal) while not compromising the total number of target tokens analyzed from each task.

Participants' productions from both tasks were analyzed acoustically using Praat v.6.2.12 (Boersma &Weenink, 2022) signal-processing software. Using the waveform and spectrogram in Praat, VOT of /p t k/ was measured in ms as the interval between the release of the stop closure and the beginning of voicing in the following vowel (González-Bueno, 1997a; Zampini, 1998), as shown in Figures 2 and 3.

Figure 2: L2 Spanish learner's production of /k/, with a VOT of 67 ms, in "como" from the reading task

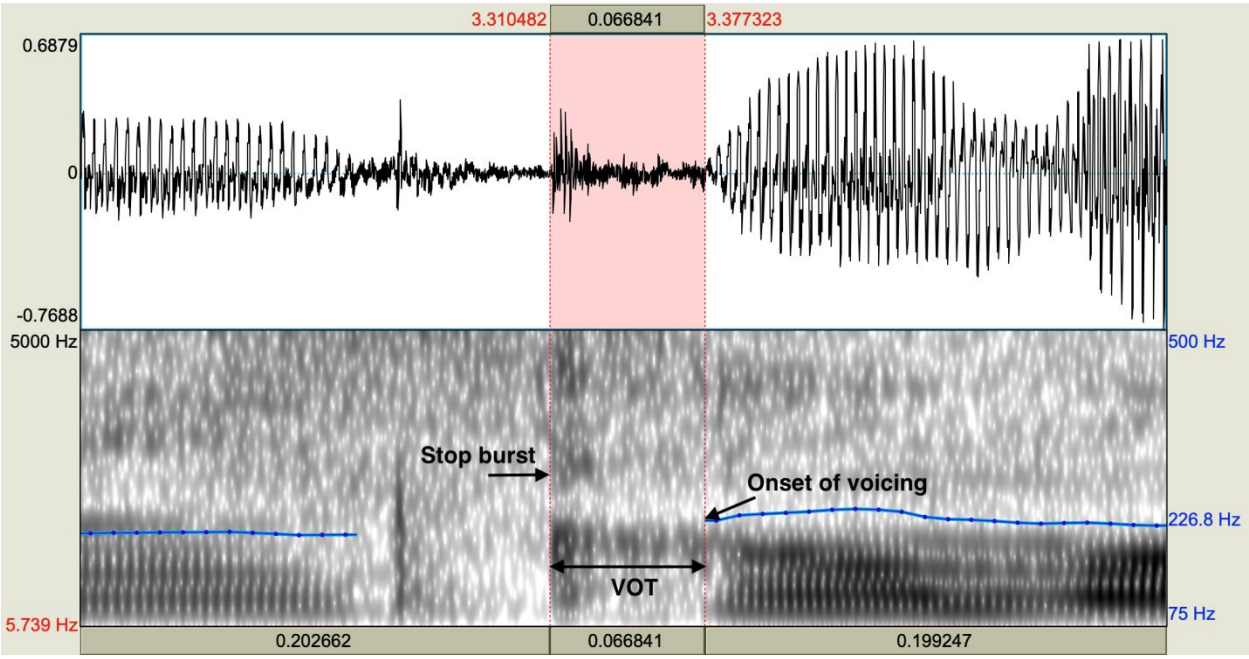
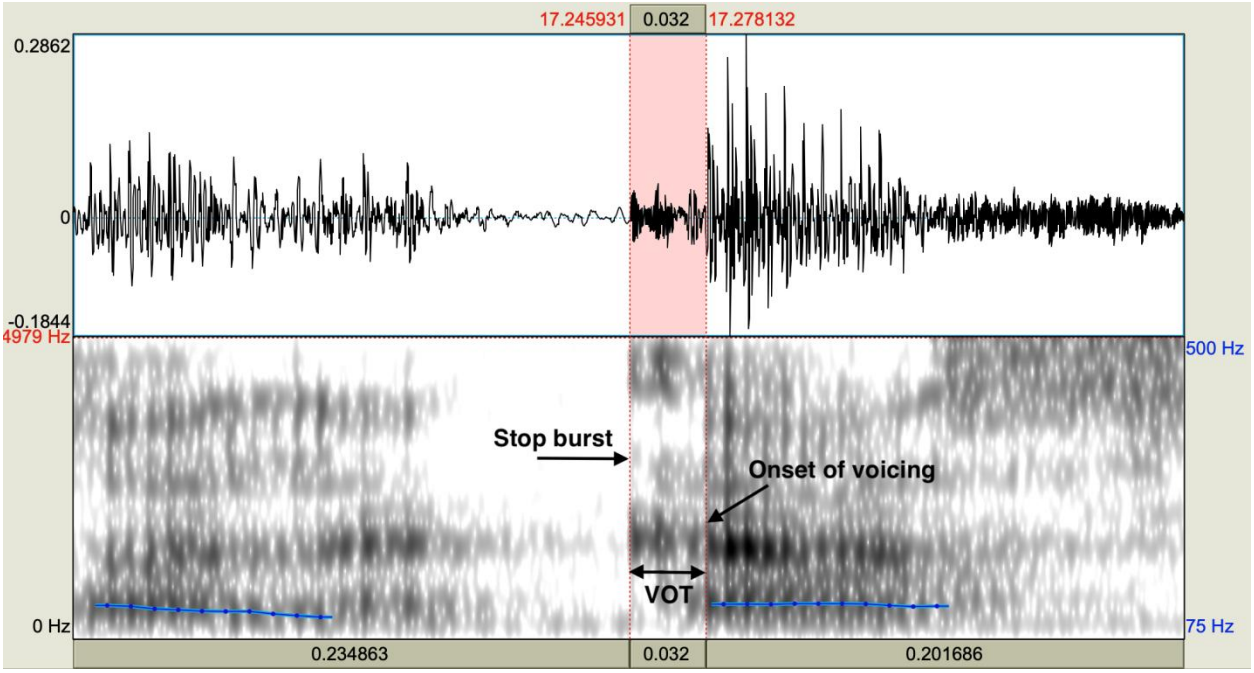


Figure 3: L1 Spanish speaker's production of /k/, with a VOT of 32 ms, in "caza" from the reading task



Following the acoustic analysis in Praat, the data were submitted to statistical analysis in SPSS (Statistical Package for the Social Sciences, 2021). First, descriptive statistics – including mean, standard deviation, and range – for VOT of voiceless stops produced by the L2 Spanish learners and L1 Spanish speaker on both tasks were obtained. Analysis of variance (ANOVA) was then performed on the data to answer the research questions about the potential effect of speech style on L1 English-speaking L2 Spanish learners' production of voiceless stops and whether utterance/word position has a differential effect on their production of these sounds. Specifically, a three-factor (one between-subjects factor: speech style and two within-subjects factors: sound and word position) ANOVA was performed on the data, with mean VOT as the dependent variable. In addition, a separate three-factor (one between-subjects factor: speaker level and two within-subjects factors: speech style and sound) ANOVA was performed on the data, with mean VOT as the dependent variable, to determine whether there was a significant difference between L2 Spanish learners' and the L1 Spanish speaker's production of VOT based on speech style and the individual target sound.[1] Post-hoc Tukey HSD tests were subsequently carried out to determine the nature of significant findings revealed by the ANOVAs. The level of significance was set at $p = 0.05$ for all statistical tests.

4. Results

4.1 Results of the Formal Reading Task

Descriptive statistics for VOT of Spanish voiceless stops /p t k/ produced on the formal reading task are reported in Tables 2 and 3. The 1,144 tokens of /p t k/ analyzed are broken down by speaker (L1 Spanish speaker/L2 Spanish learners), phoneme, and word position in Tables 2 and 3. Included in these tables are mean VOT values, standard deviations, and the range of VOTs produced.

[1] Speaker level refers to L1 Spanish speaker and L2 Spanish learners.

Table 2: Descriptive statistics for L1 Spanish speaker's VOT of /p t k/ from formal reading task

PHONEME	WORD POSITION	N	MEAN (MS)	STANDARD DEVIATION	RANGE
/p/	Absolute initial	4	14.0	2.6	11:17
	Word initial	9	12.6	1.6	10:15
	Word internal	7	13.6	4.0	8:19
	Total	20	13.2	2.7	8:19
/t/	Absolute initial	2	21.0	8.5	15:27
	Word initial	6	19.5	4.8	13:26
	Word internal	12	18.1	3.3	14:26
	Total	20	18.8	4.1	13:27
/k/	Absolute initial	2	30.5	2.1	29:32
	Word initial	9	32.1	8.6	20:50
	Word internal	9	29.0	7.7	18:39
	Total	20	30.6	7.7	18:50

Table 3: Descriptive statistics for L2 Spanish learners' VOT of /p t k/ from formal reading task

PHONEME	WORD POSITION	N	MEAN (MS)	STANDARD DEVIATION	RANGE
/p/	Absolute initial	32	39.3	20.1	9:92
	Word initial	72	50.1	26.7	10:127
	Word internal	51	44.3	24.2	9:109
	Total	155	46.0	24.8	9:127
/t/	Absolute initial	18	46.4	13.8	21:67
	Word initial	54	60.2	28.0	14:137
	Word internal	107	46.5	25.2	12:120
	Total	179	50.6	25.9	12:137
/k/	Absolute initial	18	54.7	12.8	26:84
	Word initial	80	58.2	20.7	15:124
	Word internal	80	47.7	19.5	13:107
	Total	178	53.1	20.1	13:124

As observed in Table 2, the overall mean VOT for each voiceless stop consonant produced by the L1 Spanish-speaking participant on the formal reading task was within the short-lag range of 0 to 30 ms reported in the literature (Casteñada Vicente, 1986; Lisker& Abramson, 1964; Rosner et al., 2000; Williams, 1977).Consistent with findings from previous studies on VOT in L1 Spanish, the L1 Spanish-speaking participant in the present study produced /p/ with the shortest VOT (13.2 ms) and /k/ with the longest VOT (30.6 ms) on the reading task. With respect to utterance/word position, the L1 Spanish speaker in the present study produced /p/ and /t/ with the longest mean VOT in absolute initial position, while he produced /k/ with the longest mean VOT in word-initial position. He produced /p/ with the shortest mean VOT in word-initial position, but /t/ and /k/ with the shortest mean VOTs in word-internal position. It is possible that the L1 Spanish speaker produced /k/ with a slightly shorter mean VOT in absolute initialthan in word-initial position because despite the obligatory pausal context, he did not always pause before producing tokens of /k/ in absolute initial position.

A comparison of Tables 2 and 3 reveals that the L2 Spanish learners in the present study produced voiceless stops with longer mean VOTs than the L1 Spanish-speaking participant in all cases on the formal reading task. However, similar to the L1 Spanish speaker in this study and to findings from previous studies on VOT and place of articulation in L1 Spanish (Lisker& Abramson, 1964; Michnowicz & Carpenter, 2013; Rosner et al., 2000; Williams, 1977), the L2 learners produced /p/ with the shortest VOT (46 ms) and /k/ with the longest VOT (53.1 ms) on the reading task. With respect to utterance/word position, L2 Spanish learners produced each voiceless stop with the longest mean VOT in

word-initial position, while they produced /p/ and /t/ with the shortest mean VOT in absolute initial position, but /k/ with the shortest mean VOT in word-internal position.

4.2 Results of the Informal Conversational Task

Descriptive statistics for VOT of Spanish voiceless stops /p t k/ produced on the informal conversational task are reported in Tables 4 and 5. The 1,144 tokens of /p t k/ analyzed are broken down by speaker (L1 Spanish speaker/L2 Spanish learners), phoneme, and word position in Tables 4 and 5. Included in these tables are mean VOT values, standard deviations, and the range of VOTs produced.

Table 4: Descriptive statistics for L1 Spanish speaker's VOT of /p t k/ from informal conversational task

PHONEME	WORD POSITION	N	MEAN (MS)	STANDARD DEVIATION	RANGE
/p/	Absolute initial	1	7.0		7:7
	Word initial	15	14.3	4.0	7:23
	Word internal	4	11.3	2.4	8:13
	Total	20	13.3	4.1	7:23
/t/	Absolute initial	1	16.0		16:16
	Word initial	13	18.8	4.1	13:28
	Word internal	6	18.0	5.1	10:23
	Total	20	18.5	4.2	10:28
/k/	Absolute initial	0			
	Word initial	12	30.0	6.4	20:38
	Word internal	8	33.3	8.3	20:44
	Total	20	31.3	7.2	20:44

Table 5: Descriptive statistics for L2 Spanish learners' VOT of /p t k/ from informal conversational task

PHONEME	WORD POSITION	N	MEAN (MS)	STANDARD DEVIATION	RANGE
/p/	Absolute initial	14	41.1	19.2	15:75
	Word initial	124	44.9	21.7	10:148
	Word internal	17	29.8	12.9	10:53
	Total	155	42.9	21.1	10:148
/t/	Absolute initial	26	58.1	25.9	15:127
	Word initial	97	57.4	25.2	10:115
	Word internal	56	51.7	34.4	16:157
	Total	179	55.7	28.4	10:157
/k/	Absolute initial	16	69.9	22.9	27:125
	Word initial	92	63.8	24.0	25:131
	Word internal	70	56.9	29.9	17:157
	Total	178	61.7	26.6	17:157

As indicated in Table 4, the overall mean VOTs for /p/ and /t/ produced by the L1 Spanish-speaking participant on the informal conversational task were within the short-lag range of 0 to 30 ms, while the overall mean VOT of 31.3 ms for /k/ was just above the short-lag range. Aligning with the findings for place of articulation in the L1 and L2 reading task data reported in Tables 2 and 3 and with findings from previous studies on VOT in L1 Spanish, the L1 Spanish-speaking participant in the present study produced /p/ with the shortest VOT (13.3 ms) and /k/ with the longest VOT (31.3 ms) on the conversational task. With respect to utterance/word position, the L1 Spanish speaker in this study produced /p/ and /t/ with the longest mean VOT in word-initial position, while he produced /k/ with the longest mean VOT in word-internal position. For /p/ and /t/, the L1 Spanish speaker produced the shortest mean VOTs in absolute initial position; however, there was only one token each of /p/ and /t/ in absolute initial position on the conversational

task. Similar to the L1 reading task data for /k/, it is likely that his shorter mean VOTs for /p/ and /t/ in absolute initial position on the conversational task are due to a lack of pauses before these tokens despite the obligatory pausal context. For /k/, the L1 Spanish-speaking participant produced the shortest mean VOT in word-initial position.

Similar to the reading task data, L2 Spanish learners produced voiceless stops with longer mean VOTs than the L1 Spanish-speaking participant in all cases on the informal conversational task.L2 Spanish learners produced /p/ with the shortest VOT (42.9 ms) and /k/ with the longest VOT (61.7 ms) on the conversational task, which aligns with findings from the reading task reported in Tables 2 and 3 and with findings from previous studies on VOT and place of articulation in L1 Spanish (Lisker & Abramson, 1964; Michnowicz & Carpenter, 2013; Rosner et al., 2000; Williams, 1977). With respect to utterance/word position, as observed in Table 5, L2 Spanish learners produced /p/ with the longest mean VOT in word-initial position, but /t/ and /k/ with the longest mean VOTs in absolute initial position on the conversational task. In contrast, L2 Spanish learners produced each voiceless stop with the shortest mean VOT in word-internal position on the conversational task.

4.3 Results of the Statistical Analysis

The results of the three-factor (one between-subjects factor: speaker level and two within-subjects factors: speech style and phoneme) ANOVA on L2 Spanish learners' and the L1 Spanish speaker's mean VOT of voiceless stops are reported in Table 6.

Table 6: Results of the ANOVA on L2 Spanish learners' and the L1 Spanish speaker's mean VOT of /p t k/

SOURCEOF VARIATION	SUMOF SQUARES	Df	MEAN SQUARE	F	SIG.	PARTIAL ETA SQUARED
Speaker level	101374.502	1	101374.502	183.142	.001*	.139
Speech style	362.335	1	362.335	.655	.419	.001
Phoneme	16798.670	2	8399.335	15.174	.001*	.026
Speaker level x Speech style	299.573	1	299.573	.541	.462	.000
Speaker level x Phoneme	1177.814	2	588.907	1.064	.345	.002
Speech style x Phoneme	685.837	2	342.919	.620	.538	.001
Speaker level x Speech style x Phoneme	593.711	2	296.856	.536	.585	.001
Error	626593.852	1132	553.528			

*p < 0.05

The ANOVA revealed a main effect of speaker level (F (1, 1132) = 183.142, p< .001, η^2= .139) on participants' mean VOT, as the L1 Spanish-speaking participant produced voiceless stops with significantly shorter mean VOTs than the L2 Spanish learners.[2] There is also amain effect of phoneme (F (2, 1132) = 15.174, p< .001, η^2= .026)on participants' mean VOT, as the L1 Spanish speaker's and L2 learners' mean VOT of /p t k/ differed significantly based on the individual phoneme.[3]However, there is not a main effect of speech style, as the mean VOT of voiceless stops produced by the L1 Spanish-speaking participant and L2 Spanish learners did not differ significantly between the formal reading task and informal conversational task (F (1, 1132) = .655, p = .419, η^2= .001). In addition, none of the interactions are significant. The non-significant interaction between speaker level and speech style (F (1, 1132) = .541, p= .462, η^2= .000) and the non-significant interaction between speaker level and phoneme (F (2, 1132) = 1.064, p= .345, η^2= .002)

[2] Citing Cohen (1988), Eddington (2015) states that "for ANOVA, partial eta^2 values around .01 show a weak effect, those around .06, a medium effect, and values of about .14 and larger, a large effect" (p. 66). Based on this, the value of .139 indicates a large effect size.

[3] Citing Cohen (1988), Eddington (2015) states that "for ANOVA, partial eta^2 values around .01 show a weak effect, those around .06, a medium effect, and values of about .14 and larger, a large effect" (p. 66). Based on this, the value of .026 is between a weak and medium effect.

indicate that the effect of speaker level on participants' mean VOT does not depend on speech style or on the individual target phoneme, respectively. Similarly, the interaction between speech style and phoneme (F (2, 1132) = .620, p= .538, η^2= .001) is not significant, suggesting that the effect of the individual target phoneme on participants' VOT production does not depend on speech style. Finally, the non-significant three-way interaction between speaker level, speech style, and phoneme (F (2, 1132) = .536, p= .585, η^2= .001) indicates that the effects of speaker level and phoneme on participants' VOT production do not depend on speech style.

Post-hoc Tukey HSD tests revealed that the mean VOT difference of /p/ and /t/ (p< .001) and that of /p/ and /k/ (p< .001) were significant, as both the L1 Spanish-speaking participant and L2 Spanish learners produced /p/ with a significantly shorter mean VOT than /t/ and /k/, respectively, on both tasks. Similarly, post-hoc testing indicated that the mean VOT difference of /t/ and /k/ (p< .007) was significant, as both the L1 Spanish speaker and L2 learners produced /t/ with a significantly shorter mean VOT than /k/ on both tasks.

The results of the three-factor (one between-subjects factor: speech style and two within-subjects factors: phoneme and word position) ANOVA on L2 Spanish learners' mean VOT of voiceless stops are reported in Table 7.

Table 7: Results of the ANOVA on L2 Spanish learners' mean VOT of /p t k/

SOURCE OF VARIATION	SUM OF SQUARES	Df	MEAN SQUARE	F	SIG.	PARTIAL ETA SQUARED
Speech style	1304.449	1	1304.449	2.183	.140	.002
Phoneme	28864.596	2	14432.298	24.154	.001*	.046
Word position	16202.237	2	8101.119	13.558	.001*	.026
Speech style x Phoneme	6371.430	2	3185.715	5.332	.005*	.010
Speech style x Word position	2556.685	2	1278.342	2.139	.118	.004
Phoneme x Word position	1353.970	4	338.492	.567	.687	.002
Speech stylex Phoneme x Word position	2001.745	4	500.436	.838	.501	.003
Error	601096.644	1006	597.512			

*p < 0.05

The ANOVA did not reveal a main effect of speech style, as L2 Spanish learners' overall mean VOT of voiceless stops did not differ significantly between the formal readingand informal conversational tasks (F (1, 1006) = 2.183, p = .140, η^2= .002). However, there is a main effect of phoneme (F (2, 1006) = 24.154, p< .001, η^2= .046) and of utterance/word position (F (2, 1006) = 13.558, p < .001, η^2= .026), as L2 learners' mean VOT of /p t k/ differed significantly based on the individual target phoneme and its position within utterances and words.[4]In addition, the interaction between speech style and phoneme (F (2, 1006) = 5.332, p< .005, η^2= .010) is significant, indicating that the effect of speech style on learners' mean VOT depends on the individual target voiceless stop consonant. Despite the significant interaction between speech style and phoneme, the remaining three interactions are not significant. The non-significant interaction between speech style and word position (F (2, 1006) = 2.139, p= .118, η^2= .004) indicates that the effect of word position on L2 Spanish learners' mean VOT does not depend on speech style. Similarly, the interaction between phoneme and word position (F (4, 1006) = .567, p= .687, η^2= .002) is not significant, suggesting that the effect of the individual target phoneme on learners' VOT production does not depend on its position within an utterance or word. Finally, the non-significant three-way interaction between speech style, phoneme, and word position (F (4, 1006) = .838, p= .501, η^2= .003) indicates that the effects of phoneme and word position on L2 Spanish learners' VOT production do not depend on speech style.

[4] Citing Cohen (1988), Eddington (2015) states that "for ANOVA, partial eta^2 values around .01 show a weak effect, those around .06, a medium effect, and values of about .14 and larger, a large effect" (p. 66). Based on this, the value of .046 approximates a medium effect, while the value of .026 is between a weak and medium effect.

Post-hoc Tukey HSD tests revealed that L2 Spanish learners' mean VOT of /p/ was significantly different from that of /t/ ($p < .001$) and that of /k/ ($p < .001$), as they produced /p/ with a significantly shorter mean VOT than /t/ and /k/, respectively. Post-hoc Tukey HSD tests indicated that the difference between L2 Spanish learners' mean VOT of /t/ and /k/ was approaching significance but was not significant ($p = .053$). Post-hoc Tukey HSD tests on utterance/word position revealed that only the difference between learners' mean VOT of target sounds in word-initial and word-internal positions ($p < .001$) was significant, as they produced voiceless stops in word-initial position with a significantly longer mean VOT than in word-internal position. Finally, post-hoc Tukey HSD tests indicated that the difference between L2 Spanish learners' mean VOT of voiceless stops in absolute initial and word-initial positions ($p = .185$) was not significant and the difference between their VOT of target sounds in absolute initial and word-internal positions ($p = .640$) was also not significant. The findings from the three-factor ANOVA on L2 Spanish learners' mean VOT of voiceless stops will be further discussed in the context of the research questions, presented in Section 2.4, and results of previous studies in Section 5.

5. Discussion

5.1 Research Question #1

The first research question asked how speech style (formal/informal) affects L1 English-speaking L2 Spanish learners' acquisition of voiceless stop /p t k/ consonants. In other words, do L1 English-speaking L2 Spanish learners produce Spanish /p t k/ with shorter VOTs on a more formal reading task or more informal conversational task? The results of the ANOVA, reported in Table 7 in Section 4.3, revealed a significant interaction between speech style and phoneme (F (2, 1006) = 5.332, $p < .005$, $\eta^2 = .010$), indicating that speech style affects L2 Spanish learners' VOT production of voiceless stops for select sounds only.Based on the Estimated Marginal Means, speech style is likely significant for only /t/ and /k/, as the difference in mean VOT between the formal reading and informal conversational tasks was largest for /k/ (8.54 ms) and /t/ (5.07 ms). The difference in mean VOT between the formal reading and informal conversational tasks for /p/ was smaller at 3.08 ms. The L2 learners in this study produced /t/ and /k/ with shorter overall mean VOTs on the more formal reading task, while they produced /p/ with a shorter overall mean VOT on the more informal conversational task, as observed in Table 8.

Table 8: L2 Spanish learners' overall mean VOT of /p t k/ by task

TASK	SOUND	TOTAL MEAN VOT (MS)
Formal reading task	/p/	46.0
	/t/	50.6
	/k/	53.1
Informal conversational task	/p/	42.9
	/t/	55.7
	/k/	61.7

It is possible that this unexpected finding may be attributed to an imbalance in the number of target tokens of /p/ between the reading and conversational tasks. Specifically, the difference in target word-initial tokens of /p/ between the two tasks, at 52, is larger than the difference between target absolute initial tokens of /p/, at 18, and the difference between target word-internal tokens of /p/, at 34, between the two tasks. The 52 additional tokens of word-initial /p/ with a shorter mean VOT on the conversational task could be driving the lower overallVOT of /p/ on the conversational task, as there were substantially fewer tokens of word-initial /p/ with a longer mean VOT on the reading task.

Based on the Stylistic Corollary of Major's (2001) OPM, it was hypothesized earlier that L2 learners in the present study would produce Spanish voiceless stops with shorter VOTs on the more formal reading task than the informal conversational task. The results generally confirm this hypothesis, as learners produced /t/ and /k/with shorter VOTs on the more formal reading task but /p/ with a shorter VOT on the conversational task. Therefore, learners' VOT production of /t/ and /k/ provide support for the claim made by the Stylistic Corollary of the OPM that learners' production is more accurate as speech style becomes more formal. The results of the present study, specifically learners' VOT production of /t/ and /k/, also provide support for Elliott's (1997) results that L2 learners more accurately produce Spanish /p t k/ on formal tasks. In contrast, Díaz-Campos (2006) found that both AH and SA

learners produced Spanish voiceless stops more accurately on a less formal conversational task. The present results and those of Elliott (1997) likely differ from those of Díaz-Campos (2006) because Díaz-Campos found that SA learners produced Spanish /p t k/ in a target-like fashion on the conversational task more than AH learners. Díaz-Campos attributes SA learners' greater accuracy on the conversational task to the fact that they have more contact with L1 Spanish speakers in different daily life situations than AH learners.

5.2 Research Question #2

The second research question asked whether utterance/word position affects L1 English-speaking L2 Spanish learners' overall production of voiceless stop /p t k/ consonants. As observed in Table 7, L2 Spanish learners' mean VOT of /p t k/ differed significantly based on utterance/word position. Specifically, learners produced voiceless stops in word-initial position with a significantly longer mean VOT than in word-internal position. This result is similar to Michnowicz and Carpenter's (2013) finding that L1 speakers of Yucatan Spanish produced voiceless stops with longer VOTs in word-initial and in utterance-initial positions than in word-medial and utterance-medial positions, respectively, and to Face and Menke's (2020) finding that long-time native English-speaking residents of Spain who began learning Spanish as an L2 after the age of six produced voiceless stops with significantly longer VOTs in utterance-initial than in word-medial position.

6. Conclusion

The present study's investigation of L1 English-speaking L2 Spanish learners' production of voiceless stop consonants contributes to our understanding of L2 acquisition of these sounds by focusing on the role of the understudied extralinguistic factor of speech style. While many previous studies have examined L2 acquisition of Spanish voiceless stops by L1 English speakers (Camus, 2019; Díaz-Campos, 2004, 2006; Díaz-Campos & Lazar, 2003; Elliott, 1997; Face & Menke, 2020; González-Bueno, 1997a, 1997b; González López & Counselman, 2013; Kissling, 2013; Lord, 2005; Nagle, 2017; Olson, 2019, 2021; Reeder, 1998; Zampini, 1998), few studies (Díaz-Campos, 2006; Elliott, 1997) have considered the effect of speech style on their acquisition of these sounds, finding different effects of speech style on L2 Spanish learners' production of /p t k/. Furthermore, the effect of speech style on L2 Spanish learners' acquisition of Spanish /p t k/ was not previously well-understood because it was studied in combination with another extralinguistic factor (e.g., explicit pronunciation instruction and context of learning).By isolating speech style as the sole extralinguistic factor under investigation, the present study addresses the effect of speech style alone on L2 learners' acquisition of Spanish voiceless stops.The results of this study indicate that the effect of speech style on learners' mean VOT depends on the individual target voiceless stop consonant.In addition to shedding further light on the effect of speech style, the present study also contributes to our understanding of L2 acquisition of Spanish voiceless stops by providing additional data on learners' VOT production of target sounds in different word positions, finding that they produced word-initial /p t k/ with significantly longer VOTs than word-internal /p t k/.

The results of this study also further point to the continued need for explicit pronunciation instruction on voiceless stop consonants in the L2 Spanish classroom since learners produced /p t k/ with VOTs outside of the short-lag range of 0 to 30 ms reported in L1 Spanish on both tasks. Although L2 Spanish learners in previous studies who received explicit pronunciation instruction on /p t k/ produced VOT values outside of the short-lag range following instruction, they still benefited from such instruction as their VOT values decreased from the pre-instruction to post-instruction periods. It is possible that more sustained pedagogical intervention from first-, second-, and third-year Spanish language classes to upper-level Spanish linguistics or phonetics classes rather than isolated treatment in a single class mayaid L2 learners in reducing their VOT of Spanish voiceless stops even more so that it falls closer to or within the short-lag range of 0 to 30 ms. In addition, this sustained explicit pronunciation instruction across the L2 Spanish curriculum should also incorporate different speech styles, providing learners the opportunity to practice and improve their VOT production of /p t k/ on both formal reading and more informal conversational tasks.

While the present study contributes to our understanding of L2 acquisition of Spanish voiceless stop consonants, it is important to acknowledge that our understanding of the present findings may be limited given the limited number of L2 learners who generously gave of their time to voluntarily participate in the study. To compensate for the relatively small sample size, sixty tokens of /p t k/ from the reading task and sixty tokens of /p t k/ from the conversational task were identified per participant for analysis. Following the removal of some target tokens, described previously in Section 3.3, a total of 1,024 (512 from the passage readings + 512 from the conversations) L2 learner productions of /p t k/ were analyzed between the two tasks. Our understanding of the present findings may also be limited given the imbalance in the number of target tokens of /p/ and /t/, in particular, in certain word positions (e.g., word-initial and word-internal) between the reading and conversational tasks, as it does not always make for the most equal

comparisons. As stated in Section 3.3, every attempt was made to balance tokens of voiceless stops across the linguistic factors under consideration in the present study: place of articulation (bilabial, dental, velar) and word position (absolute initial, word initial, word internal) while not compromising the total number of target tokens analyzed from each task. However, given the aforementioned challenges of working with both scripted and spontaneous speech data in the same study, it was not always possible to have an equal number of tokens of individual target phonemes in the same word positions between the two tasks.

In conclusion, given the contributions of the present study and despite its limitations, the results suggest that this topic is ripe for further research. First, future studies on the effect of speech style on L2 acquisition of Spanish voiceless stops should focus on the voiceless bilabial stop /p/ since the imbalance in the number of target tokens in word-initial position, in particular, between the reading and conversational tasks may have affected the present results. Another topic that warrants investigation in the future is whether differences observed acoustically in the learner data on both the formal reading and less formal conversational tasks – such as producing Spanish /p t k/ with native English-like VOT values – impact how L1 Spanish speakers perceive L2 Spanish learners' speech. While there is a long line of SLA research on foreign accent in general (cf. Flege et al., 1995; Munro, 1993; Munro &Derwing, 1994, 1995), perception of foreign accent by native speakers has not been widely studied with respect to L2 acquisition of Spanish voiceless stops. González-Bueno (1997b) – focusing on the voiceless velar stop – is the only such study, to the best of my knowledge, finding that English-accented productions of /k/, the result of long VOT and aspiration, noticeably affected L1 Spanish speakers' perception of L2 Spanish learners' productions. Given this finding and Kissling's (2013) claim that "it remains an empirical question to what extent accuracy in production and perception of … L2 … segments impacts accent, comprehensibility, and/or intelligibility" (p. 172), future studies should examine L1 Spanish speakers' perception of L2 Spanish learners' production of the remaining voiceless stop (/p/ and /t/) consonants. Finally, more research is needed to better understand L1 English-speaking L2 Spanish learners' longitudinal development of Spanish VOT. Nagle (2017) examined novice L2 Spanish learners' longitudinal development of /p/ and /b/ over two semesters of language instruction, finding that learners produced more native-like VOTs over time by decreasing their VOT of /p/ and /b/ at rates of -19 and -26 ms, respectively, per semester of instruction. Similar studies are needed that investigate L2Spanish learners' longitudinal development of Spanish VOT of the remaining voiceless (/t/ and /k/) and voiced (/d/ and /g/) stop consonants. Such future studies should also consider longitudinal development in L2 learners with intermediate and advanced levels of proficiency in Spanish.

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