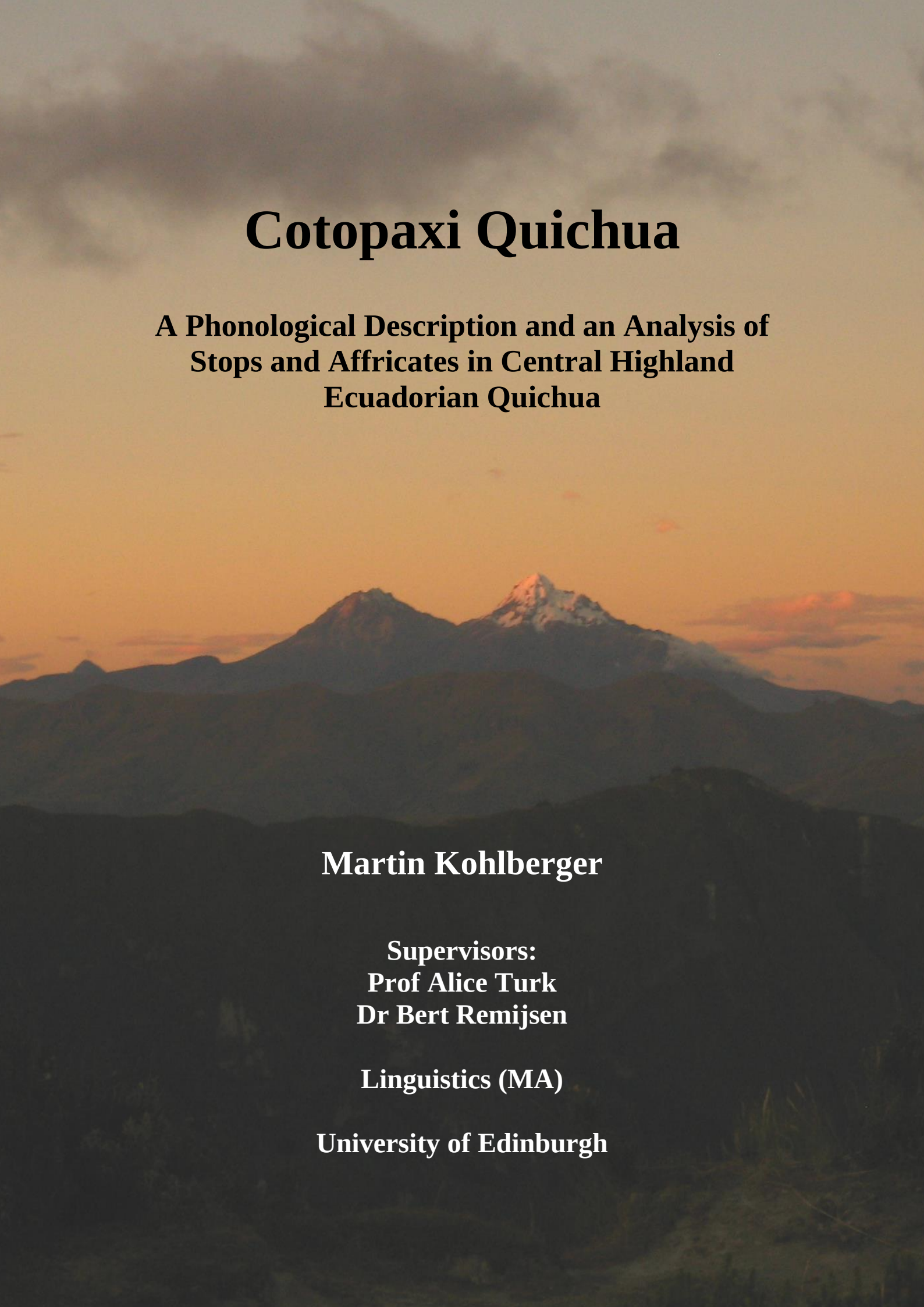

Cotopaxi Quichua

A Phonological Description and an Analysis of Stops and Affricates in Central Highland Ecuadorian Quichua

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Abstract

Quechua is a language continuum spoken in the Andes Mountains in South America. Despite extensive linguistic fieldwork on it, some Ecuadorian dialects of it remain undocumented and some questions are unresolved. Aspirated and ejective obstruents have emerged in some Quechua dialects against the expectations of regular sound change, but the only well documented case of this innovation is a southern Peruvian/Bolivian dialect. The first two aims of this investigation were to find an undocumented Ecuadorian dialect and describe its phonology. The third aim was to examine its obstruent system, establish whether aspiration/glottalisation contrasts exist, and determine whether they were likely to be a result of the same innovation as the one that the southern Peruvian/Bolivian dialect underwent. The dialect chosen for this study was the Cotopaxi Quichua dialect and fieldwork was conducted in the Quilotoa community of central Ecuador. Most of the data collection was done through recorded elicitation sessions with local native speakers. In addition to providing an overview of its phonology, it was found that Cotopaxi Quichua does indeed have phonemic aspiration contrasts. Furthermore, there is robust evidence to suggest that it acquired the aspiration through the same innovation as the southern Peruvian/Bolivian dialect.

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List of Conventions and Abbreviations

/ /	phonemic brackets
[ ]	phonetic brackets
.	syllable boundary
-	morpheme bounday
*	ungrammatical or non-existent form
F1	first vowel formant
F2	second vowel formant

Italics denotes	1) a book title
	2) an ethnic group
	3) an English or Spanish word equivalent

In glosses:

ALL	allative case marker
PL	plural marker
Q	question marker

In morphophonological rules:

[± cont]	continuant
[± son]	sonorant
[± voice]	voiced
[± nasal]	nasal
+	morpheme boundary
$	syllable boundary
#	word boundary
W → X / Y_Z	reads as “W becomes X if it appears after Y and before Z”

QUILOTOA COMMUNITY

Acknowledgements:

First and foremost, I would like to thank the Quilotoa Community. Without the permission and cooperation of the local residents, this project would have been impossible. Their hospitality, generosity and willingness to participate will be duly remembered. Although the list below is not exhaustive, it includes the members of the community who wished to be recognised by their name. However, this should not overshadow the contributions made by those who prefer to remain anonymous.

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David Latacunga	Blanca Umajinga	Janeth Jácome
Myrian Teresa Chaluisa	Williams Palomo	

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1. Introduction

1.1. Fieldwork

Fieldwork is an invaluable research tool in linguistics because it can provide access to a wealth of previously unexplored knowledge about human language. Data collected through fieldwork are fundamental to the development of linguistic theory so that it is less affected by specific language bias and more representative of language as a whole. In a discipline which has been historically dominated by the analysis of Indo-European languages, it is crucial for linguists to embark on extensive language documentation so that the full range of features that occur in natural language can be examined.

One particular domain of linguistics which has benefited greatly from language fieldwork is phonetics and phonology. A widely accepted standard for phonetic reference, *The Sounds of the World's Languages* (Ladefoged & Maddieson 1996), draws heavily on fieldwork findings: it describes for instance a palatalised retroflex trill, an articulation deemed impossible by the International Phonetic Association, documented as a result of fieldwork on the Toda language (Spajić, et al., 1994). Phonological theory has also been significantly advanced by language documentation. A notable example is the contribution of field research on African tonal systems to the development of Goldsmith's (1976) autosegmental phonology, highlighting the inadequacy of classical segmental generative phonology in accounting for the fieldwork findings (Hyman 2003).

In addition to advancing the scope of theoretical linguistics, fieldwork results can have very practical applications beyond pure academics. Countless speech communities around the world suffer under the influence of a more

powerful or prestigious language to the detriment of their own. Language fieldwork in these cases can be used as a basis for revitalisation and education projects for languages that have been neglected and therefore have limited resources available to them. More specifically, for non-written languages, a phonological description can act as a valuable foundation in creating a simple and straightforward orthography.

With this in mind, the primary purpose of this investigation is to conduct phonological fieldwork on a previously uninvestigated language. The following sections will outline the motivation behind the language family that was chosen and will define the specific aims of this study.

1.2. Quechua Studies

1.2.1. Gaps in the Literature

The Quechuan language family is a dialect continuum which stretches from northern Argentina to southern Colombia, straddling the Andes Mountains in the regions conquered by the Inca Empire. It has been subject to much descriptive fieldwork for the past 40 years because of its complex phonology and morphology, resulting in extensive documentation of many dialect groups (Adelaar & Muysken 2004: 183). However, some dialects of Quechua have remained completely underrepresented or even undocumented, particularly in some remote areas of Ecuador. These gaps in the literature are problematic for two reasons. Firstly, any linguistic analysis of this language family has to rely on data from documented varieties of Quechua. And yet undocumented dialects, especially those that have had minimal contact with other languages in isolated regions,

might exhibit revealing characteristics about Quechua and its development which have so far been ignored. Secondly, ongoing standardisation processes are biased towards well researched prestige dialects. In the case of Ecuador, education authorities have tried to develop a unified orthography by taking into account cross-dialectal variation (MECC 1990). However, the goal of having a truly unified writing system is futile if not all dialects have been examined yet. Evidently there is a need for further documentation of Quechua in Ecuador.

1.2.2. The Emergence of Complex Stops and Affricates

An area of Quechua linguistics that has attracted particular scrutiny is the development of its sound system, most notably the emergence of aspirated and ejective obstruents in the Cuzco-Bolivian dialects spoken in the far south of the Quechua linguistic area. This innovation has caused much debate in the field for two reasons. Firstly, it cannot be explained by assuming regular sound change (Adelaar & Muysken 2004: 199). Secondly, a similar development seems to have occurred simultaneously in only one other dialect group, the Central Highland Ecuadorian dialects, located 1,500 kilometres further north at the other geographical extreme of the Andes. Linguists are still unsure of how to fully account for this development.

Cuzco-Bolivian is one of the best documented dialect groups of Quechua, especially because its speakers are centred around the ancient Inca capital, Cuzco, which is now a cultural focal point for Quechua studies. Correspondingly, the innovation of aspirated and ejective obstruents has been researched extensively in this dialect group. In-depth analyses by Mannheim (1991) and Parker (1997)

show that the distribution of aspirated and ejective stops and affricates is severely constrained both semantically and morphophonologically. These findings have led to well-substantiated theories explaining the emergence and spread of these features in Cuzco-Bolivian Quechua.[1]

Central Highland Ecuadorian dialects on the other hand have been represented much less in the literature. Consequently, hardly anything is known about the status and distribution of complex stops and affricates in Ecuadorian dialects. Although impressionistic accounts have shown that these dialects also exhibit aspirated obstruents, there have been no reports of ejectives co-occurring as well. Research has also shown that the aspirated stops in Central Highland Ecuadorian do not correspond systematically to the aspirated and ejective stops in Cuzco-Bolivian (Torero 1984). Because of these asymmetries between the two dialect groups, it has been difficult to establish whether the developments in both Ecuador and in Cuzco/Bolivia are a result of the same innovation or just a product of coincidence. It seems essential that to understand the nature of the change in the stop and affricate inventory, more information is required about its status in Ecuadorian Central Highland dialects, in order to compare that data with what is already known about Cuzco-Bolivian.

1.3. Aims

Motivated by the concerns addressed above, this study has three primary aims. The preliminary goal of this study is to identify an undocumented variety of Central Highland Ecuadorian Quechua and to take it on as the object of study for

[1] For a more thorough description of their analyses, see section 2.3.2.

this investigation. Furthermore, an adequate fieldwork site needs to be found, as well as speakers who are willing to participate as language informants. This will henceforth be referred to as Part I of the project.

The second objective is to examine the phonology of that dialect by documenting its phoneme inventory, describing allophonic variation and outlining phonotactic constraints. Not only will this be a contribution to the academic field of Quechua dialectology, but it can act as a basis for educational projects such as orthography development as well. This will be labelled as Part II of the investigation.

The third objective, also referred to as Part III of this study, is to devote special attention to the stop and affricate system of that dialect. Of particular interest is data regarding the existence and distribution of aspirated stops and affricates, so that these findings can be compared to analogous research on Cuzco-Bolivian obstruents. Specifically, this study endeavours to evaluate the validity of Mannheim's and Parker's claims about aspirated and ejective obstruents in Cuzco-Bolivian with respect to Central Highland Ecuadorian dialects, thereby giving an indication of whether the emergence of aspirated stops in both dialect groups can be attributed to the same innovation.

A final additional aim of this project is to go beyond impressionistic fieldwork. All claims made in the process of this investigation will be backed up by high quality recordings which can be analysed acoustically, resulting in more robust empirical evidence than that which has been produced in the past for most Quechua research.

2. Background

2.1. The Historical Development of Quechua

2.1.1. Proto-Quechua Phonology

The Quechuan languages can be traced back to so-called Proto-Quechua, a language spoken around the central coast of modern-day Peru until the first millennium AD, after which it began expanding and splitting off into diverse branches (Torero 1984: 382-383). Table 1 shows the currently accepted reconstruction of the Proto-Quechua phoneme inventory, as shown in Adelaar and Muysken (2004: 196). Marginal and controversial phonemes have been excluded for simplicity.[2] Assuming regular sound change, most of the phonology of modern Quechua dialects can be derived from that inventory.

PROTO-QUECHUA PHONEMES

Consonants							
		Labial	Alveolar	Palatal	Retroflex	Velar	Uvular
Voiceless	Stops	p	t			k	q
	Affricates			č	č̣		
	Fricatives		s	š		h	
Voiced	Nasals	m	n	n^y			
	Laterals			l^y			
	Rhotics		r				
	Glides	w		y			
Vowels							
		Back		Central		Front	
High		u				i	
Low				a			

TABLE 1

[2] A critical analysis of the reconstruction of Proto-Quechua phonology is beyond the scope of this study. For a more elaborate discussion on this issue, see Adelaar and Muysken (2004).

2.1.2. The Spread of Quechua into Modern-Day Ecuador

When the Spanish colonisation of South America began in the early sixteenth century, Quechua was the administrative language of the Inca Empire. For this reason, the expansion of the Quechua language was traditionally associated with the military conquest of the Middle Andes by the Incas. Nevertheless, it seems that the arrival of Quechua in Ecuador occurred before the arrival of the Incas in 1470 (Torero 2003; Adelaar & Muysken 2004: 180). Before the Inca conquest of modern-day Ecuador, dozens of different ethnic groups lived in the Ecuadorian Andes, including the *Pasto, Cara, Panzaleo, Puruhá* and *Cañar* amongst others (Jijón y Caamaño 1945). None of their vernacular languages were related to Quechua, but the latter started being used as a lingua franca for intercultural trade as early as the fourteenth century (Torero 2003). After the conquest, the Incas exerted political domination over Ecuadorian territories but they never actively sought to eliminate local linguistic variety in favour of their own Quechua language (Mannheim 1991: 36). Even so, by the end of the sixteenth century, all ethnic groups in the Ecuadorian highlands had abandoned their original vernaculars and adopted dialects of Quechua as their only language. Traces of the pre-Inca languages, however, can still be found as substratum influence in the regions where they were originally spoken (Gómez Rendón 2008: 176). As such, they are partially the cause for rich dialectal variation within Ecuador.

2.2. Ecuadorian Quichua

2.2.1. Overview

Quechua is currently spoken by around 2 million people in Ecuador and is often referred to as Quichua (or Kichwa) there, which helps distinguish it from Quechua varieties in other countries (Adelaar & Muysken 2004: 620; Gómez Rendón 2008: 170). Figure 1 is a Quechua family tree which shows how Ecuadorian Quichua relates to the rest of the Quechuan languages. The chart is modelled on Torero's (1964) classification of Quechua dialects, which is currently used as a standard reference in Quechua linguistics. This classification places all Ecuadorian dialects in the QIIB branch. Figure 2 is a map of South America which illustrates the geographic distribution of Quechua dialect groups, confirming that the of the IIB dialect area is mostly within the state borders of Ecuador.

QUECHUA DIALECT GROUPS

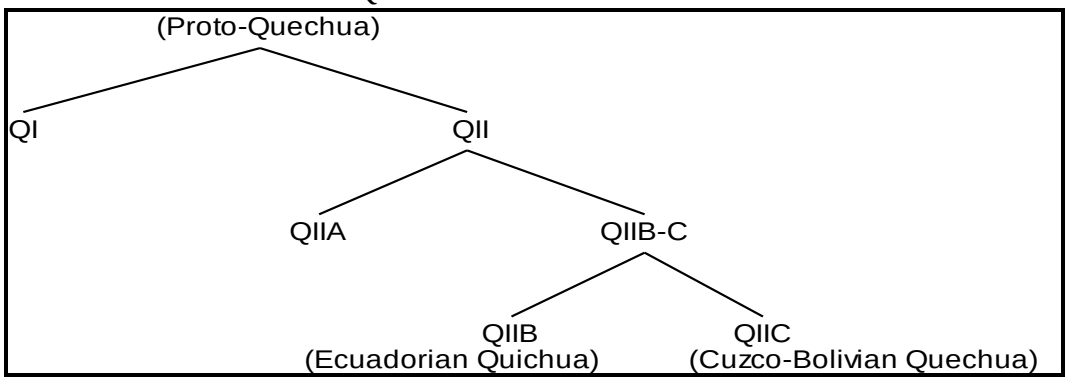


FIGURE 1

MAP OF QUECHUA DIALECTS

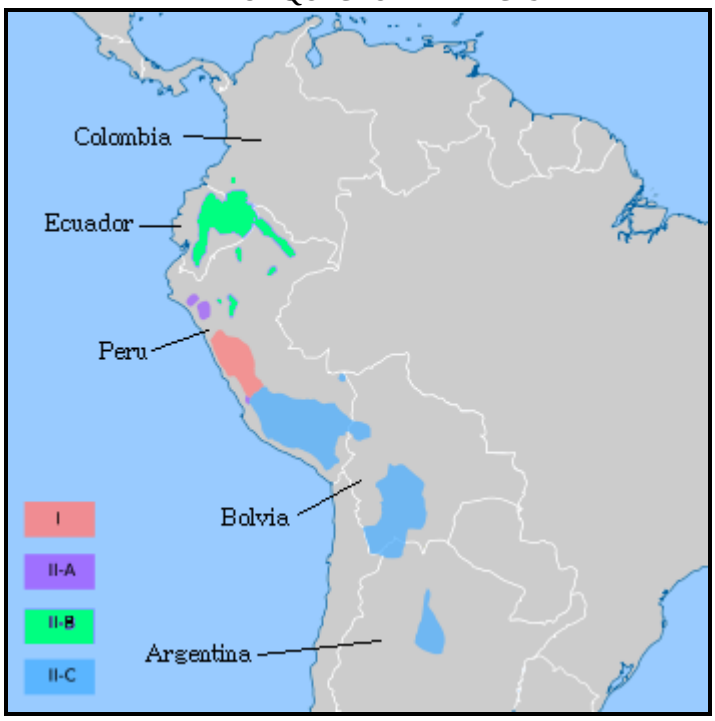


FIGURE 2

(LLL 2007)

2.2.2. Dialectal Variation in Ecuador

Figure 3 illustrates a genetic tree of Ecuadorian Quichua, compiled from Gómez Rendón (2008) and Aschmann (2006). The main dialectal division of Quichua within Ecuador is largely determined by altitude: Highland Quichua is a group of dialects spoken by Andean mountain communities over 2000 metres above sea level, whereas communities in the Amazon jungle speak Lowland Quichua (Knapp 1991). In terms of speaker numbers, Highland Quichua is considerably larger, with only 29% of Ecuador's indigenous population speaking Lowland varieties. Within the Highland group, the dialects of the Cotopaxi, Bolívar, Tungurahua, and Chimborazo provinces are clustered under the term Central Highland Quichua and together they represent the strongest Quichua-speaking

area in Ecuador, encompassing nearly half of the Quichua speakers in the entire country (Gómez Rendón 2008: 169-170).

ECUADORIAN QUICHUA DIALECTS

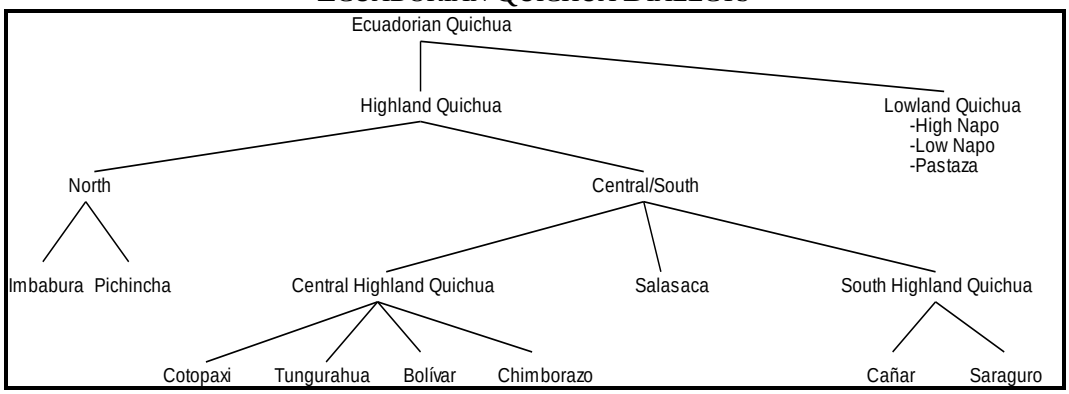


FIGURE 3

Figure 4 is a map of Ecuadorian Quichua dialects. It is important to note that, at the most subordinate level, Quichua dialects are usually referred to by the name of the province in which they are spoken (with the exception of Salasaca and Saraguro, which are both towns rather than provinces). This is due to the fact that provincial borders are principally determined by topographic features, such as mountains and rivers, which in most cases also define dialectal boundaries. Therefore, although Figure 4 does not show different colouring for each individual Central Highland dialect, the provincial borders indicate their boundaries.

MAP OF ECUADORIAN QUICHUA DIALECTS

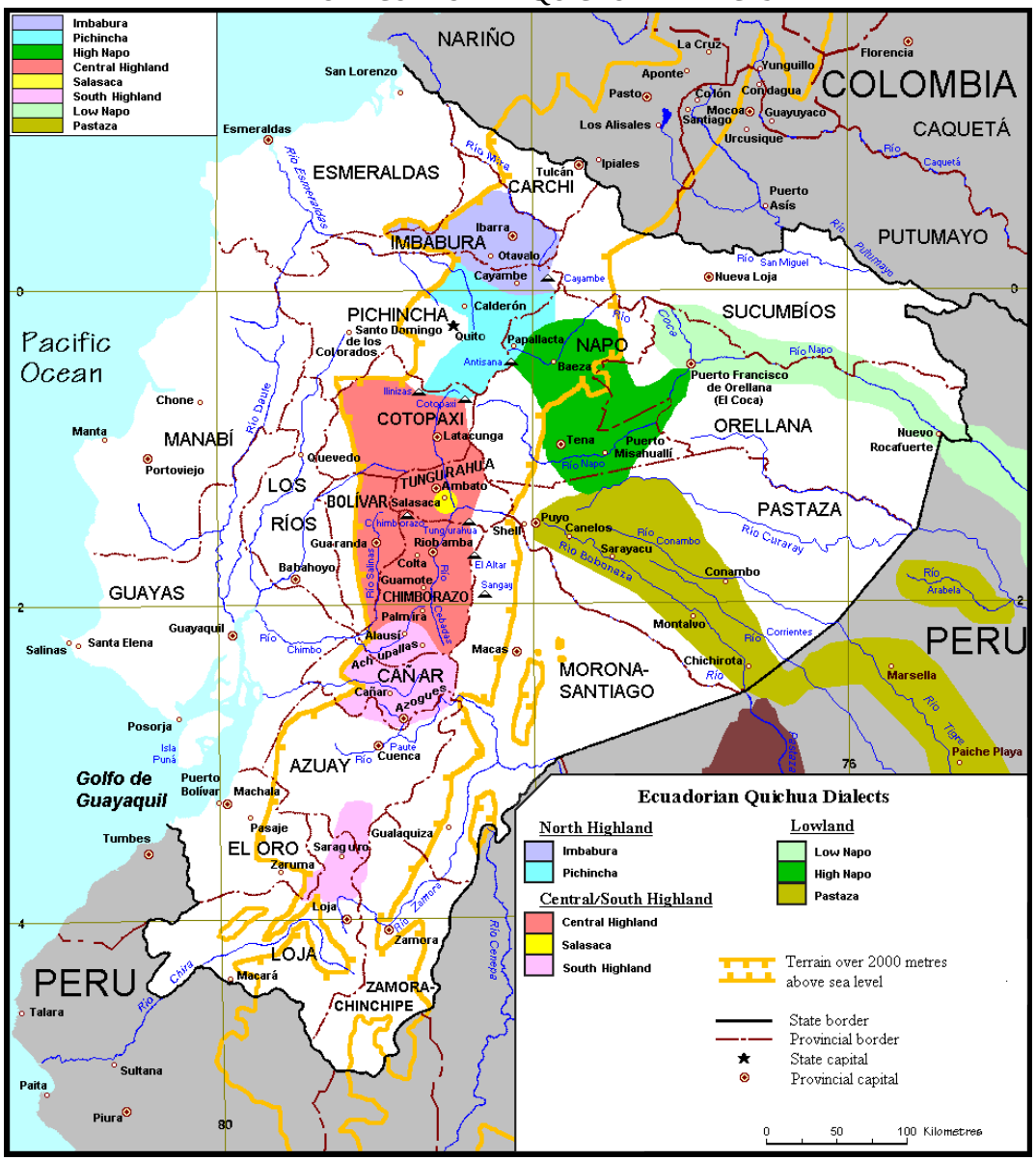


Figure 4

(adapted from Aschmann 2006)

2.2.3. Issues with Standardised Orthography and Dialectal Variation

Gómez Rendón (2008) asserts that "the most noticeable differences in the Ecuadorian dialects are phonetic in nature" (p.181). For this reason, creating a standardised orthography for Ecuadorian Quichua has been a challenge. Over the years, academic and educational boards have continuously reformed Quichua

spelling but in 2004 the semi-official Kichwa Language Academy approved an orthography which purportedly is the best compromise given cross-dialectal variation (MEC 2009: 13). Nonetheless, some prominent features of non-prestige dialects are overlooked in the new standard.

Variation in the Quichua stop and affricate system has received great attention in the literature. One salient phonetic feature of some dialects is the widespread use of voiced stops. The standard orthography, however, only includes voiceless obstruents because their voiced counterparts are considered to be a non-Quechua addition. The reasoning behind this is that most contemporary Quechua dialects across the Andes only exhibit voiceless obstruents, so some sources attribute the apparition of voiced counterparts to the influence of Spanish, a development which bears colonising overtones (MECC 1990: 122). However, while some describe the use of voiced stops as allophonic (MECC 1990: 122-123; Adelaar and Muysken 2004: 198), others maintain that voiced stops have achieved phoneme status in some dialects (Lombeida-Naranjo 1976). If this were indeed the case, then the orthography might be ignoring important phonemic contrasts, regardless of whether they might be a result of Spanish contact.

In addition, a more widely quoted phonetic characteristic is the aforementioned presence of aspirated stops and affricates in some Central Highland varieties. Table 2 shows the stops and affricates which are reported to appear in the Chimborazo dialect by Lombeida-Naranjo (1976) and MECC (1990). Once again, the standard orthography ignores this distinction and includes only plain[3] stops, reflecting the situation of all dialects in Ecuador except the Central

[3] In phonetic contexts, the word 'plain' will be used in this paper to describe unvoiced, unaspirated stops or affricates. It is equal to the term 'tenuis'.

Highland group. As with voicing, it is still unclear to what extent aspirated stops and affricates are phonemically distinct from their plain counterparts. If the distinction is a phonemic one, as Lombeida-Naranjo (1976) suggests, the orthography would be proven inadequate. Whatever the case might be, the aspiration distinction in Central Highland dialects poses many unresolved questions beyond simple orthographic problems. The next section will elucidate these issues.

ECUADORIAN CENTRAL HIGHLAND QUICHUA STOPS AND AFFRICATES

[p	p^h	t	t^h	k	k^h	tʃ	$tʃ^h$	ts	ts^h]

TABLE 2

2.3. The Emergence of Aspiration

2.3.1. The Case in Central Highland Ecuadorian Dialects

Impressionistic reports of aspirated stops and affricates appearing in Central Highland Ecuadorian dialects can be found in a number of sources (Lombeida-Naranjo 1976; MECC 1990; Adelaar & Muysken 2004). However, only few of those sources state anything about their phonemic status or indeed about their emergence. From the point of view of historical linguistics, the development of an aspiration contrast is highly unusual. Contemporary accounts agree that Proto-Quechua did not exhibit anything but plain obstruents, as shown in Table 1. Given natural tendencies of regular sound change, this rules out the possibility that Central Highland Ecuadorian dialects inherited such a distinction from Proto-Quechua. Intriguingly, as stated in the introduction, Ecuadorian Central Highland dialects are not the only Quechuan dialects to have unexpectedly developed an

aspiration distinction. Cuzco-Bolivian dialects (marked as IIC in Figure 2) in southern Peru and Bolivia underwent a similar innovation.

2.3.2. The Case in Cuzco-Bolivian Dialects

In Cuzco-Bolivian Quechua, the voiceless stops /p t k q/ and the affricate /č/ not only have aspirated counterparts like in Ecuadorian Central Highland dialects, but they also have ejective counterparts as shown in Table 3 (Parker 1997). In the literature, it has become common practice to refer to the aspirated and ejective consonants of Quechua as laryngealised consonants. Parker (1997) lists a series of morphophonological constraints that have been found for the distribution of laryngealised stops in Quechua, most notably that they can only occur (1) in roots, never in suffixes; (2) in syllable-onset position, never in codas; (3) as the first syllable-initial stop of the word; and (4) once per root (p.2). In addition, Mannheim (1991) claims that aspiration and glottalisation in Cuzco-Bolivian Quechua play an iconic role representing the expulsion of air, for example in words like /t^{h}ukaj/ (*to spit*) or /hač'ij/ (*to sneeze*). Therefore, their distribution seems to be semantically constrained as well.

CUZCO-BOLIVIAN QUECHUA STOPS AND AFFRICATES

p	t	k	q	č
p^{h}	t^{h}	k^{h}	q^{h}	č^{h}
p^{ʔ}	t^{ʔ}	k^{ʔ}	q^{ʔ}	č^{ʔ}

TABLE 3

2.3.3. Explaining the Innovation

Due to extensive research of the Cuzco-Bolivian varieties of Quechua, well-founded theories have been put forth about the phonological development of that dialect group. The currently accepted view is that aspirated and ejective consonants entered Cuzco-Bolivian Quechua through loanwords from a neighbouring language, such as Aymara, and then spread into the native Quechua vocabulary by a process of semantic analogy (Adelaar & Muysken 2004: 195; Mannheim 1991). This is why words that exhibit laryngealised consonants seem to be semantically related.

In stark contrast, not nearly enough is known about the status of aspirated obstruents in Ecuadorian dialects for linguists to make any robust claims about their emergence. Adelaar and Muysken (2004) state that "Ecuadorian aspiration has been interpreted as a case of Cuzco adstratum, dating from the short period of Inca occupation [between 1470 and 1530], possibly in combination with a putative legacy of the area's pre-Quechuan languages" (p.195).

However, given the minimal information available on Central Highland Ecuadorian aspiration, claims like these are premature because they assume that Ecuadorian aspiration is analogous to that in Cuzco-Bolivian. But as shown in previous sections, there are substantial differences between the inventories of the two dialect groups. Central Highland Ecuadorian Quichua only distinguishes between plain and aspirated obstruents, while Cuzco-Bolivian Quechua has ejectives as well. Furthermore, by comparing cognates, Torero (1984) shows that there are no systematic correspondences between aspirated stops in Ecuadorian

Central Highland Quichua and so-called laryngealised stops in Cuzco-Bolivian. That is to say, the evidence linking the emergence of aspiration in Ecuador with that in Cuzco-Bolivian dialects is vague at best. The above claims about the development of aspiration in Central Highland Ecuador can only be assessed once more is known about the status of those phonemes and how their distribution compares to that of similar segments in Cuzco-Bolivian varieties.

3. Part I - Setting up the Fieldwork

3.1. Finding an Appropriate Dialect

The preliminary aim of this investigation was to identify a dialect of Ecuadorian Quichua that could be documented. The first prerequisite was that the dialect should belong to the Central Highland dialect group, in order to explore the nature of aspiration contrasts in Ecuador. As seen in Figures 3 and 4, the Central Highland group includes four dialects: Cotopaxi, Tungurahua, Bolívar and Chimborazo. Impressionistic reports in MECC (1990) suggest that all four dialects should exhibit aspiration.

A second consideration was that the dialect should be somewhat isolated to other dialects and languages. The reasoning behind this is that aspiration contrasts do not exist in neighbouring Quichua dialects or indeed in Spanish. Lombeida-Naranjo (1976) implies that aspiration contrasts might be in the process of disappearing in peripheral areas due to pressure from other linguistic varieties that surround Central Highland Quichua. In this sense, Tungurahua Quichua is problematic because it exists in close proximity to another Quichua dialect, Salasaca. Furthermore, out of the four central highland provinces, Tungurahua is

the one with the highest proportional number of Spanish speakers (Büttner 1993: 48). Therefore, Tungurahua Quichua was not considered as an option for this investigation.

A third prerequisite was that the sought dialect should not have been previously investigated, so that this project can contribute to the documentation of so far neglected Quichua dialects. This narrows the scope even more because descriptive fieldwork has already been carried out for Bolívar (Lombeida-Naranjo 1976) and Chimborazo (Beukema 1975) Quichua, ruling these two dialects out for the present study. This process of elimination leaves the Cotopaxi province as the best candidate.

3.2. Cotopaxi Quichua

The vitality of Quichua in the Cotopaxi province is one of the highest in Ecuador: over 83% of the province's inhabitants speak Quichua as a first language (Büttner 1993). In addition, intense seismic and volcanic activity over millennia has given Cotopaxi a dramatically irregular terrain of towering mountains and rift canyons, which renders many Quichua communities isolated from the Spanish speaking world.

Prior to the beginning of fieldwork, I drove through many of these communities in search of one that would agree to participate in this project. Probably because of their isolation, the idea of an outsider conducting linguistic research was not well received in most villages. However, in a remote western corner of the province, the Quilotoa community agreed to let me stay there for a number of weeks and investigate the phonology of their dialect. It is likely that

their proximity to a renowned crater lake of the same name had made the community accustomed to strangers visiting.

Although there is no census information available, the Quilotoa community claims to have 120 adult members. Traditionally, Quilotoa was an agricultural community, but with the increasing numbers of tourists visiting the nearby lake, more and more locals are offering accommodation and guiding services to visitors.

It was instantly observable that the only language in use within the community is the local variety of Quichua. Because of the requirements of state bilingual education, children are exposed to both Spanish and Quichua at school. This has two important consequences. To start with, all community members from their teenage years onwards can speak at least basic Spanish. However, due to the infrequent use of Spanish in the area, only certain adults, mostly men who visit nearby cities for trade, are fully competent Spanish speakers. The second consequence of state education is that, although the vernacular variety of Quichua is used in spoken discourse by the teachers, the Quichua textbooks are written for all Ecuadorian dialects in the official orthography approved by the Kichwa Language Academy. This means that children become aware of Quichua words and structures from other dialects which do not exist in their local dialect. Nevertheless, the overwhelming use of Cotopaxi Quichua in Quilotoa and the pride expressed towards it by community members imply that the local dialect is nowhere near endangered.

It is important to note that the inhabitants of this village, like most of the remaining province, used to be part of a distinct ethnic group, the *Panzaleos*,

which at some point after the Inca conquest adopted Quichua as their language. They now consider themselves to be *Quichuas*, along with the remaining Quichua-speaking population in the country. Nevertheless, remnants of their original culture are still apparent. For example, the *ponchos* worn by the men as part of their traditional clothing have particular red colours which are not worn by other Ecuadorian indigenous groups. Although information about the extinct *Panzaleo* language is fragmentary, *Panzaleo* words are still largely present in toponyms, characterized mostly by ending in *–paxi*, *–oa*, *–awa*, and *–alo* (Jijón y Caamaño 1945: 82). It is also likely that Cotopaxi Quichua has a significant *Panzaleo* substrate, potentially explaining some of the local dialectal variation.

4. Part IIa – Fieldwork Design

4.1. The Participants

When I initially arrived at the community, it was agreed that accommodation and food would be provided by one particular family which had guest rooms available for visitors. By virtue of living with that family, most of my contact with the community was through them. The members of this family were very willing to involve themselves as participants in my fieldwork from the very beginning. However, as knowledge of my investigation spread through the community, people from other families started volunteering themselves as participants as well.

Soon it became clear that two of the participants were particularly good informants. They were not only quick to understand the aims of individual tasks, but they also seemed to have a deeper awareness of their language's phonology compared to other speakers. Their intuitions were excellent leads for my

understanding of phonological alternations and constraints in Cotopaxi Quichua. Fortunately the two of them, Dora Latacunga and Agustín Vega[4], participated extensively throughout the research process. They will henceforth be referred to as the primary participants.

In the end, 9 men and 9 women were involved as participants. All of them had Cotopaxi Quichua as their native and preferred language, but all spoke Spanish to varying degrees as well. The average (median) age of the participants was 26 years, with ages ranging from 16 to 38[5]. All of them agreed to be recorded.

4.2. Research Method

4.2.1. Collecting Words in Isolation

Vaux and Cooper (1999) point out that a good starting point for any kind of fieldwork investigation is eliciting words in isolation through a vocabulary list. Although this study is primarily phonological rather lexicographic, collecting a substantial vocabulary is crucial. This method works under the assumption that if enough words are collected and transcribed, the researcher can become aware of the language's sound system and identify many phonemes through the surface forms of the collected words. A suggested standardized vocabulary list is the Swadesh wordlist, which includes 200 basic words. For this study, the Swadesh wordlist was translated into Ecuadorian Spanish and used as a base, but it was moderately adapted so that it only included vocabulary that was likely to exist in Cotopaxi Quichua. For example, because the Quilotoa community is well over the tree line at 4,000 metres above sea level, the word *forest* is irrelevant and was

[4] They signed forms asking explicitly to be recognized by their real names.
[5] By local indigenous law, all participants are considered adults.

not included. Furthermore, prepositions such as *in*, *at*, and *with* are all expressed by dependent postpositional affixes in Quichua, so they were removed from the list as well. The final list used can be found in Appendix A.

Vocabulary elicitation sessions involved one participant at a time and lasted approximately an hour each. I presented every Spanish word on the list verbally and participants were instructed to translate each word into Quichua. They were asked to pronounce the words three times, twice carefully and once at natural speed. This allowed me to transcribe each word and correct the transcription if necessary. Participants were also advised to produce words that would normally be used within the community. This was done to avoid any borrowings from Spanish or Standard Quichua which might not actually be used in the local variety. This procedure was repeated with 7 participants.

4.2.2. Analysing the Phonology

The next step in the research process was to compile the phoneme inventory of Cotopaxi Quichua. This required careful examination of the elicited wordlists. Taking into consideration the variation of the surface forms elicited, I attempted to recover the underlying phonemic form of each word. During this part of the investigation, I often appealed to the intuitions of the primary informants, as well as to my own knowledge of universally common phonological processes such as assimilation and voicing. After drawing up a list of all potential phonemes in the language, I worked extensively with the primary participants in order to fill possible accidental gaps. The validity of the proposed phonemic inventory was

confirmed by the discovery of minimal pairs for every ambiguous group of segments.

In order to determine the permissible syllabic configurations, I asked the primary participants to divide the previously elicited words into syllables using their intuitions. One informant was familiar with the concept of syllables in writing, so he preferred to write out the syllabic components of every word. The other informant preferred to clap her hands rhythmically while pronouncing each syllable individually.

Subsequently, I continued to work with the primary informants to reveal allophonic variations and phonotactic constraints. I systematically tried to elicit examples of each phoneme in every possible syllabic position and in every possible combination of segments. A typical question to the informants would be postulated in the following form: "can you think of a word with […]", where the ellipsis stands for a sought combination of segments. Although this was a time consuming task, the two primary participants were very talented at retrieving words that corresponded to my queries. They were also very clear in pointing out combinations or distributions of particular phonemes that seemed unnatural. In addition to elucidating phonological variation and constraints, this process resulted in a large increase of collected vocabulary.

Finally, in an effort to uncover further allophonic variation and morphophonemic alternations, I elicited connected speech. Participants were asked to put previously elicited words in a sentence. For example, if the word *cow* had been elicited, a participant might come up with the following sentence: *The cow eats grass*. The reason why sentences were not given to the speakers for

translation was to avoid morphological or syntactic influence from Spanish. Furthermore, three speakers volunteered to tell stories. These stories provided excellent insight into spontaneous and natural speech, uncovering phenomena that would not have been discovered as easily with elicitation.

4.2.3. Documenting the Findings with Recordings

All elicitation sessions were recorded using a small solid state professional field recorder, the Marantz PMD660. The input was recorded directly onto uncompressed 16-bit PCM WAV files at 48 kHz. The microphone that was used was a Shure SM10, a low-impedance unidirectional dynamic microphone, mounted on a steel headband designed for close-talk.

It is important to note that there were certain limitations regarding the recordings. Firstly, as would be expected with field recordings, the quality of sound is at times far from optimal. All precautions were taken in order to reduce unwanted noise. Sessions were typically held in a closed room. Because it involved their language, the locals understandably deemed this investigation to be a public enterprise, so it was often impossible to isolate informants from onlookers during sessions. Although onlookers were generally very quiet throughout the elicitation sessions, in a dynamic village environment there is almost constant human-induced background noise. Natural noise, such as very strong gusts of wind that are characteristic of the Quilotoa area, also jeopardised the quality of the recordings. Nevertheless, all recordings are intelligible and many capture the fine phonetic detail which can be analysed in spectrograms.

An unexpected second limitation to the recordings was the fact that the microphone was attached to a headset. In the early stages of fieldwork I soon realized that in many Quichua communities wearing a felt hat is a sign of adulthood and honour. Asking someone to take their hat off in public would be wholly inappropriate and might even be considered a transgression of privacy. Therefore, a headset microphone is entirely incompatible with fieldwork amongst the Quichua. The only other microphones that were available during my stay in Quilotoa were the built-in condenser microphones of the PMD660 recorder. Nonetheless, it was discovered that the headset microphone could still yield better recordings, as long as the headset was held steadily in the hands of the speaker so that the microphone would be positioned near the side of the mouth. Unfortunately, occasional rustling and moving of the microphone caused slight irregularities in the recordings.

All subsequent acoustic analysis of the recordings was done by producing waveforms and spectrograms with Praat (Boersma & Weenink 2010). If the reader is not familiar with waveform and spectrogram analysis, please refer to Appendix C.

5. Part IIb – Fieldwork Results

5.1. Elicited Vocabulary

As mentioned above, an important step in the process of examining the phonology of Cotopaxi Quichua was to collect vocabulary. Each of the original seven elicitation sessions yielded a list of the same basic Quichua vocabulary translated by different speakers. Appendix A shows a compilation of all seven lists. It is

interesting to note that there was hardly any variation in the translations by the seven participants. That is to say, nearly every individual Spanish word was translated into the same Quichua word by all speakers. The only exception was the translation of Spanish *flaco* (*thin*), which produced two synonyms[6]. For every other word, translations were uniform. They only varied slightly in their phonetic realisations. These seemed to be freely-varying allophonic variations because they occurred both across and within participants. Appendix A lists every phonetic form collected in order of frequency as well as the underlying phonemic form.

Vocabulary that was collected in subsequent parts of the research is listed in Appendix B. It should be noted that these words were not systematically elicited through a translation list, but were collected mostly as a result of the search for minimal pairs, allophones and phonotactic constraints. Like before, Appendix B lists all collected phonetic forms as well as the expected phonemic form for every word.

5.2. The Phonology of Cotopaxi Quichua

5.2.1. The Phoneme Inventory

5.2.1.1. Overview

Table 4 illustrates the phonemic inventory that was found for Cotopaxi Quichua. Note that while the following sections will describe details about each individual phoneme, stops and affricates will not discussed here as they will be covered

[6] In this case, four speakers produced one word ([tsala]) and three produced another ([zariŋ]).

explicitly in Part III (Section 7). They therefore appear in dark shadowing in Table 4.

COTOPAXI QUICHUA PHONEMES

Consonants						
		Labial	Alveolar / Dental	Postalveolar	Palatal	Velar
Voiceless	Plain Stops	p	t			k
	Aspirated Stops	p^h	t^h			k^h
	Affricates		c [7]	č [8]		
	Fricatives		s	ʃ		x
Voiced	Fricatives		z	ʒ		
	Nasals	m	n		ɲ	
	Laterals		l			
	Rhotics		r			
	Glides	w			j	

Vowels			
	Front	Central	Back
High	i		u
Low		a	

TABLE 4

5.2.1.2. Fricatives

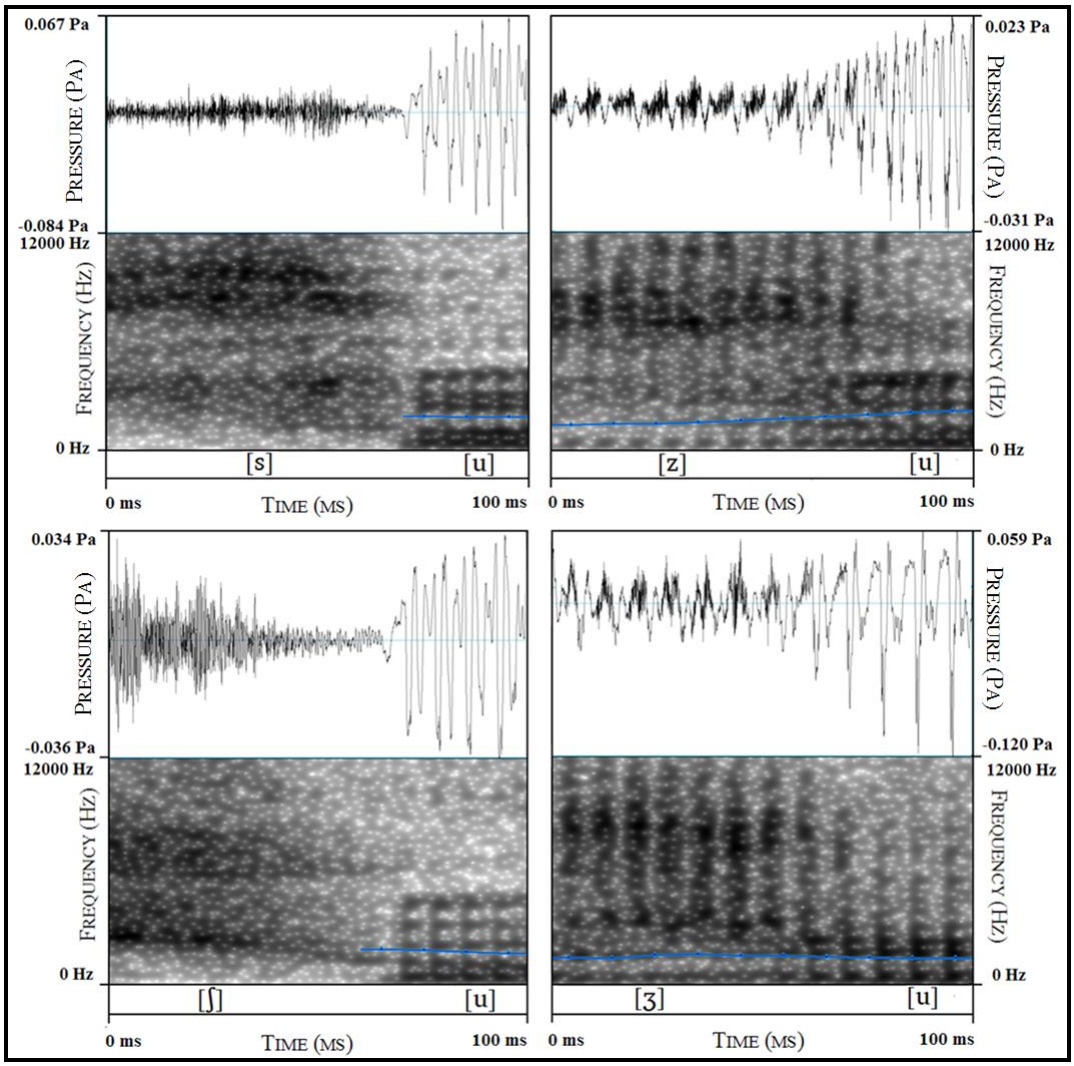
Out of the five fricatives that Cotopaxi Quichua distinguishes phonemically, four of them are sibilants. /s/ is realised as a voiceless alveolar sibilant fricative [s]; /z/ is realised as a voiced alveolar sibilant fricative [z]; /ʃ/ is realised as a voiceless palato-alveolar sibilant fricative [ʃ]; and /ʒ/ is realised as a voiced palato-alveolar

[7] /c/ represents [t͡s]. /c/ is used instead of /ts/ because the latter might be interpreted as /t/ + /s/

[8] /č/ represents [t͡ʃ]. /č/ is used instead of /tʃ/ because the latter might be interpreted as /t/ + /ʃ/

sibilant fricative [ʒ]. There is no noteworthy allophonic variation amongst these phonemes.

MINIMAL SET OF SIBILANT FRICATIVES



(top left: /**su**.ju/; top right:/**zu**.ru/; bottom left: /**ʃu**.ju/; bottom right: /**ʒu**.ču/; all by speaker 5)

FIGURE 5

Figure 5 shows waveforms and spectrograms of a near minimal quartet which confirms the distinction between those phonemes. The first syllables of /su.ju/ (*region*), /zu.ru/ (*fence*) and /ʃu.ju/ (*drawing*) and /ʒu.ču/ (*naked*) are shown. A

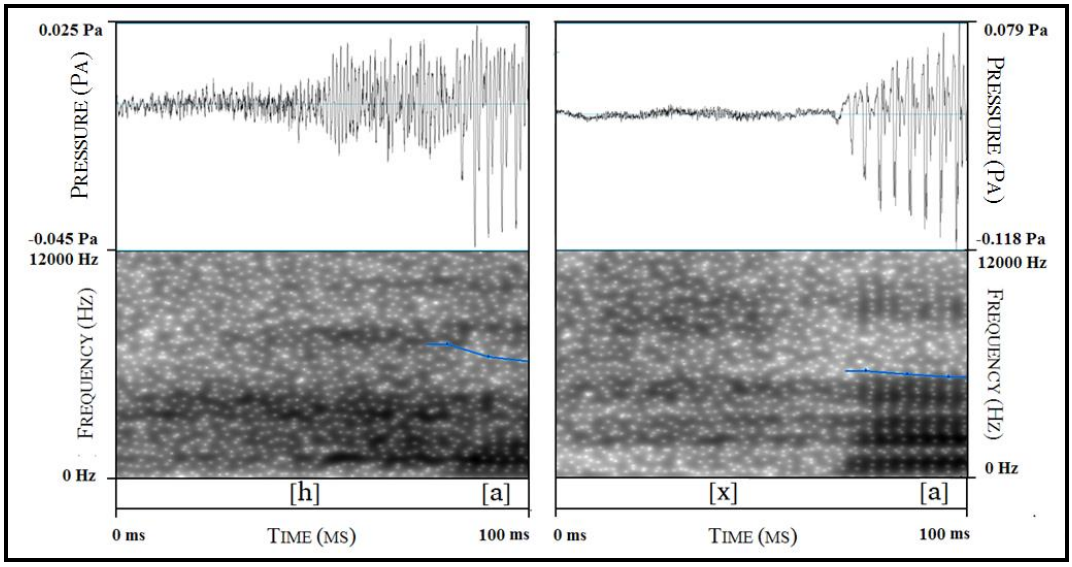
salient distinguishing characteristic is that the energy of /s/ and /z/ is located at high frequencies, whereas /ʃ/ and /ʒ/ have energy distributed more evenly across lower frequencies as well. /z/ and /ʒ/ are voiced, as shown by the unbroken blue "pitch tracker" (which tracks the fundamental frequency, indicating vibration of the vocal folds). Furthermore, for /z/ and /ʒ/ the presence of glottal pulses can be seen clearly in the waveforms.

In the lexicon collected, /s/, /ʃ/ and /ʒ/ appear both in syllable-initial and syllable-final position. /z/, on the other hand, appears only in syllable initial position, and seems to exist only marginally. Speakers could only think of three words that had this phoneme (/za.rin/ (*thin*), /zu.ru/ (*fence*) and /juk.zi/ (*sand*)).

The other phonemic fricative in Cotopaxi Quichua is /x/. Most speakers realise it as a voiceless velar fricative [x], but some speakers prefer to pronounce it as a voiceless glottal transition [h]. Those two allophones are in free variation, and seem to be determined mostly by the preference of the speaker. Figure 6 shows spectrograms and waveforms for the first syllable of the word /xam.pi/ (*medicine*) pronounced by two different speakers, exemplifying the two realisations of this phone. Because the [h] realisation has no particular place of articulation, it appears in the waveform and spectrogram as a gradual anticipation of the vowel, whereas the [x] realisation shows a clear boundary at the vowel

onset. It should also be noted that /x/ only appears in syllable-initial position in the words collected for this investigation.

ALLOPHONIC VARIATION OF /x/



(left: /**xa**m.pi/ by speaker 6; right: /**xa**m.pi/ by speaker 5)

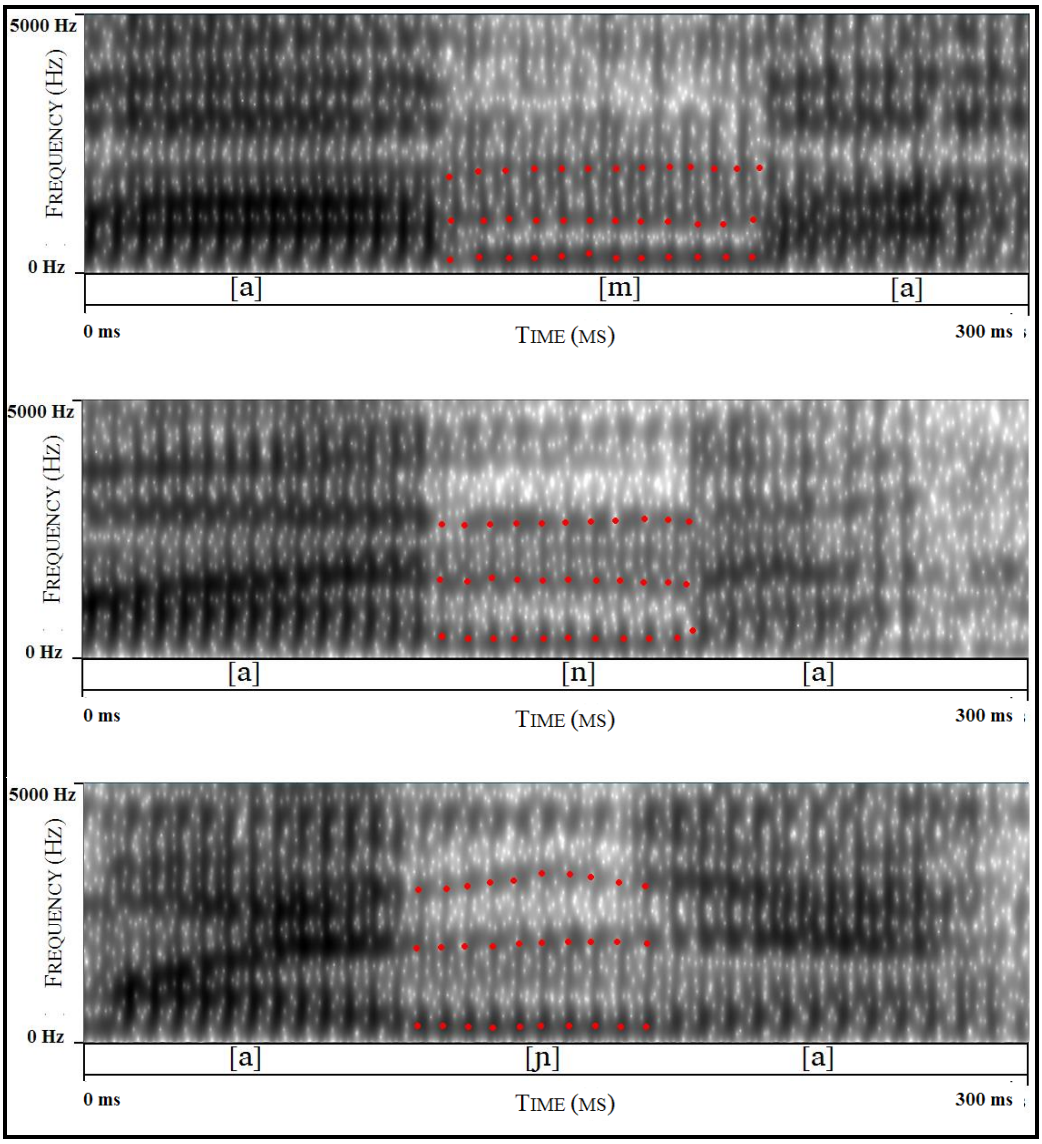
FIGURE 6

5.2.1.3. Nasals

Cotopaxi Quichua has three phonemically distinct nasals: /m/, /n/ and /ɲ/. /m/ always surfaces as a bilabial nasal [m] and /ɲ/ is always a palatal nasal [ɲ]. Syllable-initially, /n/ is always pronounced as an alveolar nasal [n]. Figure 7 shows spectrograms for a near-minimal triplet for the three phonemes in syllable-onset position (in the second syllable of /ma.ma/ (*mother*), /ma.na/ (no) and /ma.ɲan/ (*he/she requests*). In the three cases, nasal segment shows distinctly

different (and characteristic) formant frequencies, tracked by the red dots, confirming the difference in place of articulation.

THE NASAL PHONEMES



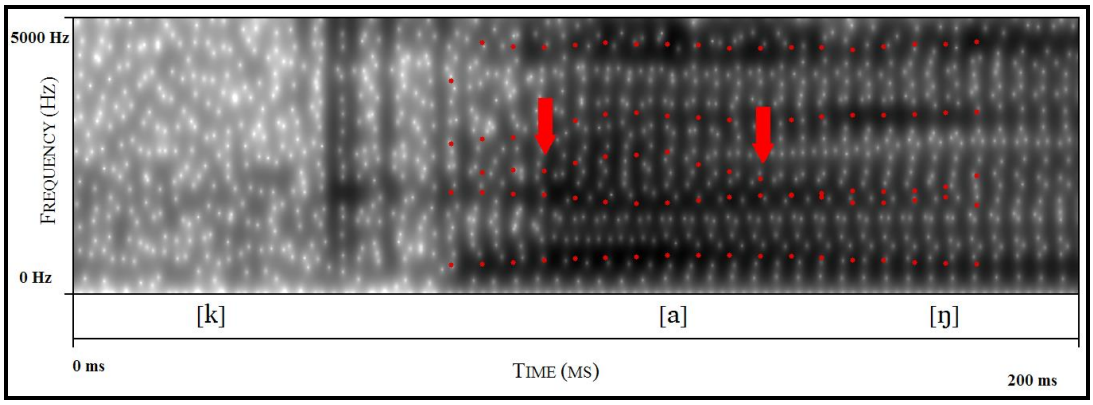
(top: /m**a.ma**/; middle: /m**a.na**/; bottom: /m**a.ɲa**n/; all by speaker 5)

FIGURE 7

Syllable-finally, /n/ appears to have substantial allophonic variation. In syllable codas, /n/ often takes on the place of articulation of the following consonant. This

type of assimilation is very frequent cross-linguistically, so it is not surprising that /n/ is pronounced [m] if it precedes a bilabial stop, [n̪] if it precedes a dental stop and [ɲ] if precedes the post-alveolar affricate. However, it is intriguing that in every other environment, syllable-final /n/ surfaces as [ŋ]. Even word-finally, in the absence of anticipatory assimilation contexts, /n/ is pronounced [ŋ]. Figure 8 shows this to be the case in the word /kan/ (*you*). Formant transitions, tracked by red dots on the spectrogram, show that the /n/ has a velar locus (notably characterised by the approximation of the second and third formants). The red arrows show that the formant transitions out of the velar stop /k/ are the same as the formant transitions into the nasal.

ALLOPHONIC VARIATION OF /n/



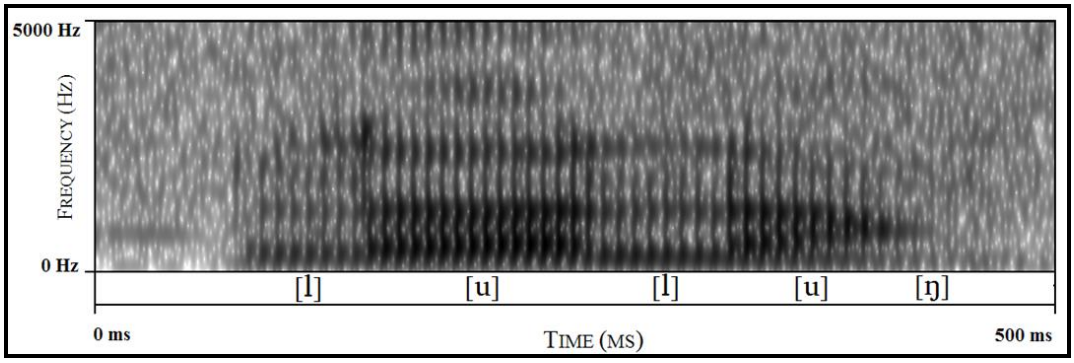
(/kan/ by speaker 7)

FIGURE 8

5.2.1.4. The Lateral Approximant

/l/ is realised as a lateral alveolar approximant [l]. It appears both at the onset and coda of syllables, and does not exhibit notable allophonic variation. Figure 9 exemplifies this phone with a waveform and spectrogram for the word /lulun/ (*egg*). It must be noted that it is a fairly marginal phoneme, as it appears in only 3% of the vocabulary elicited.

THE LATERAL APPROXIMANT



(/lu.lun/ by speaker 5)

FIGURE 9

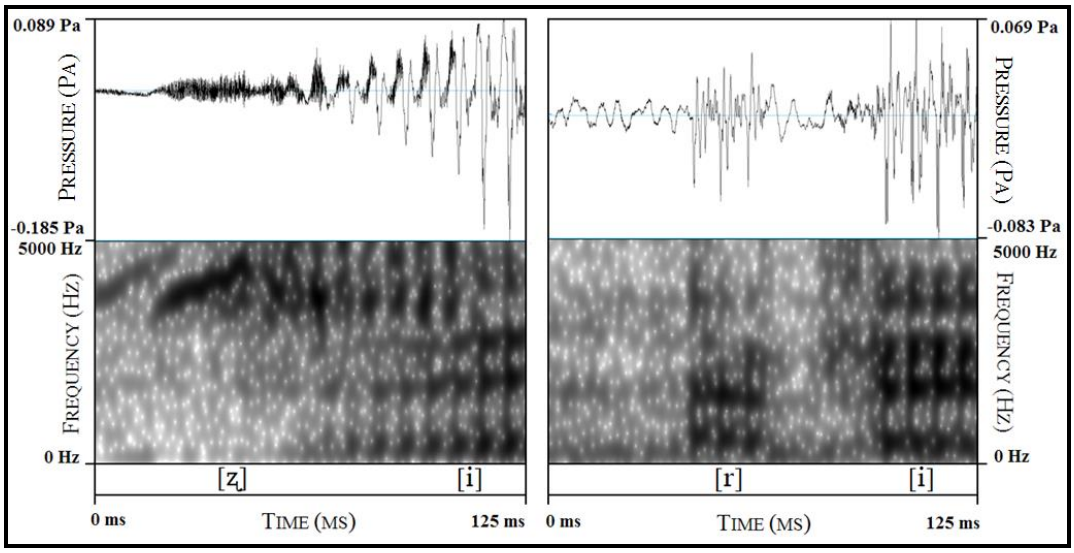
5.2.1.5. Rhotics

Although there is only one phonemic rhotic /r/ in Cotopaxi Quichua, it has notable allophonic variation. Word-initially and word-finally, two freely varying allophones were observed: a voiced retroflex fricative [ʐ] and an alveolar trill [r]. The choice of either allophone seems to depend largely on the speaker. Word-medially, if /r/ occurs adjacent to a nasal, it exhibits those same two allophones. Figure 10 shows the two allophones as pronounced by different speakers at the

onset of the word /**r**in.**r**i/ (*ear*). Note the turbulent fricative noise seen for [z̨i̯], as opposed to the trills seen for [**r**i].

In every non-nasal context word-medially, be it syllable-initial or syllable-final, /r/ is pronounced as an alveolar flap or tap [ɾ]. Figure 11 illustrates a word-medial syllable-initial /r/ produced as an alveolar tap in /k^{h}a.**r**i/ (*male*).

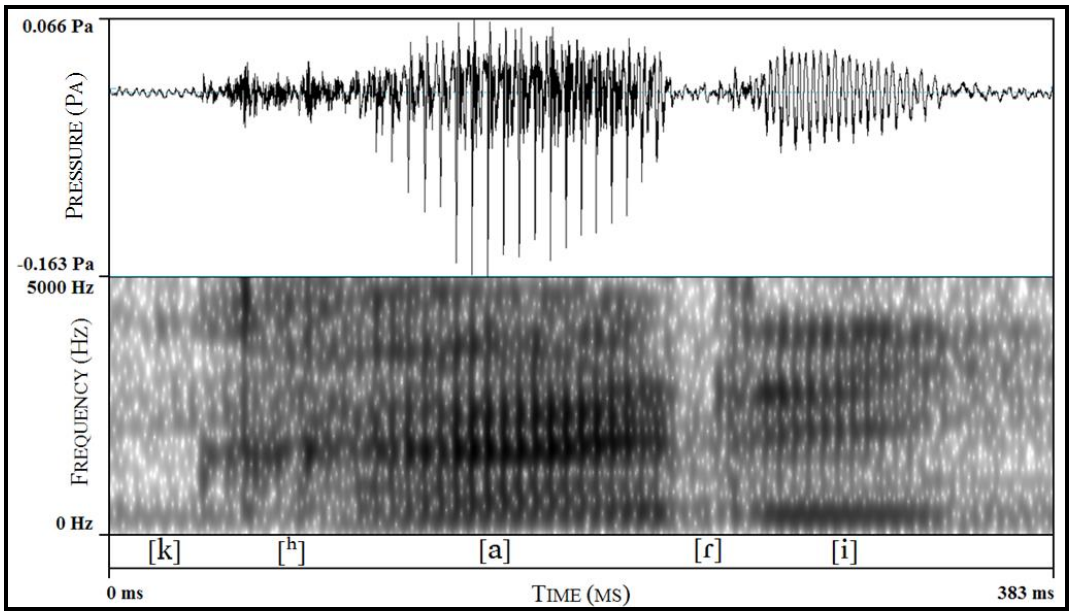
ALLOPHONIC VARIATION OF WORD-INITIAL /**r**/



(left: /**r**in.**r**i/ by speaker 7; right: /**r**in.**r**i/ by speaker 5)

FIGURE 10

WORD-MEDIAL SYLLABLE-INITIAL /ɾ/



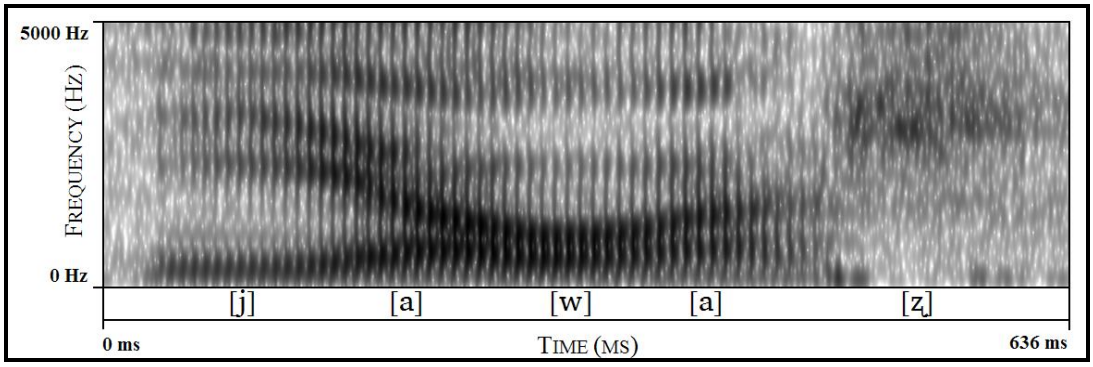
(/kʰa.ɾi/ by speaker 5)

FIGURE 11

5.2.1.6. Glides

Cotopaxi Quichua has two glides: /w/ and /j/. /w/ is pronounced as a voiced labiovelar approximant [w], whereas /j/ is realised as a palatal approximant [j]. They can both occur syllable-initially and syllable-finally, but they are restricted from appearing before their vocalic counterpart: */wu/ and */ji/. Figure 12 illustrates both glides in the word /jawar/ (*blood*).

THE GLIDES



(/ja.war/ by speaker 7)

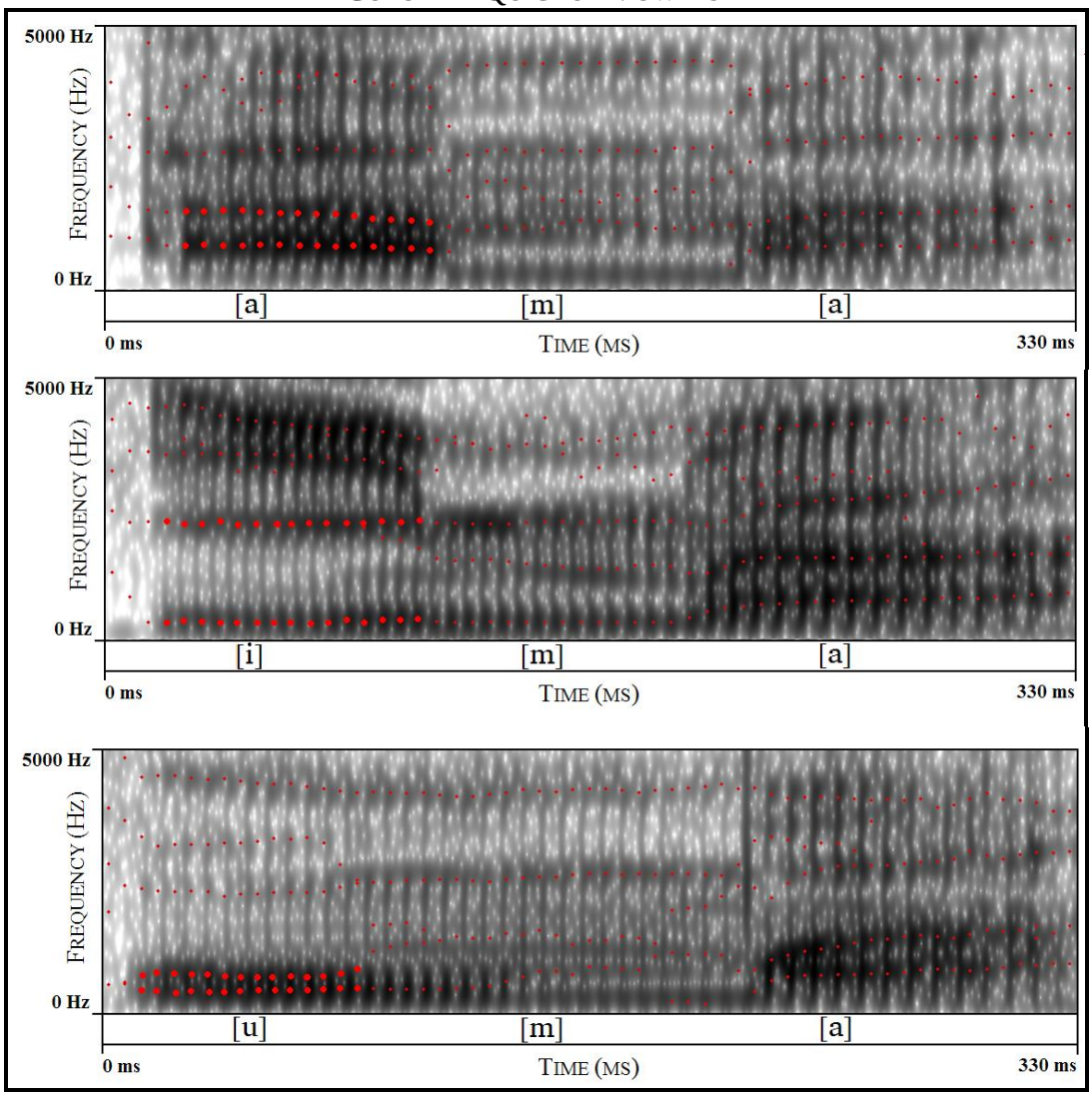
FIGURE 12

5.2.1.7. Vowels

There are three vowel phonemes in Cotopaxi Quichua: a high front unrounded vowel /i/, a high back rounded vowel /u/ and a low central unrounded vowel /a/.

There are a number of minimal triplets which confirm the phonemic distinctiveness of the three vowels. Figure 13 shows spectrograms of the three vowels in minimally contrasting positions: /ama/ (*no*), /ima/ (*what*) and /uma/ (*head*). The large red dots track the characteristic vowel formants: high F1 and middle F2 for /a/, low F1 and high F2 for /i/, and low F1 and low F2 for /u/.

COTOPAXI QUICHUA VOWELS



(top: /a.ma/; middle: /i.ma/; bottom: /u.ma/; all by speaker 5)

FIGURE 13

There is considerable variation in the phonetic realisation of each vowel. In particular /i/ and /u/ vary in height from [i] to [e] and from [u] to [o] respectively. These alternations seem to be free-varying. However, /a/ exhibits salient alternations which seem to be restricted to certain suffixed morphemes. It was found that the vowel nucleus of a number of frequent inflectional morphemes was

pronounced quite differently in careful speech and in spontaneous speech. Table 5 lists the alternations discovered during this fieldwork.

VOWEL ALTERNATIONS IN INFLECTIONAL MORPHEMES

Morpheme Realisation in Careful Speech	Morpheme Realisation in Spontaneous Speech	Morpheme Function
-[maŋ]	-[muŋ]	Allative marker (≈ *to*)
-[manda] ~ -[manta]	-[munda]	Ablative marker (≈ *from)*
-[pax] ~ -[pak]	-[βux]	Genitive marker (≈ *of*)
-[paʃ]	-[βiʃ]	Coordinating marker (≈ *and*)

TABLE 5

In these morphemes, /a/ is raised to a high back rounded vowel [u] (and to a high front vowel [i] in one case) when uttered spontaneously. Although these alternations were only discovered in realisations of the listed morphemes, it is unlikely that the list presented here is exhaustive. Unfortunately, it is beyond the scope of this investigation to find exact underlying motivations for allophonic variation in the Cotopaxi Quichua vowel system[9].

Despite the variation described, the average values of the first and second formants of each vowel can be plotted onto a vowel chart. Chart 1 was produced with values from the minimal triplet presented above (/ama/, /ima/, /uma/). This minimal triplet was chosen because it had the most consistently clear formant traces of all the recorded vowel sets. For the calculations, 3 repetitions of each word by 6 speakers (3 males and 3 females) were examined. The formant values were taken at the midpoint of the first vowel of each word.

[9] The alternations of the stop consonants, on the other hand, will be discussed at length in section 6 of this report.

VOWEL CHART

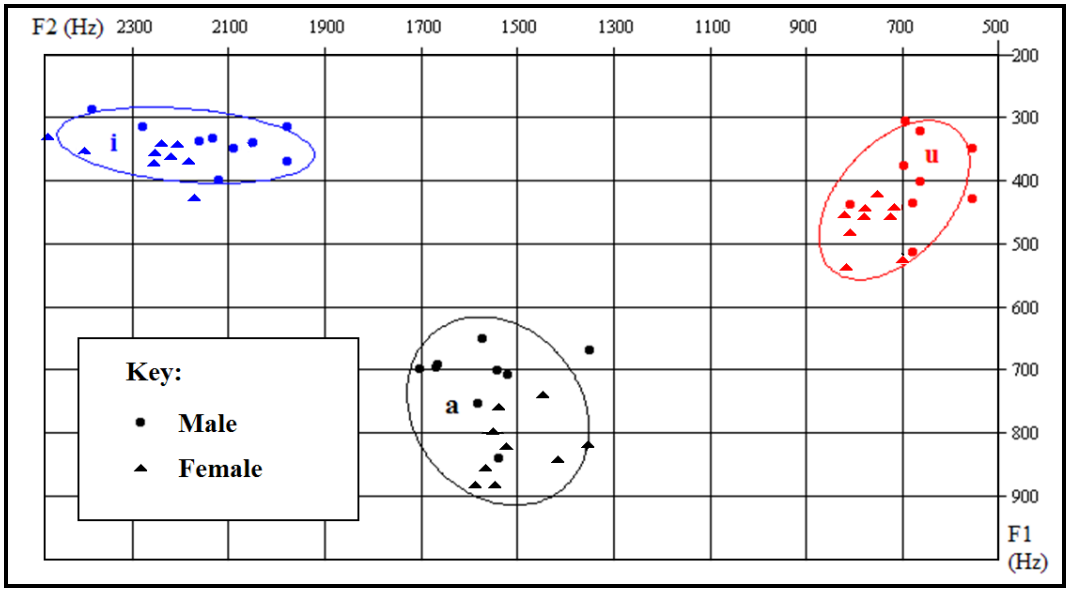


FIGURE 14

5.2.2. Some Suprasegmental Considerations

5.2.2.1. Syllable Structure

The collected vocabulary shows that the only permissible syllable configurations in Cotopaxi Quichua are the following ones: CV, CVC, VC and V, where C stands for a consonant and V for a vowel. Chart 1 shows the frequency of each syllable type in the lexicon collected for this fieldwork. CV is by far the most common syllable type, followed by CVC. VC and V syllables only appear marginally in word onset positions.

FREQUENCY RATIO OF SYLLABLE TYPES

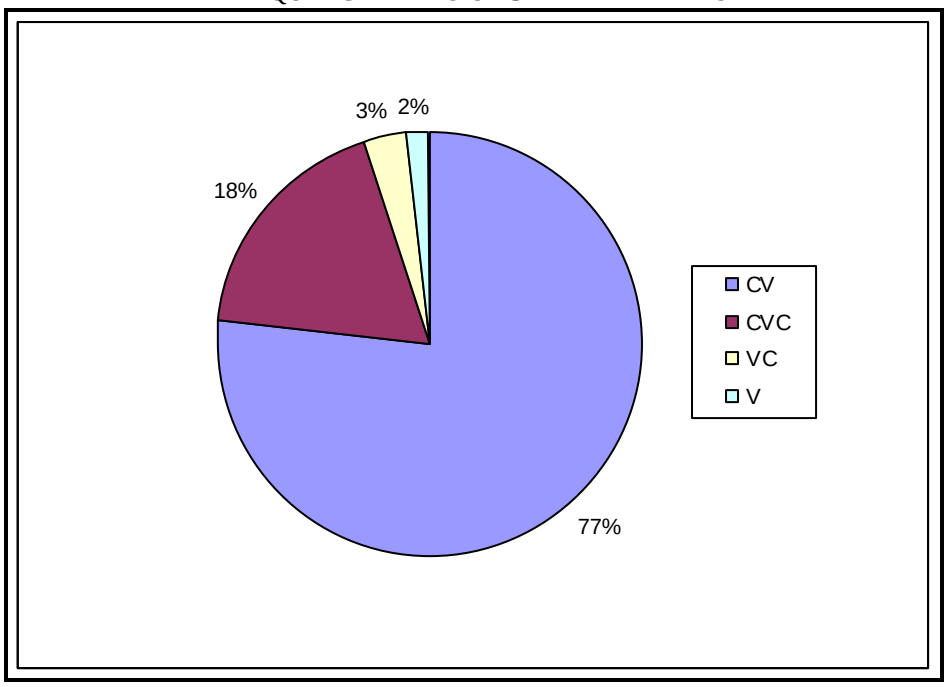


CHART 1

5.2.2.2. Stress

In every word collected, stress falls on the penultimate syllable. Because Quichua is a polysynthetic agglutinative language, lexemes can have numerous morphemes suffixed to them. Stress is sensitive to these changes and moves accordingly to the next-to-last syllable. Table 6 shows an example of this.

Only one exception to the rule above was collected: the token [ɲuˈkaʃ]. Subsequent enquiry revealed that it is a contraction of /ɲu.ˈka.paʃ/, whereby the morpheme -/paʃ/ is shortened to /ʃ/ and attached to the previous vowel as a coda. Interestingly, the second syllable retains the stress it has in /ɲu.ˈka.paʃ/, as if the elided morpheme still carried syllabic weight.

STRESS MOVEMENT

Quichua phonemic form	Morphemic Summary with English gloss	English translation
ˈwa.si	wasi house	house
wa.ˈsi.man	wasi-man house-ALL	to the house
wa.si.ˈku.na	wasi-kuna house-PL	houses
wa.si.ku.ˈna.man	wasi-kuna-man house-PL-ALL	to the houses
wa.si.ku.na.ˈman.ču	wasi-kuna-man-ču house-PL-ALL-Q	to the houses?

TABLE 6

6. Part IIc – Discussion

6.1. Diachronic Comparison

If one compares Adelaar and Muysken's (2004) Proto-Quechua phonemic inventory (laid out in Table 1) with the Cotopaxi Quichua inventory proposed in this paper (in Table 4), it is clear to see the phonological changes that Cotopaxi Quichua underwent. This section will elucidate the similarities and differences of the two phonologies, with the exception of stops and affricates which will be compared diachronically in section 8.

Most of the phonemes in Cotopaxi Quichua correspond perfectly to those in Proto-Quechua. The Proto-Quechua fricatives /s/, /š/ and /h/ match up exactly

with Cotopaxi Quichua /s/, /ʃ/ and /x/[10]. Similarly, the Proto-Quechua nasals (/m/, /n/, /nʸ/), the rhotic (/r/) and the glides (/w/ and /y/) have direct correspondences in Cotopaxi Quichua (namely /m/, /n/, /ɲ/, /r/, /w/ and /j/ respectively). The vowels are also unchanged: /a/, /i/ and /u/ exist for both Proto-Quechua and Cotopaxi Quichua.

There is, however, some disparity between the two sound systems. Firstly, an equivalent of the Proto-Quechua palatalised lateral /lʸ/ is not attested in Cotopaxi Quichua. Conversely, Cotopaxi Quichua has three phonemes which cannot be traced back to its ancestor: the alveolar lateral /l/, the voiced alveolar fricative /z/, and the voiced post-alveolar fricative /ʒ/. Nevertheless, explanations for all these differences can be found in the literature.

Adelaar and Muysken (2004) state that an alveolar lateral /l/ was marginally attested as a phoneme in Proto-Quechua. As /l/ only appeared in 3% of the elicited words in Cotopaxi Quichua, it is highly likely that it is a reflex of the marginally existing Proto-Quechua /l/.

Adelaar and Muysken (2004) also confirm that in many dialects of Quechua, /lʸ/ is realised as [ʒ]. There seems to have been an areal process affecting both Andean Spanish and Quichua which turned palatal laterals into post-alveolar fricatives. This explains why Proto-Quechua /lʸ/ appears to have

[10] The differences in the symbols should be ignored.

vanished in Cotopaxi Quichua, and why Cotopaxi Quichua /ʒ/ is not found in Proto-Quechua: they are one and the same.

Finally, MEC (1990) confirms that some Ecuadorean dialects adopted the voiced alveolar fricative /z/ from Pre-Incan languages in the region. This explains why /z/ only appears in three Cotopaxi Quichua words and why it is not found in Proto-Quechua.

6.2. Cross-Linguistic Comparison

Although typological classification is not an aim of this project, it is worthwhile to evaluate the findings for Cotopaxi Quichua cross-linguistically. The data used for comparison all stem from Maddieson (1984).

Cotopaxi Quichua has 5 fricatives, like 8.2% of the world's languages. This is relatively uncommon, as languages most commonly exhibit 2 or 3 fricatives. On the other hand, languages which do have 5 fricatives are likely to have a voicing distinction and are most likely to have /s/ and /z/, which is true for Cotopaxi Quichua.

Nearly a third of all languages have three phonemic nasals like Cotopaxi Quichua. Cross-linguistically, the two most common nasals are bilabial and alveolar nasals, both of which are attested in Cotopaxi Quichua. The other nasal found in Cotopaxi Quichua, the palatal /ɲ/, is found in just over a third of the languages, making it fairly common as well.

Regarding Cotopaxi Quichua liquids, /l/ with an alveolar realisation is very common cross-linguistically as it makes up 45% of all laterals worldwide. However, the fricated realisation of /r/ found in Cotopaxi Quichua is very uncommon, accounting for only 3% of the r-sounds attested across all languages.

As for its approximants, Cotopaxi Quichua follows the overwhelming cross-linguistic trend: 86% of languages exhibit a voiced palatal approximant /j/ and 76% of them have a labio-velar approximant /w/.

Finally, the vowels that were found in Cotopaxi Quichua are not surprising. Although it is more common for languages to have 5 vowel systems, nearly all languages in the world have /a/, /i/ and /u/.

7. Part III – The Stops and Affricates of Cotopaxi Quichua

7.1. A Guided Approach

The steps taken to examine the stop and affricate system of Cotopaxi Quichua were very similar to those described in the method of Part II, but they were much more thorough. This part of the investigation was guided by very specific questions which allowed for a slightly more in-depth investigation compared to what was done in Part II. The guiding questions used are listed below:

1) What are all the phonetic realisations of stops and affricates in Cotopaxi Quichua? More importantly, does Cotopaxi Quichua exhibit voiced, aspirated and/or ejective stops and affricates?
2) Which distinctions are phonemic?
3) Which are allophonic?

4) If aspirated/ejective stops and affricates are attested, is their distribution constrained morphophonologically or semantically?

Every following sub-section will outline the method that was used to answer each of the questions, followed by the results obtained.

7.2. The Phonetic Surface Forms

As in Part II, in order to identify the range of phonetic realizations of stops and affricates in Cotopaxi Quichua, the elicited wordlists were examined. Table 7 shows all the stops and affricates that were attested in the transcriptions of the sessions with participants. Nine different stops were found, with three different places of articulation (bilabial, dental and velar) and three phonation types (voiced, plain and aspirated). In addition, there are two plain affricates which differ in place of articulation (alveolar and post-alveolar). It might seem striking that fricatives are listed in the table as well, as this part of the investigation was meant to focus on stops and affricates only. However, it is clear from the transcriptions that speakers alternated freely between stops and fricatives in some contexts, so that words that clearly contained a stop were sometimes pronounced with a fricative instead. For this reason, the fricatives involved in these alternations were added to the table below and will be included in the analysis of the stops and affricate system. Refer to section 7.4. for more information on the exact phonological conditioning in which stops are fricated.

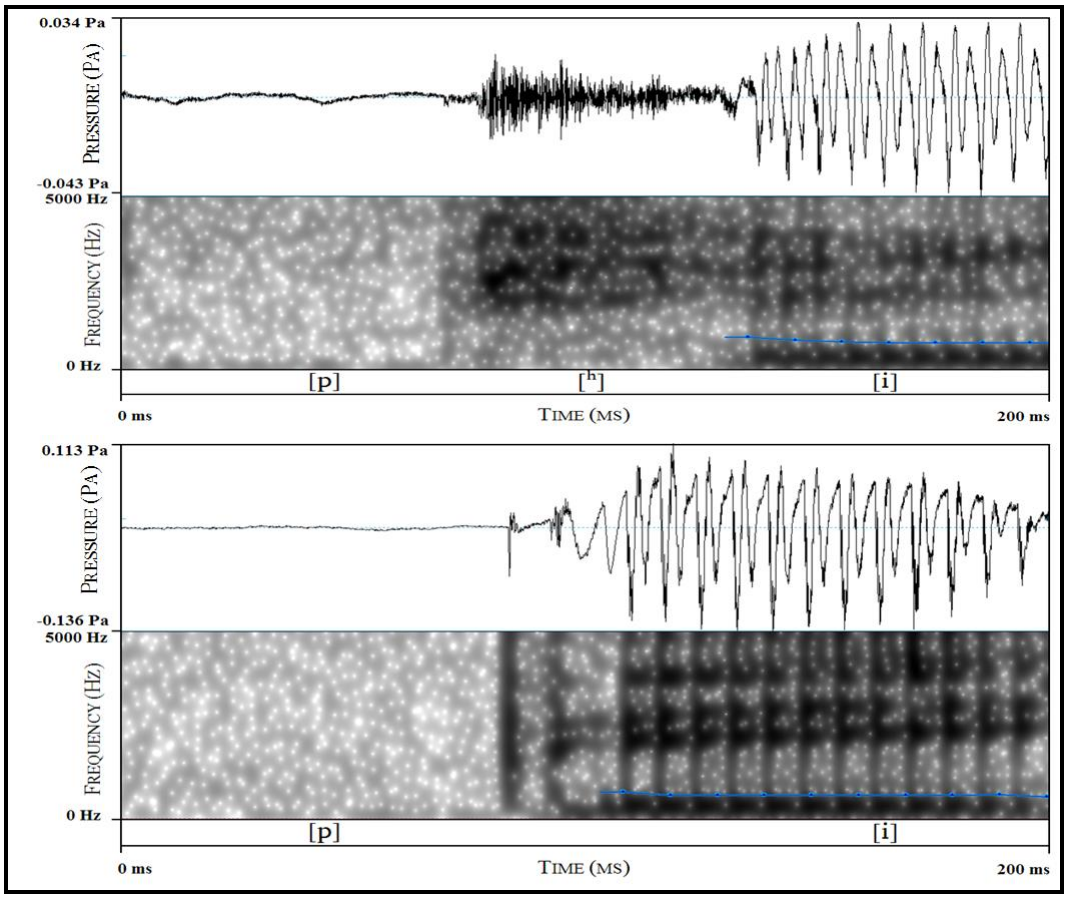
REALISATIONS OF STOPS AND AFFRICATES IN COTOPAXI QUICHUA

		Bilabial	Alveolar / Dental	Post-Alveolar	Velar
Stops	Aspirated	p^h	$t̪^h$		k^h
	Plain Voiceless	p	t̪		k
	Voiced	b	d̪		g
Fricatives	Voiceless	ɸ			x
	Voiced	β	ð		ɣ
Affricates	Plain		t͡s	t͡ʃ	

TABLE 7

To exemplify differences in manner of articulation and phonation type amongst stops, waveforms and spectrograms corresponding to the bilabial series are shown in Figures 15a/15b. Note the following distinguishing acoustic features. For [b] and [β] there is periodic movement in the waveform and the fundamental frequency is uninterrupted as shown by the blue F0 tracker in the spectrogram. This means that for [b] and [β] there are vocal fold vibrations present, confirming their status as voiced. [p], [p^h] and [ɸ], on the other hand, do not exhibit any form of vocal fold vibration, indicating that they are voiceless. Compare [p] and [p^h] regarding voice onset time: the vowel starts immediately after the release of [p], but for [p^h] there is a long period of turbulence following the release and a long voice onset time characteristic of aspirated stops. As for manner of articulation, [p^h], [p] and [b] have a clear silent interval signifying a stop, whereas [ɸ] and [β] show the acoustic turbulence which would be expected in fricatives.

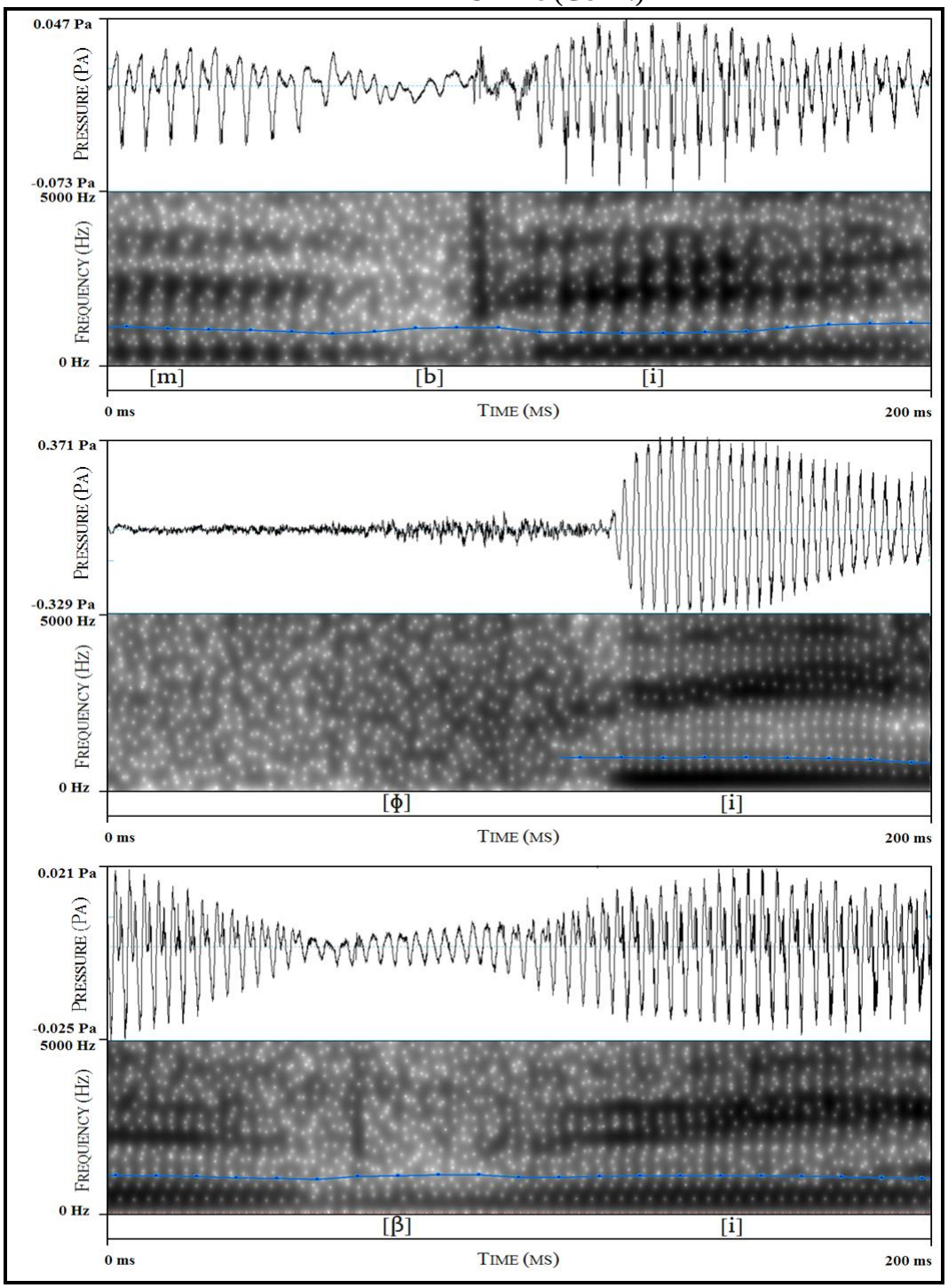
THE BILABIAL SERIES



(top: [**pʰiɲa**]; bottom: [**pix**i]; all by speaker 7)

FIGURE 15A

THE BILABIAL SERIES (CONT.)

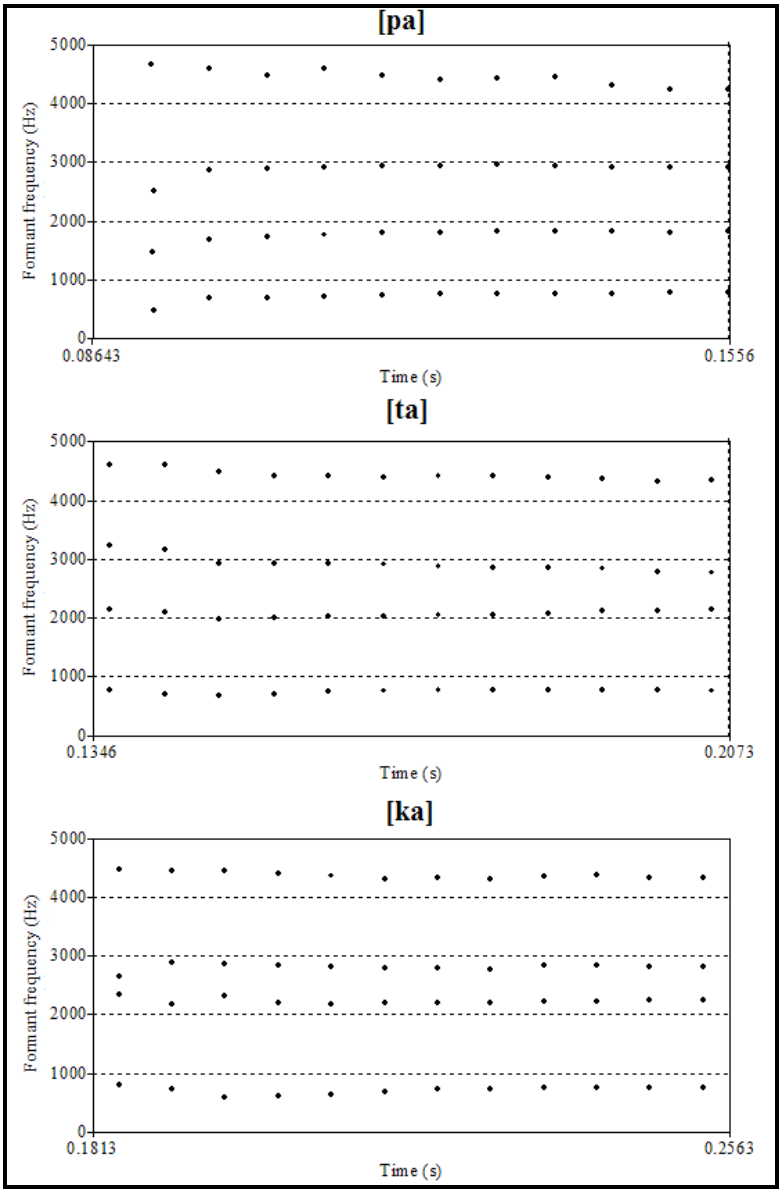


(top: [xa**mbi**]; middle: [**ɸi**ŋa]; bottom: [wasi**βi**]; all by speaker 7)

FIGURE 15B

To illustrate the differences in place of articulation found amongst Cotopaxi Quichua stops, Figure 16 shows formant transitions in [pa], [ta] and [ka]. The different locus of every place of articulation can be seen quite clearly in the formant trajectories.

PLACES OF ARTICULATION OF STOPS

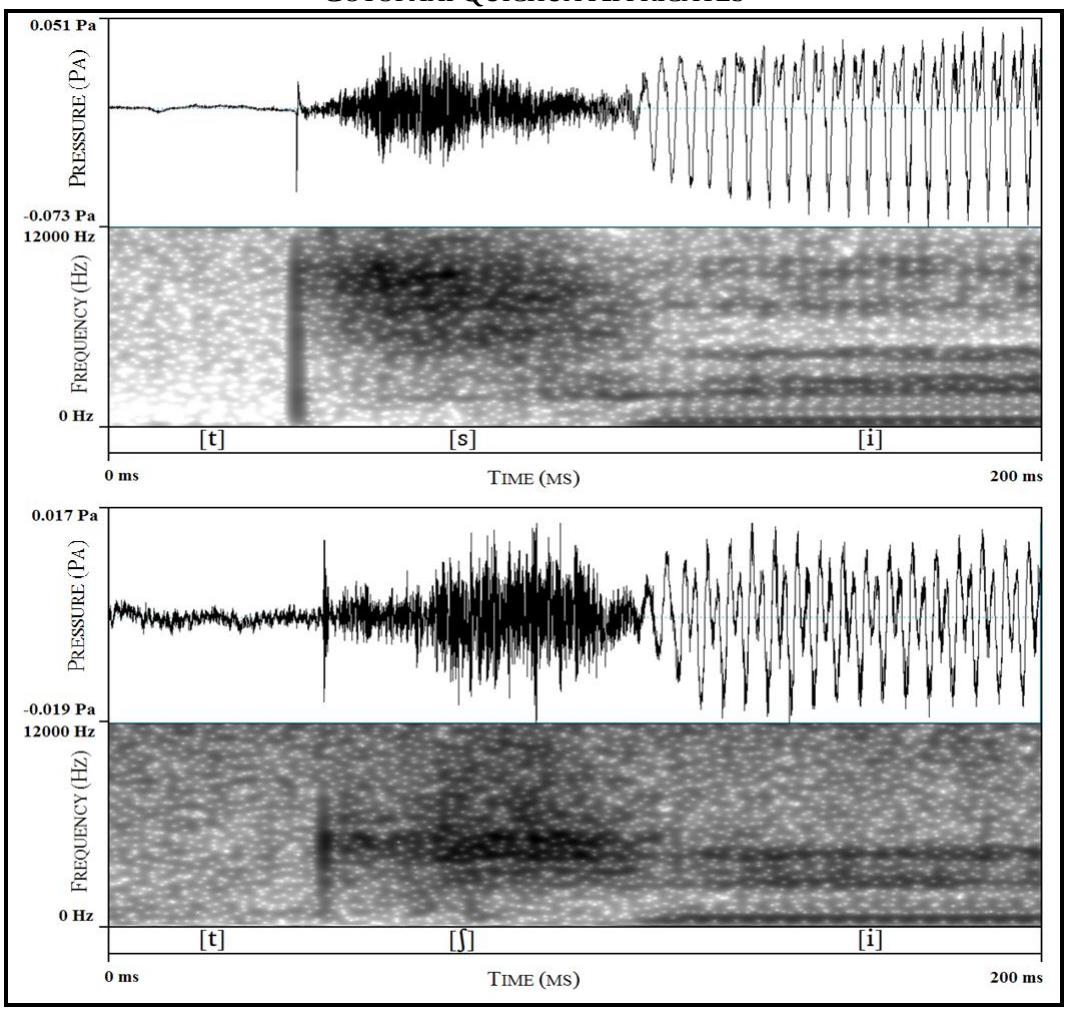


(top: [**pa**mba]; middle: [**ta**ki]; bottom: [**ka**tʃi]; all by speaker 10)

FIGURE 16

Amongst affricates there are much fewer distinctions than amongst stops. Figure 17 demonstrates the acoustic differences between the alveolar affricate [t͡s] and the post-alveolar affricate [t͡ʃ]. The frication noise of [t͡s] has energy at much higher frequencies than the frication noise of [t͡ʃ].

COTOPAXI QUICHUA AFFRICATES



(top: /**ci**ri/; bottom: /**či**ni/; all by speaker 3)

FIGURE 17

7.3. Phonemic Categories

7.3.1. Overview

Having compiled a list of all phonetic realisations of stops and affricates, the next question was addressed: what are the underlying phonemic categories? Once again, this involved careful examination of all the elicited wordlists. The distribution of every phonetic form was analysed in order to determine whether certain phonetic realisations were phonologically predictable. Finding minimal pairs also played a crucial role in answering this question. Finally, like in Part II, the intuitions of the primary informants were particularly helpful in identifying and confirming allophonic variation within phonemic categories.

Table 8 sums up all the phonemic categories for stops and affricates. This section will outline evidence which supports the idea that these categories are truly distinct. Section 7.4. will provide the link between the abstract phonological representations show here and the phonetic realisations shown earlier.

STOP AND AFFRICATE PHONEMES

	Bilabial	Alveolar / Dental	Post-alveolar	Velar
Plain Stops	p	t		k
Aspirated Stops	p^h	t^h		k^h
Affricates		c	č	

TABLE 8

As noted in a previous footnote, in this paper the use of /c/ and /č/ as symbols to represent an alveolar affricate and a post-alveolar affricate is preferred to avoid ambiguity. A diagraph, like for example /ts/ or /tʃ/, might indeed be more similar

to the symbols used for their phonetic realisation, but they might be interpreted as two consecutive phonemes (/t/ followed by /s/ or /ʃ/) rather than one.

7.3.2. Minimal Pair Evidence

Although perfect minimal pairs were nearly impossible to find, Table 9 lists a near-minimal set which shows that the phonemes suggested in Table 8 all contrast with each other in identical contexts.

MINIMALLY CONTRASTING SETS

↓ Phoneme \ Context→	#_a	#_i	#_u
Stops			
p	**pa**ni	**pi**xi	**pu**ka
p^h	**p^ha**ki	**p^hi**ɲa	**p^hu**ju
t	**ta**ki	**ti**ka	**tu**ri
t^h	**t^ha**nkana	-	**t^hu**ka
k	**ka**či	**ki**či	**ku**ri
k^h	**k^ha**ta	**k^hi**wa	**k^hu**ru
Affricates			
c	**ca**la	**ci**ri	**cu**ru
č	**ča**ki	**či**ni	**ču**ru

TABLE 9

Although the sets in Table 9 leave little doubt that the phonemes listed are truly contrastive, there are certain shortcomings with this approach. To start with, the grid is not complete. Despite systematic elicitation, speakers of Cotopaxi Quichua could not think of any words which started with the sequence /t^hi/. Secondly, the words listed above are only near-minimal sets. While the

distinctiveness of the two affricates is proved by a perfect minimal pair (/curu/ and /čuru/), the distinctiveness of every unaspirated stop and its aspirated counterparts must be explored a bit further.

7.3.3. Acoustic Evidence

Another way to determine whether two sounds belong to different categories is to investigate the acoustic evidence available. If the goal is to verify whether aspirated stops are distinct from plain stops, the relevant acoustic correlate that should be examined is voice onset time (VOT). VOT is the time between the release of the stop and the beginning of voicing for the following vowel. By their nature, aspirated stops have a longer VOT than unaspirated stops, as shown schematically by Figure 18.

VOICE ONSET TIME

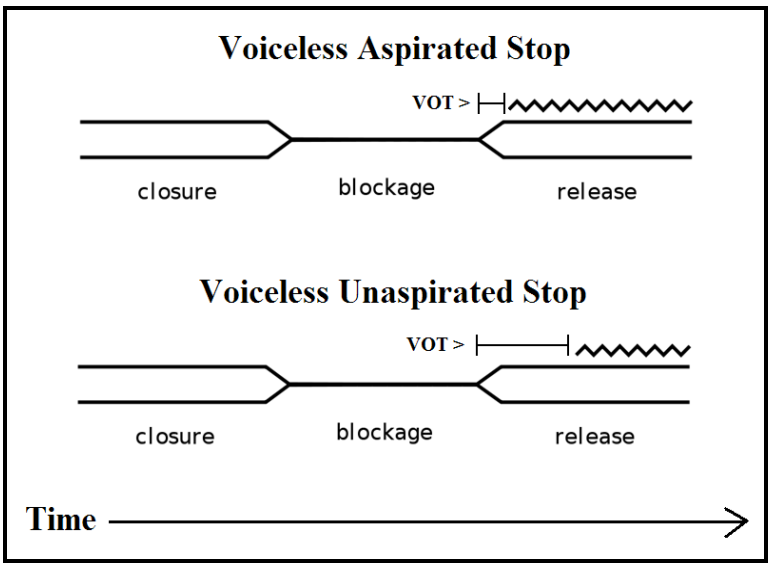


FIGURE 18

To perform this acoustic analysis of VOT, recorded tokens from 6 speakers (chosen because of the clarity of their recorded sessions) were used. For every speaker, the first four word-initial instances of each stop phoneme were extracted from the recordings. Given that these phonemes vary by place of articulation and phonemic aspiration, 24 tokens were collected from every speaker altogether (4 instances × 3 places of articulation × 2 phonemic aspiration settings). These tokens were segmented using Praat (Boersma and Weenink 2010) and their VOT was measured. The mean VOT of every stop phoneme is illustrated in Chart 2.

MEAN VOT BY PHONEME

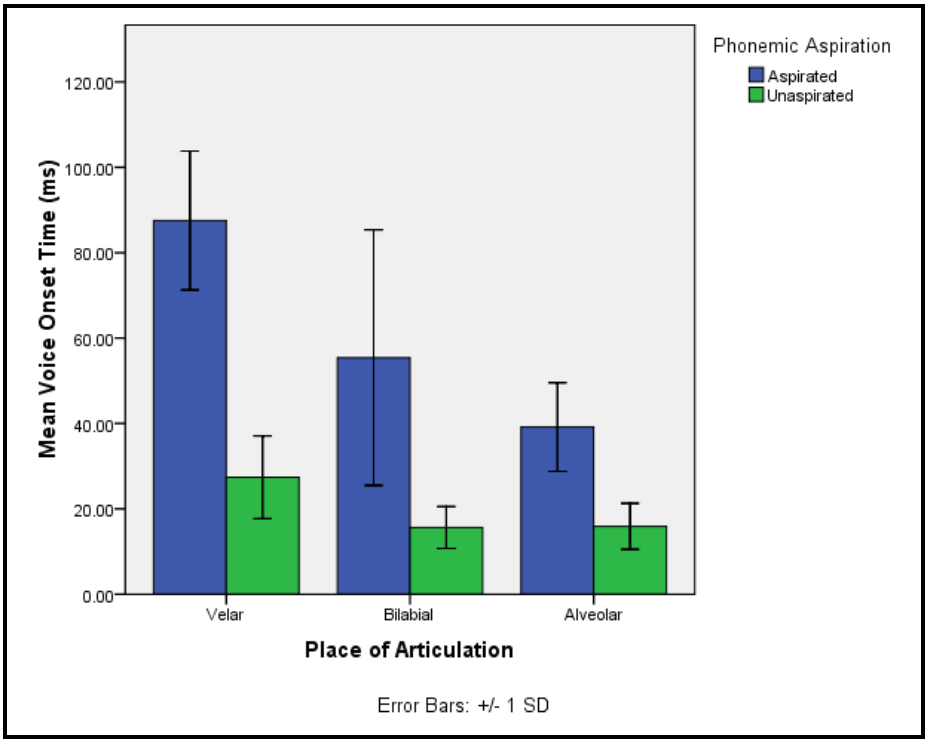


CHART 2

To determine whether VOT durations of aspirated phonemes were significantly different to those of unaspirated ones, a statistical test was conducted: a factorial analysis of variance with three independent variables (speaker, place of

articulation and phonemic aspiration). The results show that there is a significant main effect of phonemic aspiration on VOT length (F (1, 108) = 217.1, p < .001).

EFFECTS OF ASPIRATION AND PLACE OF ARTICULATION ON VOT

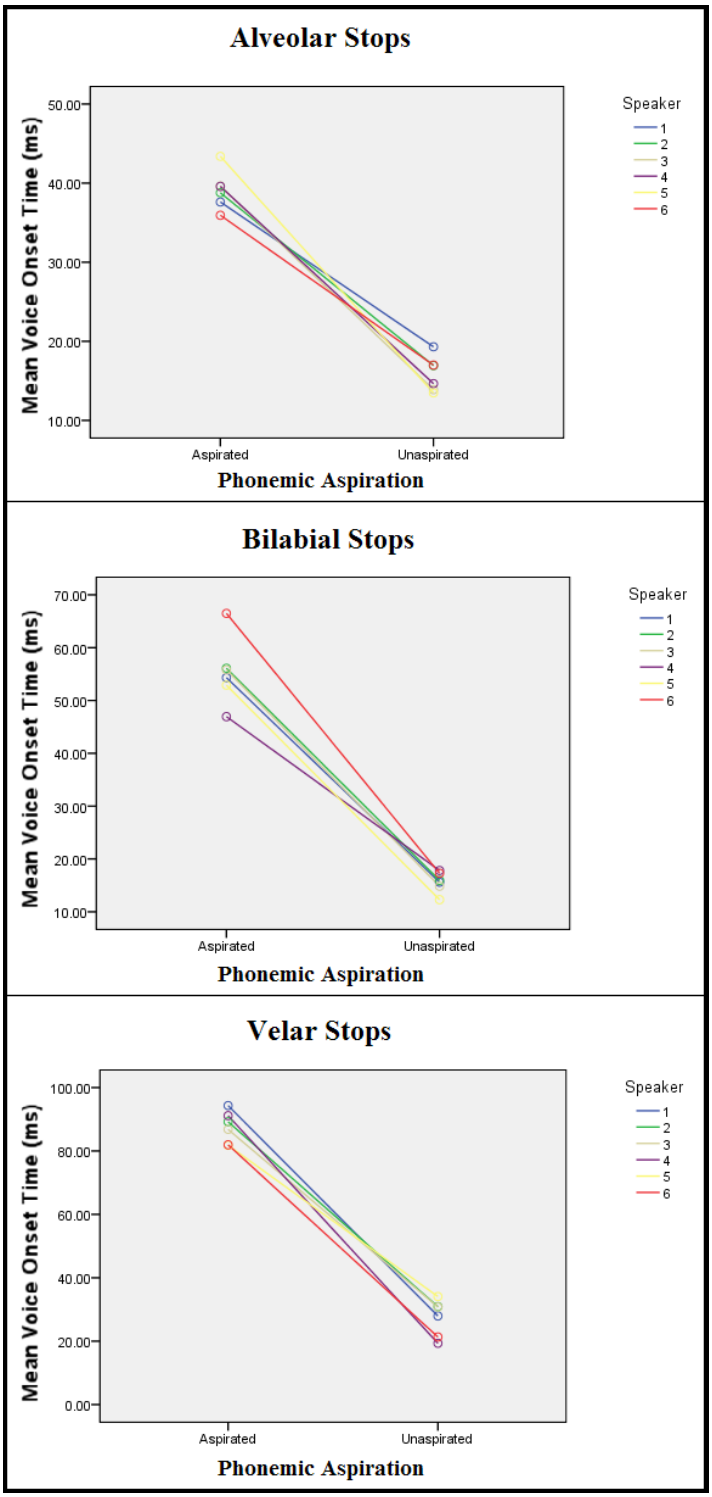


CHART 3

In addition, the place of articulation also significantly affects the duration of a stop's VOT (F (2, 108) = 41.26, $p < .001$). The individual speakers, on the other hand, have no significant effect on aspiration (F (5, 108) = 0.122, $p = .987$). It should also be noted that phonemic aspiration affects each place of articulation differently, as there is a significant interaction effect between the two (F (2, 108) = 14.63, $p < .001$). Chart 3 shows these results graphically.

Together, the evidence from minimal pairs and that from acoustic analysis provide robust evidence for the existence of the phonemic categories proposed. The next section will describe how the phonemes surface phonetically.

7.4. Allophonic Variation

7.4.1. Plain Stops: /p/, /t/, /k/

Plain stops are most commonly realised as the voiceless unaspirated stops [p], [t̪] and [k]. However, in certain phonologically predictable contexts there is considerable allophonic variation.

7.4.1.1. Voiced Stops

In careful elicited speech, plain stops are sometimes pronounced as voiced when following a nasal. The fact that voiced stops only occur after nasals implies that they are not phonemes unto themselves, but rather freely-varying allophones of plain stops in that phonological context. It should be noted that in normal spontaneous speech, voiceless and voiced stops seem to be in full complementary distribution, where the following rule applies:

$$\begin{bmatrix} -cont \\ -son \\ -voice \end{bmatrix} \rightarrow [+voice] \Big/ \begin{bmatrix} -cont \\ +nasal \end{bmatrix} \_\_$$

For example, although /pam.pa/ might be pronounced [pampa] (*plain*) in careful speech, it is pronounced [pamba] in spontaneous speech (see Figure 15b for a spectrogram).

7.4.1.2. Fricatives

Plain stops are often pronounced as fricatives in syllable-final position. Like with the voiced stop allophones, this alternation seems optional in careful speech. However, in spontaneous speech, the following rule applies:

$$\begin{bmatrix} -cont \\ -son \\ -voice \end{bmatrix} \rightarrow \begin{bmatrix} +cont \\ \alpha voice \end{bmatrix} \Big/ \_\_ \$[\alpha voice]$$

The alpha indicates that the fricative assimilates in voicing to the following segment. If it occurs word-finally, the fricative is simply voiceless. For example, in careful speech /wak.ra/ (*cow*) and /pu.sak/ (*eight*) might be pronounced [wakɾa] and [pusak] respectively. Nevertheless, in normal speech, they would be pronounced [waɣɾa] and [pusax].

7.4.1.3. Voiced Fricatives after Morpheme Boundaries

There is one further kind of alternation between plain stops and voiced fricatives that should be noted. Plain stops can be pronounced as voiced fricatives if they occur syllable-initially immediately after a morpheme boundary. At this point, it is important to mention once again that Quichua is a heavily agglutinating and polysynthetic language, which means that morphemic particles are affixed to root lexemes (refer back to Table 6 for examples). This results in frequent morpheme boundaries within words. As with the previous allophones, although this alternation is optional in careful speech, the following rule applies for normal speech:

$$\begin{bmatrix} -cont \\ -son \\ -voice \end{bmatrix} \rightarrow \begin{bmatrix} +cont \\ +voice \end{bmatrix} \Big/ +\_\_$$

For example, the locative marker /pi/ might be pronounced [pi] in careful speech, as in [wasi-pi] (*in the house*). However, in normal speech, it is pronounced [βi], as in [wasi-βi] (see Figure 15b for a spectrogram).

7.4.2. Aspirated Stops: /p^h/, /t^h/, /k^h/

The three aspirated stops of Cotopaxi Quichua are most commonly realised as [p^h], [$t̪^h$] and [k^h]. However, /p^h/ and /k^h/ may be realised as [ɸ] and [x]

respectively. Interestingly, /t^h/ was not attested to have a fricated allophone [θ], as one might expect given the allophones of /p^h/ and /k^h/. These allophones are not phonologically predictable, so it can be said that they are in free variation. Because the variation is not context-dependent, no morphophonological rule is proposed. It should also be stressed that while plain stops never fricate syllable-initially, aspirated stops do.

7.5. Constraints on the Distribution of Aspirated Stops

7.5.1. Morphophonological Constraints

The distribution of aspirated stops is heavily constrained morphophonologically. Every single instance of an aspirated stop in the elicited vocabulary shares the following characteristics:

(a) Aspirated stops only occur in root morphemes, never in suffixes.

(b) They only occur once in every word.

(c) They only occur in word-initial (and therefore syllable-initial) position.

Every effort was put into finding exceptions to these apparent rules. Despite guided prompts, the primary informants could not think of any words that had aspirated stops in a different position to the one stated. Furthermore, informants were asked to repeat nonsense words pronounced by me which contained a word-

initial plain stop and a word-medial aspirated stop. For example, I pronounced [pap^{h}aj], [kak^{h}aj] and [tat^{h}aj]. Systematically, the aspiration was moved to the word-initial stop, so that the examples were repeated [p^{h}apaj], [k^{h}akaj] and [t^{h}ataj] respectively.

Another interesting confirmation of the constraints listed above was observed with a Spanish borrowing. It was noticed during the fieldwork that the Spanish word *fósforo* (*match (to light fire)*) was pronounced [p^{h}uspuɾu] in Cotopaxi Quichua. In the local Spanish variety, the word is pronounced [ɸosɸoɾo], so it is not surprising that Quichua speakers reanalysed the syllable-initial bilabial fricative [ɸ] as an allophone of /p^{h}/. However, the second fricative, although it is also syllable-initial, is not aspirated. This is highly indicative of the morphophonological constraints described.

7.6.2. Semantic Constraints

There is no concrete evidence that aspirated stops are fully constrained semantically. Nevertheless, it should be noted that certain semantic tendencies were found amongst words that exhibit aspirated stops. Every elicited word that involves an expulsion from the mouth (i.e. *to spit, to blow*) contains an aspirated stop. Also, every word that denotes an abrupt or violent action (i.e. *to throw*, *to push*, *to break*) also begins with an aspirated stop. It is therefore likely that aspiration, although possibly not exclusively, plays a prominent iconic or onomatopoeic role.

8. Part IIIb – Discussion

8.1. Evaluation of Results

The results of Part III provide clear answers to the questions asked at the onset of this investigation. Firstly, it is apparent that Cotopaxi Quichua exhibits aspirated stops and that they are phonemically distinct from plain stops. Furthermore, the aspirated stops show strict distributional constraints on a morphophonological level, as well as sound symbolic characteristics on a semantic level. Regarding allophonic variation, plain stops were found to have a number of different phonologically predictable allophones, ranging from voiced stops to fricatives. Aspirated stops, on the other hand, were found to alternate between two types of freely varying allophones. In contrast to stops, the affricates were found to appear only in unvoiced unaspirated form and did not exhibit any noteworthy allophonic variation.

8.2. Orthographic Implications

One of the open questions at the start of this investigation was whether the standard orthography of Ecuadorian Quichua is adequate given the considerable dialectal variation that exists. In particular, because the orthography only has unvoiced unaspirated stops and affricates, it was uncertain whether it accommodates for the full range of stops and affricates in all dialects. These results show that there is no need for a series of voiced stops in the orthography because variation in voicing is purely allophonic and phonologically predictable. On the other hand, Cotopaxi Quichua does distinguish aspirated stops

phonemically while the orthography does not. This calls for a review of the standard so that the pan-Ecuadorian orthography can be useful for dialects which do distinguish stops by aspiration.

During the fieldwork, I had a conversation with a school teacher who tenaciously complained about the use of aspirated stops in Cotopaxi Quichua. He insisted that aspirated stops were an "incorrect" pronunciation and that it was a bad habit of the locals. To support his argument, he noted that the standard orthography did not have any aspirated consonants. In this sense, inadequacies in the standard orthography are not only impractical, but can lead to critically denigrating views of local dialectal variation, such as the one described.

8.3. Diachronic Comparison

The stop and affricate system changed substantially between Proto-Quechua and Cotopaxi Quichua. The first salient fact is that the uvular stop /q/ was lost in Cotopaxi Quichua. However, /q/ is shown by Maddieson (1984) to be more unstable than other stops, so it is likely that it simply merged with /k/ in Quichua. Secondly, although the post-alveolar affricate was preserved, it seems that the retroflex affricate /c̣/ was fronted to become an alveolar affricate. Nevertheless, the most apparent difference is the emergence of aspirated stops in Cotopaxi Quichua. The following subsection will cover this in detail.

8.4. Historical Implications – The Aspiration Innovation

The most significant implications of this study's findings relate to the historical development of the Quechua languages. As explained in the introduction, there has not been robust evidence so far linking the emergence of aspirated and ejective obstruents in the far southern Cuzco-Bolivian dialects of Quechua with the emergence of aspirated obstruents in Central Ecuadorian Quichua, mostly because of lack of information from the latter. However, the findings of this study are highly relevant to this issue.

On the one hand, the results show that the phonemic innovation in the stop and affricate inventory of Cuzco-Bolivian Quechua is quite different to that of Cotopaxi Quichua. While Cuzco-Bolivian Quechua has a series of aspirated and a series of ejective stops and affricates, Cotopaxi Quichua just exhibits aspirated stops. The lack of ejective stops or indeed complex affricates in Cotopaxi Quichua strengthens Torero's (1984) claim that there are no systematic similarities between the obstruents of Cuzco-Bolivian Quechua and those of Central Highland Ecuadorian Quichua.

However, the majority of the evidence found in this project points precisely in the opposite direction. In other words, this research strongly advocates the view that Cotopaxi Quichua (and potentially other Central Highland Ecuadorian dialects) underwent one and the same innovation as Cuzco-Bolivian dialects. This conclusion can be drawn by examining the similarities between the constraints on the distribution of complex obstruents in both dialect groups.

The reader is reminded that there is considerable previous past research on this topic for Cuzco-Bolivian dialects. Claims about the morphophonological

constraints on the distribution of aspirated and ejective stops and affricates are described in detail by Parker (1997). Similarly, Mannheim (1991) outlines semantic constraints, maintaining that complex obstruents in Cuzco-Bolivian dialects were spread through a process of sound symbolic iconicity.

Parker's (1997) constraints of Cuzco-Bolivian dialects line up nearly identically with those found for Cotopaxi Quichua: namely that aspiration appears (1) only in roots, (2) only syllable-initially, (3) only once per word, and (4) only on the first stop of a word. Mannheim's (1991) assertion that the spread of aspiration in Quechua was governed through an onomatopoeic principle of iconicity is also compatible with the results found for Cotopaxi Quichua.

The fact that both dialect groups exhibit the same set of extremely specific constraints for complex obsruents strongly indicates that both dialect groups underwent the same innovation. Nevertheless, if that is the case, a number of new questions emerge.

1) Why does Cotopaxi Quichua lack ejective stops, aspirated affricates and ejective affricates?
2) How were both dialects affected by the same innovation given that they are divided geographically by 1,500 kilometres of highly isolating and irregular terrain?
3) Why did other Quechua dialect groups not undergo this innovation?

As noted earlier, Adelaar and Muysken (2004) briefly explain that the answer to these questions might lie in exploring two factors. The first is a possible

adstratum influence from the prestigious Cuzco dialect during times of Inca domination of Ecuador. As Cuzco was the capital of the empire, the Cuzco dialect might have been used by government officials in far away regions that would have normally never come into contact with the Cuzco-Bolivian varieties. The second relevant factor could be a substratum influence of pre-Inca languages in Ecuador. Perhaps if a certain group previously spoke a language which had aspiration distinctions already, they might have been more likely to accept an aspiration innovation in Quechua. Whatever the case may be, the answers to these questions are unfortunately beyond the scope of this investigation.

9. Conclusion

True to its aims, this investigation contributed in advancing the field of Quechua linguistics by collecting information which had never before been available for academic scrutiny. It was successful in fulfilling its other aims as well: in addition to providing an overview of the phonology of Cotopaxi Quichua, this investigation brought to light evidence to support a claim which so far has been mostly speculative.

The weaknesses of this study lay mostly in the recordings. Because of the unforeseen problems with the headset microphone, many of the recordings had to be discarded. Similarly, background noise could have been controlled slightly more in order to keep the recordings free of other stimuli which potentially obscure speech cues. It is highly recommended that any future project analogous to this one make even more provisions for optimal quality recordings.

Finally, this research should not be regarded as concluded. Quite the contrary, it should trigger further fieldwork to answer the next set of open questions. Regarding the phonology of Cotopaxi Quichua, there is still much scope for research, in particular regarding so-called freely varying allophonic variation. There is also much to be said about the effect of state education and the ever-growing influence of Spanish on local Quichua dialects. On a less specific level, as shown by the end of the discussion section, there are many unanswered questions about the development of Quechua as a whole which require more conclusive research as well.

In this sense, this study should be considered a piece of an unfinished puzzle: it links on to pieces that have already been laid out, but it also provides clues to the bigger picture. It is now up to any of us linguists to continue completing the puzzle.

Word Count: 10,024

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Appendix A: Initial Vocabulary List

#	**Spanish word**	**English word**	**Quichua phonetic transcription(s)** / separates different phonetic realisations of the same word, // separates different words	**Quichua phonemic form**
1	agua	water	jaku	ˈja.ku
2	aire	air	wajɾa	ˈwaj.ra
3	año	year	wata	ˈwa.ta
4	ayer	yesterday	kajna	ˈkaj.na
5	boca	mouth	ʃimi	ˈʃi.mi
6	botar/arrojar	to throw	sitana	si.ˈta.na
7	brazo	arm	maki	ˈma.ki
8	bueno	good	aʒi	ˈa.ʒi
9	cabeza	head	uma	ˈu.ma
10	camino	road	ɲaŋ	ˈɲan
11	cara	face	ɲawi	ˈɲa.wi
12	carne	meat	ajtʃa	ˈaj.ča
13	casa	house	wasi	ˈwa.si
14	ceniza	ash	uʃpa	ˈuʃ.pa
15	chancho	pig	kutʃi	ˈku.či
16	comer	eat	mikuna	mi.ˈku.na
17	corazón	heart	ʃuŋgu / ʃuŋku	ˈʃun.ku
18	día	day	pʰuɲtʃa / ɸuɲtʃa / puɲtʃa	ˈpʰun.ča
19	diente	tooth	kiɾu	ˈki.ru
20	dolor	pain	nanaj	ˈna.naj
21	dulce	sweet	miʃki	ˈmiʃ.ki
22	empujar	to push	tʰaŋgana / tʰaŋkana / taŋgana / taŋkana	tʰan.ˈka.na
23	escupir	to spit	tʰukana / tukana	tʰu.ˈka.na
24	flaco	thin	tsala // zaɾiŋ[11]	ˈtsa.la // ˈza.rin
25	flor	flower	sisa	ˈsi.sa
26	frío	cold	tsiɾi	ˈci.ri
27	fuego	fire	nina	ˈni.na
28	gallina	hen	ataʒpa	a.ˈtaʒ.pa
29	gato	cat	misi	ˈmi.si
30	grande	big	xatuŋ	ˈxa.tun
31	hembra	female	waɾmi	ˈwar.mi
32	hermana de hombre	man's sister	pani	ˈpa.ni
33	hermana de mujer	woman's sister	ɲaɲa	ˈɲa.ɲa
34	hermano de	man's	wawki	ˈwaw.ki

[11] Subsequent questioning revealed that both words were interchangeable.

	hombre	brother		
35	hermano de mujer	woman's brother	turi	ˈtu.ri
36	hija	daughter	uʃuʃi	u.ˈʃu.ʃi
37	hijo	son	tʃuri	ˈču.ri
38	hombre	man	kʰari / xari / kari	ˈkʰa.ri
39	hoy	today	kunaŋ	ˈku.nan
40	hueso	bone	tuʒu	ˈtu.ʒu
41	huevo	egg	luluŋ	ˈlu.lun
42	jalar	to pull	tʃutana	ču.ˈta.na
43	lago	lake	kutʃa	ˈku.ča
44	lengua	tongue	kaʒu	ˈka.ʒu
45	lluvia	rain	tamja	ˈtam.ja
46	macho	male	kʰari / xari / kari	ˈkʰa.ri
47	mamá	mother	mama	ˈma.ma
48	mañana	tomorrow	kaja	ˈka.ja
49	mano	hand	maki	ˈma.ki
50	mes	month	kiʒa	ˈki.ʒa
51	mitad	middle	tʃawpi	ˈčaw.pi
52	montaña	mountain	urku	ˈur.ku
53	mujer	woman	warmi	ˈwar.mi
54	muro/pared	wall	pirka	ˈpir.ka
55	nariz	nose	siŋga / siŋka	ˈsin.ka
56	neblina	fog	pʰuju / ɸuju / puju	ˈpʰu.ju
57	negro	black	jana	ˈja.na
58	niña	female child	wawa	ˈwa.wa
59	niño	male child	wawa	ˈwa.wa
60	noche	night	tuta	ˈtu.ta
61	nombre	name	ʃuti	ˈʃu.ti
62	nube	cloud	pʰuju / ɸuju / puju	ˈpʰu.ju
63	nuevo	new	muʃux / muʃuk	ˈmu.ʃuk
65	ojo	eye	ɲawi luluŋ	ˈɲa.wi ˈlu.lun
66	oreja	ear	ʐiŋʐi / riŋri	ˈrin.ri
64	oveja	sheep	ʒama	ˈʒa.ma
67	pájaro	bird	urpi	ˈur.pi
68	pan	bread	taɳda / taɳta	ˈtan.ta
69	papá	father	tajta	ˈtaj.ta
70	pegar	to hit	takana	ta.ˈka.na
71	pelo	hair	axtʃa / aktʃa	ˈak.ča
72	perro	dog	aʃku	ˈaʃ.ku
73	persona	person	ʐuna / runa	ˈru.na
74	pie	foot	tʃaki	ˈča.ki
75	piedra	stone	ʐumi / rumi	ˈru.mi
76	pierna	leg	tʃaŋga / tʃaŋka	ˈčan.ka

77	plata/dinero	money	kuʒki	ˈkuʒ.ki
78	pueblo	town	ʒaxta / ʒakta	ˈʒak.ta
79	puente	bridge	tʃaka	ˈča.ka
80	pulga	flea	piki	ˈpi.ki
81	quebrada	cliff	wajku	ˈwaj.ku
82	ratón	mouse	ukutʃa	u.ˈku.ča
83	sal	salt	katʃi	ˈka.či
84	sangre	blood	jawazɻ / jawar	ˈja.war
85	soplar	to blow	pʰukuna / ɸukuna / pukuna	pʰu.ˈku.na
86	sucio	dirty	kʰarka / xarka / karka	ˈkʰar.ka
87	tierra	dirt	aʒpa	ˈaʒ.pa
88	tomar/beber	drink	uβjana / upjana	up.ˈja.na
89	toro	bull	waɣɾa / wakɾa	ˈwak.ra
90	vaca	cow	waɣɾa / wakɾa	ˈwak.ra
91	viejo	old	ʐuku / ruku	ˈru.ku
92	viento	wind	wajɾa	ˈwaj.ra
93	yerba	grass	kʰiwa / xiwa / kiwa	ˈkʰi.wa

Appendix B: Additional Vocabulary Collected

#	**Quichua phonetic transcription(s)** / separates different phonetic realisations of the same word, // separates different words	**Quichua phonemic form**	**Spanish translation**	**English translation**
94	aʃka	ˈaʃ.ka	bastante	much
95	ama	ˈa.ma	no	no
96	tʃaɣɾa / tʃakɾa	ˈčak.ra	huerta	vegetable garden
97	tʃamba / tʃampa	ˈčam.pa	bola de arena	sand block
98	tʃaɾina	ča.ˈri.na	tener	to have
99	tʃaskina	čas.ˈki.na	recibir	to receive
100	tsawar / tsawaz̧	ˈca.war	cabuya	type of plant
101	tʃiɲtʃi	ˈčin.či	duro	hard
102	tʃini	ˈči.ni	ortiga	nettle
103	tsuɣni / tsukni	ˈcuk.ni	lagaña	sleep
104	tʃumbi / tʃumpi	ˈčum.pi	paja	straw
105	tsuntsu	ˈcun.cu	melenudo	long-haired
106	tsuɾu	ˈcu.ru	carrizo	type of plant
107	tʃuɾu	ˈču.ru	babosa	slug
108	ʃamuna	ʃa.ˈmu.na	llegar	to arrive
109	ʃuju	ˈʃu.ju	dibujo	picture
110	iʃkaj	ˈiʃ.kaj	dos	two
111	ilma	ˈil.ma	heces	faeces
112	ima	ˈi.ma	qué	what
113	indi / inti	ˈin.ti	sol	sun
114	jaja	ˈja.ja	abuelo	grandfather
115	juɣzi / jukzi	ˈjuk.zi	arena	sand
116	juɾa	ˈju.ra	árbol	tree
117	jutu	ˈju.tu	perdiz	partridge
118	kana	ˈka.na	ser	to be
119	kaɾa	ˈka.ra	piel	skin
120	kawsaj	ˈkaw.saj	vida	life
121	kʰata / xata / kata	ˈkʰa.ta	cobija	blanket
122	kʰatuna / xatuna / katuna	kʰa.ˈtu.na	vender	to sell
123	kitʃi	ˈki.či	tipo de pájaro	type of bird
124	kimsa	ˈkim.sa	tres	three
125	kuʃni	ˈkuʃ.ni	humo	smoke
126	kuɾi	ˈku.ri	oro	gold
127	kusa	ˈku.sa	marido	husband
128	kutana	ku.ˈta.na	moler	to grind
129	laɲtʃa	ˈlan.ča	rayo	lightning
130	laɾka	ˈlar.ka	acequia	ditch

131	liɣlix / liɣlik / liklix / liklik	ˈlik.lik	tipo de pájaro	type of bird
132	maʃi	ˈma.ʃi	amgio	friend
133	mana	ˈma.na	no	no
134	maɲana	ma.ˈɲa.na	pedir	to request
135	masu	ˈma.su	tronco	trunk
136	miʒma	ˈmiʒ.ma	lana	wool
137	muju	ˈmu.ju	semilla	seed
138	musu	ˈmu.su	joven	young man
139	ɲuka	ˈɲu.ka	yo	I
140	ɲukaɲtʃix / ɲukaɲtʃik	ɲu.ˈkan.čik	nosotros	we
141	ɲuɲu	ˈɲu.ɲu	tetilla	teat
142	patsax / patsak	ˈpa.cak	cien	one hundred
143	pamba / pampa	ˈpam.pa	llanura	plain
144	papa	ˈpa.pa	papa	potato
145	pʰaki / ɸaki / paki	ˈpʰa.ki	pedazo	piece
146	pʰakina / ɸakina / pakina	pʰa.ˈki.na	romper	to break
147	pʰiɲaɾi.na / ɸiɲaɾina / piɲaɾina	pʰi.ɲa.ˈɾi.na	enojarse	to get angry
148	pʰiɲa / ɸiɲa / piɲa	ˈpʰi.ɲa	enojado	angry
149	pitʃka	ˈpič.ka	cinco	five
150	piɲa	ˈpi.ɲa	quebrada	cliff
151	puʃkana	puʃ.ˈka.na	hilar	to spin thread
152	puka	ˈpu.ka	rojo	red
153	puɲtʃu	ˈpun.ču	poncho	poncho
154	puŋgu / puŋku	ˈpun.ku	puerta	door
155	pusax / pusak	ˈpu.sak	ocho	eight
156	ʐajmi / rajmi	ˈraj.mi	fiesta	party, holiday
157	ʐakina / rakina	ra.ˈki.na	repartir	to distribute
158	ʐandina / ʐantina / randina / rantina	ran.ˈti.na	comprar	to buy
159	ʐixsina / ʐiksina / rixsina / riksina	rik.ˈsi.na	conocer	to know
160	ʐikuna / rikuna	ri.ˈku.na	ver	to see
161	ʐimana / rimana	ri.ˈma.na	hablar	to speak
162	ʐuɾana / ruɾana	ru.ˈra.na	hacer	to do
163	sami	ˈsa.mi	aire	air
164	sambu / sampu	ˈsam.pu	zapallo	pumpkin
165	suju	ˈsu.ju	trasero	backside
166	suxta / sukta	ˈsuk.ta	seis	six
167	sumax / sumak	ˈsu.mak	hermoso	beautiful
168	suni	ˈsu.ni	alto	tall
169	taki	ˈta.ki	canción	song
170	takina	ta.ˈki.na	tocar (música)	to play (music)
172	taɾpuna	tar.ˈpu.na	sembrar	to sow
173	tawɾi	ˈtaw.ri	chocho	lupin
174	tʰuka / tuka	ˈtʰu.ka	saliva	saliva

.175	tijaɾina	ti.ja.ˈri.na	sentarse	to sit
176	tika	ˈti.ka	teja	tile
177	tiɣɾamuna / tikɾamuna	tik.ra.ˈmu.na	regresar	to return
178	tukuna	tu.ˈku.na	producir	to produce
179	utʃiʒa	u.ˈči.ʒa	pequeño	small
180	uxtaɾina / uktaɾina	uk.ta.ˈri.na	apurarse	to hurry
181	uɾmana	ur.ˈma.na	caerse	to fall
182	waxtʃa / waktʃa	ˈwak.ča	huérfano	orphan
183	waxtsux / waktsux / waxtsuk / waktsuk	ˈwak.cuk	tipo de pájaro	type of bird
184	wiki	ˈwi.ki	lágrima	tear
185	xamba / xampa	ˈxam.pa	rechazo	rubbish
186	xambi / xampi	ˈxam.pi	remedio	medicine
187	xitʃana	xi.ˈča.na	regar	to spill
188	xiʒu	ˈxi.ʒu	goloso	sweet-toothed
189	xumbi / xumpi	ˈxum.pi	sudor	sweat
190	xunda / xunta	ˈxun.ta	lleno	full
191	zuɾu	ˈzu.ru	malla	fence
192	ʒaŋkana	ʒan.ˈka.na	jugar	to play
193	ʒiki	ˈʒi.ki	roto	broken
194	ʒutʃu	ˈʒu.ču	desnudo	naked

Appendix C: Waveforms and Spectrograms

Waveforms and spectrograms are two ways to plot acoustic information visually. They are both highly useful in acoustic analysis of speech. Every articulation has acoustic cues which are characteristic to it. By examining waveforms and spectrograms, it is often possible to recognise those cues, giving the researcher information about where and how every sound was produced.

A waveform plots pressure (on the y-axis) over time (on the x-axis). The amount of pressure exerted by a sound wave on a microphone gives an indication of the intensity of a sound. The shape of a waveform can also give information about how a sound was produced. For example, if the wave is periodic, it is indicative of voicing.

Spectrograms have slightly more information, as they plot both frequency (on the y-axis) and pressure (on the z-axis) over time (on the x-axis). Because spectrograms plot three variables on a two-dimensional plane, pressure is portrayed by the darkness of the image. Darker colour indicates higher pressure (and therefore intensity) values. Spectrograms are very practical ways of determining at what frequencies sounds have high energy. Different patterns are indicative of different articulations.

For much more detailed information about acoustic analysis using waveforms and spectrograms, please refer to the following books:

Ladefoged, P. & Maddieson, I. (1996). *The Sounds of the World's Languages.* Oxford: Blackwell.

Ladefoged, P. (2003). *Phonetic Data Analysis: An Introduction to Fieldwork and Instrumental Techniques.* Oxford: Blackwell.