

# **Jaqaru Phonology: A Phonemic Analysis**

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## Table of Contents

<b>Item</b>	<b>Page</b>
1.1. Introduction	3
1.2. Related languages	3
1.3. Information source	3
1.4. Note on transcription	4
1.5. Note on accuracy and completeness	4
2.1. Consonants	5
2.2. Following the leader	6
Table 2.2. Jaqaru consonant phonemes	7
3.1. Vowels	8
4.1. Syllable structure and phonotactics	9
4.2. Suprasegmentals	10
5.1. Proof of consonants	10
5.2. Proof of stops and affricates vertically	12
5.3. Proof of stops and affricates horizontally	14
5.4. Proof of fricatives and resonants vertically	15
5.5. Proof of fricatives and resonants horizontally	16
5.6. Proof of fricatives and stops / affricates	18
6.1. Proof of vowels	18
6.2. Back vowels	19
6.3. Front vowels	20
6.4. Low vowels	21
6.5. Vowel length	22
Table 6.5. Jaqaru vowel phones	22

## **1.1. Introduction**

Jaqaru is an indigenous language of Peru spoken by a few thousand people. Many speakers reside in the village of Tupe, while other speakers have relocated to Lima and elsewhere.

## **1.2. Related languages**

Jaqaru belongs to the Jaqi language group. ‘Jaqi’ means ‘people.’ Related languages include Aymara—spoken by indigenous Peruvians as well as in neighboring Bolivia—and Kawki. With over a million speakers, the most widely spoken Jaqi language is Aymara. Jaqaru and Kawki used to be considered varieties of the same language by some linguists, but they are now considered two separate languages.

The language group spread before the Inca conquest, when the Jaqi culture covered a larger part of Southern Peru and Bolivia. The Inca empire was responsible for the widespread adoption of Quechua—another indigenous language unrelated to Jaqaru, Aymara, or Kawki—in the Andes, and Spanish spread as a lingua franca through much of Central and South America during the age of European exploration and colonialism.

## **1.3. Information source**

Consultants for this paper and during our Field Methods course include Dr. Dimas Bautista, a native speaker of Jaqaru, and his wife, Dr. MJ Hardman, who is also fluent in the language.

The primary consultant was Dr. Bautista, who grew up in Tupe speaking Jaqaru with his family. He also learned Spanish at a young age, and began English while living and working in the United States. By training Dr. Bautista is a biologist, but he has also developed an understanding of the linguistics of his own language by working with American linguists and their students.

I hereby offer my sincere thanks and appreciation for what the consultants have given me thus far. Without their encouragement and patience, this paper would not have been possible. Of course, any and all errors remain the responsibility of the author!

#### **1.4. Note on transcription**

Linguists have developed many systems for phonetic transcriptions. The number increases when monolingual dictionaries and language learning materials are included. It is likely that other systems will be used in the future that differ from the systems most common in linguistics today. There are two contemporary systems of transcription in mainstream linguistics: the International Phonetic Alphabet (IPA) and the Anthropological Phonetic Alphabet (APA).

In this paper I have endeavored exclusively to use the IPA as it stands in late 2009. This is the only alphabet I am familiar enough with to trust myself to use consistently. That means that IPA [ɟ] is equivalent to APA [š], IPA [j] is equivalent to APA [y], [c] is a voiceless palatal stop, and so on.

#### **1.5. Note on accuracy and completeness**

This paper represents the work I have done on Jaqaru phonology as a member of the 2009 Field Methods seminar. Drawing from 150 vocabulary items, this paper is not intended to be a complete description of any part of the language. Even more important, there are bound to be many transcription mistakes that *I* made. These mistakes will certainly invalidate parts of my analysis and, although unintentionally, ultimately distort Jaqaru phonology. In that case, I hope that at least the way I have done the analysis is theoretically sound and ethical (fair to speakers of the language).

## 2.1. Consonants

The Jaqaru consonantal system is quite complex. It consists of stops, fricatives, affricates, nasals, a tap, laterals, and glides.

These manners can be pronounced at a wide range of places of articulation. Jaqaru contrasts for the following primary places of articulation:

- bilabial
- dental/alveolar (stops and affricates are dental; /n/, /r/, and /s/ are alveolar)
- post-alveolar
- lateral (only the lateral liquid /l/, which contrasts with a palatal liquid)
- palatal
- velar
- uvular

Suprasegmentals also play a crucial role in Jaqaru phonology. Jaqaru contrasts for three phonation types (aka states of the glottis, voice onset time, etc.):

- plain
- aspirated
- glottalized

These phonation types are only relevant for stops and affricates.

Consonant voicing, on the other hand, is non-contrastive in Jaqaru. Obstruents (stops, affricates, and fricatives) are voiceless. Resonants (nasals, liquids, taps, and glides) are voiced.

Since so many features are used to contrast Jaqaru consonants, there is not much room left for allophony. There is, for instance, probably no palatalization of consonants before front vowels (a common allophonic variation). So far no language has been discovered by Western linguists that contrasts between pure palatal and palatalized sounds, or between glottalized and ejective sounds. Jaqaru does not present a counterexample to these generalizations. Thus the symbol /c/ for a voiceless palatal

stop could just as well have been transcribed /k<sup>j</sup>/ for a palatalized velar stop, /t<sup>j</sup>/ for a palatalized dental stop, or any other symbol. Another common rule is absent in Jaqaru: nasal assimilation. In many languages, a nasal assimilates in place of articulation to a following consonant (cf 28. [ˈhiŋtʃu] ‘ear’).

There are too many interesting facts to list here. A proof for the consonantal system including examples from the language and phonological rules is found in section 5.

## 2.2. Following the leader

In most languages consonants and vowels interact in some nuanced way involving, for instance, secondary articulation of a consonant, or assimilation of vowels to some acoustic property of surrounding consonants. In such cases it is important to decide whether consonants or vowels “drive” the system. If both drive, the reasoning can become circular. If neither drive, alternations remain unaccounted for. Consider the pronunciation of /xaqaru/:

consonant-driven:

/xaqaru/                      ↔    **[haqaro]**

i.     /x/ → [h] / # \_

ii.    /u/ → [o] / r \_

vowel-driven:

**[haqaro]**                      ↔     /xaqaro/

i.     /x/ → [h] / # \_

ii.    /t/ → [ɾ] / \_ o , V \_ V ?

Let’s take the vowel-driven allophony as a first hypothesis. In order for the vowels to drive allophonic consonants, we would have to prove that vowels are contrastive. In the example above, [o] and [u] would have to be allophones of different phonemes. Since this not the case in Jaqaru, relatively stable consonants drive the relatively variable vowels.

[ see Jaqaru Consonant Chart ]

### 3.1. Vowels

In contrast to the complicated consonantal system of Jaqaru, there are only three contrastive vowels in the language, /a/, /u/, and /i/. These are the least-marked vowels cross-linguistically. Each vowel in Jaqaru can be either short or long, creating an extra layer of phonemic contrast. Most of the allophony in Jaqaru involves the vowels; although not in the underlying forms, [o] and [e] are common surface segments. For instance, the name of the language can be pronounced [haqaro].

A small complexity to this otherwise straightforward system is that unlike the high vowels /i/ and /u/, length in the vowel /a/ is not realized as lengthened and normal length. The length contrast surfaces as regular and ultra-shortened length. One *could* use abstraction here so that all possible vowels could be captured by the binary features [long], [high], and [back], with /A/ being underspecified for backness. A filter (or rule of impoverishment) would delete the feature [back] for all [—high] vowels:

**Table 3.1.1. Jaqaru vowel phonemes as binary feature bundles**

	[long]	[high]	[back]	
/i/	—	+	—	
/i:/	+	+	—	
/u/	—	+	+	
/u:/	+	+	+	
/a/	—	—	○	Rule of impoverishment:
/a:/	+	—	○	[back] → ∅ / [—high]

**Table 3.1.2. Abstract Jaqaru vowel phonemes**

	<i>front</i>	<i>back</i>
<i>high</i>	/i/ /i:/	/u/ /u:/
<i>low</i>	/a/ /a:/	

This use of abstraction seems to be unjustified. The shorter of the two low vowel phonemes is consistently pronounced noticeably shorter than either of the two shorter high vowel phonemes. A more “optimized” and realistic approach to Jaqaru vowels



makes use of surface forms for the underlying form wherever possible. This has the advantage of being closer to the system as it's used (instead of a slightly distorted, mathematically “perfect” system created by a linguist):

**Table 3.1.3. Optimized Jaqaru vowel phonemes**

	<i>front</i>	<i>back</i>
<i>high</i>	/i/ /i:/	/u/ /u:/
<i>low</i>	/ǎ/ /a/	

Nonetheless, there are many allophones of these phonemes. These will be discussed in section 6.

#### 4.1. Syllable structure and phonotactics

Phonotactic constraints in Jaqaru are generally straightforward. One gray area is the analysis of complex consonants. Does a word like 16. /tʃʰipi/ ‘bird’ have four, five, or six segments?

**Table 4.1. Mono-, bi-, and tri-segmental parsing in the onset of 16. ‘bird’**

	C <sub>1</sub>	C <sub>2</sub> ?	C <sub>3</sub> ?	V	C	V
I.	<u>tʃ</u> <sup>ʰ</sup>			i	p	i
II.	t <sup>ʰ</sup>	ʃ		i	p	i
III.	t	?	ʃ	i	p	i

The best way to answer this question is to listen to when the phonation occurs in the cluster. When aspirated, the “puff of air” [X<sup>h</sup>] is always heard *after* both the stop [t] and fricative [ʃ] components of /tʃ/, heard especially clearly when Dr. Bautista pronounced a word like 140. [ ts<sup>h</sup> i . r a . r a ] ‘black’ slowly. So options II-III turn out to be wrong, and the best analysis of the onset is option I: an affricate that is sometimes followed by phonemic glottalization or aspiration. Jaqaru allows many consonant clusters, generally following the sonority hierarchy, but does not allow clusters of type VV.

## 4.2. Suprasegmentals

Languages are not spoken in a monotone! Stress, pitch, volume, and other prosodic elements must be taken into account to speak a language like a native speaker. Jaqaru is a non-tonal language without contrastive stress. Stress is predictable: it falls on the penultimate syllable of a word. There are a few exceptions, like 29. ['axari] 'vomit,' but also pairs like 138. [q<sup>2</sup>a<sup>2</sup>tʃi] / [q<sup>2</sup>a<sup>2</sup>tʃisa] 'who is [informal ~ formal]' that speak in favor of stress being a mechanical rule of the language and non-phonemic.

Unfortunately, although it is absolutely essential for speaking a language correctly, linguists have not yet developed a good system for transcribing intonation, so it will be omitted from this analysis.

### 5.1. Proof of Consonants

This section is devoted to phonemic analysis of consonants. Using example words and phrases illicit in class, I attempt to justify the consonantal inventory given on page 7. I also give some preliminary P-rules for the language in an attempt to account for Jaqaru allophony. The next section, section 6, is devoted to the phonemic analysis of Jaqaru vowels.

Perhaps the most striking characteristic of Jaqaru consonants at first glance is the full paradigm of obstruents. Six places of articulation must be justified. In languages like English, the appearance of palatal segments like [çuw] "Hugh" /hju/ can be predicted from context ( \_ ju). This is not the case for Jaqaru.

Furthermore, three phonemic phonation types must be justified. In languages like English and German, aspiration is important for sounding native but it can be predicted from context. Many languages, like Russian and French, do not use aspiration at all. In Jaqaru, this is not so. Aspiration and glottalization are used, and are phonemic.

One way to prove that phones are allophones of separate phonemes is to show the existence of minimal pairs, triplets, etc. If phonation type were not contrastive in Jaqaru, the following triplet (voluntered by Dr. Bautista) could not exist:

	<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
Ex. 5.1.2.	117.	[ˈnampa]	‘shovel’	X
	116.	[ˈnamp <sup>h</sup> a]	‘(give me) a shovel’	X <sup>h</sup>
	100.	[ˈnamp <sup>ʔ</sup> a]	‘head’	X <sup>ʔ</sup>

For the affricates, though, there is only a partial proof (Ex. 5.1.3.):

	<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
Ex. 5.1.3.	147.	[ˈutsa]	‘our house’	X
	146.	[ˈuts <sup>h</sup> a]	‘pudding’	X <sup>h</sup>
	84.	[ˈatʃ <sup>h</sup> i]	‘sneeze’	Y <sup>h</sup>
	57.	[ˈatʃ <sup>ʔ</sup> i]	‘many’	Y <sup>ʔ</sup>
	91.	[ˈatʃ <sup>ʔ</sup> i]	‘scratch’	Z <sup>ʔ</sup>

This evidence begins to justify the three phonemic phonation types of Jaqaru. At this point it is good to hypothesize a full paradigm. In a full paradigm, all phonation types of all stops and affricates exist and are contrastive. There are two ways this hypothesis can be supported—by finding minimal pairs, and by finding the different phones in analogous environments. The other options for allophones of a single phoneme are segments in free variation or complementary distribution.

In order to justify the consonants I walk through the system in two parts. First I show how the stops and affricates at one place of articulation contrast vertically. Then I justify each place of articulation (going horizontally). Next, I do the same with fricatives and resonants, first vertically, and then horizontally. Finally, I connect the fricatives to the other obstruents in the same column to show that they, too, are allophones of different phonemes.

My approach is the longer-winded yet older of two traditional approaches. It assumes that the phoneme is the basic unit of phonology, not the distinctive features (see Halle 1956 *The Sound Pattern of Russian*, Chomsky and Halle 1969 *The Sound Pattern of English*, and many subsequent references). Each line of my proof thus constitutes a “suspicious pair.”

## 5.2. Proof of stops and affricates vertically (i.e. by phonation type; see note p. 7)

### /P/ bilabial stops – minimal triplet

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
117.	[ˈnampa]	‘shovel’	/p/
116.	[ˈnamp <sup>h</sup> a]	‘(give me) a shovel’	/p <sup>h</sup> /
100.	[ˈnamp <sup>2</sup> a]	‘head’	/p <sup>2</sup> /

### /T/ dental stops – minimal triplet, (near) analagous environments

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
—	*[ˈata]	[no meaning]	/t/
141.	[ˈat <sup>h</sup> a]	‘seed(s)’	/t <sup>h</sup> /
142.	[ˈat <sup>2</sup> a]	‘group’	/t <sup>2</sup> /

  

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
6.	[ˈtati]	‘father’	# _ a	/t/
32.	[ˈt <sup>2</sup> anti]	‘bread’	# _ a	/t <sup>2</sup> /
77.	[jakˈt <sup>2</sup> utuma]	‘please serve me’	_ u	/t <sup>2</sup> /
103.	[ut <sup>h</sup> uˈnoxma]	‘please sit’	_ u	/t <sup>h</sup> /

### /TS/ dental affricates – minimal pair, near analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
147.	[ˈutsa]	‘our house’	/ts/
141.	[ˈuts <sup>h</sup> a]	‘pudding’	/ts <sup>h</sup> /

  

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
94.	[ts <sup>h</sup> iˈrara]	‘black’	# _ V	/ts <sup>h</sup> /
48.	[ts <sup>2</sup> aka]	‘bone’	# _ V	/ts <sup>2</sup> /

**/Tʃ/ post-alveolar affricates** – analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
53.	[a'tʃaqa]	'noise'	a _ a	/tʃ/
140.	['kʰatʃʰa]	'to whom'	a _ a	/tʃʰ/
84.	['atʃʰi]	'sneeze'	a _ i	/tʃʰ/
66.	['atʃʰiki]	'cold'	a _ i	/tʃʰ/

**/C/ palatal stops** – analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
1.	[hi'laci]	'thank you'	a _ i	/c/
8.	[ʃa amuru'tʃaʃi]	[greeting]	a _ i	/cʰ/
140.	['acʰi]	'dig'	a _ i	/cʰ/

To my ears, [j] is the most common allophone of /cʰ/. (In item 8, [a] of the penultimate syllable also occurs in free variation with [e] as both phones are allophones of /a/). Although [j] would be the only voiced obstruent in the language, I did hear it consistently in other items like 60. [uh'jija] 'small' and 88. [kʰujju] 'guinea pig.' What I did not hear was [cʰ], which led me to believe that for Dr. Bautista, [VjV] was a grammatical pronunciation of /VcʰV/.

In other positions, however, I heard [ç], which I believe to be another allophone of /cʰ/ due to its breathy quality:

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>phoneme</i>
121.	['tçipma]	'plug it!'	t _ i	/cʰ/
121.	['ʃçimi]	'mouth, tooth'	ʃ _ i	/cʰ/

The following P-rule accounts for this alternation:

/cʰ/ → [ç] / C \_  
 → [j] / V \_

**/Tʂ/ retroflex palatal affricates** – analogous environment?

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
57.	[a'ts <sup>h</sup> i] ??	'many'	a _ i	/ts <sup>h</sup> /
91.	[a'ts <sup>?</sup> i]	'scratch'	a _ i	/ts <sup>?</sup> /

These phones were exceedingly difficult for me to hear, and there is more going on than I was able to perceive.

**/K/ velar stops – analogous environment, near analogous environment**

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
27.	[a'tjak <sup>h</sup> a]	'old man'	a _ a	/k <sup>h</sup> /
54.	[a'paka]	'old woman'	a _ a	/k/
75.	[k <sup>h</sup> uʌu]	'firewood, log'	# _ V	/k <sup>h</sup> /
23.	[k <sup>?</sup> oto]	'top of mountain'	# _ V	/k <sup>?</sup> /

**/Q/ uvular stops – near analogous environment**

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
135.	[qaj'ʌewi]	'X began'	# _ V	/q/
88.	[q <sup>h</sup> ujju]	'guinea pig'	# _ V	/q <sup>h</sup> /
140.	[q <sup>h</sup> osa]	'what'	# _ V	/q <sup>h</sup> /
24.	[q <sup>?</sup> aq <sup>?</sup> a]	'mountain/cliff'	# _ V	/q <sup>?</sup> /

**5.3. Proof of stops and affricates horizontally (by place of articulation)**

**/p/ ~ /t/ - analogous environment**

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
111.	[p <sup>h</sup> u'tsaka]	'stomach, belly, punch big stone or log'	# _ u	/p/
44.	[tu]	'woman to man'	# _ u	/t/

**/t/ ~ /ts/ - analogous environment**

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
6.	[tati]	'father'	# _ a	/t/
48.	[ts <sup>?</sup> aka]	'bone'	# _ a	/ts/

/ts/ ~ /tʃ/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
94.	[ts <sup>h</sup> irara]	'black'	# _ i	/ts/
12.	[tʃikkasa]	'I'm going'	# _ i	/tʃ/

/tʃ/ ~ /tʂ/ - minimal pair

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
84.	[ʼatʃ <sup>h</sup> i]	'sneeze'	a _ i	/tʃ/
91.	[ʼatʂ <sup>h</sup> i]	'scratch'	a _ i	/tʂ/

/tʃ/ ~ /c/ ~ /k/ - minimal triplet

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
79.	[ʼʃutʃi]	'sneeze'	/tʃ/
39.	[ʼʃuci]	'name'	/c/
33.	[ʼʃuki]	'shoes'	/k/

/k/ ~ /q/ - minimal pairs

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
108.	[ʼkaka]	'wing'	/k/
24.	[ʼq <sup>2</sup> aq <sup>2</sup> a]	'mountain, cliff'	/q/
14.	[ʼnak.ʃʌo]	'burn'	/k/
15.	[ʼnaq.ʃʌo]	'pick up something	/q/

gelatinous from  
floor with hand'

#### 5.4. Proof of fricatives and resonants vertically (by manner of articulation)

/m/ ~ /w/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
3.	[maj]	'one'	# _ a	/m/
62.	[ʼwasa]	'walks'	# _ a	/w/

/s/ ~ /r/ ~ /n/ - analogous environments

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
18.	['nasa]	'nose'	a _ a	/s/
62.	[ts <sup>h</sup> i'rara]	'walks'	a _ a	/r/
103.	[ut <sup>h</sup> u'nuxma]	'please sit'	u _ u	/n/
10.	['nuru]	'egg'	u _ u	/r/

/ɲ/ ~ /ʎ/ ~ /j/ - analogous environments

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
51.	[maj'atsk <sup>2</sup> a]	'repeat again'	a _ a	/j/
7.	[a'ɲaŋka]	'leg'	a _ a	/ɲ/
75.	[k <sup>h</sup> uʎu]	'firewood, log'	u _ u	/ʎ/
89.	[k <sup>h</sup> uju]	'whistle'	u _ u	/j/

/x/ ~ /ŋ/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
29.	['axari]	'vomit'	a _ a	/x/
145.	[qaʎ'jaŋa]	'my baby'	a _ a	/ŋ/

## 5.5. Proof of fricatives and resonants horizontally (by place of articulation)

/s/ ~ /ʃ/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
127.	['suxta]	'six'	# _ u	/s/
33.	['ʃuki]	'shoes'	# _ u	/ʃ/

/m/ ~ /n/ ~ /ɲ/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
3.	[maj]	'one'	# _ a	/m/
18.	[nasa]	'nose'	# _ a	/n/
43.	[ɲa]	'woman to woman'	# _ u	/ɲ/



/ɲ/ ~ /ŋ/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
7.	[a'ɲaŋka]	'leg'	a _ a	/ɲ/
145.	[qaʎ'jaŋa]	'my baby'	a _ a	/ŋ/

/r/ ~ /l/ ~ /ʎ/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
0.	[haqaru]	'Jaqaru'	a _ u	/r/
58.	[p <sup>h</sup> alu]	'eat'	a _ u	/l/
105.	[naʎu]	'rain'	a _ u	/ʎ/

/w/ ~ /j/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
62.	['wasa]	'walks'	# _ a	/w/
77.	[jak't <sup>2</sup> utuma]	'please serve me'	# _ a	/j/

[x] ~ [h] - allophones of the same phoneme, /x/

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>phone</i>
1.	[hi'laci]	'thank you'	# _ i	[h]
2.	['haʎpi]	'lick'	# _ a	[h]
4.	['hunt <sup>2</sup> ki]	'burn'	# _ u	[h]
60.	[uh'jɨa]	'small'	u _ j	[h]
106.	['ahtsa]	'big'	a _ <u>ts</u>	[h]
29.	['axari]	'vomit'	a _ a	[x]
36.	['nixra]	'arm'	i _ r	[x]
56.	['naxra]	'tongue'	a _ r	[x]
82.	[marq <sup>h</sup> ajx'qiwa]	'they are all going'	x _ q	[x]
103.	[ut <sup>h</sup> u'nuxma]	'please sit'	u _ m	[x]
113.	[wa'raxa]	'star'	a _ a	[x]

/x/ → [h] / # \_  
 → [h] / \_ { j, ts }  
 → [x] / elsewhere

This P-rule is “messy” as the environments for [h] are not a natural class. (A brace can join two natural classes together, but this is less than ideal.) In another paper, this would be a good place to try an optimality theoretic approach (Prince and Smolensky 1993, McCarthy and Prince 1993, and many subsequent references).

## 5.6. Proof of fricatives and stops / affricates

/s/ ~ /t/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
18.	['nasa]	‘nose’	a _ a	/s/
141.	['at <sup>h</sup> a]	‘seed(s)’	a _ a	/t/

/ʃ/ ~ /tʃ/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
33.	['ʃuki]	‘shoes’	# _ u	/ʃ/
25.	['tʃuntʃo]	‘sylvan’	# _ u	/tʃ/

/ɲ/ ~ /ŋ/ - analogous environment

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>variation</i>
29.	['axari]	‘vomit’	a _ a	/x/
54.	[a'paka]	‘old woman’	a _ a	/k/

## 6.1. Proof of vowels

This section is devoted to phonemic analysis of Jaqaru vowels and runs parallel to Section 5 on consonants. Using example words and phrases illicit in class, I attempt to justify the vocalic inventory given on page 9. I also give some preliminary P-rules for the language in an attempt to account for Jaqaru allophony.

Section 6.2. is devoted to the back vowels, 6.3. to the front vowels, 6.4. to the low vowels, and 6.5. to vowel length.

## 6.2. Back vowels

[u] ~ [o] ~ [ʊ] – in free variation; allophones of the same phoneme, /u/

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>phone</i>
10.	[ˈnuɾo]	‘egg’	r _ #	[o]
14.	[ˈnakʃʌo]	‘burn’	ʌ _ #	[o]
23.	[ˈkʰoto]	‘top of mountain’	kʰ _ t, t _ #	[o]
58.	[ˈpʰalo]	‘eat’	l _ #	[o]
74.	[ˈtʰosqʰe]	‘smoke’	tʰ _ s	[o]
33.	[ˈʃuki]	‘shoes’	ʃ _ u	[u]
63.	[pʰaˈluruma]	‘please eat’	l _ r	[u]
75.	[ˈkʰuʌu]	‘firewood, log’	kʰ _ ʌ, ʌ _ #	[u]
103.	[utʰuˈnoxma]	‘please sit’	# _ tʰ, tʰ _ n	[u]
136.	[ˈuxtʰmata]	‘do come’	# _ x	[u]
147.	[ˈutsa]	‘our house’	# _ ts	[u]
103.	[utʰuˈnoxma]	‘please sit’	n _ x	[ʊ]
118.	[atʰuˈnoxma]	‘put a brick in!’	n _ x	[ʊ]
127.	[ˈsuxta]	‘six’	s _ x	[ʊ]

The main allophone of the phoneme /u/ is [u]. It also has the allophone [o], which occurs in free variation with [u], particularly word-finally and after a glottalized segment (cf 14 and 75, 23 and 75). There are no instances of [o] word initially. Since there are counterexamples to the general phonological rule, it may be possible to account for this alternation stochastically, but for now, the following P-rule is satisfactory:

/u/ often → [o] / \_ #  
 → [o] / Cʰ \_  
 often → [ʊ] / \_ x  
 → [u] / elsewhere

These instances of lowering allophony are very similar to the allophony of the front vowel phoneme /i/.

### 6.3. Front vowels

[i] ~ [e] ~ [ɪ] – in free variation; allophones of the same phoneme, /i/

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>phone</i>
5.	[ˈnejra]	‘eye’	n _ j	[e]
21.	[ˈkajampujnejma]	‘let your baby nurse’	n _ j	[e]
74.	[ˈtʰosqʰe]	‘smoke’	qʰ _ #	[e]
19.	[ˈnupʰe]	‘sunlight’	pʰ _ #	[e]
1.	[hiˈlæci]	‘thank you’	h _ l, c _ #	[i]
28.	[ˈhiŋtʃu]	‘ear’	h _ ŋ	[i]
29.	[ˈaxari]	‘vomit’	r _ #	[i]
30.	[ˈurpʰi]	‘cloud’	pʰ _ #	[i]
34.	[ˈmami]	‘mother’	m _ #	[i]
84.	[ˈatʰi]	‘sneeze’	tʰ _ #	[i]
57.	[ˈatʰi]	‘many’	tʰ _ #	[i]
91.	[ˈatʰi]	‘scratch’	tʰ _ #	[i]
143.	[iʌˈwiwa]	‘X saw’	# _ ʌ, w w	[i]
94.	[ˈinti]	‘sun’	# _ n	[ɪ]

The main allophone of the phoneme /i/ is [i]. [e] is in free variation with [i] word-finally. The phone [ɪ] is rare and occurs in only one item, 96. ‘sun.’

/i/ often → [e] / \_ #  
 → [e] / \_ j  
 → [ɪ] / # \_ n  
 → [i] / elsewhere

These instances of lowering allophony are very similar to the allophony of the back vowel phoneme /u/.

Perhaps not all instances of [e] are allophones of /i/, however. One day in class, Dr. Bautista confused the English words ‘die’ and ‘day.’ This suggests that for him, [e]—perhaps only before /j/—is also an allophone of /a/. Choosing an underlying form for 5. ‘eye’ is difficult for the linguist. (It is like English [warə]: is it /water/ or /wader/?) In Jaqaru, /a/ and /i/ must be neutralized before /j/.

## 6.4.

### Low vowels

[a] ~ [æ] ~ [e] – in free variation; allophones of the same phoneme, /a/

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>environment</i>	<i>phone</i>
1.	[hi'læci]	'thank you'	l _ c	[æ]
8.	[ʃa amuru'tʃæʃi]	[greeting]	tʃ _ ʃ	[æ]
29.	[ʼaxari]	'vomit'	# _ x, x _ r	[a]
34.	[ʼmami]	'mother'	m _ m	[a]
84.	[ʼatʃ <sup>h</sup> i]	'sneeze'	# _ tʃ <sup>h</sup>	[a]
57.	[ʼatʃ <sup>ʔ</sup> i]	'many'	# _ tʃ <sup>ʔ</sup>	[a]
86.	[ʼnak <sup>ʔ</sup> a]	'clay'	n _ k <sup>ʔ</sup> , k <sup>ʔ</sup> _ #	[a]
91.	[ʼatʃ <sup>ʔ</sup> i]	'scratch'	# _ tʃ <sup>ʔ</sup>	[a]
107.	[ʼwila]	'blood'	l _ #	[a]
113.	[wa'raxa]	'star'	w _ r, r _ x, x _ #	[a]
5.	[ʼnejra]	'eye'	n _ j	[e]
22.	[ʼkajampujma]	'let your baby nurse'	n _ j	[e]

The main allophone of the phoneme /a/ is [a]. Other allophones occur in “raising” environments. /a/ is pronounced [æ] before palatal stops. Under an alternate reading of 5. and 22., [e] is the allophone of /a/ before the palatal glide /j/. This is supported by Dr. Bautista’s transfer error into English: <day> /dej/ ↔ \*[daj].

/a/ → [æ] / \_ { c , ʃ }  
 → [e] / \_ j  
 → [a] / elsewhere

## 6.5. Vowel length

In addition to height allophony, Jaqaru vowels contrast in length. This was heard clearly in 59. ['i:ki] ‘sleep’ and is best illustrated by three minimal pairs:

### /a/ ~ /ǎ/ - minimal pairs

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
47.	['tsʔǎka]	‘chest, heart’	/ǎ/
48.	['tsʔaka]	‘bone’	/a/
108.	['kaka]	‘wing’	/a/
109.	['kǎkǎ]	‘uncle’	/ǎ/

### /i/ ~ /i:/ - minimal pair

<i>gloss #</i>	<i>word</i>	<i>gloss</i>	<i>variation</i>
16.	['tʃʔipi]	‘bird’	/i/
17.	['tʃʔi:pi]	‘squint’	/i:/

Although [u] is a common vowel, it seems that short /u/, like [ɪ] as an allophone of [i], is rare enough not to be displayed in any minimal pairs or analogous environments from the 159 items elicited so far. Nonetheless, I believe I heard it in at least one item, 69. ['naki] ‘burn.’ My transcription here is inexact/wavy, as I transcribed the same root in 70. [nak'kiwa] ‘it’s burning’ with [a]. My English phonology must have made it hard for me to hear those phones, unless I also heard /u/ as [ʊ] in 103. [utʰu'nuxma] ‘please sit,’ [atʰnuxma] ‘put a brick in!’, and 127. ['suxta] ‘six.’ In general I had trouble double-checking vowel length. For 113., When I said [waraxa] and [wǎřǎxǎ], Dr. Bautista accepted both, so the distinction between [a] and [ǎ] must be neutralized in many words.

**Table 6.5. Jaqaru Vowel Phones**

	FRONT	BACK
HIGH	[i] [i:]	[u]
	[ɪ]	[ʊ]
MID	[e]	[ʌ]? [o]
	[æ]	
LOW	[ǎ] [a]	