Sociophonetic Variation in Bolivian Quechua Uvular Stops

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Quechua is an indigenous language of the Andes region of South America. In Cochabamba, Bolivia, Quechua and Spanish have been in contact for over 500 years. In this thesis, I explore sociolinguistic variation among bilingual speakers of Cochabamba Quechua (CQ) and Spanish by investigating the relationship between the production of the voiceless uvular stop /q/ and speakers' sociolinguistic backgrounds. I conducted a speech production study and sociolinguistic interview with seven bilingual CQ-Spanish speakers. I analyzed manner of articulation and place of articulation variation. Results indicate that manner of articulation varies primarily due to phonological factors, and place of articulation varies according to sociolinguistic factors. This reveals that among bilingual CQ-Spanish speakers, production of voiceless uvular stop /q/ does vary sociolinguistically.

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Preface

This thesis exists because of the kindness of my collaborators in Cochabamba. A million thanks for being willing to participate in my experiment and to so graciously share your stories and knowledge.

Pachi, gracias, and thank you to all my mentors, friends, and family that supported me through this. Alana, thank you for being my mentor, my Quechua mom, and my friend. Wiñachiwanaykipaq pachi wiñaypaq pachi ima. Claude, thank you for your advice, board game recommendations, and putting up with my constant procrastination. Hilda, sinchiykiwan sunquykiwan Runasimita yachachiwanaykipaq pachi. Tyler, thank you for being being a wonderful friend and travel partner. Jesus, yachanaykipaq willanaykipaq pachi. Janine y Joaquin, gracias por toda su ayuda y su apoyo. Bertha y Daniel, gracias por su compasión, su comida, y sus historias. Melinda, thank you for your support and all your help with R and Praat. Marty, thank you for all your love and support. I couldn't have done this without all of you.

1.0 Introduction

Every living language is alive and changing. A language will change in isolation and in situations of contact alike. When languages interact, more often than not, the pronunciations, words, and grammatical structures that survive the test of time are that of the dominant: the dominant language, the dominant dialect, the dominant class. But language contact is far more complex than just the individual features that change – it is fundamentally tied to the culture in which it exists, and for a language's speakers, is both global and personal at the same time.

In this thesis, I will investigate the phonetics of Cochabamba Quechua (CQ), also called South Bolivian Quechua. Quechua, the most common of Bolivia's 35 official indigenous languages, is spoken by approximately 2 million people within the country. The total number of speakers of Quechuan languages is around 10 million, and speakers live throughout the Andes region and in parts of the Amazonian basin. If considered as one language, Quechua is the most spoken Amerindian language. But despite its seemingly large number of speakers, Quechua is often considered endangered, due to the long-term language contact with Spanish and "dialects" that are often not mutually intelligible (Hornberger & Coronel-Molina, 2004). Quechua people continue to suffer from the violent effects of colonialism: discrimination from governments and social institutions, the devastation of global warming on traditional agriculture, and poor access to healthcare and higher than average mortality rates.

My research was conducted in Cochabamba, a city and a governmental department in Southern Bolivia, stretching from the altiplano, or Andean plateau, to the edges of the Amazon rainforest. Within Cochabamba city, over 50% of the population are bilingual speakers of Spanish and an indigenous language, and an additional 2.5% are monolingual indigenous language

speakers (Sichra, 2005). Though the census data does not specify which languages, historically, the vast majority of indigenous people in Cochabamba are Quechua. The percentage of monolingual speakers has been decreasing, while bilingualism appears to be stable. Spanish and Quechua exist in many of the same spaces – in the marketplace, in homes, with family and friends, at religious ceremonies and celebrations. Despite government efforts such as indigenous language proficiency requirements for government employment and Quechua-language education in some primary and secondary schools and universities, Spanish remains the dominant language of the public sphere.

In Cochabamba, as throughout the Andes region, the current situation of Quechua-Spanish language contact is predominantly shaped by migration. The language contact situation in Bolivia is influenced primarily by Quechua moving into urban domains and Spanish into rural domains, though in some cases migration is rural to rural – many Quechua migrant workers work in coca-growing regions such as Santa Cruz, the department with the largest percentage of Spanish speakers (Hornberger & Coronel-Molina, 2004). The city of Cochabamba, where my research is focused, is one of the main centers for rural to urban migration. Many recent Quechua migrants work in lower class jobs or are unemployed, while many longtime Quechua city dwellers have moved into professional and academic fields.

Language use is also impacted by gender and class divides. There are still many monolingual indigenous language speakers among women in rural parts of Bolivia as well as Southern Peru, and in situations of community-wide language shift, women, children, and elderly people are the ones who continue to use Quechua (Hornberger & Coronel-Molina, 2004). Though these three groups do include workers, they are typically not wage workers – it is usually rural men who pursue wage work, who often must use Spanish in their jobs.

To examine the much larger issues of how language contact impacts Quechua, I am looking at potential changes in production of Quechua sounds, focusing on the voiceless uvular stop /q/. I conducted a production study with seven Quechua-Spanish bilinguals. The speakers I worked with were (coincidentally) all women, three of whom lived in the city or nearby urban suburbs and work or had worked in educational fields, and four who live outside Cochabamba, in a peri-urban, formerly rural small town, all of whom work at a women's farming cooperative. Due to Spanish dominance in economic spheres, Quechua-speaking people in academic or professional fields effectively must be bilingual Spanish speakers, and it is difficult for lower class workers to find jobs or sell their goods without Spanish knowledge.

In this thesis, I will first describe the literature on Quechua language contact and sociolinguistic variation, both across the Andes and in Bolivia and Cochabamba specifically. I will review relevant phonetic and phonological research on CQ and other Quechuan languages. I then describe the methods of my experiment and analyze my results. Finally, I summarize my findings on how /q/ is realized in different contexts, describe the correlations between pronunciations and patterns of language use, and explain how these relationships may have been affected by language contact.

2.0 Literature Review

2.1 Sociolinguistic Context

2.1.1 Cochabamba Quechua (CQ)

Cochabamba is a city and a governmental department in South Central Bolivia. The city of Cochabamba is often called the Quechua word *llaqta* ("city") by its residents. Throughout this thesis, I will use the term llaqta to differentiate between the city and the surrounding department. The llaqta's population is around 600,000, and the department as a whole has around 1.7 million residents. Figure 1 shows a map of the Cochabamba Department, including labels for each province. The llaqta is the province labeled 101.

Quechua was first introduced to the region by the Incas, and functioned as the lingua franca during Inca colonization and later under Spanish colonial rule. CQ continued to increase in speakers into the 20th century as agrarian reform and a resurgence of mining spread Quechua into new areas.

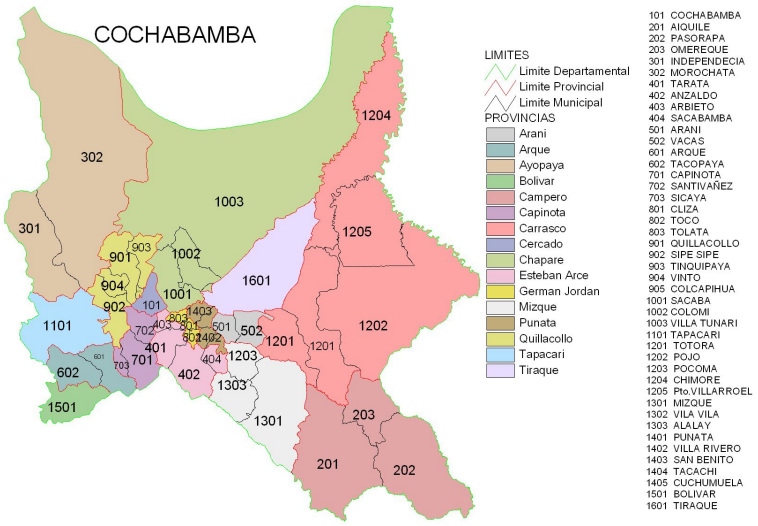

Figure 1. Map of Provinces - Cochabamba Department. Reprinted from UDAPE (Unidad de Análisis de Políticas Sociales y Económicas). Retrieved from http://www.udape.gob.bo/.

In 2012, 66% of the over 15 population in Cochabamba department spoke CQ (UDAPE, 2012). The llaqta is typically characterized as having stable bilingualism. Within the llaqta, 51% of the population are bilingual speakers of Spanish and an indigenous language, and an additional 2.5% are monolingual indigenous language speakers (Sichra, 2005).

These numbers reveal the extent of language contact between CQ and Spanish. In this project, I will investigate the ways in which language contact and the sociolinguistic situation of CQ affect phonetic variation. Sociolinguist Fought explains that "to analyze the effects of linguistic contact, then, we must understand the context in which speakers in a community construct their own ethnicity" (Fought, 2010). As these numbers were determined using speaker self-identification, it is important to discuss what it means to identify as a Quechua speaker.

"For many, being Quechua means speaking Quechua" (Hornberger & Coronel-Molina, 2004). To identify as Quechua is to identify as indigenous. In Bolivia, identifying as indigenous is "largely a political stance, and people's ethnic identification can shift through changes in social

status or political orientation" (Babel, 2018). Language use, along with related aspects of identity such as ancestry, histories of migration, geographical origin, and physical characteristics, are all highly racialized (Babel, 2018). Speaking Quechua is less about the ability to speak Quechua and more about an individual's racialized identity.

The complicated politics of identifying as a Quechua speaker are illustrated in Babel's "Between the Andes and the Amazon" (2018). She told the story of a family friend who "confidently identified himself as a Quechua speaker. [He said,] 'How could I not be, when you know that my mother speaks Quechua?'" Despite this, he preferred to speak primarily in Spanish, even with his Quechua-speaking family members. Though he had identified as a "Spanish-dominant speaker in his youth, as he grew older he identified more strongly as a Quechua bilingual".

While living in Bolivia, I stayed with an elderly couple, both bilingual speakers of Spanish and Quechua. My host mom, a former teacher, told me that none of her friends spoke Quechua – or if they did, she didn't know. She doubted they knew she spoke Quechua. As a middle class retiree, identifying as a Quechua speaker did not fit the image she wanted to project. But I often heard her slip into a line or two of Quechua while on the phone with friends, going back and forth between the two languages without even noticing.

She was still proud of her ability to speak Quechua, even if not publicly. My host parents' daughter, raising children of her own, elected for her children to learn English in school rather than Quechua. My host mom thought it was more important to learn Quechua – how else could you speak with the people in the *campo* or in the markets? English has nothing to do with Bolivia, she told her daughter while arguing at dinner. Quechua is part of Bolivian culture.

In Cochabamba and throughout the Quechua-speaking world, it is clear that many Quechua speakers hold complex and conflicting attitudes towards their own language. Speakers' language ideologies are influenced by language contact born out of Spanish colonialization, violent oppression against indigenous peoples, and systems of racialized social stratification. In order to discuss the ways that this language contact influences sociolinguistic variation, I will first look at the history and context of language contact throughout the Quechua-speaking realm and in Bolivia and Cochabamba specifically.

2.1.2 Language Contact throughout the Andes

Quechua and Spanish have been in contact for over 500 years, beginning with Spanish colonization in the 1500s. In its history, Quechua has been both a colonizing and colonized language. Quechua was the main language of the Inca Empire, centered in Cuzco in what is now Peru (Escobar, 2011). Quechua maintained its status as the lingua franca within the Andes region for most of Spanish colonial rule, and continued to replace Aymara and other indigenous languages during this time. The Spanish used Quechua as a tool to maintain political and social control by continuing the Inca *mítmac* system of forced labor, as well as using Quechua as a way to evangelize and maintain social stratification between Spanish and indigenous peoples (King & Hornberger, 2006). The Spanish government did not outlaw use of Quechua until the late 1700s, in response to indigenous rebellions led by Tupac Amaru. Quechua language was a key component in organizing the rebellions, and a unifying factor among participants in the rebellion.

Though the spread of Quechua began long prior to the existence of the Incan Empire, Cochabamba and the rest of Southern Bolivia was introduced to Quechua through Incan colonization (King & Hornberger, 2006). After independence from Spain, following the European

nation-state model, Bolivia and many other new South American countries adopted Spanish as their official language, interpreting indigenous heterogeneity as in direct opposition to their new unified national identity. Though Spanish was the language of the state and powerful institutions, the two languages, divided by ethnic and economic stratification, existed in relatively separate realms until the 20th century.

Prior to the agrarian reform of the 1950s, bilingualism was primarily found in landowning Mestizo families living in rural areas (Sichra, 2005). The agrarian reform in the 1950s and the resurgence of mining in the 1960s resulted in a shift in linguistic prestige and growth and an increase in the numbers of Quechua speakers. Large populations of Quechua people from the Cochabamba valley migrated to mining areas in Potosí Department, which were traditionally Aymara-speaking. Quechua, "the language of prestige associated with the mines and modernization", continues to have prestige over Aymara to this day (Howard-Malverde, 1995).

Presently, Quechua has official status or recognition in Peru, Bolivia, and Ecuador, though Spanish is still the language of government, education, media, and social institutions. But government policy valuing and prioritizing indigenous language and culture has not translated into real change. Official documents honoring indigenous heritage matter little when governments continue to enforce neoliberal policies that exacerbate poverty, inequality and discrimination – all of which disproportionately affect indigenous people. These policies of neoliberal multiculturalism, pushed on governments in the Global South by non-governmental organizations (NGOs) like the World Bank and foreign donors, are superficially progressive attempts to justify free market policies that speak of cultural inclusion while worsening conditions for the people they claim to include (Gustafson, 2014).

2.1.3 Language Contact in Cochabamba

CQ and Spanish are in frequent contact, co-existing in many of the same domains, communities, and families. In the llaqta, CQ continues to be associated with rural living and older speakers, but Quechua language and culture are alive and prevalent throughout the city. Quechua people are increasingly migrating to urban areas for economic opportunities, often due to environmental threats to agriculture. Outside of the city, government-run education and mass media are rapidly spreading to traditionally isolated rural areas and bringing Spanish with them (Sichra, 2005). Because of this, "the number of language contact scenarios is nearly as great as the number of Quechua-speaking communities" (King & Hornberger, 2006).

However, Quechua speakers moving into urban areas does necessarily mean that Quechua is spoken in urban settings. Indigenous rural-urban migration has increased in recent years (UN Permanent Forum on Indigenous Issues, 2008). Looking at Latin America specifically, "the high proportion of young indigenous people who do not speak their native language reflects the structural cultural loss that takes place as a result of displacement, disaggregation and atomization of indigenous languages" (Del Popolo et al., 2007). In urban environments, indigenous people face discrimination for using their native language, as well as pressure to "integrate" into the "global Spanish-speaking society" (Del Popolo et al., 2007).

Throughout the Andes, indigenous language speakers often avoid using their language in multilingual situations and do not teach their language to their children. In 2004, Hornberger and Coronel-Molina saw that "Quechua speakers often find that they are actively discriminated against and made to feel ashamed if they cannot communicate in Spanish". In the present day, the shame and stigma of being indigenous and speaking an indigenous language continues, though the situation may be improving in Bolivia. There is evidence that positive attitudes towards Quechua

language and identity are increasing, and many people I spoke to in Bolivia believe discrimination against indigenous people has decreased since the election of Bolivia's first indigenous president, Evo Morales, in 2005 (Escobar, 2011).

The situation of the llaqta differs from many other Quechua language contact situations due to the existence of a fairly stable bilingualism. Mannheim argues that in Cochabamba, "Quechua is freely accepted in mass media and in other public venues" (Mannheim, 2018). The term *llaqta* is used by all Cochabambinos, regardless of ethnic identity or knowledge of CQ. *Warmi* ("woman") is used in the names of many women's organizations, and Cooperativa Tukuypaj (*tukuypaq*, "for all"), a savings and credit cooperative, has locations around the city.

Figure 2. Cooperativa Tukuypaj – Cochabamba. Reprinted from Cooperativa Tukuypaj Ltda. Retrieved from https://cooperativa-tukuypaj-ltda.negocio.site/.

2.1.4 Quechua Standardization

The original inspiration for this project was spelling variation. While studying CQ as an American undergraduate student, I noticed that words prescriptively containing /q/ were instead written with k, j, or x. (See Figure 2 above for an example: Cooperativa Tukuypaj.) I initially hypothesized that this was due to the influence of Spanish on the Quechua phoneme inventory. However, as I have worked on this project, it has become clear that spelling variation could reflect any number of sociolinguistic factors. Spanish influence may be at play, as well as Quechua documentation attempts by non-native speakers (and non-speakers). The majority of Quechua speakers do not read and write in Quechua, regardless of Spanish literacy. And even when Quechua speakers are taught how to read and write in Quechua, the written Quechua that they learn often has little similarity to the Quechua that they speak.

Attempts to standardize Quechua often try to restore Quechua to its "pure", pre-colonial state. Spellings are "based on the reconstructed pronunciations of centuries past" and there is "enormous effort to salvage archaic forms at the level of words and suffixes" (Luykx, 2003). Most dictionaries, including the one I used to judge spellings and prescriptive pronunciation for my experimental stimuli, include words that are either archaic or were created from other roots to replace Spanish loans (Laime Ajacopa, 2007). This method of spelling standardization is motivated both by language purists and by the academic push to create a unified standard alphabet for all of Quechua's varities. Peruvian Quechua linguist Cerrón Palomino explains this view in his paper "Normalization in Andean Languages" (1991). Cerrón Palomino views "descriptivist" and "transcriptionist" methods of writing negatively, since he believes that "language codification presupposes the development of alternate registers for the language" and the "idea that orthography must reflect the actual pronunciation of the language" is "wrong". He emphasizes the importance

of tradition and Quechua history, and believes in situations of polymorphism, the most conservative option is best – even if it does not reflect what is actually spoken. To him, "postulat[ing] a variety of innovative forms which, although perfectly valid in speech, clearly deviate from more conservative and easily 'recoverable' ones" negatively impacts the development of a Quechua writing system.

Throughout the Quechua-speaking world, "there is a hierarchy of linguistic registers within the indigenous languages that reflects social domination" (Mannheim, 2018). Systems of racialized social stratification give prestige to Spanish-influenced versions of Quechua. Prestigious and supposedly pure "standardized" Quechua, as is used in academic texts and by few educated elite, uses fewer Spanish loanwords but shows the influence of Spanish in "phonology, core grammatical systems such as person and voice, the meanings of lexical stems, and everyday interactional-practices" (Mannheim, 2018). It is clear that Quechua, the language of the community, and Quechua, how it is written and studied by academics, are two very different languages. When Quechua is taught in Bolivian schools, the difference between the standardized academic Quechua and spoken Quechua means that "the standardized school texts are at times so puzzling that [some Bolivian schoolteachers] skip over parts of lessons because they cannot understand the instructions" (Luykx, 2003).

"All public knowledge of Quechua linguistic structure, all grammatical analysis, all documentation of lexical meaning is mediated through Spanish" (Mannheim, 2018). Within academic studies of Quechua language, non-Quechua researchers are likely to "find their research intermediated by Spanish-inflected Quechua", failing to recognize the differences between Spanish-inflected Quechua and the language of monolingual speakers (Mannheim, 2018). As a non-native Quechua speaker, primarily relying upon work written in English and Spanish, my

interpretation of Quechua phonetics will always be intermediated by the influence of Spanish. I depend on the feedback and assistance of my indigenous colleagues and mentors, as well as research conducted by native Quechua speaker linguists.

By investigating sociolinguistic variation in CQ phonetics, I aim to show CQ as it is really spoken, in its many and diverse variants. I acknowledge that my understanding will always be from the perspective of a non-native speaker, and I will return to this issue in the conclusion.

2.2 Phonetics of Quechua

The Quechua consonant phonology differs widely across varieties. The following Cochabamba Quechua consonant inventory is adapted from Gallagher (2015).

Table 1. Consonant Inventory - Cochabamba Quechua.

		Labial	Alveolar	Postalveolar	Velar	Uvular	Glottal
Stop	Plain	p	t	tʃ	k	q	
	Aspirate	p^h	t^h	$tʃ^h$	k^h	q^h	
	Ejective	p’	t’	tʃ’	k’	q’	
Fricative			s				h
Nasal		m	n	ɲ			
Liquid			l ɾ	ʎ			
Glide		w		j			

Most Quechuan languages have a three vowel system, with vowels /ɑ, i, u/. Some varieties have allophones [e, o] replacing [i, u] near uvular consonants. Quechua scholars disagree as to whether [e, o] are phonemic vowels or simply allophones, as well as whether a change in vowel inventory reflects the influence of Spanish (Weber, 2005). Spanish uses a five vowel system, with

vowels /a, i, e, o, u/ (Ronquest, 2018). However, much of Quechua phonetics research generalizes patterns from bilingual speakers to all speakers, failing to consider sociolinguistic variation (Mannheim, 2018). When considering sociolinguistic variation, it is clear that vowel inventories differ across groups of speakers.

Mannheim surveyed the literature on the vowel space of Quechuan languages and determined a pattern of "enregistered internal differentiation in Quechua, depending on qualitatively distinct patterns of exposure to Spanish" (Mannheim, 2018). He separated speakers into three distinct sociolingusitic registers. Register 1 is monolingual speakers of Quechua. Monolingual speakers distinguish three vowels, and in the context of a uvular sound, the high front /i/ moves further back and the high back /u/ becomes further front. Neither vowels lower. In register 1, vowel backing/fronting is a coarticulatory effect. Register 2 is first language speakers of Quechua who have learned Spanish fluently. These bilingual speakers differentiate the five vowels of Spanish in their Quechua, relocating their Quechua vowels to the same place as their Spanish vowels. In the context of uvular sounds, high vowels /i/ and /u/ become lowered but not backed, and low vowel /a/ becomes backed. In register 2, vowel lowering is phonological. Register 3 is first language speakers of Spanish who learned Quechua as a second language. These speakers interpret Quechua vowels through the Spanish vowel system. Their five vowels, in both Quechua and Spanish, are phonemically distinct. They produce mid vowels both in the context of uvulars and not in the context of uvulars. In register 3, vowel lowering is phonemic.

The case of Quechua vowels demonstrates that it is critical to include sociolinguistic context in phonetic research. "The pattern of vowels— both in paradigmatic terms and in terms of their coarticulatory modifications— is saturated with social affect and racialized" (Mannheim, 2018).

2.2.1 Quechua uvular stop

Research about Quechua speakers' production of /q/ reveals a variety of possible trends, and the diversity of Quechuan languages, dialects, and speaking communities means that all of these trends could be happening in different locations. In the words of Mannheim, "linguistic contact between Spanish and the indigenous languages [is not] flat; rather, it varies from region to region, consonant with local histories and with differences in the linguistic structure of the indigenous language in question" (Mannheim, 2018). While the phonological changes happening in other varieties of Quechua are not reflective of the exact phonological processes happening in Bolivian Quechua, these changes reveal how other Quechuan languages have changed while in contact with Spanish and provide context to the situation of Bolivian Quechua.

Weber (2005) looked at variation in /q/ production across Quechuan languages. He found that certain dialects of Ecuadorian Quechua have already lost the uvular /q/, due to a merging of /k/ and /q/ in the San Martín dialect, and there is a complete loss of /q/ pronunciation in the Peruvian Wanka dialect. Weber proposed that /q/ has seven possible allophones, which are [g, g̟, ɣ, ɣ̟, x, x̟, :], with [:] representing a long vowel. Cerrón-Palomino (1973) investigated the loss of /q/ in Peruvian Wanka. He found that word-initial /q/ has become a glottal stop [ʔ] or voiceless glottal fricative [h], and word-final /q/ has become the voiceless velar fricative [x] or is dropped altogether.

2.2.2 Cochabamba Quechua uvular stop

The phoneme inventory of CQ contains two plain dorsal stops, /q/ and /k/. The plain uvular /q/ is phonemically distinct from ejective /q'/ and aspirate /q^h/. My current investigation looks only

at the plain uvular stop /q/. In the following review of the current literature on CQ /q/, I will discuss studies looking at Quechua uvulars as a category. I will not delve deeply into the differences between plain, aspirate, and ejective stops. For more discussion of these differences in Quechua, consult Gallagher's "Acoustic and articulatory features in Phonology – the case for [long VOT]" (2011). Vowel lowering effects are observed across all CQ uvulars.

Linguists and native speakers have observed that the uvular stop /q/ has a fricative allophone. Through my own subjective observations, almost exclusively with bilingual speakers, I have often heard uvular /q/ produced as a fricative word-medially and word-finally. Gallagher (2015), based on her work with both monolingual and bilingual CQ speakers, observed that /q/ is often produced as approximant [ʁ], while /q^h/ is often produced as fricative [χ]. Weber (2005) claimed CQ has undergone a sound change causing syllable-final /q/ and /k/ to be realized as a fricative. The current literature on CQ phonetics lacks comprehensive acoustic investigations into the manner of articulation of uvular stops. The majority of the research exploring the CQ uvular stop investigates the role of vowel height in perception and production, in both bilinguals and monolinguals.

Gallagher (2015) documented vowel height allophony in Cochabamba Quechua, and explored how vowel height is used in the perception of dorsal place, specifically regarding the uvular and velar stops. She found that vowel height is a strong cue for the uvular-velar contrast. An acoustic study with primarily monolingual Quechua speakers revealed a consistent lowering effect from both preceding and following uvular consonants. Vowel lowering occurred independently of the presence of a velar consonant in a stem. When compared to vowels following a labial consonant, she found that front vowels following a uvular have a higher F1 and lower F2, and back vowels have a higher F1 and no change in F2. A follow-up perceptual study with bilingual

speakers presented speakers with nonce words containing a uvular or velar ejective followed by either [i] or [e]. When the vocalic cues conflicted, i.e. a uvular consonant followed by a high vowel, listener perception decreased in accuracy. She concluded that perception of velars depends more on the surrounding vowels than perception of uvulars.

Holliday and Martin (2018) conducted an acoustic study of the vowel spaces of bilingual CQ–Spanish speakers in Cochabamba Department, with a particular focus on the height of mid and high vowels. Similar to the findings of Gallagher, Holliday and Martin found that Quechua high vowels do appear to undergo systematic lowering following uvular consonants, with lowering being consistent throughout the duration of the vowels. This finding challenges a purely coarticulatory motivation for the observed lowering pattern. A second acoustic study was performed with same group of bilingual speakers to determine the Spanish vowel space and compare to that of Quechua. They found that bilingual speakers appear to have different formant values for each of the vowels in their two languages. This indicates that bilingual speakers may be maintaining separate vowel systems for Quechua and Spanish.

While these studies provide important phonetic information, they do not significantly discuss the role of sociolinguistic variation in speaker production and perception. Gallagher's two studies worked with two different groups of speakers: primarily rural monolingual and urban bilingual. Additionally, the bilingual participants are all literate in Quechua, which is rare among Quechua speakers. Holliday and Martin's study worked with bilingual, college-educated speakers. 10 of the 11 speakers were students or faculty at an indigenous university in the Cochabamba department. Holliday and Martin made an important comment on this, noting that "in general, speakers of Bolivian Quechua do not have extensive experience reading Quechua, and thus may not have a high level of comfort nor would they produce naturalistic pronunciations in a Quechua

reading task... bilingual speakers may especially be affected by prescriptive norms of pronunciation, and these norms may differ from speaker to speaker, depending on their level and type of education" (2014). Because of this, they chose to conduct a translation task, rather than a reading task. However, familiarity with academic Quechua could still influence auditory perception and production.

This thesis aims to provide sociophonetic context to the discussion around the uvular /q/ in CQ. Similar sociophonetic research has been conducted with Cuzco Quechua, regarded as a variant similar to Bolivian Quechua. Molina Vital (2011) compared production of vowels near uvulars and velars across four different groups of Cuzco Quechua speakers: Spanish-Quechua bilinguals who acquired both languages in early childhood, Quechua L1 speakers who acquired Spanish later, Quechua L2 speakers who acquired Spanish first, and monolingual or near-monolingual Quechua speakers. He found that vowel lowering in uvular context has categorical features, though there is variation across groups of speakers. The Spanish-influenced groups, bilinguals and Quechua L2 speakers, showed more categorical lowering of /i/ and /u/ in a uvular context. Among Quechua L1 and monolingual speakers, speakers showed more variation and less lowering, though some features of categorical lowering were still present. Unable to find clear patterns of categorical lowering or co-articulatory effects, he concluded that there is much research to be done.

3.0 Experiment

To explore sociophonetic variation in the production of uvular /q/, I elicited uvular stop sounds in a variety of different contexts. The goal of this experiment was to determine sociophonetic variation in the production of /q/.

3.1 Participants

I collected data from seven people, three in the city of Cochabamba and four in a peri-urban town outside of Cochabamba. The research participants were all fluent Spanish and CQ speakers who began learning both languages in early childhood. All seven participants were women. They ranged in age from 22 to 59. This data was collected in May and June 2018.

3.2 Sociolinguistic Interview

In order to investigate sociophonetic patterns of variation, each participant was interviewed to determine their personal and familial language histories. The interview was conducted in Quechua by myself, a non-native speaker of Quechua. I am a native English speaker and a conversational speaker of Quechua and Spanish. At the time, I was in my fifth semester of Bolivian Quechua at the University of Pittsburgh.

Questions included how long, how frequently, and where and with who the participant speaks Quechua. The questions are attached in Appendix A. The interview results are summarized in the table below. A more in-depth table of interview results can be found in Appendix C.

Table 2. Summary of sociolinguistic interviews.

		Age	Languages spoken by parents	Frequency of Quechua use	Occupation
Speaker residence	Urban	59	Spanish, Quechua	Every day	Teacher
		40	Spanish	Three times a week	Former teacher, researcher
		27	Spanish, Quechua	Every day	Masters student in Quechua linguistics
	Peri-urban	36	Spanish	Every day	Farmer at a Women's Farming Cooperative
		22	Quechua	Every day	Farmer at a Women's Farming Cooperative
		28	Spanish, Quechua	Every day	Farmer at a Women's Farming Cooperative
		57	Quechua	Every day	Farmer at a Women's Farming Cooperative

3.3 Photo Identification Task

The acoustic data was collected through a photo identification task. The stimuli were 53 photos. 22 photos were intended to depict words containing /q/, and another 16 were intended to depict words containing /q'/ or /q^h/. The remaining 15 were meant to depict words without /q/ variants, as to not reveal the intention of my experiment. Prescriptive productions were verified using a Bolivian Quechua dictionary and with the assistance of my Bolivian Quechua professor

(Laime Ajacopa, 2007; H. A, personal communication, June 6, 2018). The target words contained an even distribution of plain uvular sounds in word-initial, word-medial and syllable-initial, word-medial and syllable-final, and word-final positions. The word list is attached as Appendix B. Because of ambiguity in the pictures, I also collected data on words containing /q/ that I did not anticipate.

3.4 Procedure

The experiment was conducted in Quechua by myself. The three llaqta participants were interviewed either in my apartment in Cochabamba or at their workplace. The four peri-urban participants were interviewed at their workplace, a women's farming cooperative. The sociolinguistic interview was conducted first, followed by the photo identification task. The photos were shown to the participants using a laptop computer. Each photo was presented one at a time. After viewing the photo, the participant was prompted to identify the subject of the photo. The audio was recorded using an Olympus LS-P2 handheld recorder at a sampling rate of 44.1 kHz. After the task, I gave each participant a box of tea.

3.5 Analysis

The data was manually coded in Praat for word and phoneme boundaries (Boersma & Weenink, 2018). Each /q/ was manually labeled as stop, fricative, or dropped. Dropped sounds were excluded from the final analysis. The formant data for the surrounding vowels was collected

using a Praat script. F1 and F2 were measured at 20%, 50%, and 80% of the vowel's duration. 61 tokens, accounting for 4.1% of the data, were excluded due to background noise.

Initial exploration of the formant data was done using the Python *Pandas* package (McKinney, 2010). All summary statistics were generated using *Pandas*. Variation in formants across measurement times was analyzed using the ANOVA function from the Scipy *stats* package (Virtanen et al., 2019). Formant values were then analyzed with a linear mixed model regression in R. The models were fit using the lmer() function from the R package *lme4* (Bates, Maechler, Bolker, & Walker, 2015). P-values were generated using the *lmerTest* package (Kuznetsova, Brockhoff, & Christensen, 2017).

The manner of articulation variation was analyzed with binomial logistic regression using the glm() function in base R. All graphs were created using *ggplot2* (Wickham, 2016).

3.6 Results

3.6.1 Formant variation

I based my expected F1 and F2 values on the models generated by Holliday and Martin (2018). Holliday and Martin's study is the most recent and comprehensive analysis of the CQ vowel space, and focuses on the variation in F1 and F2 in the context of a uvular sound. They created a linear mixed model regression which included a fixed effect for gender as a control variable, two- and three-way interactions of gender, vowel, and language, and random intercepts and random slopes for language by speaker. The below table shows the expected F1 and F2 values

for female Quechua speakers producing /i/ and /u/ in uvular and non-uvular contexts. All formant values were rounded to three decimal points. All values are in Hertz (Hz).

Table 3. Summary of Holiday and Martin's predicted values for CQ vowel formants. Adapted from Holiday and Martin (2014).

vowel		uvular	non-uvular
/i/	F1	607.567	469.259
	F2	2276.596	2431.433
/u/	F1	639.958	499.902
	F2	1244.899	1221.899

In the context of a uvular, front vowel /i/ is expected to lower and back, increasing F1 and decreasing F2. Back vowel /u/ is similarly expected to lower, increasing in F1. The difference between F2 values for /u/ is not significant.

3.6.2 Front Vowel

Table 4. F1 values at 20%, 50%, and 80% duration for front vowel /i/.

Measurement time	F1	Difference from expected value (607.567)
F1-20	623.219	+15.652
F1-50	584.814	–22.753
F1-80	492.500	–115.067

The difference between front vowel F1 at the 80% mark and F1 at the 20% mark is just under 131 Hz. At the 80% mark, F1 is far closer to the typical F1 for a non-uvular front vowel.

Table 5. F2 values at 20%, 50%, and 80% duration for front vowel /i/.

Measurement time	F2	Difference from expected value (2276.596)
F2-20	2154.681	–121.915
F2-50	2085.995	–190.601
F2-80	2043.024	–233.572

F2 shows a similar pattern. The 20% mark is closest to the expected value. The differences between the measurements are not statistically significant (F1: F=0.96523053, p=0.38673022, F2: F=0.39954175, p= 0.67239819).

3.6.3 Back Vowel

Table 6. F1 values at 20%, 50%, and 80% duration for back vowel /u/.

Measurement time	F1	Difference from expected value (639.958)
F1-20	490.946	–149.012
F1-50	488.344	–151.614
F1-80	525.814	–114.144

Back vowel F1 measurements show less of an increase than expected, and the values are much closer to the expected value in a non-uvular context (499.902).

Table 7. F2 values at 20%, 50%, and 80% duration for back vowel /u/.

Measurement time	F2	Difference from expected value (1244.899)
F2-20	1161.211	–83.688
F2-50	1136.426	–108.473
F2-80	1338.306	+93.407

Holliday and Martin (2018) did not find a statistically significant increase in F2 for back vowels. F2 measurement at the 80% mark is more extreme than predicted. The difference between F1 measurements is not statistically significant, but the difference between F2 is statistically significant (F1: F=0.60210562, p=0.54883471, F2: F=6.16477376, p=0.00260832).

3.6.4 Comparing vowels preceding /q/ and following /q/

I will now look at variation based on vowels preceding and following /q/. If lowering and backing are coarticulatory effects, the most lowering and backing will be seen closest to the uvular. For vowels preceding /q/, this would be at 80% duration. For vowels following /q/, this would be at the 20% duration.

3.6.4.1 Front vowel /i/ preceding /q/

Table 8. F1 values at 20%, 50%, and 80% duration for front vowel /i/ preceding /q/.

Measurement time	F1
F1-20	596.971
F1-50	382.914
F1-80	**344.514**

Table 9. F2 values at 20%, 50%, and 80% duration for front vowel /i/ preceding /q/.

Measurement time	F2
F2-20	2365.157
F2-50	2145.371
F2-80	**2120.043**

Tables 8 and 9 show F1 and F2 values for front vowel /i/ when preceding /q/. Values closest to the uvular are bold and in red text. These values differ from what I expected and the results of Holliday and Martin. F1 is decreasing, showing raising, rather than lowering. F2, however, is decreasing, showing the effect of backing.

3.6.4.2 Front vowel /i/ following /q/

Table 10. F1 values at 20%, 50%, and 80% duration for front vowel /i/ following /q/.

Measurement time	F1
F1-20	**636.343**
F1-50	685.764
F1-80	566.493

Table 11. F2 values at 20%, 50%, and 80% duration for front vowel /i/ following /q/.

Measurement time	F2
F2-20	**2049.443**
F2-50	2056.307
F2-80	2004.514

Tables 10 and 11 show F1 and F2 values for front vowel /i/ when following /q/. Values closest to the uvular are bold and in red text. These values are similar to what I expected. Following

a uvular, back vowel /i/ lowers but does not back. F1 is increasing, though F1 is the highest at 50% duration, rather than 20% duration. F2 is not changing significantly.

3.6.4.3 Back vowel /u/ preceding /q/

Table 12. F1 values at 20%, 50%, and 80% duration for back vowel /u/ preceding /q/.

Measurement time	F1
F1-20	487.291
F1-50	516.394
F1-80	**589.647**

Table 13. F2 values at 20%, 50%, and 80% duration for back vowel /u/ preceding /q/.

Measurement time	F2
F2-20	1254.672
F2-50	1246.116
F2-80	**1366.069**

Back vowels preceding /q/ are consistent with the expected pattern of lowering, but do not show backing. F1 at 80% duration is over 100 Hz greater than at 20% duration. F2 is the greatest at the 80% mark, indicating fronting. Backing was not expected for back vowel /u/.

3.6.4.4 Back vowel /u/ following /q/

Table 14. F1 values at 20%, 50%, and 80% duration for back vowel /u/ following /q/.

Measurement time	F1
F1-20	**582.267**
F1-50	575.092
F1-80	568.797

Table 15. F2 values at 20%, 50%, and 80% duration for back vowel /u/ following /q/.

Measurement time	F2
F2-20	**1281.458**
F2-50	1322.442
F2-80	1510.783

Back vowels following /q/ are not consistent with expectations. F1 at 20% duration (582.267) is not significantly different from at 80% duration (568.797). However, F2 is significantly lower at 20% than at 80%, showing a potential backing effect that was not predicted.

3.7 Modeling F1 and F2 variation

3.7.1 F1

A linear mixed effects model was fit to F1. The model included a random intercept for variation by speaker and interactions for the effects of vowel, speaker residence (urban or peri-urban), and speaker family language background (bilingual, Spanish, or Quechua). The predicted intercepts are shown in Figure 3. For the full results of the model, see Appendix C.

```
Fixed effects:
                                                                 Estimate
(Intercept)                                                        603.43
Voweli                                                            -161.96
Vowelu                                                              96.08
Speaker_residenceurban                                             117.23
Speaker_family_lang_backgroundquech                                201.39
Speaker_family_lang_backgroundspan                                 235.96
Voweli:Speaker_residenceurban                                     -187.25
Vowelu:Speaker_residenceurban                                     -280.69
Voweli:Speaker_family_lang_backgroundquech                        -165.05
Vowelu:Speaker_family_lang_backgroundquech                        -355.60
Voweli:Speaker_family_lang_backgroundspan                          -74.54
Vowelu:Speaker_family_lang_backgroundspan                         -393.27
Speaker_residenceurban:Speaker_family_lang_backgroundspan         -384.86
Voweli:Speaker_residenceurban:Speaker_family_lang_backgroundspan   210.40
Vowelu:Speaker_residenceurban:Speaker_family_lang_backgroundspan   404.88
```

Figure 3. Fixed effects of linear mixed model regression fit to F1.

Speaker residence and speaker family language background had significant effects on the value of F1. There were significant interactions between vowel and speaker residence for both front and back vowels. Urban speakers were predicted to have additional F1 decrease for back vowels ($t=-4.222$, $p<0.001$). The trends for urban speakers to increase F1 ($t=2.027$, $p=0.05716$) across all vowels and decrease F1 for front vowels ($t=-1.883$, $p=0.05988$) are approaching significance. There were also significant interactions between back vowels and speaker family language background across backgrounds. Speakers with Quechua monolingual family backgrounds ($t=-4.927$, $p<0.001$) and Spanish monolingual backgrounds ($t=-4.408$, $p<0.001$) exhibited significant decrease in back vowel F1 when compared with speakers with bilingual backgrounds. There were additional significant interactions between urban and Spanish family background ($t= -4.677$, $p<0.001$) as well as urban and Spanish family background and back vowel

/u/ (t=4.286, p<0.001), all contributing to a higher predicted F1 value. Figures 4 and 5 are boxplots showing variation in F1 by speaker residence and family language background.

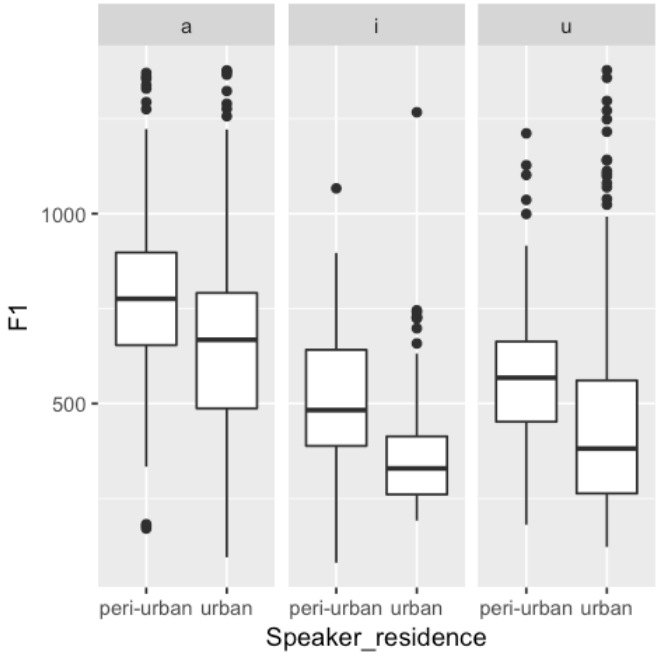

Figure 4. F1 variation by speaker residence.

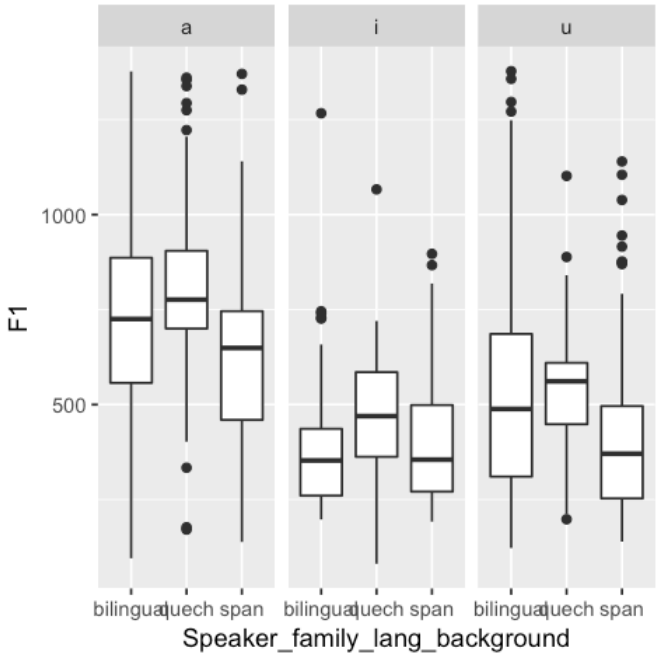

Figure 5. F1 variation by speaker family language background.

3.7.2 F2

A linear mixed effects model was fit to F2. The model included a random intercept for variation by speaker and interactions for the effects of vowel and speaker residence (urban or peri-urban) and vowel and speaker family language background (bilingual, Spanish, or Quechua). The results are summarized in Figure 6. For the full results of the model, see Appendix D.

```
Fixed effects:
                                                        Estimate
(Intercept)                                             1701.066
Voweli                                                   285.902
Vowelu                                                  -192.765
Speaker_residenceurban                                     7.114
Speaker_family_lang_backgroundquech                       -2.096
Speaker_family_lang_backgroundspan                      -128.281
Voweli:Speaker_residenceurban                            146.095
Vowelu:Speaker_residenceurban                           -254.966
Speaker_residenceurban:Speaker_family_lang_backgroundspan  222.885
Voweli:Speaker_family_lang_backgroundquech               199.215
Vowelu:Speaker_family_lang_backgroundquech              -140.220
Voweli:Speaker_family_lang_backgroundspan                 68.180
Vowelu:Speaker_family_lang_backgroundspan                 -7.854
```

Figure 6. Fixed effects of linear mixed model regression fit to F2.

Speaker residence alone did not have a significant effect, but the interaction between speaker residence and vowel revealed a significant decrease for urban speakers' back vowel F2 ($t=-3.350$, $p<0.001$). Speakers with a Spanish family background Urban speakers with Spanish family background had a significant increase in F2 across vowels ($t=3.395$, $p<0.001$). There was an additional trend between front vowel /i/ and Quechua family background ($t=1.811$, $p=0.070328$). Figures 4 and 5 are boxplots showing variation in F2 by speaker residence and family language background.

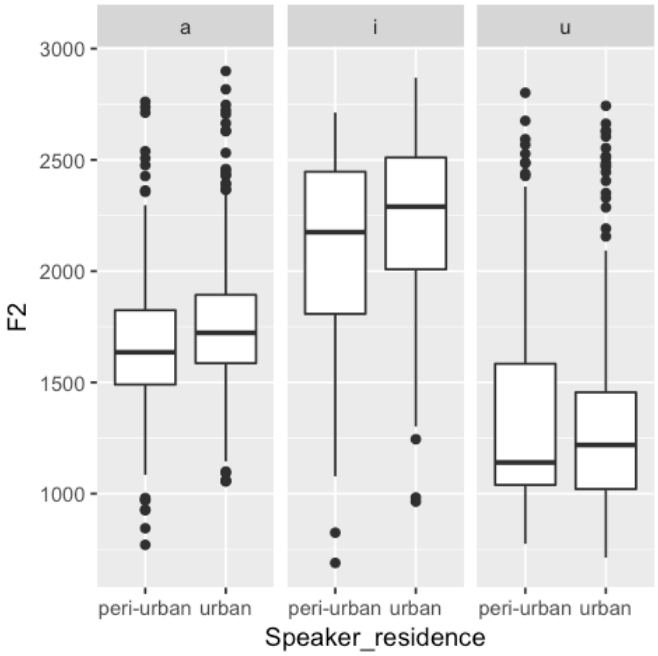

Figure 7. F2 variation by speaker residence.

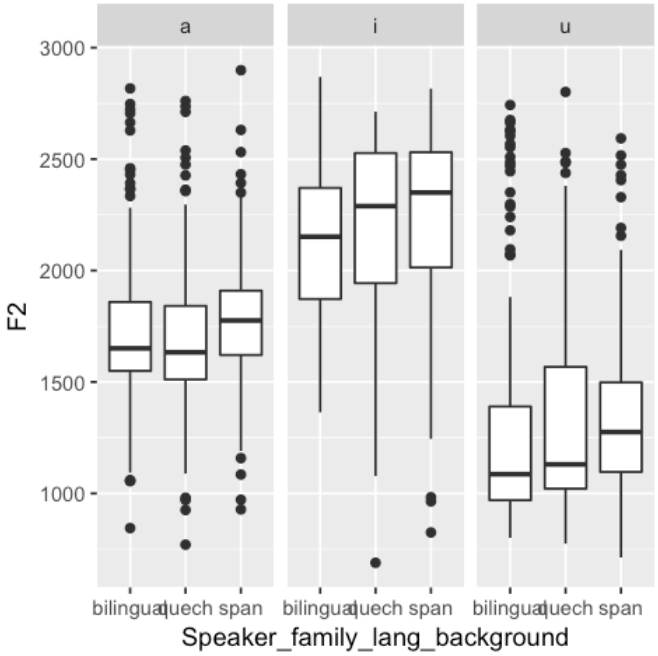

Figure 8. F2 variation by speaker family language background.

3.8 Modeling manner of articulation variation

A binomial logistic regression was fit to the manner of articulation data. The model included fixed effects for position in word (word-initial, word-medial, and word-final), position in syllable (syllable-initial and syllable-final), speaker residence, and speaker family language background. The baseline is stop articulation. Estimated coefficients are shown below. For a full description of the model, see Appendix E.

```
Coefficients:
                                  Estimate
(Intercept)                       -2.36355
Position_in_wordMedial             2.06741
Position_in_wordFinal              4.22426
Position_in_syllableFinal          1.46796
Speaker_residenceurban             0.10404
Speaker_family_lang_backgroundquech -0.02458
Speaker_family_lang_backgroundspan  -0.88173
```

Figure 9. Binomial logistic regression fit to manner of articulation variation.

Word-medial position ($z=2.645$, $p = 0.012672$), word-final position ($z=3.656$, $p<0.001$), and syllable-final position ($z=2.864$, $p=0.004183$) significantly increase the likelihood of realizing the uvular /q/ as a fricative. There is an additional trend for Spanish family language background ($z=-1.944$, $p=0.051842$).

4.0 Discussion

4.1 Manner of Articulation

I did not find a relationship between sociolinguistic background and manner of articulation variation. Manner of articulation shows phonological variation, influenced by the position of the uvular within the word and the syllable. Word-medial uvular stops are likely to become spirantized in both syllable-final and syllable-initial positions. Syllable-final stops are also likely to become spirantized. This supports the intuitions of prior linguists and aligns with similar trends across Quechuan languages. Figure 9 shows the word-initial /q/ in *quwi* (“guinea pig”) realized as a stop. Figure 10 shows the word-medial, syllable-initial /q/ in *alqu* (“dog”) realized as a fricative.The segments containing the uvular sound are outlined with a red box.

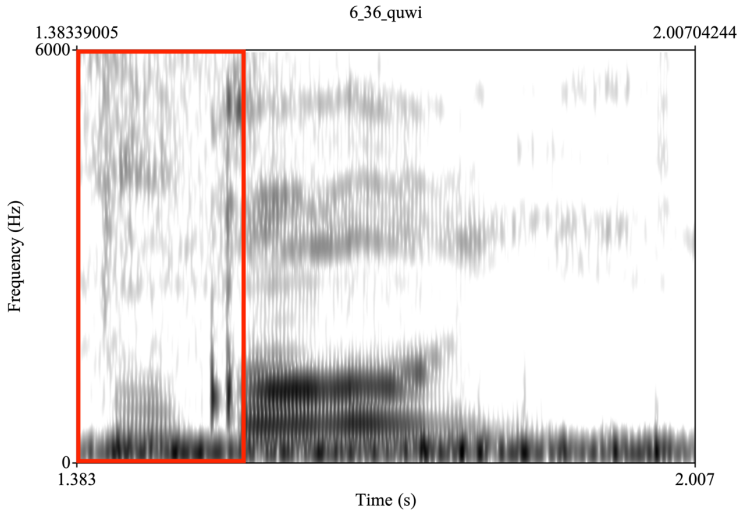

Figure 10. Word-initial stop in quwi (“guinea pig”).

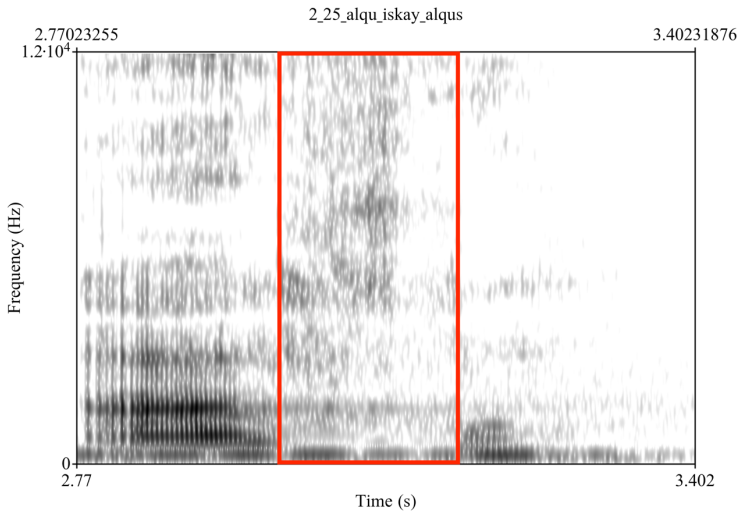

Figure 11. Word-medial fricative in alqu ("dog").

The effect of Spanish family language background was approaching significance, but at this time I cannot conclude that family background has an impact. Further research is necessary to determine if phonological patterns of production vary by sociolinguistic factors.

Using my subjective judgments, I perceived the more open allophone of /q/ as a fricative, but some linguists have proposed that the uvular may also be realized as approximant. Gallagher suggested that the CQ uvular stop may be realized as voiced uvular approximent [ʁ] (2015). A more comprehensive phonetic study is needed to determine whether /q/ is realized as an approximant in certain situations, and if this is governed by a phonological rule.

4.2 Variation in Vowel Production

Sociolinguistic background and vowel lowering in the context of a uvular do have a significant relationship. The data reveals clear contrasts between speakers based on residence and family language background.

4.2.1 Front vowel /i/

For peri-urban speakers, front vowel /i/ is backed but not lowered. Peri-urban speakers are predicted to have a greater F1value for /i/ (mean F1 across language backgrounds = 507.390 Hz) than that of urban speakers, though that value is still closer to the expected non-uvular value of F1 than the expected uvular F1 (Holliday & Martin, 2018). This shows that there is little to no lowering occuring for peri-urban speakers. However, when considering potential interactions, peri-urban speakers with Spanish family language background are predicted to have the greatest F1 (602.890 Hz) out of all groups, suggesting that lowering correlates with Spanish influence. Peri-urban speakers are predicted to have significantly lower F2 (mean F2 across language backgrounds = 2032.641 Hz) compared to urban speakers, and the average predicted value is over 200 Hz lower than the expected value in uvular contexts. This indicates that /i/ is being produced further back.

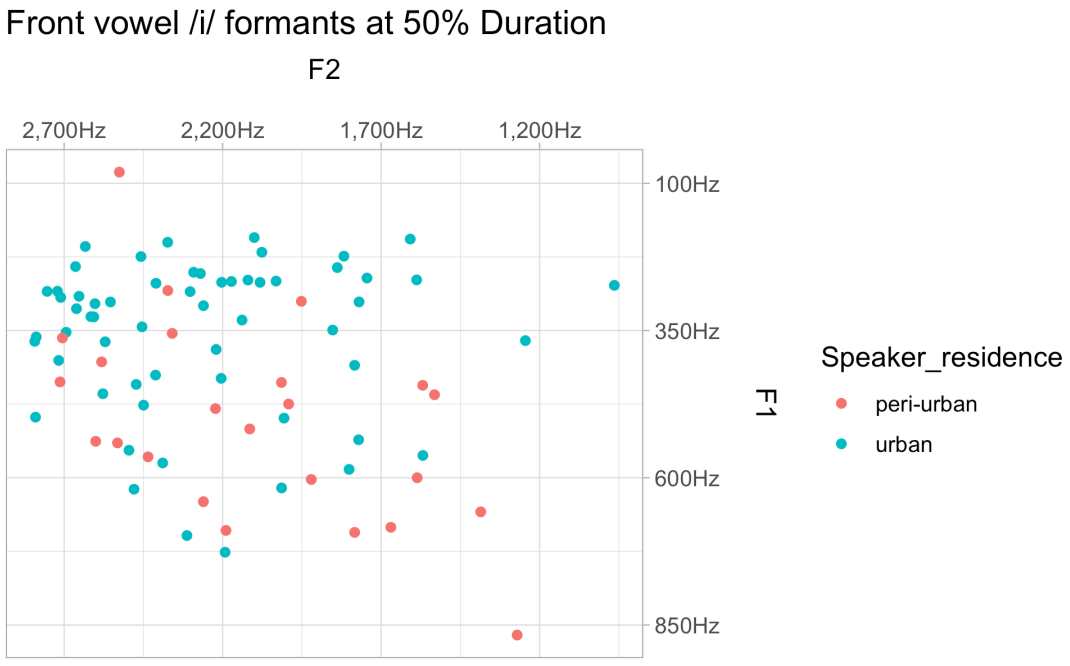

Figure 12. Front vowel /i/ formants at 50% duration, color coded for speaker residence.

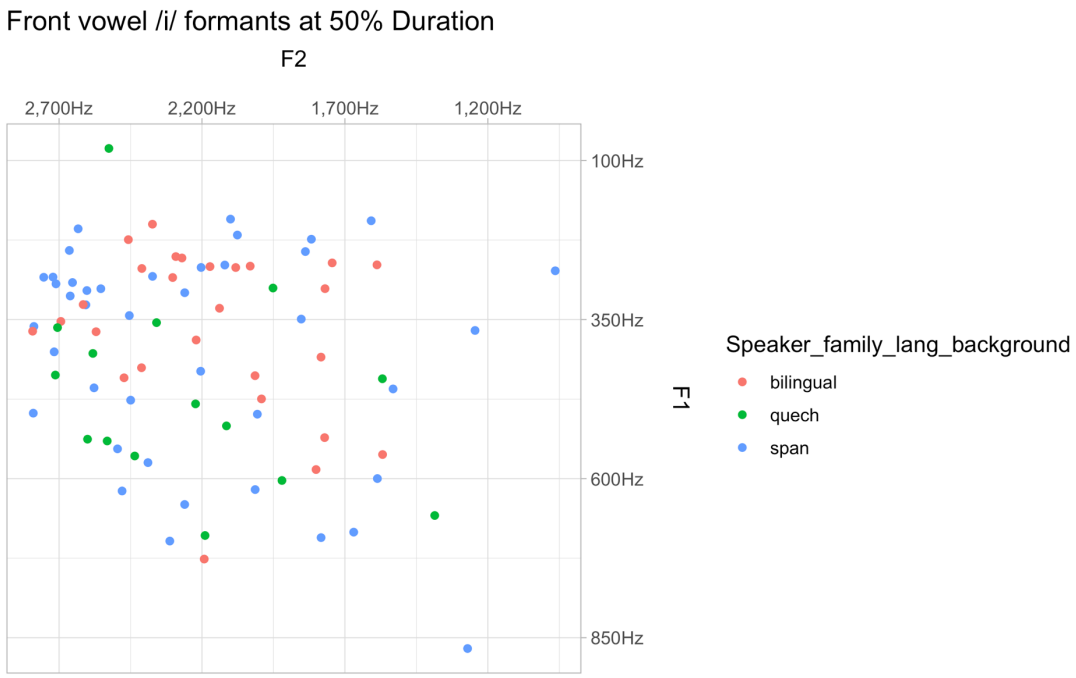

Figure 13. Front vowel /i/ formants at 50% duration, color coded for speaker family language background.

Urban speakers do not show lowering or backing for front vowel /i/. Urban speakers' predicted F1 for front vowel /i/ in a uvular context is lower than the expected non-uvular value (mean F1 across language backgrounds = 379.216 Hz). Urban speakers with bilingual and Spanish family language backgrounds are predicted to have F1 values far lower than the expected non-uvular value (371.45 Hz and 358.41 Hz). This indicates the complete absence of lowering, seemingly contradicting the trend seen for Spanish background peri-urban speakers. The mean F2 across language backgrounds (2260.1446 Hz) is similar to the expected non-uvular value, showing little to no backing. Figures 11 and 12 are scatterplots showing the relationship between front vowel /i/ formants and speaker residence and family language background, respectively.

4.2.2 Back vowel /u/

For peri-urban speakers, back vowel /u/ is lowered and fronted, becoming more centralized. Peri-urban speakers are predicted to have greater F1 for /u/ (mean F1 across language backgrounds = 595.67 Hz) than that of urban speakers (mean value across language backgrounds = 438.883 Hz). This F1 is closer to the expected F1 in the context of a uvular, showing the effect of lowering.

Peri-urban speakers are expected to have an average F2 value of 1415.484 Hz across all language backgrounds, significantly greater than urban speakers (mean F2 across language backgrounds = 1241.927 Hz) and the expected F2 value in a uvular context. This indicates that the vowel is fronted. Quechua background peri-urban speakers have the lowest predicted F2 overall (1365.985 Hz).

For urban speakers, back vowel /u/ is neither lowered nor fronted. The average F1 across all language backgrounds (438.883 Hz) is lower than the expected value for F1 in a non-uvular context, once again showing a complete absence of lowering for urban speakers. Mean F2 conforms to the expected value for uvular and non-uvular contexts predicted by Holliday and Martin, who did not find significant differences in F2 (2018). Lowering is predicted for urban, bilingual background speakers (536.050 Hz), showing a potential lowering effect due to Spanish influence, though this pattern is not seen in urban, Spanish background speakers. Figures 13 and 14 are scatterplots showing the relationship between back vowel /u/ formants and speaker residence and family language background, respectively.

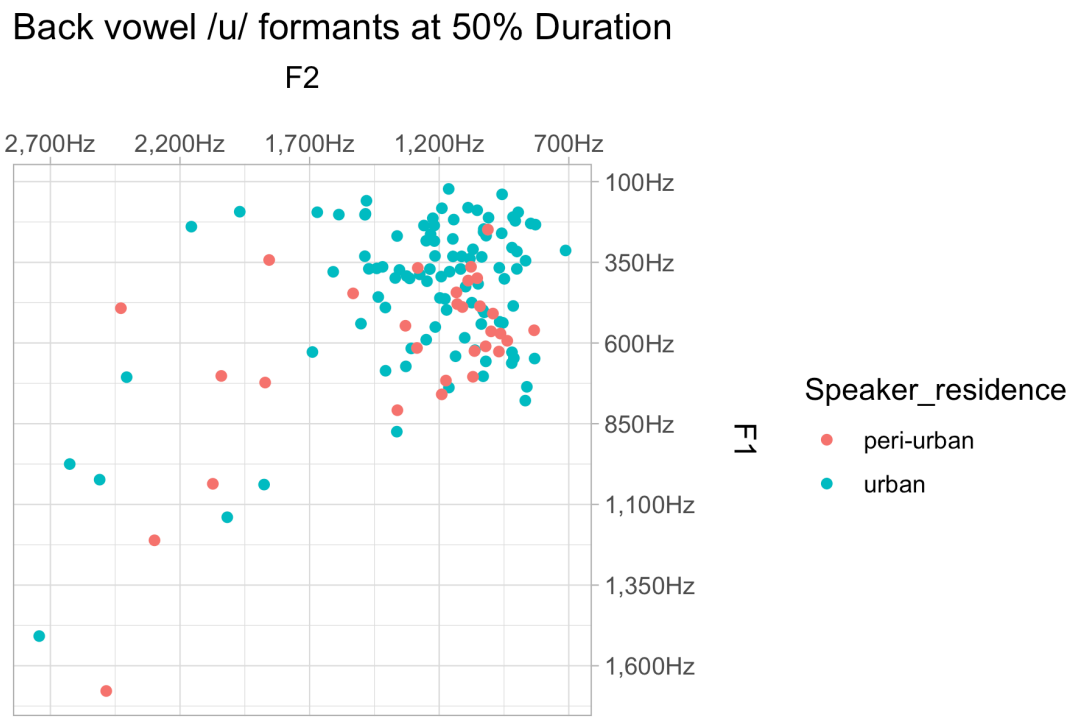

Figure 14. Back vowel /u/ formants at 50% duration, color coded for speaker residence.

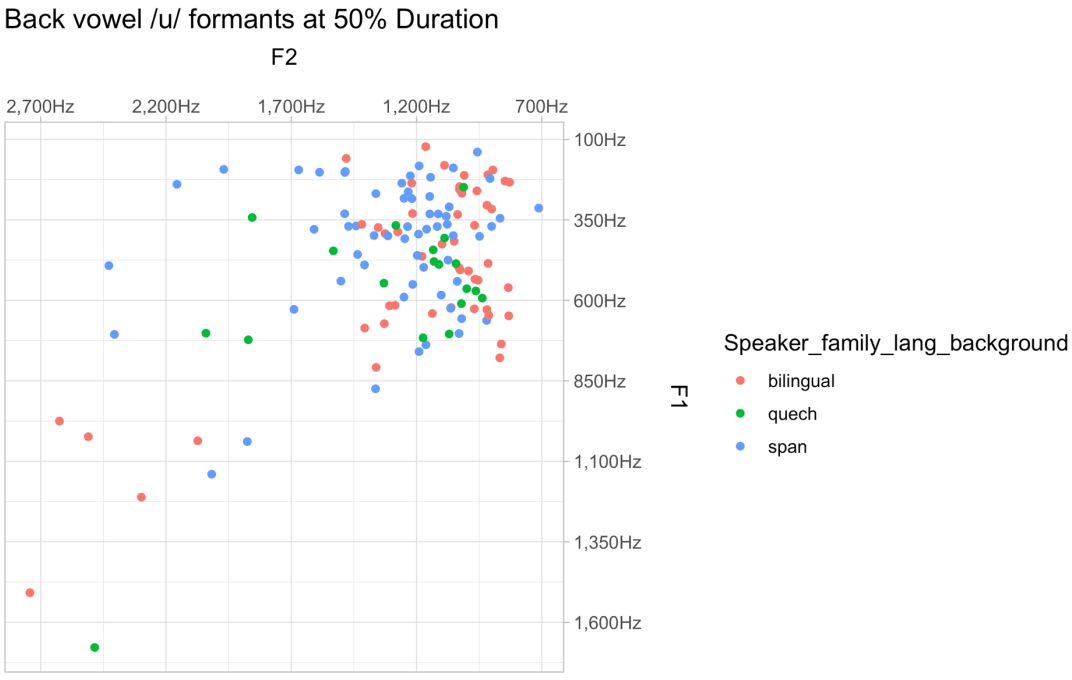

Figure 15. Back vowel /u/ formants at 50% duration, color coded for speaker family language background.

4.3 Sociolinguistic Implications

4.3.1 Grouping Speakers

In previous sociolinguistic studies of vowel lowering, speakers were grouped into either three or four groups. Mannheim, surveying several different phonetic studies of vowels across Quechuan languages, found patterns revealing three different registers. Register 1, Quechua monolinguals, showed backing for /i/ and fronting for /u/, but not lowering. Register 2, Quechua L1 and Spanish L2 speakers, showed vowel lowering but not backing. Register 3, Spanish L1 and Quechua L2 speakers, showed vowel lowering not just near uvulars but outside of a uvular context as well, indicating these speakers have five phonemic vowels (Mannheim, 2018). Molina Vital, in his work on Cuzco Quechua, separated speakers into four different groups: Quechua monolinguals, Quechua L1 and Spanish L2, bilinguals, and Spanish L1 and Quechua L2 (2011). He then compared across the groups by Spanish influence, with monolinguals and Quechua L1 speakers being less influenced by Spanish, and bilinguals and Quechua L2 showing more Spanish influence. Among less Spanish-influenced speakers, vowels showed more variation and less lowering.

Though I only conducted research with bilingual speakers of CQ and Spanish, I still found significant variance among bilingual speakers based on sociolinguistic factors. I do not have enough data to separate speakers into clear groups, and the sociolinguistic factors involved are rarely so cut and dry. I will instead use a spectrum of Spanish influence to analyze my results, based on four factors: family language background, current residence, place of origin, and social class. Spanish and bilingual family background, urban residence, urban origin, and professional working class membership all correlate with more Spanish influence. These factors, however, are

a gross simplification of the realities of actual people's lives. For this reason, I use the term spectrum to show the variance among the speakers who fit into these factors broadly.

Additionally, these factors are interconnected and overlapping: Spanish is the dominant language of urban life, so speakers raised in the llaqta are more likely to have been raised in bilingual or predominantly Spanish-speaking households. The three urban speakers are all members of the professional working class, either working or formally working in education. Access to professional jobs correlates with Spanish speaking ability and urban residence. The four peri-urban speakers are all members of the agricultural working class, all working at a women's farming cooperative. Peri-urban and rural life is more connected to Quechua monolingual and Quechua dominant environments, agricultural work, and migration – all four peri-urban speakers were originally from rural towns.

Fought explains that when considering situations of language contact, "ethnicity is often tied to social class in a way that makes it difficult to separate the two. In many Latin-American countries, for example, the upper classes may speak Spanish, while the lowest classes speak an indigenous language, such as Quichua or Yucatec Mayan. At the same time, however, the higher social classes consist mostly of Latinos, while members of indigenous groups belong to lower socioeconomic groups. Historically, the different languages are tied to differences in ethnic group membership, and the correlation with social class is a secondary one, resulting from the economic consequences of discrimination" (Fought, 2010). Because of the ways in which these sociolinguistic factors are inherently connected, it might not be possible to ever separate out the effects of each factor individually, even with more data.

Another complication is that the three urban residents have all been exposed to academic Quechua through their work in education. The four peri-urban residents have never studied or

taught Quechua formally. I found that linguistic observations regarding academic and non-academic registers of Quechua held true. The three urban Quechua speakers had 6%, 4%, and 0% Spanish loans in their responses**,** respectively. As an American student of Quechua traveling to Bolivia for the first time, I did not realize that many of the words I thought were common and used in my targeted word list were actually academic neologisms, such as *qillqana* ("pencil"). The urban speakers correctly identified all of these uncommon academic target words. The four peri-urban speakers were not as familiar with academic terminology, and they had 23%, 17%, 26%, and 26% Spanish loans in their responses, respectively. My findings for urban speakers may not hold true for all urban speakers, as knowledge of the academic register of Quechua is fairly uncommon.

4.3.2 Sociophonetic Variation

The four peri-urban speakers were all raised in rural settings and never studied Quechua formally. Amongst the peri-urban speakers, there is a similar pattern to Mannheim's register 1: vowel backing but no lowering for /i/, and centralization of /u/ (Mannheim, 2018). These speakers are more similar to monolingual speakers. This data corroborates Molina Vital's finding that less Spanish-influenced speakers show less lowering (2011). For the one peri-urban speaker raised in a monolingual Spanish-speaking household, she exibited lowering, similar to other more Spanish-influenced bilingual speakers.

The urban speakers, two from bilingual family backgrounds and one from a Spanish monolingual background, showed an unexpected pattern. Urban speakers produced /i/ and /u/ very similarly to what would be expected for those sounds in a non-uvular context. This diverges from previous research. Lowering is predicted for the urban, bilingual background speakers, but not for urban, Spanish background speaker. I propose that the reason lowering is not found for urban

background speakers is due to a more Spanish-influenced consonant phonology. Lowering is a coarticulatory effect observed in the presence of a uvular, but not in the presence of a velar. As I only worked with seven speakers total, more data is needed to prove this conclusively.

Babel investigated language contact and the uvular stop through the ways that Quechua words are loaned into Spanish. Babel looked at Bolivian Spanish in contact with Quechua, and the pronunciation of Quechua loanwords containing ejectives and aspirates (2017). She found that Spanish speakers producing Quechua loanwords often realize Quechua uvular stops as aspirate or ejective velar stops. The high proportion of bilingual speakers of Quechua and the traditional dominance of Spanish could result in rephonologized Spanish pronunciations becoming more common than their prescriptive counterparts, especially for urban speakers living in predominantly Spanish-speaking environments.

Despite the urban speakers' tendency to produce velars over uvulars, they still accurately produced other sounds not found in Spanish like aspirates and ejectives. It seems contradictory that the urban, Spanish-dominant speakers could not consistently produce uvulars while they could produce aspirates and ejectives, demonstrably more difficult sounds to produce. One potential explanation is that the contrast between uvular and velar consonants is difficult for Spanish-dominant bilinguals to perceive. In Babel's investigation of Spanish pronunciations of Quechua loanwords, she concluded that aspirate and ejective sounds, which are not found phonemically in Spanish, are very salient to Spanish speakers and Spanish-dominant bilinguals (2017). Even when speaking Quechua, Spanish-dominant bilinguals pronounce words with stereotypical "Quechua sounds" like aspirates and ejectives, even when those sounds are not found in the prescriptive pronunciation of the word. [q] and [k] overlap in manner of articulation as well as voicing quality, and the places of articulation – the velum versus the uvula – are both dorsal and close together in

the mouth. It may be that this similarity makes it difficult for bilingual speakers to perceive and produce the uvular/velar distinction, while the noticeably different sounds are easier to perceive and thus produce. Further perception research is needed to support this hypothesis.

5.0 Conclusion

The production of the voiceless uvular stop in Cochabamba Quechua is phonologically conditioned. In my results, I found that /q/ is typically realized as a stop word-initially, and as a fricative word-medially and word-finally. These results reflect the intuitions of other linguists studying South Bolivian Quechua, as well as similar research conducted on other Quechuan languages.

To explore the ways in which language contact influences CQ phonetics, it was necessary to give social context and analysis to my phonetic data. Using the data collected from the demographic survey, I considered the speakers' patterns of language use and their demographic backgrounds when looking for sociolinguistic patterns. Speakers varied across a spectrum of Spanish influence. The less Spanish-influenced speakers were peri-urban residents, living about an hour's bus ride outside of Cochabamba and speakers raised in Quechua monolingual households. More Spanish-influenced speakers were urban residences, living within Cochabamba proper or in its next biggest suburb, Quillacollo, and speakers raised in bilingual or Spanish monolingual households. Less Spanish-influenced speakers pronounced /q/ closer to patterns of pronunciation found in other studied monolingual and Quechua L1 bilinguals speakers. More Spanish-influenced speakers did not demonstrate coarticulatory or phonological lowering near uvulars, potentially illustrating the influence of Spanish phonology, which does not contain a uvular stop.

The divisions of residence also reflected class divisions. The urban speakers all work or previously worked in professional or academic jobs, fields that require the use of Spanish. The peri-urban speakers were all raised in rural communities, and now work at a women's farming

cooperative in their town. All four peri-urban speakers use Quechua at work as well as Spanish, and were more likely to use Spanish borrowings in their Quechua without switching languages. The difference between groups reveals that more frequent Spanish use impacts speech production for bilingual Spanish-Quechua speakers.

To situate the differences between groups of speakers, I considered the social factors involved in determining when, where, and with who Quechua is spoken. The current situation of Quechua language contact is shaped by three main elements: rural-urban migration, domains of language use, and power dynamics. Cochabamba is a main center for rural to urban migration, and many recent migrants do wage work or are unemployed. The peri-urban community that I worked in was formerly rural, but as the city and industry have expanded outward, it is now accessibly to a main highway and a destination for many rural-urban migrants. The four peri-urban speakers were all migrants from rural areas within Cochabamba Department: three from Tapacari and one from Morochata, both rural provinces surrounding small towns of the same name. Tapacari, "once an important colonial town and home to an elite controlling the peasant population around it, is now largely empty due to high levels of migration to urban centres" (Felber, 2013). Morochata's provincial population in 2012 was 13,000, down from 34,000 in the 2001 census.

Spanish is the language of media, as well as most education, healthcare, and professional fields. Most middle and upper class Quechua speakers are bilingual, and almost all literate Quechua speakers are bilingual. Spanish knowledge is necessary to pursue careers in academic or professional fields. Almost all of the speakers I worked with used Quechua in the marketplace and in their homes, two domains in which Spanish and Quechua come into contact more frequently. The interaction between social class and place of residence becomes clear when looking at language use at work. For the women working at the women's farming collective, CQ was the

primarily language used to communicate with other workers. For the women who work in education, even though they work or previously worked as Quechua educators, they were teaching Quechua primarily to Spanish speakers. As discussed previously, academic Quechua differs greatly from Quechua spoken in the community. The environment of a classroom is not the same kind of natural language environment as talking casually with your coworkers.

5.1 Implications

The case of CQ uvular stops reflects a common phonological process cross-linguistically: spirantization, the process of stops weakening to fricatives. This investigation contributes to the broader literature on spirantization as well as descriptions of uvular sounds.

This research also contributes to the growing body of literature on the diversity of Quechuan languages. The ways in which CQ is changing while in contact with Spanish do not necessarily reflect other Quechuan varieties, but this study can still serve as a point of reference for future investigations of Quechua sound change. This investigation is relevant to the field Quechua-Spanish language contact linguistics as well as the field of contact linguistics as a whole. The case of CQ is unforunately not unique – there are likely no varieties of Quechua that exist outside of the hispanosphere. The languages of colonizers continue to maintain social and political dominance over indigenous languages all around the world.

5.2 Further research

One potential problem with my interpretation is that I failed to account for the effect of individual variation. As I only worked with seven speakers, it is not possible to determine if these patterns are reflective of sociolinguistic variation or individual variation. Further research is needed to determine if these patterns are generalizable.

In the future, I hope to continue this research, working with more speakers overall and speakers with a wider variety of gender, class, and occupational backgrounds. In situations of community-wide language shift, women, children, and elderly people are the members of the community who continue to use Quechua (Hornberger & Coronel-Molina, 2004). This is no doubt connected to the relationship between gender and occupation. In peri-urban communities, it is typical for adult men (and sometimes boys) to pursue wage work such as working in factories, where Spanish is advantageous for maintaining and advancing their careers. The four peri-urban speakers were all women working at a women's farming collective, where Quechua was used as the primary language. For peri-urban Spanish-Quechua bilinguals, situations of Quechua language use are primarily determined by gender and occupation, and for this reason the speech of male peri-urban residents could reveal gendered differences in pronunciation. I could not find research on the ways in which gender impacts professional, middle, and upper class Quechua speakers, but working with more speakers of these backgrounds might reveal differences that can be further explored.

Appendix A Sociolinguistic interview

Appendix A.1 Pre-Experiment Questionnaire (Quechua)

- Kunan mashka watayuq kanki?
- Mayk'aq Qheshwata parlayta qallarirqanki?
- Mayk'aq Castellanota parlayta qallarirqanki?
- Mamayki mayqin simikunata parlan?
- Tatayki mayqin simikunata parlan?
- Wasiykipi Qheshwata parlankichu?
- Llank'aspa Qheshwata parlankichu?
- Qhatupi Qheshwata parlankichu?

Appendix A.2 Pre-Experiment Questionnaire (English translation)

- How old are you now?
- How old were you when you began speaking Quechua?
- How old were you when you began speaking Spanish?
- What languages does your mother speak?
- What languages does your father speak?

- Do you speak Quechua at home?
- Do you speak Quechua while working?
- Do you speak Quechua in the market?

Appendix B Word list

Appendix B.1 Words containing /q/

Appendix B.1.1 Word-initial /q/

Quwi – guinea pig

Quri – gold

Qillqana – pencil

Quyllur – star

Qina – quena, type of flute

Appendix B.1.2 Syllable-initial, word-medial /q/

Alqu – dog

T'uqu – window

Urqu – mountain

Puquy – fruit

Uqa – type of sweet potato

Pisqu – bird

Appendix B.1.3 Syllable-final, word-medial /q/

Chaqra – field

Llaqta – town or city, sometimes used to refer to Cochabamba

Llaqwa – chili paste/sauce, common in Bolivia

Tiqni – hip

Uqllay – hug

Appendix B.1.4 Word-final /q/

Yachaqaq – student

Atuq – fox

Awaq – weaver

Siraq – seamstress

Yachachiq – teacher

Kamachiq – leader

Appendix B.1.5 Word-initial /q'/

Q'umer – green, vegetable

Q'upa – trash

Q'usñi – smoke

Q'uwa – offering to the Pachamama (Mother Earth), frequently held on the first Friday of every month by both indigenous and non-indigenous Bolivians

Q'aytu – wool or string

Appendix B.1.6 Syllable-initial, word-medial /q'/

Wayq'u – ravine

Jisq'un – nine

Siq'i – drawing

Appendix B.1.7 Word-initial /q^h/

Qhari – man

Qhucha – lake

Qhurana – hoe

Qhura – herb

Qhatu – market

Appendix B.1.8 Syllable-initial, word-medial /q^h/

Aqha – chicha, a fermented corn drink very common to the Andes region

Iqha – skin lesion

Laqhi – leaf

Appendix B.2 Words not containing /q/

Inti – sun

Killa – moon

T'ika – flower

Nina – fire

Rit'i – snow

Wallpa – chicken

Wasi – house, building

Ñawi – eye

Runtu – egg

Sara – corn

Tiyana – chair

Kuka – coca leaves

Misi – cat

Khuru – worm

Ruk'ana – finger

Appendix C Linear mixed regression model fit to F1

```
Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
  method [lmerModLmerTest]
Formula:
F1 ~ (1 | Speaker) + Vowel * Speaker_residence * Speaker_family_lang_backg
round
   Data: f1_df
Control: lmerControl(optCtrl = list(maxfun = 1e+05))

     AIC      BIC   logLik deviance df.resid
 18649.7  18738.5  -9307.8  18615.7     1354

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.0685 -0.5762 -0.0132  0.5460  4.4352

Random effects:
 Groups   Name        Variance Std.Dev.
 Speaker  (Intercept)  1126     33.56
 Residual             45815    214.04
Number of obs: 1371, groups:  Speaker, 7

Fixed effects:
                                                                    Estimate
(Intercept)                                                           603.43
Voweli                                                               -161.96
Vowelu                                                                 96.08
Speaker_residenceurban                                                117.23
Speaker_family_lang_backgroundquech                                   201.39
Speaker_family_lang_backgroundspan                                    235.96
Voweli:Speaker_residenceurban                                        -187.25
Vowelu:Speaker_residenceurban                                        -280.69
Voweli:Speaker_family_lang_backgroundquech                           -165.05
Vowelu:Speaker_family_lang_backgroundquech                           -355.60
Voweli:Speaker_family_lang_backgroundspan                             -74.54
Vowelu:Speaker_family_lang_backgroundspan                            -393.27
Speaker_residenceurban:Speaker_family_lang_backgroundspan            -384.86
Voweli:Speaker_residenceurban:Speaker_family_lang_backgroundspan      210.40
Vowelu:Speaker_residenceurban:Speaker_family_lang_backgroundspan      404.88

                                                                    Std. Error
(Intercept)                                                              51.03
Voweli                                                                   95.47
Vowelu                                                                   62.36
Speaker_residenceurban                                                   57.83
Speaker_family_lang_backgroundquech                                      60.50
Speaker_family_lang_backgroundspan                                       68.91
Voweli:Speaker_residenceurban                                            99.43
Vowelu:Speaker_residenceurban                                            66.49
Voweli:Speaker_family_lang_backgroundquech                              103.15
Vowelu:Speaker_family_lang_backgroundquech                               72.18
Voweli:Speaker_family_lang_backgroundspan                               110.97
Vowelu:Speaker_family_lang_backgroundspan                                89.23
Speaker_residenceurban:Speaker_family_lang_backgroundspan                82.28
Voweli:Speaker_residenceurban:Speaker_family_lang_backgroundspan        117.05
```

```
Vowelu:Speaker_residenceurban:Speaker_family_lang_backgroundspan     94.46

                                                                       df
(Intercept)                                                         25.46
Voweli                                                            1365.20
Vowelu                                                            1365.20
Speaker_residenceurban                                              18.71
Speaker_family_lang_backgroundquech                                 21.94
Speaker_family_lang_backgroundspan                                  21.20
Voweli:Speaker_residenceurban                                     1365.24
Vowelu:Speaker_residenceurban                                     1366.44
Voweli:Speaker_family_lang_backgroundquech                        1369.74
Vowelu:Speaker_family_lang_backgroundquech                        1367.79
Voweli:Speaker_family_lang_backgroundspan                         1365.20
Vowelu:Speaker_family_lang_backgroundspan                         1365.20
Speaker_residenceurban:Speaker_family_lang_backgroundspan           14.10
Voweli:Speaker_residenceurban:Speaker_family_lang_backgroundspan 1365.23
Vowelu:Speaker_residenceurban:Speaker_family_lang_backgroundspan 1365.83

                                                                    t value
(Intercept)                                                          11.825
Voweli                                                               -1.697
Vowelu                                                                1.541
Speaker_residenceurban                                                2.027
Speaker_family_lang_backgroundquech                                   3.328
Speaker_family_lang_backgroundspan                                    3.424
Voweli:Speaker_residenceurban                                        -1.883
Vowelu:Speaker_residenceurban                                        -4.222
Voweli:Speaker_family_lang_backgroundquech                           -1.600
Vowelu:Speaker_family_lang_backgroundquech                           -4.927
Voweli:Speaker_family_lang_backgroundspan                            -0.672
Vowelu:Speaker_family_lang_backgroundspan                            -4.408
Speaker_residenceurban:Speaker_family_lang_backgroundspan            -4.677
Voweli:Speaker_residenceurban:Speaker_family_lang_backgroundspan      1.798
Vowelu:Speaker_residenceurban:Speaker_family_lang_backgroundspan      4.286

                                                                   Pr(>|t|)
(Intercept)                                                     7.70e-12 ***
Voweli                                                           0.09001 .
Vowelu                                                           0.12363
Speaker_residenceurban                                           0.05716 .
Speaker_family_lang_backgroundquech                              0.00306 **
Speaker_family_lang_backgroundspan                               0.00252 **
Voweli:Speaker_residenceurban                                    0.05988 .
Vowelu:Speaker_residenceurban                                    2.58e-05 ***
Voweli:Speaker_family_lang_backgroundquech                       0.10980
Vowelu:Speaker_family_lang_backgroundquech                       9.39e-07 ***
Voweli:Speaker_family_lang_backgroundspan                        0.50187
Vowelu:Speaker_family_lang_backgroundspan                        1.13e-05 ***
Speaker_residenceurban:Speaker_family_lang_backgroundspan        0.00035 ***
Voweli:Speaker_residenceurban:Speaker_family_lang_backgroundspan 0.07247 .
Vowelu:Speaker_residenceurban:Speaker_family_lang_backgroundspan 1.94e-05
***
```

Appendix D Linear mixed regression model fit to F2

```
Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
  method [lmerModLmerTest]
Formula: F2 ~ (1 | Speaker) + Vowel * Speaker_residence + Speaker_residenc
e *
    Speaker_family_lang_background + Vowel * Speaker_family_lang_backgroun
d
   Data: f2_df
Control: lmerControl(optCtrl = list(maxfun = 1e+05))

     AIC      BIC   logLik deviance df.resid
 20425.2  20503.8 -10197.6  20395.2     1385

Scaled residuals:
    Min      1Q  Median      3Q     Max
-4.2422 -0.6319 -0.1038  0.4799  4.2061

Random effects:
 Groups   Name        Variance Std.Dev.
 Speaker  (Intercept)      0     0.0
 Residual             124256   352.5
Number of obs: 1400, groups:  Speaker, 7

Fixed effects:
                                                          Estimate Std. Error
(Intercept)                                               1701.066     54.455
Voweli                                                     285.902     90.359
Vowelu                                                    -192.765     75.120
Speaker_residenceurban                                       7.114     56.712
Speaker_family_lang_backgroundquech                         -2.096     63.834
Speaker_family_lang_backgroundspan                        -128.281     64.211
Voweli:Speaker_residenceurban                              146.095     85.927
Vowelu:Speaker_residenceurban                             -254.966     76.119
Speaker_residenceurban:Speaker_family_lang_backgroundspan 222.885     65.654
Voweli:Speaker_family_lang_backgroundquech                 199.215    109.992
Vowelu:Speaker_family_lang_backgroundquech                -140.220     94.511
Voweli:Speaker_family_lang_backgroundspan                   68.180     57.762
Vowelu:Speaker_family_lang_backgroundspan                   -7.854     47.738

                                                                 df t value
(Intercept)                                               1400.000  31.238
Voweli                                                    1400.000   3.164
Vowelu                                                    1400.000  -2.566
Speaker_residenceurban                                    1400.000   0.125
Speaker_family_lang_backgroundquech                       1400.000  -0.033
Speaker_family_lang_backgroundspan                        1400.000  -1.998
Voweli:Speaker_residenceurban                             1400.000   1.700
Vowelu:Speaker_residenceurban                             1400.000  -3.350
Speaker_residenceurban:Speaker_family_lang_backgroundspan 1400.000   3.395
Voweli:Speaker_family_lang_backgroundquech                1400.000   1.811
Vowelu:Speaker_family_lang_backgroundquech                1400.000  -1.484
Voweli:Speaker_family_lang_backgroundspan                 1400.000   1.180
Vowelu:Speaker_family_lang_backgroundspan                 1400.000  -0.165
```

```
                                                          Pr(>|t|)
(Intercept)                                                < 2e-16 ***
Voweli                                                    0.001589 **
Vowelu                                                    0.010388 *
Speaker_residenceurban                                    0.900191
Speaker_family_lang_backgroundquech                       0.973806
Speaker_family_lang_backgroundspan                        0.045932 *
Voweli:Speaker_residenceurban                             0.089311 .
Vowelu:Speaker_residenceurban                             0.000831 ***
Speaker_residenceurban:Speaker_family_lang_backgroundspan 0.000706 ***
Voweli:Speaker_family_lang_backgroundquech                0.070328 .
Vowelu:Speaker_family_lang_backgroundquech                0.138132
Voweli:Speaker_family_lang_backgroundspan                 0.238059
Vowelu:Speaker_family_lang_backgroundspan                 0.869346
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
fit warnings:
fixed-effect model matrix is rank deficient so dropping 1 column / coeffic
ient
```

Appendix E Binomial logistic regression model fit to manner of articulation variation

```
Call:
glm(formula = Manner ~ Position_in_word * Position_in_syllable +
    Speaker_family_lang_background + Speaker_residence, family = binomial,
    data = q_df3)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.6323  -0.7667   0.2521   0.7017   2.1720

Coefficients: (2 not defined because of singularities)
                                                Estimate Std. Error z value
(Intercept)                                     -2.36355    0.94813  -2.493
Position_in_wordMedial                           2.06741    0.78148   2.645
Position_in_wordFinal                            4.22426    1.15547   3.656
Position_in_syllableFinal                        1.46796    0.51255   2.864
Speaker_family_lang_backgroundquech             -0.02458    0.77302  -0.032
Speaker_family_lang_backgroundspan              -0.88173    0.45346  -1.944
Speaker_residenceurban                           0.10404    0.61214   0.170
Position_in_wordMedial:Position_in_syllableFinal      NA         NA      NA
Position_in_wordFinal:Position_in_syllableFinal       NA         NA      NA
                                                Pr(>|z|)
(Intercept)                                     0.012672 *
Position_in_wordMedial                          0.008157 **
Position_in_wordFinal                           0.000256 ***
Position_in_syllableFinal                       0.004183 **
Speaker_family_lang_backgroundquech             0.974637
Speaker_family_lang_backgroundspan              0.051842 .
Speaker_residenceurban                          0.865034
Position_in_wordMedial:Position_in_syllableFinal       NA
Position_in_wordFinal:Position_in_syllableFinal        NA
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 230.03  on 165  degrees of freedom
Residual deviance: 154.06  on 159  degrees of freedom
AIC: 168.06

Number of Fisher Scoring iterations: 5
```

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