An Investigation of the Effect of K'iche' Glottalic Consonants on Spanish Consonant Production
in K'iche'-Spanish Bilinguals

Research Thesis

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by

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Production in K'iche'-Spanish Bilinguals

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1. Introduction

How does L1 phonology affect the phonology of L2? What factors influence the production of L2 speech sounds in bilinguals? What are the differences in speech sound productions among different types of bilinguals? Linguists have aimed to answer these questions through decades of investigations in bilingual speech production. Past research indicates that both age of acquisition of L2 and frequency of L2 use can influence the phonological acquisition and subsequent production of L2. In Guion's 2003 study of Spanish-Kichwa bilinguals' production of Kichwa and Spanish vowels, the author found that bilinguals who learned the two languages simultaneously had distinct vowels for both languages, while bilinguals who learned Kichwa at a later age produced Kichwa vowels less like Kichwa monolinguals, suggesting the successful acquisition of Kichwa vowels by bilinguals who acquired Kichwa at an early age. Kang & Guion (2012) performed a similar study, investigating the acquisition of English phonemes by native Korean speakers, and found the rate of native-like production increased with lower age of L2 acquisition. Flege et al. (2002) found that both age of acquisition of L2 and frequency of L2 use play a united role in the production of L2 speech sounds. Italian-English bilingual participants were divided into four categories, by age of acquisition (early-late) and frequency of L2 usage (low-high). The study showed the highest rate of successful English vowel production occurred with participants of low age of L2 acquisition and high frequency of L2 usage.

The current study is an investigation of consonant production in bilingual speakers dependent upon their language dominance score, a measurement that captures both age of acquisition of L2 and frequency of L2 use, as well as linguistic proficiency, and linguistic attitudes. This measurement was collected and calculated via Birdsong, Gertken, & Amengual's 2012 Bilingual Language Profile, and will be further discussed in the background section of this study. The languages investigated here are K'iche' Mayan and Guatemalan Spanish. K'iche' (Quiche') is a Mayan language spoken in the central highlands of Guatemala by the K'iche' people, an indigenous Maya group. It is comprised of over 2,000,000 speakers and is recognized as the second-most spoken language of Guatemala after Spanish. Of the K'iche' speaking population, some 300,000 speakers are monolinguals, with the remaining population having some degree of Spanish proficiency (Simons & Fennig 2018).

The sound inventory of the K'iche' language includes a series of ejective consonants, /t' k' q'/, a quite salient speech sound that is featured and contrastive in about 20% of the world's languages. Ejective consonants are produced with a glottalic airstream as opposed to a pulmonic airstream, meaning the sound is produced with air from the glottis instead of the lungs. In addition to this, K'iche features an implosive consonant, /ɓ/, another type of glottalized sound in which the consonant is produced with an ingressive airstream, meaning the sound is produced by drawing in air, rather than expelling it. Implosives are contrastive in about 10% of world languages, and thus are not featured in the majority of languages, Spanish included (Ladefoged 2001). The sound inventory of Spanish indeed contains pulmonic consonants /p t k/ that pattern as counterparts to K'iche's glottalic sounds / ɓ t' k'/. The current study assesses the production of Spanish /p t k/ consonants by both native speakers of K'iche' and native speakers of Spanish to establish the differences of production based on the language dominance of the speaker. Of

prime importance in this study is the influence of the K'iche' ejective consonants, /t'/ and /k'/, on

their Spanish pulmonic counterparts, /t/ and /k/, as produced by K'iche'-Spanish bilinguals.

2. Background

2.1 Bilingualism of Mayan Languages and Spanish

Though there exists an extensive number of studies investigating the production of L2

Spanish phonology by L1 speakers of English, Catalan, Portuguese, etc., the number of

investigations of L1 speakers of Maya languages is limited. Existing studies of Maya influence

on Guatemalan Spanish focus on influences present in the *dialect* of Guatemalan Spanish, rather

than the Spanish of bilingual speakers. That being said, McKinnon (to appear) investigated the

bilingual context of Kaqchikel and Spanish in Guatemala, and how Kaqchikel influence affect

VOT duration of Spanish voiceless plosives. In addition, Baird (2010, 2014, 2015) has

conducted a series of investigations on the Spanish system of bilingual speakers of K'iche' and

Spanish, and how K'iche' affects the L2 Spanish of bilinguals.

McKinnon (to appear) studied VOT variation in Spanish voiceless plosives among

Kaqchikel-Spanish bilinguals in central Guatemala. The study found greater VOT duration for

Spanish voiceless plosives in the Kaqchikel-Spanish contact dialect than in non-contact dialects.

In addition to this, Kaqchikel-Spanish bilinguals were found to have greater VOT durations for

Spanish plosives than monolingual Spanish speakers of the region, though the results were not

found to be significant. Baird (2010) investigated the vowel systems of K'iche'- Spanish

bilinguals from several dialects of K'iche'. It was found that dialects of K'iche' that no longer

phonemically contrast vowel length presented a more centralized vowel space than dialects that

maintained the contrast. These differences in vowel space were reflected in the Spanish vowels

of bilinguals from the respective dialect. In a 2014 intonation study, Baird found that language

dominance was correlated with greater pitch span when marking contrastive focus in K'iche'-Spanish bilinguals, such that bilinguals reflected their dominant language when marking contrastive focus in Spanish. Finally, Baird (2015) investigated peak alignment in pre-nuclear stressed syllables as produced by K'iche'-Spanish bilinguals and found correlation with peak alignment and language dominance. The greater the Spanish dominance of a bilingual, the later the peak was produced.

While previous investigations studied VOT duration variation in Kaqchikel-Spanish bilinguals and the vowel spaces and prosodic elements of K'iche'-Spanish bilingual speech production, the current study seeks to investigate consonant production, namely, the influence of K'iche' on Spanish voiceless pulmonic plosive consonant production in the speech of K'iche'-Spanish bilinguals. Due to findings of the aforementioned investigations, the current study posits that K'iche' will have an effect on L2 consonant production based on the acoustic differences between the target Spanish consonants /p t k/ and their K'iche' glottalic counterparts / ɓ t' k'/.

The phonetic inventory of K'iche' features several glottalic consonants including both ejectives and implosive consonants as can be seen in Figure 2.1.

Figure 2.1: The Phonemic Inventory of K'iche'. Consonants of interest: / ɓ t' k'/. From Aissen, England, & Zavala Maldonado (2017)

	Bilabial	Alveolar	Alveopalatal	Palatal	Velar	Uvular	Glottal
Plosive	p b' [ɓ]	t t'			k k'	q q' [q', ɢ]	' [ʔ]
Nasal	m	n					
Flap		ɾ					
Fricative		s	x [ʃ]			j [x]	
Affricate		tz [ts] tz' [ts']	ch [tʃ] ch' [tʃ']				
Lateral		l					
Approximant	w			y [j]			

The ejective consonants of interest are the alveolar /t'/ and the velar /k'/. In addition to this, we are interested in K'iche's implosive consonant, the bilabial / ɓ /. Both ejectives and implosives are glottalic consonants and they are produced with a glottalic airstream mechanism, as opposed to the pulmonic airstream mechanism of pulmonic consonants. Implosive consonants are produced with an ingressive airstream, meaning the sound is produced by drawing in air, rather than expelling it. On the other hand, ejective consonants are produced with an egressive airstream that expels air from the glottis.

The phonetic inventory of Spanish does not feature any type of glottalized sounds, as can be seen in Figure 2.2.

Figure 2.2: The phonetic inventory of Spanish. Consonants of interest: /p t k/. From Hualde, J. I. (2005).

		bilabial	labiodental	interdental	dental	alveolar	prepalatal	palatal	velar	glottal
plosive	v'less	p			t				k	
	voiced	b			d			ɟ	g	
fricative	v'less		f	θ		s	ʃ		x	h
	voiced		v			z	ʒ	ʝ		ɦ
approx.	voiced	β			ð				ɣ	
affricate	v'less						t͡ʃ			
	voiced						d͡ʒ			
nasal		m	ɱ	n̪	n̪	n	nʲ	ɲ	ŋ	
lateral				l̪	l̪	l	ʎ	ʎ		
rhotic	tap					ɾ				
	trill					r̄				

Note. The glottal sounds /h, ɦ/ that appear in this inventory are not glottalized in the sense that they are produced with air from the glottis, rather they are articulated in the glottal region of the oral cavity with a pulmonic airstream.

The purpose of the current study is to analyze the production of Spanish consonants /p t k/ by K'iche'-Spanish bilinguals under the assumption that the presence of glottalic consonants / ɓ t' k'/ in K'iche' influences the acquisition of their Spanish counterparts. The variable of interest is Voice Onset Time, the amount of time between the release of a consonant and the onset of voicing for the following vowel. K'iche' ejective consonants /t'/ and /k'/ have a longer

VOT than their Spanish pulmonic counterparts /t/ and /k/ as shown in the investigations of Kingston and Abramson and Lisker. Kingston (1984) found the VOT of K'iche' ejective consonants /t'/ and /k'/ to be 45 ms and 50 ms respectively. Abramson and Lisker (1964) found the VOT of Spanish /t/ and /k/ to be 7 ms and 25 ms respectively. It is hypothesized here that native speakers of K'iche' with greater language dominance scores for K'iche' will produce Spanish consonants /t/ and /k/ that reflect this acoustic difference between the languages, i.e. with longer VOTs than speakers with greater Spanish dominance. The K'iche' bilabial implosive / ɓ / differs from /t'/ and /k'/ in that it is voiced sound. Voiced plosives are voiced throughout the closure and release, corresponding to a negative VOT. It is then expected, that Spanish productions of /t/ and /k/ by K'iche' dominant bilinguals will have longer VOTs than /p/, as its K'iche' counterpart is voiced.

2.2 The Bilingual Language Profile

The current study captures age of L2 acquisition and frequency of L2 use with a language dominance score, a quantitative measure calculated from the Bilingual Language Profile, BLP, developed by Birdsong, Gertken, & Amengual (2012). The BLP is a recently developed, widely used instrument to calculate language dominance in bilinguals by generating a language dominance score that falls on a quantified continuum of the two languages. This score ranges from -218 to 0 (balanced bilingualism) to +218. It is calculated through bilinguals' self-reports on age of acquisition of both languages, frequency and environments of use, self-perceptions of competence in both languages, and linguistic attitudes towards the two languages and their respective cultures. The BLP organizes this information into 4 modules on the questionnaire, language history, language use, language proficiency, and language attitudes. Each language

receives its respective total score based on the values of these modules, and the dominance score is calculated by subtracting one language total from another.

This study elected to use the BLP because of its use in other L2 Spanish studies, including previous studies of K'iche'-Spanish bilinguals. In a series of K'iche'-Spanish bilingualism studies, Baird utilized the BLP to establish language dominance among the bilinguals. Baird (2010) used the BLP to establish language dominance of K'iche'-Spanish bilinguals in an investigation of bilingual vowel space in Spanish. Baird (2014) used the BLP to establish language dominance of K'iche'-Spanish bilinguals to investigate bilingual intonation. Baird (2015) used the BLP to establish language dominance of K'iche'-Spanish bilinguals to study pre-nuclear peak alignment in bilinguals.

In the current study, the BLP was completed prior to three speech production tasks. The questionnaire was translated to Spanish and administered orally by the experimenter, who would notate participant responses. To achieve the speakers' dominance scores, the language total for K'iche' was subtracted from the language total for Spanish, such that a negative score indicated K'iche' dominance and a positive score indicated Spanish dominance, with a score near 0 indicating balanced bilingualism. Individual dominance scores for each participant are provided in table 3.1 below.

2.3 Research Questions

The purpose of the current study is to analyze the production of Spanish consonants /p t k/ by native K'iche' speaking bilinguals. With the majority of native K'iche' speakers having bilingual proficiency in Spanish and K'iche', participants will be recruited for linguistic interviews and administered the BLP to achieve their respective language dominance scores. After completing the BLP, participants will be instructed to perform three speech production

tasks that consist of reading, describing images, and answering questions. The goal of this study is to determine the effect of K'iche' glottalic consonants, specifically the ejective consonants /t'/ and /k'/, on the production of Spanish consonants and to observe differences in the strength of this effect throughout the degree of linguistic dominance of K'iche'– Spanish bilinguals. Research questions:

1. To what degree does language dominance affect the production of Spanish consonants /p t k/ by K'iche'-Spanish bilinguals?

2. Are there observed differences in the production of /p t k/ dependent on task?

3. How do the linguistic factors of place of articulation, word position, preceding sound, and stress, affect the production of Spanish consonants /p t k/ by K'iche'-Spanish bilinguals and to what degree are these effects observed?

3. Methodology

3.1 Research Design

Linguistic interviews were conducted with 13 participants in the region of Antigua, Guatemala in May of 2018. These interviews took place at a local school in Antigua, and at a community building in Nahualá, Solola. The participants consisted of native speakers of K'iche' with bilingual proficiency in Spanish, native speakers of Spanish who were novice learners of K'iche', a native speaker of Spanish with bilingual proficiency in K'iche', a simultaneous K'iche'-Spanish bilingual, and a monolingual Spanish speaker. Interviews were conducted in Spanish by a native English speaker with near-native Spanish. Each interview consisted of the administration of the Bilingual Language Profile (BLP) questionnaire by Birdsong, Gertken, & Amengual (2012) and three speech production tasks. The BLP was used to assess biographical information and language history, use, proficiency, and attitudes. The participants were first

asked the questions of the BLP orally, and the experimenter recorded their answers. The three speech production tasks included reading two short stories, describing images, and answering questions, in that order. During the reading task, participants were asked to read aloud "El Viento del Norte y el Sol" and "Copacabana" with a natural voice and pacing. The picture task consisted of 40 pictures of objects compiled onto a laminated sheet. Participants were instructed to name and describe the objects as indicated by the experimenter. In the questions task, participants were asked up to 16 questions about culture, family, food, and daily life, to elicit spontaneous conversation. The purpose of each task was to elicit the production of the target consonants /p t k/ under study. Each interview ranged from 20-45 minutes. Interviews were recorded using a Sony ICDPX370 Mono Digital Voice Recorder. Recordings were analyzed using the acoustic analysis software, Praat. The BLP, short stories, pictures, and questions can be found in the appendix.

3.2 Participants

Thirteen participants (6 males and 7 females) ranging from 26 to 73 were recruited using the network of Proyecto Lingüístico Francisco Marroquín (PLFM), an indigenous Mayan and Spanish language school of Antigua, Guatemala. Six participants were native speakers of K'iche', six were native speakers of Spanish, and one was a simultaneous bilingual of K'iche' and Spanish. The six native speakers of K'iche' acquired Spanish from the ages of 5-16. Of the six native speakers of Spanish, one acquired K'iche' at age 9 and grew up in the K'iche' community, four were novice learners of K'iche' for two years or less, and one was a monolingual speaker of Spanish. The diversity of linguistic history was captured using the BLP. The BLP produced a language dominance score for each participant, resulting in a range from -135 to 203.5, with a negative score indicating stronger K'iche' dominance, a positive score

indicating stronger Spanish dominance, and a score near 0 indicating balanced bilingualism. The

monolingual speaker completed the BLP solely for Spanish to generate a Spanish language score

to be used for data analysis. Table 3.1 provides metalinguistic data and BLP scores for each

participant.

Table 3.1: BLP Scores and metalinguistic data for participants.

| Participant	Gender	Age	BLP
Participant 1	M	73	-8 (K)
Participant 2	F	26	-19 (K)
Participant 3	M	66	179 (S)
Participant 4	F	34	-6.5 (K)
Participant 5	F	51	152 (S)
Participant 6	F	26	203.5 (S)
Participant 7	M	31	168 (S)
Participant 8	M	51	195 (S)
Participant 9	F	43	29 (S)
Participant 10	F	43	-58 (K)
Participant 11	M	62	-135 (K)
Participant 12	F	27	-27 (K)
Participant 13	M	52	7 (S)

Note. S= Spanish dominant, K = K'iche' dominant.

3.3 Data Analysis

The influence of K'iche' glottalic consonants on the production of Spanish consonants by

K'iche'-Spanish bilinguals was explored by examining the VOT duration of plosives /p t k/. The

acoustic analysis software, Praat, was used to mark and measure the VOT of each token of /p t

k/. VOT was manually identified by examining the waveform in Praat and marking a point at the

release of the plosive and a point at the onset of voicing of the following vowel. Tokens were

determined fit for analyses if they met the following conditions: normal phonation (no creaky

voice or breathy voice), voiceless (no indication of voicing on the waveform or spectrograph),

and preceding a vowel (cannot precede consonants or occur in utterance final position). Tokens

that did not meet one or more of these conditions were not used for analysis. An example

waveform and spectrogram of /k/ is show in Figure 3.1. Each token was labeled as /p/, /t/, or /k/

and later coded for place of articulation (bilabial, dental, velar), word position (initial, medial), preceding sound (consonant, vowel, initial sound), stress (stressed or unstressed), and task (reading, pictures, questions). These factors were used to evaluate how phonetic components affect VOT duration of the target consonants /p t k/. This procedure was repeated for each interview, achieving a total of 2763 tokens: 1476 reading task tokens, 623 picture task tokens, and 664 question task tokens. A Praat script was used to extract the VOT duration for each token which was then exported to an Excel file.

Figure 3.1 VOT duration of /k/. The dotted vertical line indicates the beginning of the plosive release, the short vertical line on the right indicates the onset of voicing.
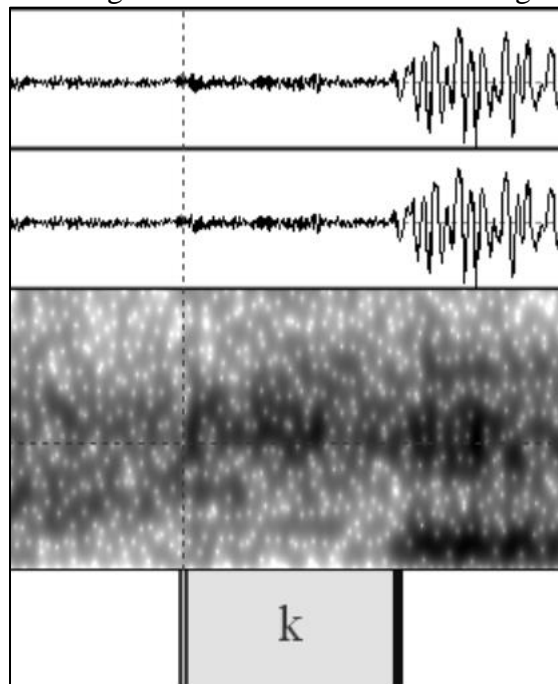
A mixed effects linear regression model was constructed to predict VOT duration by language dominance score, place of articulation, position in word, preceding sound, and task. A random effect for subjects was included. Age as a three-level factor (young, middle, old) and gender (male, female) were also included. Each multi-level factor was releveled to determine main effects. The model converged with one random effect and did not contain any interactions.

Language dominance score was treated as a continuous predictor variable in a direct relationship

with Spanish dominance: as the language dominance score increases, the degree of Spanish

dominance increases. This factor is used to determine how the degree of Spanish language

dominance affects the VOT duration of the target consonants /p t k/. Since the analysis of all the

data indicates that there are differences according to task, a separate analysis for each task was

performed in order to explore the effect of the different factors under analysis by task. The mixed

effects structure was maintained for the task-specific analyses, barring the fixed effect for task.

4. Results

The results of the acoustic analysis are organized into four sections based on production

task: all tasks, reading task, pictures task, and question task. The first section consists of a

statistical analysis on the data from all three tasks. The remaining sections evaluate the data

collected for each task individually. Each statistical test was conducted to evaluate the following

questions: How does the degree of Spanish dominance affect the VOT duration of Spanish

consonants /p t k/? What role does task play in the VOT duration of Spanish-K'iche' bilinguals?

How do place of articulation, word position, preceding sound, and stress, affect VOT duration?

4.1 All Tasks

The results of the mixed effects linear regression model for All Tasks are presented in

Table 4.1. Each multilevel factor was releveled to determine if the comparison among all levels

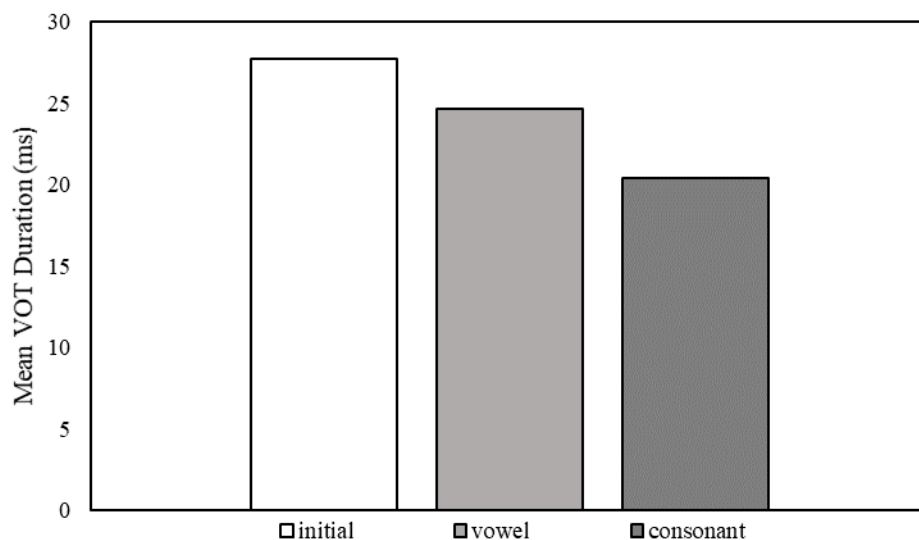was significant. The p-values for the significant results are reported in the text below.

Table 4.1: Mixed effects linear regression results for All Tasks.

|	Estimate	Standard Error	t value	p value
Intercept	20.34	2.09	9.75	<.001
Dominance score	-.029	0.01	-2.75	.02
Preceding sound (reference level is consonant) initial	3.01	0.82	3.64	<.001
Preceding sound (reference level is consonant) vowel	0.69	0.42	1.66	n.s.
Position (reference level is initial) medial	-0.75	0.45	-1.67	n.s.
Articulation (reference level is bilabial) dental	3.29	0.53	6.17	<.001
Articulation (reference level is bilabial) velar	17.7	0.49	36.08	<.001
Stress (reference level is stressed) unstressed	-0.79	0.40	-1.98	<.05
Task (reference level is pictures) questions	1.48	0.56	2.64	<.01
Task (reference level is pictures) reading	-2.97	0.48	-6.12	<.001
Age (reference level is middle) old	-5.82	3.32	-1.74	n.s.
Age (reference level is middle) young	-4.67	2.41	-1.94	n.s.
Gender (reference level is female) male	0.62	2.78	0.83	n.s.

The results of the mixed effects linear regression model for the All Tasks analysis found that as language dominance score increases VOT duration significantly decreases ($t = -2.75$, $p <$ .05). These results demonstrate that as Spanish dominance becomes stronger, VOT duration of

Spanish plosives / p t k/ become shorter. A main effect was found for preceding sound, such that plosives at utterance initial position have a significantly longer VOT duration than plosives preceded by a consonant and plosives preceded by a vowel (t = 3.64, p < .001; p < .05;) (see Figure 4.1). No significant difference was found between plosives preceded by a consonant and plosives preceded by a vowel. Place of articulation was found to be significant, such that velar plosives /k/ had a significantly longer VOT than both dental plosives /t/ and bilabial plosives /p/ (p < .001; t = 36.1 p < .001), and dental plosives /t/ has a significantly longer VOT duration than bilabial plosives /p/ (t = 6.17 p < .001) (see Figure 4.2). VOT duration for plosives was found to be significantly longer in stressed syllables than unstressed syllables (t = 1.98 p <.05). Finally, task was found to be a significant predictor of VOT duration. Questions task plosives were found to have a significantly longer VOT duration than picture task plosives and reading task plosives, (t = 2.64, p < .01; p <.001) and picture task plosives were found to have a significantly longer VOT duration than reading task plosives (t = 6.12; p < .001) (see Figure 4.3). Age, gender, and word position of plosives were not found to be significant.
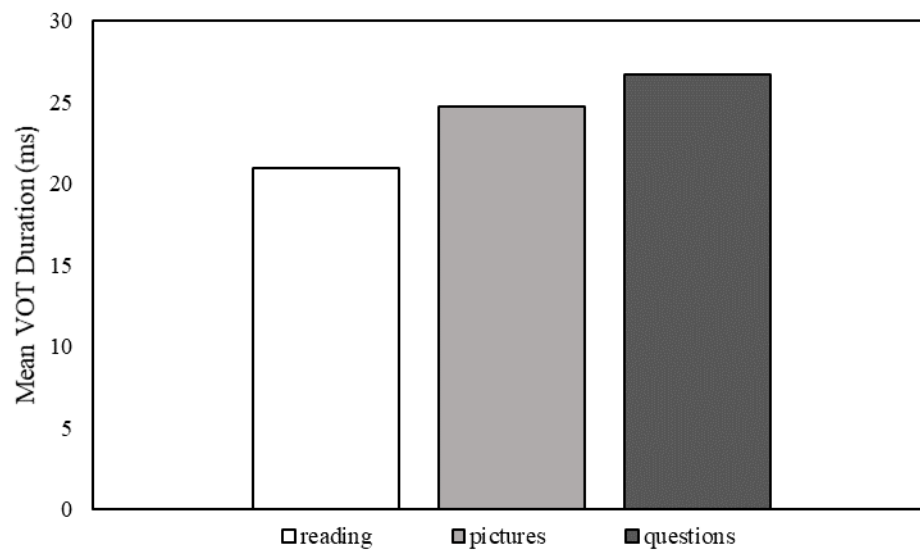
Figure 4.1: Mean VOT duration (ms) by preceding sound

Figure 4.2: Mean VOT duration (ms) by place of articulation
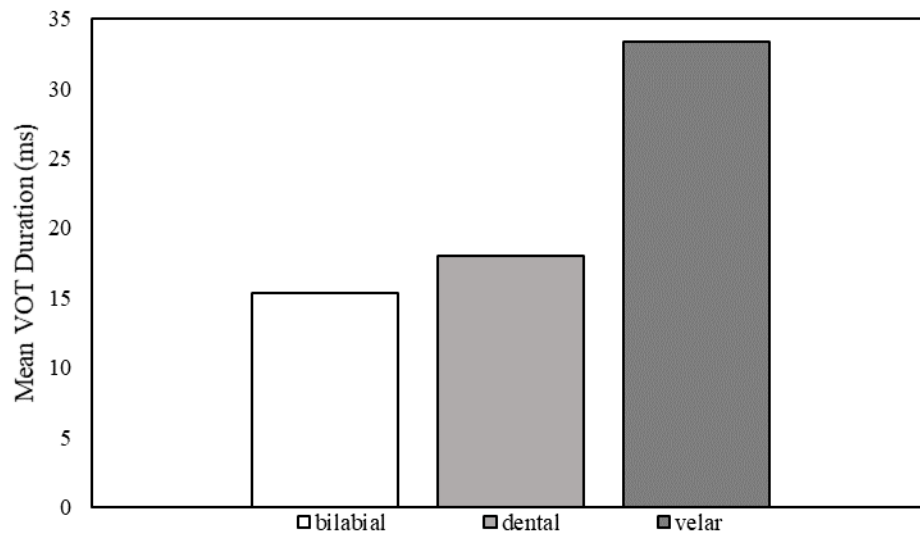
Figure 4.3: Mean VOT duration (ms) by task

4.2 Reading Task

The results for the mixed effects linear regression model for the Reading Task are

presented in Table 4.2. The reference levels for each multi-level factor are the same for the

Reading Task model as they are in the All Tasks model. Again, each factor was releveled to

evaluate significance in the comparison among levels, and the p-values of the significant results

are reported below.

Table 4.2: Mixed effects linear regression results for Reading Task.

	Estimate	Standard Error	t value	p value
Intercept	18.2	1.61	11.33	<.001
Dominance score	-0.04	0.009	-5.24	<.001
Preceding sound (reference level is consonant) initial	2.69	1.09	2.48	<.05
Preceding sound (reference level is consonant) vowel	0.19	0.56	0.35	n.s.
Position (reference level is initial) medial	-0.81	0.58	-1.39	n.s.
Articulation (reference level is bilabial) dental	2.67	0.69	3.85	<.001
Articulation (reference level is bilabial) velar	17.1	0.61	28.02	<.001
Stress (reference level is stressed) unstressed	-1.03	0.53	-1.94	n.s.
Age (reference level is middle) old	-5.37	2.51	-2.13	n.s.
Age (reference level is middle) young	-4.17	1.74	-2.41	<.05
Gender (reference level is female) male	3.68	2.04	1.81	n.s.

The results of the mixed effects linear regression model for the Reading Task analysis

mirrored those of the model for All Tasks. It was found that as language dominance score

increases, i.e. dominance score is towards Spanish, VOT duration significantly decreases (t = -

5.24, p < .001). Again, a main effect was found for preceding sound, such that plosives at

utterance initial position have a significantly longer VOT duration than plosives preceded by a consonant and plosives preceded by a vowel (t = 2.48, p < .05; p < .05); and no significant effects were found between plosives preceded by a consonant and plosives preceded by a vowel. Place of articulation was found to be significant in the same order from the results of the All Tasks analysis. Velar plosives /k/ had a significantly longer VOT duration than both dental plosives /t/ and bilabial plosives /p/ (p < .001; t = 28.0, p < .001) and dental plosives /t/ had a significantly longer VOT duration than bilabial plosives /p/ (t = 3.85, p <.01). In this model, a simple effect was found for age, such that middle aged participants have a significantly longer VOT than young participants (t = 2.41, p < .05). The results of this model did not find stress, word position of plosives, nor gender to be significant.

4.3 Pictures Task

The results for the mixed effects linear regression model for the Pictures Task are presented in Table 4.3. The reference levels for each multi-level factor are the same for the Pictures Task model as they are in the All Tasks model. Again, each factor was releveled to evaluate significance in the comparison among levels.

Table 4.3: Mixed effects linear regression results for Pictures Task.

	Estimate	Standard Error	t value	p value
Intercept	19.3	2.69	7.16	<.001
Dominance score	-0.03	0.01	-2.00	.07
Preceding sound (reference level is consonant) initial	2.19	1.75	1.25	n.s.
Preceding sound (reference level is consonant) vowel	0.08	0.91	0.09	n.s.
Position (reference level is initial) medial	-0.28	1.02	-0.27	n.s.
Articulation (reference level is bilabial) dental	4.71	1.24	3.77	<.001
Articulation (reference level is bilabial) velar	19.3	1.11	17.4	<.001
Stress (reference level is stressed) unstressed	-0.75	0.88	-0.85	n.s.
Age (reference level is middle) old	-3.8	4.21	-0.90	n.s.
Age (reference level is middle) young	-4.5	3.06	-1.50	n.s.
Gender (reference level is female) male	-0.75	3.52	-0.21	n.s.

The results of the pictures task analysis found only place of articulation to be significant in the order of the previous analyses. Marginal results show dominance score to predict VOT duration such that greater Spanish dominance is associated with shorter VOT duration.

4.4 Question Task

The results for the mixed effects linear regression model for the Questions Task are presented in Table 4.4. The reference levels for each multi-level factor are the same for the

Questions Task model as they are in the All Tasks model. Again, each factor was releveled to evaluate significance in the comparison among levels.

Table 4.4: Mixed effects linear regression results for Questions Task.

	Estimate	Standard Error	t value	p value
Intercept	22.7	2.67	8.49	<.001
Dominance score	-.02	0.01	-1.79	.10
Preceding sound (reference level is consonant) initial	4.60	1.78	2.56	<.05
Preceding sound (reference level is consonant) vowel	1.67	0.91	1.83	n.s.
Position (reference level is initial) medial	-1.10	0.94	-1.17	n.s.
Articulation (reference level is bilabial) dental	2.54	1.18	2.16	<.05
Articulation (reference level is bilabial) velar	17.10	1.12	15.26	<.001
Stress (reference level is stressed) unstressed	-0.87	0.86	-1.01	n.s.
Age (reference level is middle) old	-3.08	4.00	-0.77	n.s.
Age (reference level is middle) young	-5.13	2.93	-1.75	n.s.
Gender (reference level is female) male	-2.32	3.34	-0.69	n.s.

The results of the Questions Task analysis found only place of articulation to be significant in the same manner as the previous analyses, and a simple effect for preceding sound such that plosives at utterance initial position had a significantly longer VOT duration than

plosives preceded by a consonant. Marginal results show dominance score to predict VOT duration such that greater Spanish dominance is associated with shorter VOT duration.

5. Discussion

The goal of this study is to determine the effect of K'iche' glottalic consonants on the production of Spanish consonants and to observe differences in the strength of this effect throughout the degree of linguistic dominance of K'iche'– Spanish bilinguals. The research questions and results of analyses will be discussed below.

5.1 K'iche'-Spanish Language dominance and the production of /p t k/

The first research question and purpose of this investigation examines the influence of K'iche' glottalic consonants / ɓ t' k'/ on the production of Spanish consonants /p t k/ by K'iche'-Spanish bilinguals of varying degrees of language dominance, with primary focus on the influence of ejective consonants /t'/ and /k'/. It was predicted here, that due to the longer VOT duration for K'iche' ejective consonants /t'/ and /k'/ versus their Spanish counterparts /t/ and /k/, K'iche'-Spanish bilinguals with greater K'iche' dominance would have longer VOT duration than those with greater Spanish dominance. The All Tasks and Reading Tasks analyses indeed demonstrate this to be the case; as language dominance score increases, in this case on a quantified scale of K'iche' dominant to Spanish dominant, VOT duration significantly decreases. These results suggest that the ejective consonants present in the phonetic inventory of K'iche' influence the production of Spanish plosive consonants for K'iche'-Spanish bilinguals, in a manner that reflects the overall linguistic capabilities of the speaker. Using the BLP scores, participants were divided into a categorical variable for dominance as K'iche' dominant or Spanish dominant, with a negative BLP score corresponding to K'iche' dominance and a positive

BLP score corresponding to Spanish dominance. Figure 5.1 displays the spread of VOT durations dependent on the dominance of the speaker for all tasks.

Figure 5.1: VOT duration (ms) by dominance
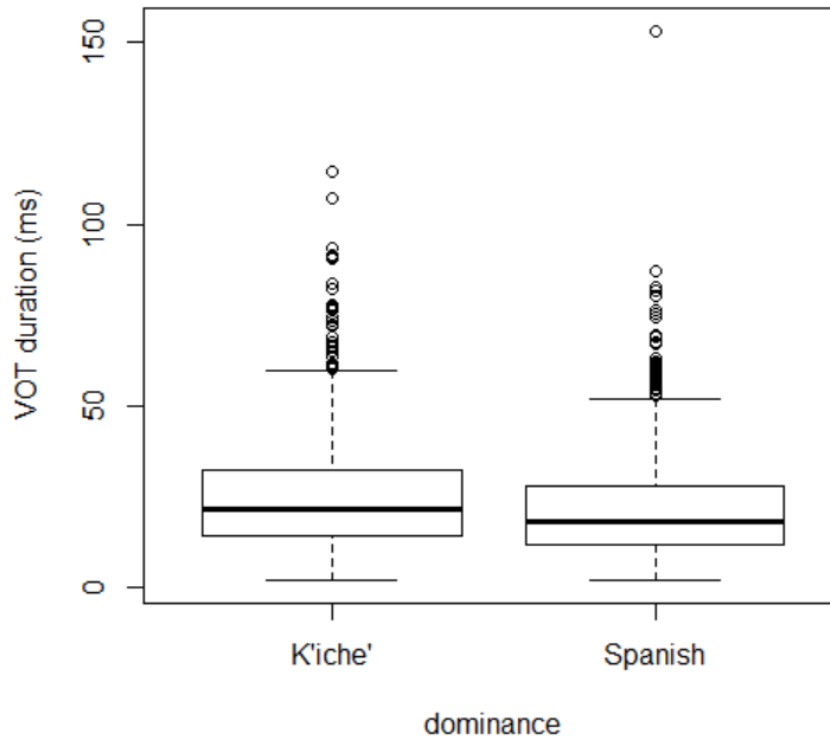
Though Figure 5.1 presents VOT durations by dominance as a categorical variable, K'iche' vs Spanish, as opposed to the continuous dominance score itself, it demonstrates the longer mean VOT duration for K'iche' dominant speakers. Note the outlier data point from the Spanish dominant speakers. This data point, in addition to many others, is from the native Spanish speaker that acquired K'iche' at age 9 and grew up in the K'iche' community. Though this speaker falls on the Spanish dominant side of the BLP spectrum with a score of 29, it is suggested here that her K'iche' bilingualism affects her VOT duration. Language dominance score as a continuous variable is thus an effective measure in this study, as it places K'iche'-Spanish bilingualism on a spectrum, and accounts for the different degrees of Spanish dominance, i.e. the different degrees of K'iche' influence.

The role of the K'iche' bilabial implosive / ɓ/ is not fully explored in this study. The results from each analysis indicate that, on average, the bilabial /p/ has significantly shorter VOT duration than the dental /t/ and velar /k/, as indicated by Figure 4.2; however, these results are expected for the production of Spanish /p t k/ (Abramson and Lisker 1964, among others). Of interest, rather, is the interaction of language dominance and place of articulation. Specifically, is there a significant difference in the differences between VOT durations of /p/ and /t k/ for K'iche' dominant speakers and for Spanish dominant speakers? The results of the analysis of this interaction would determine if ejective K'iche' consonants affect Spanish voiceless plosive category production as a whole, or if the presence of a voiced implosive / ɓ/ in K'iche' as a counterpart to Spanish /p/ allows for native like production of /p/, i.e. K'iche' ejective consonants only affect the production of their individual Spanish counterparts. The role of the bilabial implosive is left for future research.

5.2 Production of /p t k/ and task

The second research question of this study examines the role that type of task plays in in the production of Spanish consonants /p t k/. This study was organized into three speech production tasks of varying degrees of spontaneous production. The reading task involved a scripted means of speech production, the picture task involved semi-scripted and controlled means of production in that the experimenter indicated participants to name and describe an object, and the questions task involved free speech production, in which the experimenter asked questions and participants answered. It is outlined here that the questions task had the greatest degree of spontaneous speech production, followed by the pictures task, followed by the reading task. This order of spontaneous speech production is reflected in the results of the All Tasks analysis (see Figure 4.1). Questions task plosives had significantly longer VOT duration than

picture task plosives and reading task plosives, and pictures task plosives have significantly longer VOT duration than reading task plosives. These results suggest that as the degree of spontaneous speech production increases, VOT duration of Spanish plosives increases. It was also observed during acoustic analysis that participant speech rate increased as the degree of spontaneous speech production increased, though statistical tests were not conducted to determine the significance of this observation. Schmidt and Flege (1996) found the VOT duration of Spanish voiceless plosives to increase as speech rate increased. The results in the current study may contribute to these findings, such that the slower speech rate associated with controlled reading predicted shorter VOT duration, and VOT duration increased as speech production became less controlled and more spontaneous.

The Pictures Task and the Questions Task analyses yield significant results only for place of articulation in the manner previously outlined. However, both tasks achieved marginal results for the relationship between VOT duration and language dominance score in direction predicted; as Spanish language dominance increased, VOT duration decreased. It is possible that the difference in VOT duration between K'iche'-Spanish with bilinguals with different degrees of language dominance duration is more apparent in formal, controlled speech rather than spontaneous speech. In addition to this, the differences in marginal and significant results between the All Tasks and Reading Task analyses and the Pictures Task and Questions Task analyses could be attributed to the imbalance of tokens between the three tasks. The reading task was analyzed with 1476, whereas the pictures task and questions task were analyzed with 623 tokens and 664 tokens respectively. The greater quantity of tokens for the Reading Task analysis may have provided sufficient data points to find significant predictability between language

dominance score and VOT duration. Further research is needed to examine the differences in task.

5.3 Phonetic factors affecting production of /p t k/

The final research question examines how the linguistic factors of place of articulation, word position, preceding sound, and stress, affect the production of Spanish consonants /p t k/ by Spanish-K'iche' bilinguals. The results from the All Tasks analysis found place of articulation, preceding sound, and stress to be significant predictors of VOT duration for K'iche'-Spanish bilinguals (Abramson and Lisker 1964, among others). Place of articulation was found to be significant in the expected direction found by previous studies. Preceding sound was also found to be significant, such that plosives at initial position had significantly longer VOT duration than plosives preceded by consonants and plosives preceded by vowels; however, no significant difference was found between plosives preceded by consonants and plosives preceded by vowels. These results suggest that the types of sounds that precede Spanish voiceless plosives (vowels vs consonants) has little effect on VOT duration, and rather it is the presence or absence of a preceding sound that determines VOT duration of Spanish voiceless plosives for K'iche'-Spanish bilinguals. However, the results of the All Tasks analysis (as well as individual task analyses) did not find a significant difference between the VOT duration for plosives at word initial position and plosives at word medial position. This factor was well balanced, with 1489 word medial tokens and 1274 word initial tokens. These results conflict with McKinnon (accepted) who found word medial plosives to have higher VOT duration than word initial plosives for Kaqchikel-Spanish bilinguals. It is worth noting that the current study examined the effect for word position for all participants, and McKinnon's results found word position to be significant for bilinguals only. The interaction of word position and language dominance will

benefit from further research. The All Tasks analysis found stress to significantly predict VOT duration for Spanish voiceless plosives, specifically plosives in stressed syllables have significantly longer VOT duration than plosives in unstressed syllables. These results are supported by McKinnon's study among others.

Of prime importance in future research is the interaction of these phonetic factors with language dominance, and how those interactions predict VOT duration of Spanish plosives /p t k/ among the different types of K'iche'-Spanish bilinguals.

Conclusion

The current study explores the effect of K'iche' glottalic consonants / ɓ t' k'/ on the production of their Spanish plosive consonant counterparts /p t k/ by K'iche'-Spanish bilinguals. Specifically, the purpose of this study was to observe the influence of the K'iche' ejective consonants /t'/ and /k'/ on the production of Spanish consonants /t/ and /k/ by K'iche'-Spanish bilinguals through VOT duration and degree of linguistic dominance. This was examined through the analysis of three production tasks, reading, describing pictures, and answering questions. It was found in the analyses of all tasks and the reading task that K'iche'-Spanish bilinguals with greater K'iche' dominance have significantly longer VOT duration for the production of Spanish consonants /p t k/ than bilinguals with greater Spanish dominance, and marginal results in the analyses of the pictures task and questions task found the same trend. These results suggest that K'iche' ejective consonants indeed have an influence on the production of Spanish consonants for K'iche'-Spanish bilinguals, especially for bilinguals with greater K'iche' dominance. It was also found that differences in spontaneous speech production among the different types of production tasks affected the overall VOT duration of Spanish voiceless plosives, namely that as speech production became more spontaneous by task, VOT

duration increased. Certain linguistic factors were examined to explore their effect on VOT duration of Spanish voiceless plosives, and the following factors were found to be significant predictors of longer VOT duration: place of articulation (velar > dental > bilabial), preceding sound (initial position plosives, i.e. no preceding sound) and stress (stressed syllable plosives).

The results of this study call for future investigations of Spanish consonant productions by K'iche'-Spanish bilinguals. Primarily, there is a need for a comprehensive analysis of the ejective consonants of monolingual speakers K'iche', including VOT duration times, phonetic environments, phonotactics, and frequency. The results of this analysis could produce more specific Spanish /p t k/ stimuli where ejective consonant influence is expected and where it is not expected. A future study should include more participants, and a wider range of linguistic dominance for bilingual speakers to better observe the differences in Spanish consonant productions among bilinguals with different degrees of dominance. In addition to this, the VOT duration of Spanish voiceless plosives /p t k/ from a comparable sample of monolingual Spanish speakers from the region should be analyzed for comparison to bilinguals. With a greater number of tokens and sufficient research time, the interactions of language dominance with linguistic factors of place of articulation, word position, preceding sound, and stress could be analyzed to determine the contexts in which greater VOT variation is observed among K'iche'-Spanish bilinguals.

In conclusion, the results of the current study contribute to past findings for the phonological contact of Spanish and Mayan languages in Guatemala. The results of this study indeed suggest that K'iche' ejective consonants and language dominance play a role in the production of Spanish plosives /p t k/ by K'iche'-Spanish bilinguals, and further research is encouraged to determine the extent of this effect.

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Appendix

Bilingual Language Profile: Spanish-English
By: David Birdsong, Libby M. Gertken, & Mark Amengual

Nos gustaría pedir su ayuda para contestar a las siguientes preguntas sobre su historial lingüístico, uso, actitudes y competencia. Esta encuesta ha sido creada con el apoyo del 'Center for Open Educational Resources and Language Learning' de la Universidad de Texas en Austin para poder tener un mayor conocimiento sobre los perfiles de hablantes bilingües independientemente de sus diversos orígenes y en diferentes contextos. La encuesta contiene 19 preguntas y le llevará menos de 10 minutos para completar. Esto no es una prueba, por tanto no hay respuestas correctas ni incorrectas. Por favor conteste cada pregunta y responda con sinceridad, ya que solamente así se podrá garantizar el éxito de esta investigación. Muchas gracias por su ayuda.

I. Información biográfica

Nombre _____   Fecha de hoy____ /_____ /_____

Edad_____   ☐ Hombre / ☐Mujer   Lugar de residencia actual: ciudad_____ País_____

Nivel más alto de formación académica: ☐ Menos de la escuela secundaria   ☐ Escuela Secundaria
☐ Un poco de universidad   ☐ Uni____idad (diplomatura, licenciatura.)
☐ Un poco de escuela graduada   ☐Máster
☐ Doctorado   ☐ Otra: _____

Birdsong, D., Gertken, L.M., & Amengual, M. *Bilingual Language Profile: An Easy-to-Use Instrument to Assess Bilingualism.* COERLL, University of Texas at Austin. Web. 20 Jan. 2012. <https://sites.la.utexas.edu/bilingual/>.

II. Historial lingüístico

En esta sección, nos gustaría que contestara algunas preguntas sobre su historial lingüístico marcando la casilla apropiada.

1. ¿A qué edad **empezó a aprender** las siguientes lenguas?

Español

☐ ☐

D
Nacimiento

K'iche'

☐ ☐

D
Nacimiento

2. ¿A qué edad **empezó a sentirse cómodo** usando las siguientes lenguas?

Español

☐ ☐

Tan
como recuerdo

K'iche'

☐ ☐

Tan
como recuerdo

3. ¿Cuántos años de **clases (gramática, historia, matemáticas, etc.)** ha tenido en las siguientes lenguas (desde la escuela primaria a la universidad)?

Español

☐ ☐

K'iche'

☐ ☐

4. ¿Cuántos años ha pasado en un **país/región** donde se hablan las siguientes lenguas?

Español

☐ ☐

K'iche'

☐ ☐

5. ¿Cuántos años ha pasado en **familia** hablando las siguientes lenguas?

Español

☐ ☐

K'iche'

☐ ☐

6. ¿Cuántos años ha pasado en **un ambiente de trabajo** donde se hablan las siguientes lenguas?

Español

☐ ☐

K'iche'

☐ ☐

III. Uso de lenguas

En esta sección, nos gustaría que contestara algunas preguntas sobre su uso de lenguas marcando la casilla apropiada. El uso total de todas las lenguas en cada pregunta debe llegar al 100%.

7. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas con **sus amigos**?

Español	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
K'iche'	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
Otras lenguas	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %

8. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas con **su familia**?

Español	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
K'iche'	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
Otras lenguas	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %

9. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas en **la escuela/el trabajo**?

Español	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
K'iche'	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
Otras lenguas	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %

10. Cuando se habla a usted mismo, ¿con qué frecuencia **se habla a sí mismo** en las siguientes lenguas?

Español	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
K'iche'	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
Otras lenguas	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %

11. Cuando hace cálculos contando, ¿con qué frecuencia **cuenta** en las siguientes lenguas?

Español	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
K'iche'	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %
Otras lenguas	☐	☐	☐	☐ %	☐	☐	☐	☐	☐	☐	☐ %

IV. Competencia
En esta sección, nos gustaría que considerara su competencia de lengua marcando la casilla de 0 a 6.

<div style="text-align:right">

0=no muy bien   *6=muy bien*

</div>

12. a. ¿Cómo habla en **Español**?   ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

    b. ¿Cómo habla en **K'iche'**?   ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

13. a. ¿Cómo entiende en **Español**?   ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

    b. ¿Cómo entiende en **K'iche'**?   ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

14. a. ¿Cómo lee en **Español**?   ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

    b. ¿Cómo lee en **K'iche**'?   ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

15. a. ¿Cómo escribe en **Español**?   0   1   2   3   4   5   6
          ☐ ☐ ☐ ☐ ☐ ☐ ☐

    b. ¿Cómo escribe en **K'iche'**?   ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

V. Actitudes

En esta sección, nos gustaría que contestara a las siguientes afirmaciones sobre actitudes lingüísticas marcando las casillas de 0 a 6.

0=no estoy de acuerdo   6=estoy de acuerd

16. a. Me siento "yo mismo" cuando hablo en **Español**.

      0   1   2   3   4   5   6
□ □ □ □ □ □ □

  b. Me siento "yo mismo" cuando hablo en **K'iche'**.

□ 0 □ 1 □ 2 □ 3 □ 4 □ 5 □ 6

17. a. Me identifico con una cultura **Hispanohablante**.

      0   1   2   3   4   5   6
□ □ □ □ □ □ □

  b. Me identifico con una cultura **K'iche'**.

□ 0 □ 1 □ 2 □ 3 □ 4 □ 5 □ 6

18. a. Es importante para mi usar (o llegar a usar)

      0   1   2   3   4   5   6
□ □ □ □ □ □ □

  Español como un hablante nativo

□ 0 □ 1 □ 2 □ 3 □ 4 □ 5 □ 6

  b. Es importante para mi usar (o llegar a usar)

  K'iche' como un hablante nativo

  .

19. a. Quiero que los demás piensen que soy un

      0   1   2   3   4   5   6
□ □ □ □ □ □ □

hablante nativo de **Español**.

□ 0 □ 1 □ 2 □ 3 □ 4 □ 5 □ 6

  b. Quiero que los demás piensen que soy un

  hablante nativo de **K'iche'**.

Copacabana

En una península sobre el lago Titicaca encontramos la ciudad y Puerto de Copacabana, capital de la provincia boliviana de Manco Cápac. Desde la época precolombina, Copacabana es un centro de peregrinación espiritual. El santuario actual, dedicado a la Virgen de la Candelaria, se levanta sobre un antiguo templo de los coyas y los incas.

Se cuenta que el inca Francisco Tito Yupanqui talló una escultura folklórica y sin proporciones que el párroco no quiso colocar en el altar. Con el paso del tiempo, el pobre artista pudo proporcionar a su pueblo la obra pintada que hoy se conoce como la Virgen Copacabana, a la que invocan su protección peregrinos peruanos y bolivianos.

El Viento del Norte y el Sol

El Viento del Norte y el Sol disputaban sobre sus poderes, y decidieron conceder la palma al que despojara a un viajero de sus vestidos.

El Viento del norte empezó de primero, soplando con violencia; y apretó el hombre contra sí sus ropas, el Viento del Norte asaltó entonces con más fuerza; pero el hombre, molesto por el frío, se colocó otro vestido. El Viento del Norte, vencido, se lo entregó al Sol.

Este empezó a iluminar suavemente, y el hombre se despojó de su segundo vestido; luego lentamente le envió el Sol sus rayos más ardientes, hasta que el hombre, no pudiendo resistir más el calor, se quitó sus ropas para ir a bañarse en el río vecino.

From: Morgan 2010

1. ¿Ha visitado la ciudad de Antigua? ¿Qué le pareció?

2. He oído que la Semana Santa es un gran evento en Antigua, ¿cuáles son algunas tradiciones de este tiempo sagrado?

3. ¿Cuáles son algunos ejemplos de la comida Guatemalteca?

4. ¿Cuáles son algunos ejemplos de comida K'iche'?

5. ¿Cuáles son sus costumbres favoritas de la cultura k'iche'?

6. ¿Ha leído o oído usted el Popol Vuh? ¿Me podría contar sus partes favoritas?

7. ¿Cómo es un día típico para Ud.?

8. ¿Alguna vez ha sentido que iba a morir? Cuénteme lo que pasó?

9. ¿Cómo se hace la ropa tradicional?

10. ¿Qué le gusta hacer para divertirse?

11. ¿Tiene usted algunas mascotas? ¿Cómo se llaman?

12. He oído que "Nahualá" significa "agua de los espíritus", o "agua de los brujos". ¿Porque se llama así?

13. ¿Cuál era su actividad favorita cuando era niño/a?

14. ¿Cuál fue la cosa más extraña que soñó usted?

15. ¿Cual es el mejor consejo que ha oído usted?

16. ¿Cuénteme cómo fue su niñez? ¿Cuantos hermanos tiene?

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