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## A prosodic account of Ju|'hoansi consonant distributional asymmetries

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### 1 Introduction

Since DOKE (1925), linguists have recognized the unbalanced distribution of consonants at the word level in Northern Khoesan languages. However, to date there has been no complete explanation for the patterns. In part, this is because the distributional disparities involve both place of articulation and manner of articulation, and narrow phonetic transcriptions of the medial consonants have been ignored in accordance with the principle of phoneme economy. In this paper, I show that the distributional patterns in Ju|'hoansi consonants mainly involve prosodic constraints on manner of articulation at the prosodic word level, as is found cross-linguistically in well-known processes like English flapping and Spanish spirantization. Place of articulation asymmetries within the prosodic word fall out from two other cross-linguistically common patterns, namely that labial stops with laryngeal and pharyngeal release properties do not exist in the consonant inventory, and that sonorants can not bear laryngeal and pharyngeal release properties that commonly occur with obstruents.<sup>1</sup>

Ju|'hoansi manner of articulation asymmetries at the word level differ from those found in European languages in that the number of obstruents in the inventory is much larger than typically found in European languages. The larger number of obstruents results from the larger set of release properties in the guttural region. These guttural release properties are restricted to obstruents, making the disparity between the number of obstruents and the number of sonorants greater. The term guttural refers to consonants with laryngeal (aspiration and glottalization) and pharyngeal (uvularization and epiglottalization) release properties, following MILLER-OCKHUIZEN (2003), which builds on use of the term in Semitic phonology (HAYWARD & HAYWARD 1989;

<sup>1</sup> Note that voiceless and voiced nasal aspirated clicks are obstruents.

MCCARTHY 1991), including Afroasiatic phonology (VAN DER HULST & MOUS 1992; ROSE 1994), and Salishan phonology (BESSELL 1992).

In Section 2, I provide the consonantal inventory, and provide acoustic evidence that the initial consonants are obstruents, while the medial consonants are sonorants. In Section 3, I provide a phonological account of the distributional facts in terms of laryngeal features, and show that the domain of the positional constraint is the prosodic word. In Section 4, I describe place of articulation patterns, and show that the low frequency of initial labials is accounted for by the low number of labial consonants in the inventory compared with coronal, dorsal, and coronal-dorsal (click) consonants. The low frequency of labials in initial position is best accounted for by a perceptual constraint on the shape of the obstruent inventory (e.g. a ban on guttural labials). A prosodic constraint accounts for manner of articulation asymmetries at the word level, but not place of articulation asymmetries.

## 2 The Ju|'hoansi consonant inventory

### 2.1 Ju|'hoansi obstruents

Table 1 lists click and non-click obstruents that are unmarked for guttural release properties, and which occur primarily in word-initial position. As can be seen, clicks and non-clicks are parallel in the types of possible closure properties. Note that voiced and nasal obstruents do not have distinct release properties, since they are primarily characterized by voicing and/or nasalization during the closure phase of obstruents. The glottal stop occurs in roots transcribed by SNYMAN (1975) and DICKENS (1994) as vowel initial. Its phonemic status is unclear.

The questionable status of labial stops in a related Northern Khoesan variety, Neitsas !Xung, is noted by DOKE (1925:137), who says that "it is doubtful whether *p* is a genuine !Xu sound ... I recorded only one example with the unvoiced sound, viz., *pampam* (crocodile). It is possible that both the word and the sound are borrowed from the language of some non-!Xu tribe living in contact with the rivers and pools to the north and north-east. I hardly regard *p*, then, as a regular

part of !Xu phonetics." Initial labials are also low frequency in Ju|'hoansi, although more than one example has now been identified. As will be shown in Section 4, the low frequency of initial labial obstruents is tied to the lack of labials with guttural release properties in the consonant inventory.

		LABIAL	DENTAL	PALATAL	POST-ALVEOLAR		VELAR	UVULAR	EPIGLOTTAL	GLOTTAL
					CENTRAL	LATERAL				
FRICATIVES	VCLESS	(f)	s	ʃ				χ <sup>2</sup>		
	VOICED		z	ʒ						ɦ
PULMONIC STOPS	VCLESS	p	t				k			ʔ
	VOICED	b	d				g			
	NASAL	m	n				ŋ			
AFFRICATES	VCLESS		ts	tʃ						
	VOICED		dz	dʒ						
VELARIC PLOSIVES (CLICKS)	VCLESS			‡	!					
	VOICED		g	g‡	g!	g				
	NASAL		ŋ	ŋ‡	ŋ!	ŋ				

Table 1: Inventory of Ju|'hoansi consonants that are unmarked for release type and which occur in word-initial position (f occurs only in loan-words)

<sup>2</sup> Note that Dickens and Snyman describe this sound as a velar fricative, but MILLER-OCKHUIZEN (2000) provides evidence that it is a uvular fricative.

Table 2 lists the initial consonants that are marked for guttural release properties. As noted in MILLER-OCKHUIZEN (2003, 2007), these consonants all act as a natural class in several phonotactic constraints. First, guttural consonants are blocked from occurring within the same prosodic word with a guttural (breathy, glottalized and epiglottalized) vowel.<sup>3</sup> Second, and most central to this paper, guttural release properties are blocked from occurring on sonorants (with the exception of the voiced nasal aspirate, [m<sup>h</sup>], which only occurs in the diminutive plural enclitic *m<sup>h</sup>i*, and never in roots.) Third, guttural release types are banned from occurring on labial stops (to be discussed in Section 4).

The consonants in Table 2, typical of other obstruents, only occur in root initial position. Thus, Tables 1 and 2 together list all of the consonants that occur in root-initial position in the Ju|'hoansi inventory. As can be seen in Table 2, there are no labial stops with uvularized, epiglottalized or glottalized release types in the Ju|'hoansi consonant inventory. This is typical of broader Khoesan language patterns (e.g. in the inventory of !Xóõ where there are no labial pulmonic consonants bearing any of the guttural release properties). The Ju|'hoansi labial aspirates are somewhat fickle in their behavior, as there are 2 roots containing initial labial aspirates. Furthermore, as we shall see in Section 4, aspirated labials are sometimes adapted as-is in loan-words, sometimes the aspiration is dropped, and sometimes the place of articulation of the stop is changed. This fickle behavior is consistent with the fact that of the gutturals, aspirates would mask the formant transitions associated with labials the least.

<sup>3</sup> See MILLER-OCKHUIZEN (2003) for the phonetic and phonological parallelism of aspirated consonants and breathy vowels, glottalized consonants and vowels, and epiglottalized consonants and vowels.

RELEASE	PULMONIC PLOSIVE (NON-CLICK)				VELARIC PLOSIVE (CLICK)			
	ORAL		NASAL		ORAL		NASAL	
	VOICELESS	VOICED	VOICELESS	VOICED	VOICELESS	VOICED	VOICELESS	VOICED
ASPIRATED	p <sup>h</sup> t <sup>h</sup> ts <sup>h</sup> tʰ	b <sup>h</sup> d <sup>h</sup> dʒ <sup>h</sup> dʒʰ			p <sup>h</sup> ɸ <sup>h</sup> i <sup>h</sup> ʔ <sup>h</sup>	g <sup>h</sup> g <sup>h</sup> g <sup>h</sup>	ɲ <sup>h</sup> ɲ <sup>h</sup> ɲ <sup>h</sup>	ɲ <sup>h</sup> ɲ <sup>h</sup> ɲ <sup>h</sup>
GLOTTALIZED	ts <sup>ʔ</sup> tʃ <sup>ʔ</sup>	ds <sup>ʔ</sup> dʒ <sup>ʔ</sup>			ɸ <sup>ʔ</sup> ɸ <sup>ʔ</sup> ɸ <sup>ʔ</sup>			
UVULARIZED	t <sup>ʁ</sup> tʃ <sup>ʁ</sup>	d <sup>ʁ</sup> dʒ <sup>ʁ</sup>			ɸ <sup>ʁ</sup> ɸ <sup>ʁ</sup> ɸ <sup>ʁ</sup>	g <sup>ʁ</sup> g <sup>ʁ</sup> g <sup>ʁ</sup>		
EPIGLOTTALIZED	t <sup>ʰ</sup> k <sup>ʰ</sup>	g <sup>ʰ</sup>			ɸ <sup>ʰ</sup> ɸ <sup>ʰ</sup> ɸ <sup>ʰ</sup>	g <sup>ʰ</sup> g <sup>ʰ</sup> g <sup>ʰ</sup>		

Table 2: Inventory of Ju|'hoansi consonants with guttural release types<sup>4</sup>

<sup>4</sup> As with the velar fricative in Table 1, the sounds transcribed as velarized clicks by



## 2.2 Ju|'hoansi sonorants

Table 3 provides the full set of consonants that occur in medial position in the database. As can be seen by the transcription, over half of the medial consonant sounds are sonorants, thus making Ju|'hoansi consonant allophony consistent with cross-linguistic prosodically based consonant allophonic patterns. Frequencies of medial consonants by manner of articulation are provided in MILLER-OCKHUIZEN (2003:126). The labials, [β] and [m], and coronals [r] and [n] are by far the most frequent in medial position, and these are the sonorants recognized by SNYMAN (1975). The dorsal sonorants, [ŋ] and [ɣ] are very low in frequency, in parallel with the low frequency of initial dorsal stops (MILLER-OCKHUIZEN 2003:239). The obstruents [ɦ], [χ], [ʔk], [k] and [kʰ] each occur in root-medial position of only a very few roots. These roots are often loan-words, but not all of them can be recognized as such. For example, we find *doŋo* 'hand piano', *nlaxu* 'faeces', *túkú* 'scarf' (<Afr. *doek*), *dòŋgí* 'donkey' (<Afr. *donkie*), *pʰoka* *dactylenium giganteum* *chloris*, *ʔáŋá* 'to be generous towards', *pèkè* 'pick' (<Afr. *pík*), *zǎχǎ* 'saw' (<Afr. *sag*), *gaga* 'to wobble', *gǎ̀àùkǎ* 'harp'.

SNYMAN (1970, 1975) and DICKENS (1994) are transcribed as uvularized clicks following MILLER-OCKHUIZEN (2000). The transcription of *tkx'*, *kx'*, and *gkx'*, and the clicks *ʔkx'*, *ʔkx'*, *ʔkx'*, *ʔkx'* as epiglottalized consonants follows MILLER-OCKHUIZEN's (2003) usage. MILLER *et al.* (2009) refer to similar sounds in N|uu as uvularized ejected stops and clicks. It is clear that these sounds have uvular frication and glottal accompaniment during the release, and are not fully velar as described by SNYMAN (1970, 1975) and DICKENS (1994).

		SONORANTS		OBSTRUENTS	
		NASAL	APPROXIMANT	FRICATIVE	PLOSIVE
ORAL	LABIAL	m	β		
	CORONAL	n	r		
	DORSAL	ŋ	ɣ		ʔk, k
GUTTURAL	UVULAR			χ	kʰ
	GLOTTAL			ɦ	

Table 3: Inventory of medial Ju|'hoansi consonants

Most previous researchers working on Northern Khoesan languages have noted the weakness of medial consonants. DOKE (1925:137) notes that "b, though distinctly sounded as an explosive in those words in which I have recorded it, is, without any doubt, but a variant of the voiced fricative, v, which is far more commonly met with among !Xu speakers." Doke doesn't mention word or prosodic position as a contextual determinant of the allophone used.

SNYMAN (1970) does recognize that medial sounds are sonorants, and transcribes /b/ and /r/ phonetically as /β/ and /r/, but SNYMAN (1975) drops the distinction, based on the principle of phoneme economy set forth by MULDER (1968), which guides his later work. SNYMAN (1975) does, however, still recognize the variation, and focuses on the place of articulation differences which can not be done away with through the use of economic feature representations, since the contrasts exist in the inventory.

Dit is opvallend dat dit slegs die konsonante /b/, /m/, /n/ en /r/ is wat in die mediale posisie voorkom [It is conspicuous that it is only the consonants /b/, /m/, /n/ and /r/ that occur in medial position.] (SNYMAN 1975:75).

DICKENS (1994:9-10) does not recognize any variants, and claims that orthographic 'b' is phonetically [b], and orthographic 'r' is [r]. None of these researchers mention medial 'k', which occurs in very low frequency in the database (but which occurs in native roots). As I will show

in Section 4, dorsals are low frequency in all prosodic positions, and thus the low frequency in medial position is expected.

HEINE & KÖNIG (2001:21) note that in Ekoka !Xung, only *b*, *l*, *nm*, *'*, *m*, *c*, *x*, *y* and *w* occur root-non-initially, but "unlike in W1 and some other !Xun lects, intervocal *b* is not pronounced as a fricative ([β]), the norm is [b]." This interesting difference in Ekoka !Xung is worthy of investigation. One possibility might be that the language is tending more towards monosyllabic prosodic words with long vowels, and that pronunciation of medial stops as stops might go hand in hand with an increase in vowel length, and a parsing of the two syllables into two prosodic words. This would be similar to one of the loan-word adaptation strategies of words with medial [b] from English or Afrikaans into Ju|'hoansi. However, the word prosody of Ekoka !Xung is beyond the scope of the current paper.

My transcriptions show that in Ju|'hoansi, orthographic medial 'b' appears as the labial approximant [β], and 'r' occurs as the coronal flap [ɾ] medially, in accordance with SNYMAN'S (1970) transcriptions. Furthermore, most instances of medial 'k', not recognized by Snyman, are realized phonetically as the dorsal fricative [ɣ]. These sounds are considered sonorant allophones based on their distribution and on the fact that they all have short duration, and maintain voicing and often clear formant structure throughout the closure phase. They are considered intervocalic allophones of /b/, /d/, and /g/. Nasal non-click consonants are sonorants, based on their patterning (e.g. they occur more frequently in medial and final positions than in initial position), as well as on their acoustic properties. In the next section, I provide acoustic evidence for the manner of articulation differences claimed in this section based on my transcriptions.

### 2.3 Acoustic properties of initial vs. medial allophones

Figure 1 shows spectrograms of initial and medial allophones of /b/, initial [b] and medial [β]. Both sounds display clear low frequency energy in the closure interval typical of voiced stops. In the stop

allophone occurring in initial position in the upper panel of Figure 1, there is also a clear stop noise-burst occurring at about .15 s, which is lacking in the medial allophone in the lower panel. In medial position seen in the lower panel of Figure 1, the sonorant allophone displays frication noise in the closure interval.

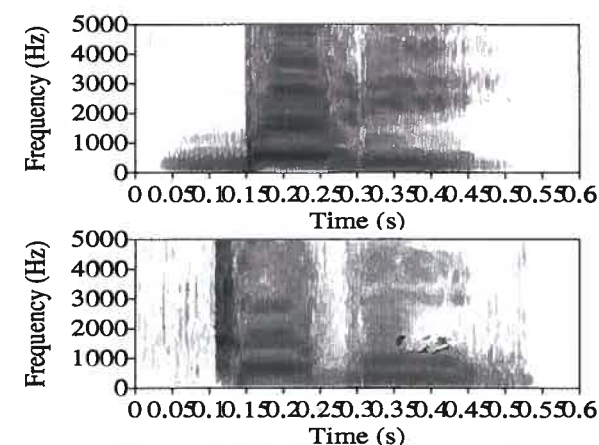


Figure 1: Spectrograms of root-initial /b/ [b] in *bàrì* 'goat' (above) and root medial /b/ [β] in *ǀǎβú* 'blood letting horn' (below) taken from MILLER-OCKHUIZEN (2003, Figure 23, p. 63) (Subject KK)

Figure 2 shows spectrograms of the allophones of /d/, initial [d] and medial [ɾ]. The stop allophone is much longer (approximately .125 s) than the medial allophone, which is merely about .01 s in length. The formant structure that is maintained almost throughout the entire duration of the medial consonant is characteristic of a sonorant. Note that the additional token of medial [ɾ] in the upper panel of Figure 1 is quite different from the medial [ɾ] in the lower panel of Figure 2. There is an approximately 40 ms transition from the preceding vowel into the consonant, which displays a diminution in amplitude, and a marked lowering of the fourth formant.

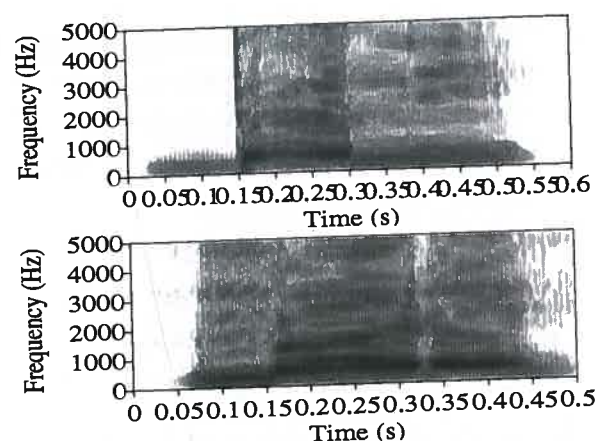


Figure 2: Spectrograms of root-initial /d/ [d] in *dā'ānì* 'container' (above) and root-medial /d/ [r] in *mārè* 'bread' (below, Subject KK)

Figure 3 shows spectrograms of the two allophones of /g/, initial [g] and medial [ɣ]. As can be seen in the spectrograms, the stop allophone, [g], is again rather long, about .14 s, and exhibits a clear stop noise-burst at about .2 s. On the other hand, the sonorant allophone, [ɣ], is only about .05 long, and displays low frequency frication noise throughout the closure, although there is no clear formant structure in this token.

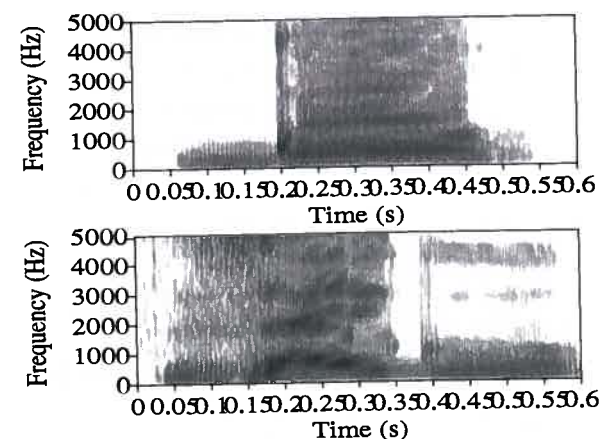


Figure 3: Spectrograms of root-initial /g/ [g] in *gō'ō'* 'grass species' (above) and root-medial /g/ [ɣ] in *zā'iyū* 'black mamba' (below, Subject KK)

While I have provided spectrograms of only the non-guttural voiced stop allophones occurring in initial position, the medial allophones could also arise from the contrastive aspirated, uvularized, epiglottalized and glottalized consonants, since these guttural release properties also do not occur in medial position. That is, just as English medial [r] is an allophone of both initial [d] and [t] as in the words *rider* and *writer*, Ju|'hoansi [r] might be considered an allophone of the larger initial set of [d, d<sup>h</sup>, t, t<sup>h</sup>, t<sup>x</sup>, t<sup>h</sup>]. A further possibility would be to analyze [r] as an allophone of initial click consonants, which would extend the allophonic relationship considerably. This would involve a loss of the tongue body gesture, as well as a weakening of the coronal constriction, in medial position. As I will show in Section 4, the lexical frequency of medial [r] matches most closely the frequency of the entire set of initial clicks, suggesting that the entire set of coronals (including coronal-dorsal clicks) may correspond to the medial flap.

The other medial consonants are nasals. While nasals occur both initially and medially, they are much more prevalent in root-medial position. Still, acoustic differences can be seen between initial and medial variants, as shown by the spectrograms in Figure 4 for [m], and Figure 5 for [n]. While the durational differences are not as clear here,



differences in the presence of formant structure are clear. That is, in both of the medial nasals, second and third formants are high in amplitude, while in the initial nasals, only the first formant frequency is clear, with the upper formant structure being less clear than in medial position.

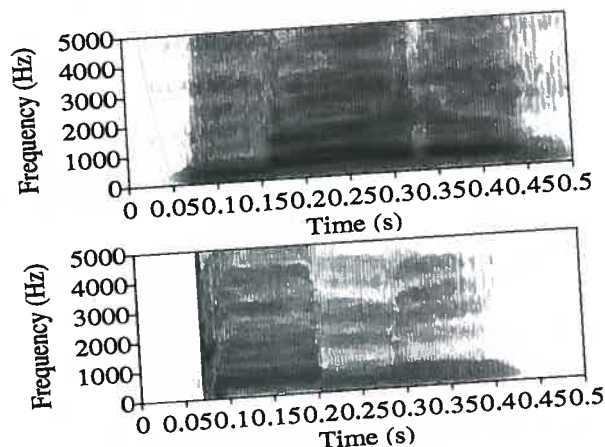


Figure 4: Spectrograms of root-initial [m] *màrè* 'bread' (above) and root-medial [m] in *ámù* 'tree trunk' (below, Subject KK)

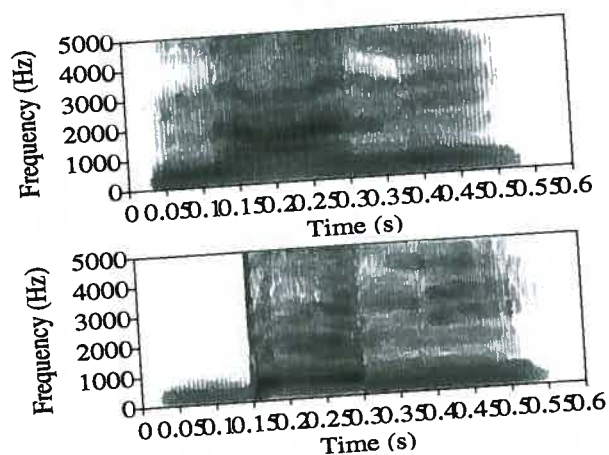


Figure 5: Spectrograms of root-initial [n] in *ná'ani* 'needle' (above) and root-medial [n] in *dá'ani* 'container' (below, Subject KK)

In this section, I have shown that acoustic properties of medial consonants in Ju|'hoansi are consistent with calling them sonorants, while initial stop variants are acoustically obstruents, realized with a silent interval representing the closure (with or without low frequency noise in the closure signaling voicing), clear noise-bursts and formant transitions. The auditory definition for sonority follows LADEFOGED (1997). In the next section, I provide phonological evidence for the obstruent vs. sonorant distinction in different root positions.

### 3 Phonological patterns: manner of articulation

#### 3.1 Phonological evidence

The prosodic hierarchy is a theoretical model outlined by SELKIRK (1984) and NESPOR & VOGEL (1986). It posits that the segments that make up words are grouped into a hierarchical structure. The prosodic word (PrWd) corresponds universally, and in Ju|'hoansi specifically, to a morphological content word, i.e. a lexical category of noun, verb, or adjective, and thus in native phonology corresponds to the morphological category of root. As a phonological entity, the prosodic word is subject to phonological constraints. In Ju|'hoansi, the prosodic word consists of a single foot, and licenses manner of articulation features. A foot consists of two moras. A mora, symbolized by  $\mu$ , is a unit of weight. In Ju|'hoansi, long vowels have two moras, and coda nasals are moraic. In trisyllabic loan-words, or words that are bisyllabic in the source language and end up being trisyllabic in Ju|'hoansi through vowel epenthesis, a single source word is parsed into two separate prosodic words. Thus, loan-word adaptation patterns suggest that the domain of manner of articulation constraints is the prosodic word rather than the morphological root.

##### 3.1.1 Frequency by manner in different word positions

Table 4 lists the frequency of occurrence of sounds in initial position grouped by manner of articulation, merging velaric and pulmonic plosives, since these sounds are phonologically both [-continuant] obstruents. Note the extremely low frequency of sonorants in prosodic



word initial position (2%). It should be noted that the sonorant allophones of stops, [β], [r] and [ɣ], never occur in prosodic word initial position, and nasal consonants and liquids are the only sonorants occurring in initial position.

CONSONANT TYPE	OBSTRUENTS		SONORANTS	TOTAL
	PLOSIVES (PULMONIC AND VELARIC)	FRICATIVES	SONORANTS (NASAL OR LIQUID)	
LEXICAL FREQUENCY	1708	137	33	1878
PER CENT	91%	7%	2%	100%
	98%		2%	100%

Table 4: Lexical frequencies of prosodic word initial consonant types in Ju|'hoansi

The lexical frequencies of sonorants and obstruents in word medial position are provided in Table 5. As we can see, the percentage of obstruents found in medial position is almost the same as the percentage of sonorants found in initial position despite the differences in raw numbers. The difference in raw numbers, of course, arises from the fact that Table 4 contains all roots in the database, while Table 5 only contains bisyllabic roots which contain medial consonants. There is then a clear split for manner of articulation, with obstruents occurring in prosodic word initial position and sonorants occurring in prosodic word medial position. In each position, there is a small amount of residue. This residue is typical of probabilistic phonotactic patterns (HAY *et al.* 2004; PIERREHUMBERT 2003).

CONSONANT TYPE	OBSTRUENTS	SONORANTS	TOTAL
LEXICAL FREQUENCY	37	798	835
PER CENT	4%	96%	100%

Table 5: Frequency of medial consonants in bisyllabic roots (CVCV and CVVCV roots)

Focusing on manner of articulation, we can state the generalization that consonants found in medial position are mainly sonorants. I analyze the sounds [β, r] as sonorant allophones of the initial voiced obstruents /b/ and /d/, following GREENBERG (1966) and SNYMAN (1970). There are several reasons underlying this assumption. First, [β, r] are the only sounds in the language that only occur in medial position. In contrast, the sonorant nasals, [m, n] that occur in medial position, also occur in initial position, and [m] occurs in final position as well. Second, the weakening of obstruents to sonorants is common cross-linguistically, and we find examples such as English flapping and Spanish spirantization. Third, there is evidence from loan-word adaptation, where Afrikaans or British English source words with a medial coronal or labial obstruent tend to be adapted with these variants. For example, the Afrikaans word *pampoen* [{p<sup>h</sup>əmp<sup>h</sup>ún}] 'pumpkin' is assimilated as *pabu* [{p<sup>h</sup>əβú}] in Ju|'hoansi, and the Setswana word *podì* 'goat' is assimilated as *parì* [{pərí}]. The few exceptions include Afrikaans *Koppie* 'cup' which is Ju|'hoansi [{kòpì}], and [{bòpí}] from Afrikaans *pop* 'doll'. Prosodic word boundaries are marked here and throughout with curly brackets, {}.

While the number of sonorants in initial position is very low, words with initial sonorants are not necessarily loan-words. The words themselves are basic vocabulary such as [{mà<sup>h</sup>á}] 'to carry a child on the back', [{mà<sup>h</sup>nì}] 'to speak a non-click language', [{nə̀rì}] 'to be slow', and [{nò<sup>h</sup>m}] 'to hook (a springhare)', and the words are generally in accordance with all other phonotactic constraints described in MILLER-OCKHUIZEN (2003).

### 3.1.2 Adaptation of monosyllabic and bisyllabic words

In this section I discuss loan-word adaptation by mono-lingual Ju|'hoansi speakers. Bilinguals produce words as they are produced natively in the source language. Loan-word adaptation of monosyllabic and bisyllabic words from Afrikaans and English show that medial obstruents are weakened to sonorants in accordance with the native root patterns found in the lexicon. When there is an illicit coda in the loan-

word, vowel epenthesis creates a bisyllabic root as shown by the data in (1)(a); or else the illicit final consonant is lost, and the vowel is lengthened, as shown by the data in (1)(b). A third repair strategy involves insertion of a vowel into an initial cluster, breaking up the illicit cluster, and creating a bisyllabic word as shown in the data in (1)(c). The medial consonant, if maintained, is realized as the sonorant allophone of the native stop consonant. All of these repair strategies occur in order for the root to conform to the native pattern where the root is a prosodic word, which conforms to the size restriction that it must be a foot.

	Afrikaans Word	Afrikaans Transcription	English Gloss	Ju 'hoansi Transcription
(a)	bal	[bal]	'ball'	[[bũ <sup>6</sup> rũ]]
	tube (<Eng.)	[tj <sup>h</sup> up]	'tube'	[[tj <sup>h</sup> úpə]]
	boer	[bu:r] <sup>2</sup>	'farmer'	[[bũrũ]]
	hof	[ɦof]	'court'	[[ɦòfə]]
	saag	[sa:x]	'saw'	[[zàχǎ]]
	doek	[duk]	'scarf'	[[tũkǎ]]
(b)	pap	[p <sup>h</sup> ap]	'porridge'	[[p <sup>h</sup> áá]]
	soek	[suk]	'to look for'	[[tũ̀̀]]
(c)	trou	[t <sup>h</sup> rœu]	'wedding'	[[tóró]]
	draad	[dra:t]	'wire'	[[tǎ <sup>6</sup> rǎ]]
	stor (<Eng.)	[stur]	'store'	[[tòrà]] <sup>6</sup>

(1) Loan-word adaptation strategies in monosyllabic roots

In adaptation of bisyllabic loan-words, if the medial consonant is a stop and there are no initial clusters or coda consonants, the medial stop is adapted with a sonorant at the same place of articulation, providing active phonological evidence for the equivalence of the stop and sonorant allophones within the consonant inventory.

Afrikaans Word	Afrikaans Transcription	English Gloss	Ju 'hoansi Transcription
T.B.	[t <sup>h</sup> ibi]	'T.B.'	[[tĩβĩ]]
pampoen	[p <sup>h</sup> əmp <sup>h</sup> oen]	'pumpkin'	[[p <sup>h</sup> əβu]]

(2) Loan-word adaptation strategies in bisyllabic roots

In this section, I have shown that in native roots, 98% of consonants in initial position are obstruents, while 96% of consonants in medial position are sonorants. Additionally, in bisyllabic loan-words, stops in medial position are realized as the sonorant counterparts. Results provided from native roots and shorter loan words are consistent with both the domain of the restrictions being the morphological root, and the foot, or the equivalent prosodic word.

### 3.1.3 Loan-word adaptation of trisyllabic words

In adaptation of loan-words that are longer<sup>5</sup> than a foot, or that become longer than a foot through epenthesis, words are split into two separate prosodic words, as shown in (3). Prosodic word boundaries are marked with curly brackets. Square brackets mark a higher prosodic boundary when these words are produced in isolation as they were in the recordings analyzed here. As can be seen by the data in (3), trisyllabic words can be adapted as three separate prosodic words with a long vowel in each word, as in (a), or as two prosodic words, with either the first word being monosyllabic and the second bisyllabic as in (b), or with the first word being bisyllabic and the second word being monosyllabic as in (c). The example in (c) shows that if repair strategies will result in more than three syllables in the Ju|'hoansi word, elision occurs resulting in a trisyllabic word.

The data in (a) and (b) show that when trisyllabic words contain a sonorant, or where one of the syllables arises through epenthesis into a stop-sonorant cluster, the word is split in a way such that all of the obstruents are aligned to the beginning of prosodic words, and sonorants are parsed in prosodic word medial positions. For example, *patroon* /p<sup>h</sup>at<sup>h</sup>rũn/ 'pattern' is parsed as [[bǎá]{t<sup>h</sup>óró}] but trunk /t<sup>h</sup>rónk/ 'jail'

<sup>5</sup> The Afrikaans [r] is actually an apical trill, and in some dialects in the Cape Area of South Africa, it is realized as a uvular trill (DONALDSON 1993: 15).

<sup>6</sup> The word 'store' is adapted by some speakers as [[sũ]{tòrà}]. This parse is provided in (3) below.

is parsed as  $[\{tóró\}\{k^hòè\}]$  and *knoop* /knúp/ 'button', is parsed as  $[\{kónó\}\{béé\}]$ .

	Afrikaans Word	Afrikaans Transcription	English Gloss	Ju'hoansi Transcription
(a)	emmer	[émɿ]	'bucket'	$[\{ʔám\}\{bàrè\}]$
	appel	[ápɿ]	'apple'	$[\{ʔáá\}\{pàrè\}]$
	petrol	[p <sup>h</sup> étrol]	'petrol'	$[\{p^hée\}\{t^hòrò\}]$
	papier <sup>7</sup>	[p <sup>h</sup> a(m)p <sup>h</sup> ir]	'paper'	$[\{k^həm\}\{p^hári\}]$
	patroon	[p <sup>h</sup> at <sup>h</sup> rún]	'pattern'	$[\{báá\}\{t^hóró\}]$
	Satan	[sát <sup>h</sup> an]	'Satan'	$[\{sáá\}\{tànà\}]$
	skool	[sku:l]	'school'	$[\{sì\}\{kórè\}]$
	store	[stu:r]	'store'	$[\{sì\}\{tòrà\}]$
(b)	tronk	[t <sup>h</sup> rónk]	'jail'	$[\{tóró\}\{k^hòè\}]$
	kers	[k <sup>h</sup> érs]	'candle'	$[\{kéré\}\{sì\}]$
	knoop	[knúp]	'button'	$[\{kónó\}\{béé\}]$
	prys	[p <sup>h</sup> reís]	'price'	$[\{p^hàrí\}\{tì\}]$
	broek	[bruk]	'trousers'	$[\{búrá\}\{k^hòè\}]$
	kruiva	[krœíva]	'wheel barrow'	$[\{kàrí\}\{báá\}]$
(c)	saal kleedjie	[sá:l k <sup>h</sup> lèèk <sup>h</sup> i]	'saddle cloth'	$[\{tàrè\}\{kíí\}]$

### (3) Loan-word adaptation strategies in longer roots

One might argue that faithfulness to syllable affiliation could account for these examples, since the word 'jail', which has the bisyllabic foot initially, contains both consonants in the same syllable in a word-initial cluster in the Afrikaans source word. Further, the word 'pattern' has the cluster medially in the Afrikaans source word, and both consonants of the cluster are maintained in the second prosodic word, which corresponds to the second syllable of the source word. However, this account fails to explain examples like *skool* [sku:l] 'school' which is parsed as  $[\{sì\}\{kórè\}]$ , and *store* [stu:r] 'store' which is parsed as  $[\{sì\}\{tòrà\}]$ . In these examples it is clearly alignment of obstruents to prosodic word initial position which is at stake, since 'sk' and 'st' initial onset clusters containing two obstruents in the source language are parsed into two separate prosodic words, with the bisyllabic word occurring second.<sup>8</sup> Parsing manner of articulation features in the input

<sup>7</sup> Some Afrikaans speakers produce this word with an intrusive nasal consonant before the /p/, while others do not.

<sup>8</sup> These clusters also happen to be sC clusters, whereas the earlier ones are stop-sonorant clusters, which could also account for the difference.

faithfully is best achieved by adaptation into two separate prosodic words. Thus, adaptation of longer words provides strong evidence that prosodic constraints on manner of articulation are active in the phonological grammar.

Additional evidence of the importance of having an obstruent at the beginning of a prosodic word is found in the fact that glottal stop is epenthesis in vowel-initial Afrikaans words like *appel* /ápɿ/ 'apple', which is parsed as  $[\{ʔáá\}\{pàrè\}]$ , and *emmer* /émɿ/ 'bucket', which is parsed as  $[\{ʔám\}\{bàrè\}]$ . Interestingly, when epenthesis of the source language word results in four syllables, one of the syllables is dropped, as in *saal kleedjie* [sá:l k<sup>h</sup>lèèk<sup>h</sup>i] 'saddle cloth', which is adapted as  $[\{tàrè\}\{kíí\}]$ . This fact suggests that these longer loan-words may be interpreted prosodically the same way as compounds, or as roots + clitics. The word length is maintained at three syllables, the maximum found in any Ju'hoansi word.

Additional evidence for the phonological status of manner of articulation asymmetries in words comes from adaptation of loan-words from Bantu languages provided in (4).

Afrikaans Orthography	Afrikaans transcription	English Gloss	Source Language	Ju'hoansi Transcription
ketting	[k <sup>h</sup> ét <sup>h</sup> ɿ]	'chain'	ouketanga	$[\{káá\}\{t^háán\}\{gáá\}]$ (Herero) <sup>9</sup>
karton	[k <sup>h</sup> art <sup>h</sup> ón]	'cardboard box'	??	$[\{kàà\}\{t^hóón\}\{gàà\}]$

### (4) Adaptation of trisyllabic loan-words from Bantu languages

Adaptation of longer loan-words provides evidence that the domain of the positional constraint on manner of articulation refers to the prosodic word.

<sup>9</sup> The Otjiherero words come from VILJOEN & KAMUPINGENE (1983).



### 3.2 Prosodic analysis of positional patterns

In this section, I provide an Optimality Theoretic (McCARTHY & PRINCE 1995) analysis of loan-word adaptation in Ju|'hoansi, showing how constraint interaction can account for the patterns seen in Section 3.2 above.

The phonotactic constraint provided in (5) aligns every obstruent to the beginning of a prosodic word. As seen by Table 3, the probability of this constraint is .98. That is, 98% of all roots have initial obstruents. The probability of a medial consonant being a sonorant is .96. It is likely that both generalizations constitute native speakers' knowledge of the language. However, the constraint proposed in (5) is likely the most useful in parsing the incoming speech stream into words, and is instantiated by loan-word adaptation strategies seen here. It is crucial that *obstruent* is the first argument here, as the alternate order would be incompatible with the facts, since some prosodic words (albeit few) are sonorant initial.

ALIGN (OBSTRUENT, L; PRWD, L): The left edge of every obstruent corresponds to the left edge of some prosodic word.

(5) Positional specification of manner features

The alignment constraint in (5) interacts with the constraints LINEARITY (NO METHATHESIS) (McCARTHY & PRINCE 1995) and the faithfulness constraint IDENT [-SON] that are provided in (6).

IDENT [-SON]: Corresponding segments have identical values for the feature [sonorant].

LINEARITY:  $S_1$  is consistent with the precedence structure of  $S_2$  and *vice versa*.

(6) Additional constraint definitions (McCARTHY & PRINCE 1995)

In Ju|'hoansi, it is more important for an obstruent to occur at the left edge of the prosodic word than it is to preserve the underlying [-sonorant] specification of a medial consonant. As a result, obstruents become sonorants in medial position. This is attributed to the high ranking of ALIGN (OBSTRUENT, L; PRWD, L) above IDENT [-SON] in Ju|'hoansi as shown below in Table 6 for the input root /nə̀bò/ 'to

gather wild food for a few days'. Crucially, the constraint LINEARITY 'NO METATHESIS' (McCARTHY & PRINCE 1995) is also ranked above IDENT [-SON] to rule out the possibility of metathesis causing a root like /nə̀bò/ 'to gather wild food for a few days' to be adapted as \*[bənò]. Instead, the correct surface form is [nə̀βò] which has two sonorants, and only violates low-ranked IDENT [-son]. There is no evidence for any ranking between LINEARITY and ALIGN (OBSTRUENT, L; PRWD, L).

/nə̀bò/	LINEARITY	ALIGN (OBSTRUENT, L; PRWD, L)	IDENT [-SON]
a. [bənò]	*!		
b. [nə̀bò]		*!	
c. [nə̀βò]			*

Table 6: Linearity, Align (Obstruent, L; PrWd, L) > > Ident [-son]

The only consonants found in final position are nasals, which we know are moraic because they are tone bearing, as evidenced by the contrast between monotonal and bitonal CVM roots such as ɓm 'dew' and ɓm 'knot (in wood)'. I propose that it is the undominated constraints WEIGHT-BY-POSITION (HAYES, 1989; MORÉN, 1999), and \*[NASAL] =  $\mu$  provided in (8), that account for the observation that only nasal consonants occur as coda consonants. There are no non-moraic codas in the language. That is, these constraints have a probability of 1.

WEIGHT BY POSITION: Coda consonants are moraic.  
 \*[-NASAL] =  $\mu$ : Non-nasal consonants are not moraic.

(8) Manner constraints on PrWd-final position

In Table 7, I show how a bisyllabic word with a complex 'sC' onset, and a medial obstruent is adapted. I assume that the input is the Afrikaans source word. Alternatively, it could be that Ju|'hoansi speakers who pronounce 'store' as [sii]{tora} actually have the RuKwangali word, *sitora* (KLOPPERS 1994), as the input. That is, the word may have been adapted into the lexicon via the Bantu language RuKwangali.



/stuxr/	LINEARITY	ALIGN (OBSTRUENT, L; PRWD, L)	IDENT [-SON]	IDENT [+SON]
a. [{sɪto}{daa}]		*!		*
b. [{sɪro}{daa}]			*!	*
c. [{sɪro}{raa}]			*!	
d. [{sɪto}{raa}]		*!		
e. [{sɪi}{tora}]				

Table 7: Linearity, Align (Obstruent, L; PrWd, L) &gt; &gt; Ident [-son]

As noted above, other Ju'hoansi speakers pronounce the word 'store' as *tora*. The pronunciation of these speakers suggests that the native strategy may be to simplify the complex cluster by eliding the /s/, although both 's' and 't' are obstruents. As shown in MILLER-OCKHUIZEN (2003:129, Table XIX), word-initial stops are much more frequent than word-initial fricatives. That is, 92.5% of roots contain either pulmonic or velaric plosives, while 23.14% contain pulmonic obstruents, compared with only 7.43% of roots that contain initial sibilant fricatives. This differs from RuKwangali, in which simplified clusters through elision preserve the fricative, as in the parallel simplified form of 'school', *sure*. The existence of both forms exhibiting epenthesis that preserves both consonants of an illicit cluster in the input, and forms with elision show the equal ranking of the faithfulness constraints on consonants, MAX C, which assures that no new material will be realized in the output, and DEP C, which assures that a consonant in the input will be realized in the output (McCARTHY & PRINCE 1995).

The ranking of LINEARITY and ALIGN (OBSTRUENT, L; PRWD, L) over IDENT [SON] also provides the correct result for cases where the bisyllabic foot is parsed initially, as shown in Table 8.

/tʰrɔŋk/	LINEARITY	ALIGN (OBSTRUENT, L;PRWD, L)	IDENT [-SON]	IDENT [+SON]
a. [{toro}{ŋee}]		*!		
b. [{too}{doɣe}]			!*	*
c. [{too}{doke}]		*!	*	*
d. [{too}{roke}]		*!		
e. [{tɔró}{kʰðè}]				

Table 8: Linearity, Align (Obstruent, L; PrWd, L) &gt; &gt; Ident [-son]

### 3.3 Similarity to European languages

The main difference between Ju'hoansi and European language phonologies is that Ju'hoansi contains a much richer set of guttural release properties than are found in European languages. In prosodic word medial position, all of the guttural release properties are neutralized, leading to a comparably very small inventory of medial consonants. Thus, in form, the prosodically based constraints on manner of articulation in Ju'hoansi and European languages are quite similar. The differences lie in the size and shapes of the obstruent inventories in the different languages.

As noted by MILLER-OCKHUIZEN (2003:131), it is not surprising that gutturals and clicks co-occur within a single inventory. Guttural release properties would mask the place of articulation features of pulmonic stops, but this is less likely in clicks given the extra salience of the click bursts (TRAILL 1997; MILLER-OCKHUIZEN 2003).

### 4 Place of articulation asymmetries

Up until this point, I have ignored existing distributional asymmetries regarding place of articulation. In this section, I show that place of articulation asymmetries are strong, but that these asymmetries fall out from additional co-occurrence constraints, and thus place of articulation is not a factor in determining positional distributional asymmetries. This is important for universal phonology, since many theories of sonority (e.g.

ZEC 1994) attempt to avoid place of articulation as a factor in determining sonority.

Labial consonants do not co-occur with most guttural release types (uvularization and epiglottalization), which results in a smaller number of labial obstruents in the inventory compared with coronals and coronal-dorsals. The low number of labial obstruents in the inventory predicts the low frequency of initial labials, since 98% of roots are obstruent-initial due to positional constraints based on manner of articulation/sonority. Dorsal consonants are low frequency in all root positions, given their phonetic ambiguity as guttural vs. oral consonants. Thus, the low frequency of medial dorsals does not need to be accounted for in terms of word position. Multiply articulated segments are completely lacking in medial position, given the lack of extremely low frequency sonorants, like [w] in the inventory.

In Table 9, I provide the distribution of place features in root-initial position, with unmarked oral releases, and with guttural (aspirated, glottalized, uvularized and epiglottalized) release properties. Throughout this paper, clicks have been referred to as coronal-dorsals. Here, click consonants are sub-divided into [-RTR] coronal-uvulars, [!] and [!], and [+RTR] coronal-uvulars, [!] and [!] based on articulatory evidence showing the place of the posterior constrictions in these clicks to be back uvular and front uvular respectively (MILLER, NAMASEB & ISKAROUS (2007), MILLER *et al.* (2009) and MILLER (2009)). These classes correspond to the classes of front clicks and back clicks used by JOHNSON (1993) and MILLER-OCKHUIZEN (2000), which were noted to be [acute] and [grave] respectively by JOHNSON (1993) and TRAILL (1994, 1997). Note that reduplicated words like *p<sup>h</sup>ee<sup>h</sup>ee* 'glutton' and *pamm pamm* 'black eagle' are not included in the database, given the fact that these words, although they may be morphologically one word, are prosodically two words, as shown by the presence of downstep in MILLER-OCKHUIZEN (2003). Similarly, all loan-words having three or more syllables are not included in the database, which focuses on lexical words that are also a single prosodic word. Numbers provided are the observed frequencies (O), Expected frequencies (E) and Observed/Expected

Frequencies (O/E). Expected frequencies are determined by (row total × column total) ÷ overall total. Note that cells with observed frequencies less than five are unreliable statistically.

INITIAL C PLACE	LABIAL	CORONAL	[-RTR] CORONAL-UVULAR	[+RTR] CORONAL-UVULAR	DORSAL	TOTAL
GUTTURAL	O=2 E=24 O/E=0.1	O=95 E=160 O/E=0.6	O=261 E=233 O/E=1.1	O=309 E=300 O/E=1	O=40 E=56 O/E=0.7	774
NON-GUTTURAL	O=51 E=31 O/E=1.6	O=261 E=209 O/E=1.2	O=258 E=305 O/E=0.9	O=357 E=391 O/E=0.9	O=84 E=73 O/E=1.2	1011
TOTAL	53	356	519	666	124	1718

Table 9: Co-occurrence of place features with guttural vs. oral release properties on prosodic word initial obstruents in CVV, CVVCV, and CVCV root types

Table 10 provides the number of consonants by place of articulation in the inventory. Note that there are only two labial obstruents with guttural release properties in Table 9, given the complete lack of uvularized and epiglottalized labial obstruents in the inventory, shown in Table 10. Recall that the two labials with guttural release properties are aspirates. Thus, there is a constraint against [RTR] specified on uvularization and epiglottalization co-occurring with the place feature [labial].

Following labials, the number of dorsals with guttural release properties is the next lowest, followed by coronals, with [-RTR] coronal-uvulars and [+RTR] coronal-uvulars (e.g. click consonants) exhibiting the highest number of roots with guttural release properties. The relative numbers then closely resemble the general relative frequencies of each place of articulation in the obstruent inventory, except for labials. As seen by the observed over expected values present in Table 9, words containing initial labials with guttural release properties are highly under-represented given the number of words with initial labial consonants, and the number of roots containing initial consonants with

guttural release properties.<sup>10</sup> Coronals, dorsals, [-RTR] coronal-uvulars and [+RTR] coronal-uvulars display observed over expected values close to 1 in Table 9, showing that the number of roots containing initial coronals, dorsals, [-RTR] coronal-uvulars and [+RTR] coronal-uvulars with oral and guttural release properties are represented at close to the expected value given the number of coronal, dorsal, [-RTR] coronal-uvulars, and [+RTR] coronal-uvulars initial roots, and the number of orally and gutturally released consonants at a particular place of articulation in the inventory. Interestingly, for both classes of clicks ([-RTR] coronal-uvulars and [+RTR] coronal-uvulars), roots containing initial clicks with guttural release properties are slightly over-represented, while roots containing initial clicks lacking guttural releases are slightly under-represented. These relative frequencies again are similar to the relative frequencies of clicks with and without guttural release properties in the inventory. Note that since nasalized clicks behave as obstruents, that is, they occur in prosodic word initial position, and they have well-defined click bursts, they are included in Table 10. The general low frequency of dorsals in Table 9 is also parallel to the low number of dorsals in the inventory.

INITIAL C PLACE	LABIAL	CORONAL	[-RTR] CORONAL- UVULARS	[+RTR] CORONAL- UVULARS	DORSAL	UVULAR	TOTAL
# OF CONSONANTS IN THE INVENTORY WITHOUT GUTTURAL RELEASE PROPERTIES	2	6	6	6	2	1	23
# OF CONSONANTS IN THE INVENTORY WITH GUTTURAL RELEASE PROPERTIES	2	18	18	17	3	0	58
TOTAL	4	24	24	23	5	1	81

Table 10: Number of obstruents in the inventory by place of articulation

<sup>10</sup> The two bisyllabic words that contain initial guttural labials are *p<sup>h</sup>òrò* 'castrated animal' and *p<sup>h</sup>èrù* [{phera}] 'pill' > Afrikaans *pil*. Other labial initial words are longer than two syllables *p<sup>h</sup>ep<sup>h</sup>e* [{p<sup>h</sup>èè}{p<sup>h</sup>èè}] 'glutton', which may be onomatopaeitic.

As was suggested by MILLER-OCKHUIZEN (2003), the absence of initial labials with guttural release properties may be due to the low salience of noise bursts associated with labial consonants. Since guttural release features often mask the formant transitions associated with the initial constriction (particularly in the case of the uvularized and epiglottalized consonants), the remaining cue for stop place is the frequency of the stop noise-burst. The low lexical frequency of dorsals in either position suggests the overall low frequency of dorsals in the language. I suggest that this is because dorsals are ambiguous with respect to their status as guttural vs. non-guttural consonants. The ambiguity is also supported by the variable phonological behavior of plain dorsals as [+RTR] with respect to the Back Vowel Constraint (MILLER-OCKHUIZEN 2003, 2000; TRAILL 1985, 1994, 1997). That is, words like 'really' in Ju'hoansi are sometimes realized as [{ki|e}] and sometimes as [{kəi|e}] as produced by the same speaker in the same social setting. In the [{kəi|e}] variant, the /i/ vowel is diphthongized, as happens in the context of [RTR] consonants.

Table 11 provides the number of bisyllabic roots (both CVCV and CVVCV) in the language that have combinations of particular initial consonants with particular medial consonants by place of articulation. As can be seen, there are no apparent active co-occurrence constraints involving place of articulation. Additionally, as can be seen, the number of prosodic word medial consonants at a given place of articulation is consistent with the number of prosodic word initial consonants at a given place of articulation, showing that the weak medial variants are allophones of the full set of initial consonants. That is, with coronals, the medial sonorant [r] appears to be a variant of the complete set of initial coronal obstruents with all of the guttural release properties that occur in initial position (including coronal-dorsal click consonants). This analysis brings the comparison to 544 initial consonants containing a coronal feature, and 489 medial coronal consonants, mostly the coronal flap [r], which are similar numbers. However, there is no equivalence in the frequency of initial labial stops and medial labial sonorants. There are only 38 roots containing initial labial obstruents, but 313 roots



containing medial labial sonorants. This can be easily understood as the result of a lack of guttural labials in the inventory.

INITIAL C ↓ MEDIAL C	LABIAL [p]	CORONAL [t]	[-RTR] CORONAL- UVULARS [l, [ʃ]	[+RTR] CORONAL- UVULARS [ɰ, [ɰ]	DORSAL [k]	PHARYNGEAL and UVULARIZED CONSONANTS	LARYNGEAL [f], [ʔ]	TOTAL
Labial [β, m]	7	58	57	113	15	56	7	313
Coronal [t, n, s, ʃ]	28	79	105	122	35	108	12	489
Dorsal [ɰ, ɰ]	1	4	2	0	2	0	0	9
Uvular [χ]	0	2	0	1	0	0	0	3
Laryngeal [f]	2	1	0	0	0	0	0	3
Total	38	144	164	236	52	164	19	817
Total	38	544			52	164	19	817

Table 11: Frequency of initial and medial place features for bisyllabic roots (CVCV and CVVCV)

Other Khoesan languages display similar patterns. For example, TRAILL (1979, 1985) notes that in !Xóǀ, there are 119 initial consonants, and 6 medial consonants. The six medial consonants in !Xóǀ are [b], [dʷ], [m], [n], [ɲ], and [l]. However, TRAILL (1985:165) notes that “the stop /dʷ/ is quite regularly pronounced as a glide [j] and b often appears as [β].” It is quite likely that the weakening of [b] and [dʷ] can be accounted for once the prosodic structure of !Xóǀ is better understood.

TRAILL (1979, 1985) accounts for the positional asymmetries in !Xóǀ with reference to the strength hierarchy, based on HOOPER's (1976) version of the hierarchy. Strength has more recently been replaced by sonority, which is fairly equivalent, but which is the inverse of strength. That is, a more sonorous segment is weaker, and a less sonorous one is stronger. Traill's language-specific strength hierarchy for !Xóǀ includes divisions based on place of articulation, with velars being stronger than labials and coronals.

BRUGMAN (2009) provides a complete account of Khoekhoe consonant distributional asymmetries at both the word level, and above the word level. In addition to manner of articulation asymmetries, she shows that there are positional asymmetries in the occurrence of click consonants.

As I have shown, the distributional regularities among labial place of articulation and guttural release properties account for the low frequency of Ju|'hoansi labials in initial position. Thus, distributional asymmetries involving place can be accounted for as constraints on the inventory, rather than as constraints on sonority per se. ZEC (1994) argues that minimal distance constraints on syllable structure should be accounted for separately from sonority constraints. Thus, the separation of place asymmetries to constraints on the inventory, and sonority constraints as positional constraints, allows the separation of constraints on place and manner proposed by ZEC (1994) to be maintained.

Looking at the !Xóǀ inventory as laid out in TRAILL (1994), labial clicks seem to demonstrate a comparable number of click accompaniments as found with other click types. However, labial pulmonic stops show a smaller inventory compared with pulmonic coronals and dorsals. This suggests then that labial clicks are still stronger perceptually than labial non-clicks.

## 6 Conclusion

In this paper, Ju|'hoansi consonantal distribution asymmetries are accounted for by cross-linguistically common principles. Obstruents are licensed in prosodic word-initial position, and sonorants occur through weakening in prosodic word-medial position. Additional apparent positional place of articulation restrictions fall out from the number of consonants in the consonant inventory. Labials are rare initially given the lack of labials with pharyngeal (uvularized and epiglottalized) release properties in the consonant inventory. I have suggested that this asymmetry in the consonant inventory is due to the general low perceptual salience of labial formant transitions. Dorsal consonants, on the other hand, are rare in both positions. This is because of their



phonetic ambiguity as guttural vs. oral consonants. I have also shown that the frequency of medial coronal flaps is similar to the frequency of initial consonants bearing a [coronal] feature (clicks and non-clicks), suggesting that coronals (including clicks) may weaken to the coronal flap, either synchronically or diachronically.

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## Juu subgroups based on phonological patterns

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### 1 Introduction

Out of Jan Snyman's many contributions to Khoesan linguistics come two important works on Comparative Juu (Northern Khoesan): his 1979 comparison of Angolan !Xung and Ju|'hoansi, and his 1997 comparison of 12 Juu lects. I offer this study as a way to honor and extend his contributions. While my classification of Juu lects differs from his in certain ways, it could not have been done without access to the data he generously published. All unmarked data in this paper come from SNYMAN (1997), the only database of matched, and consistently well-transcribed lexical items covering a wide range of Juu lects.

### 2 Preliminaries

#### 2.1 Previous classifications

Juu classifications list as few as two and as many as four major groups. BLEEK's (1929, 1956) NI, NII and NIII groups essentially correspond to Snyman's Southern, Central and Northern clusters. WESTPHAL (1956) has four total groups, splitting Bleek's NI into two groups, but WESTPHAL (1971) has only two groups (he does not consider any central area lects in this classification). MAINGARD (1957) follows Bleek and Snyman in grouping †Au|len with Ju|'hoansi together, apart from the centrally located lects, while KÖHLER (1981) claims that †Au|len is between the Southern (his "ikhung oriental") and Central (his "ikhung occidental") lects. These older classifications, then, mainly disagree as to whether †Au|len and Southern Juu are distinct major groups. These earlier classifications contrast with two recent studies which group some NII/Central lects with the NIII/Northern group based on explicit linguistic criteria. KÖNIG & HEINE (2001) use grammatical criteria to group central and northern lects together. Based on reflexes of the Proto Juu retroflex click \*!/, SANDS & MILLER-OCKHUIZEN (2000) group the more