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The Phonological System of Tumʔi

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Abstract
As part of a linguistic research team I recorded a Khoisan language currently spoken by three people in the Northern Cape province of South Africa. Since the variety of language spoken in this location is close to varieties of both the Khoekhoe and Tuu language families, the question of genetic affiliation and classification within the Khoisan language cluster becomes significant. Although reported to have significant lexical similarities due to intensive language contact (Güldemann 2006), extensive research provides evidence of numerous linguistic differences which distinguish between the varieties within the Khoisan families mentioned above (Beach 1938, Bleek 1930, Ladefoged & Traill 1994, Miller, Brugman, Sands, Namaseb, Exter & Collins 2007). Overall, this project attempts to answer the question: How unique is this undocumented language Tumʔi in comparison to varieties of geographically neighbouring Khoisan language clusters? This comparative analysis is comprised of a detailed description of the vowel and consonant systems, as well as evidence of phonetic and phonological contrasts. The clear focus on the analysis of sound contrasts is a consequence of limited data due to speaker competence. As a result of intense incomplete acquisition and linguistic attrition, the consultants produce utterances using Khoisan content words within an Afrikaans framework (Killian 2009). Specific research questions include:

- What is the sound inventory of this language?
- Are there phonation or glottalization contrasts in vowels?
- Are there laryngeal contrasts in consonants?
- What kinds of clicks make up the inventory?

This project is a direct effort toward the revitalization and documentation of indigenous languages. Determining the genetic affiliations of this language which is positioned relatively equidistant to the surrounding languages, would also contribute to gaps within the linguistic isoglosses in South Africa.

Keywords: Khoisan; endangered languages; phonetics; phonology; glottalization; clicks

1. Introduction

The goal of this research is the documentation and phonological codification of the Khoisan variety Tumʔi, within the fieldwork and constraints of ‘salvage linguistics’ (Grinevald 2003).

Tumʔi is a variety discovered in the small town of Prieska in the Northern Cape province of South Africa. The linguistic community consists of a group of three siblings between the ages of 64 and 80. The variety of Khoisan spoken by these individuals has been consensually named Tumʔi, as the speakers originally referred to their language as *hottentotstaal*, which is considered a derogatory term in South Africa. Hottentot language is also referred to by Beach (1938) as a click language originally spoken by people living in South-West Africa. This language was found situated geographically close to varieties of both the Khoekhoe and Tuu language families, therefore the question of genetic affiliation and typological similarity within the Khoisan lineages becomes significant. This is addressed through the analysis of phonetic, phonological and lexical similarities and oppositions between Tumʔi and representative Tuu and Khoekhoe languages (Beach 1938, Bleek 1930, Ladefoged & Traill 1994, Miller 2007). The results presented in this paper are the sound inventories which make up the phonological system. This includes all phonemic contrasts as well as typologically significant phonetic features.

2. Sociolinguistic context: Endangered languages and speaker competence

Based on our investigation, there are three known speakers of this language; Elsie George, age 80; Francina George, age 70; and Robert George, 64. As siblings raised in the same home in Prieska, they were all exposed to the same linguistic variety. However, their levels of exposure and resulting knowledge vary. This variation is mainly attributed to their substantial differences in age, with Elsie noticeably being the authority on the language and Robert being the least knowledgeable speaker. Aside from the age differences there is also the gender distinction - as a non-white male in South Africa, Robert was required to leave home to work on the nearby farms and contribute financially to the household. Hence, Robert's exposure to the language ended when he became a teenager, unlike his sisters who attended school for a longer period and spent most of their time helping in and around the home. Hence, within this linguistic community, which is made up of only three speakers, the speaker knowledge constitutes a continuum of proficiency, though not extending from full fluency (Dorian 1977).

The importance of speakers as a source for endangered language research and fieldwork cannot be overstated. Unlike speakers of non-endangered languages, the complete population of an endangered language may consist entirely of marginal speaker types, speakers with limited linguistic competency as a result of several interrelated factors. At the time these speakers were born, Khoe and San people had already been subjected to decades of oppression and coercion by the South African government to reidentify themselves as "Afrikaans-speaking Christian 'coloured'" communities (Killian 2009:12). This process of reclassification involved not only abandoning their indigenous identities but also their languages. Hence, the speakers of Tumʔi acquired an already endangered language--a language used only in the home and rarely directed to them as children, due to the fact that the general attitude toward the use of this language was one of trepidation.

Though the 'semi-speaker' has been found to be emblematic of the endangered language situation, the consultants involved in the documentation of Tumʔi are better described as 'terminal speakers'. The negative connotation associated with this profile has caused some debate across the literature on speaker typology, however it most accurately encompasses the distinction between the linguistic abilities of the 'semi-speaker' and that of the consultants involved in this project. The speakers of Tumʔi retain a passive knowledge of the language,

even the eldest and most knowledgeable speaker has very limited productive skills. Conversation between speakers is conducted primarily in their dominant language Afrikaans, with the insertion of fixed phrases and expressions from their endangered language (Grinevald 2003). The reality of the situation in the case of endangered language study is that the reduced use of the language generally leads to a reduced form of the language (Dorian 1977:24).

3. Data collection and elicitation

The elicitation sessions were conducted across two data collection trips, the first only three days long, and the second spanning six days. The data accumulated on the initial trip is comprised of a total of three hours and five minutes of recorded data. A total of ten hours and six minutes of elicitation was conducted on the second trip, significantly more than the initial trip as the second trip was initiated solely to collect data of this specific variety. The method of data collection consisted mainly of single word elicitations using word lists adapted from previous fieldwork expeditions. The word list consists of basic verbs and actions as well as body parts and a few possible nouns relevant to the lifestyle and surroundings of the indigenous community (Kilian 2020, appendix G). Picture prompting was also used as a method of elicitation. During this process participants were shown pictures of indigenous plants and animals taken from Branch et al. 2001, Picker et al. 2002, Iwu 2014, and Van Wyk 2013, for which they were asked to provide a name, generally resulting in the elicitation of a different but semantically related lexical item.

The methodological process of endangered language documentation is pervaded with obstacles related to competence, insecurity, and multiple layers of both linguistic and social deprivation. Due to this reality, the research team which consisted of Dr William Bennett, Dr Levi Namaseb, and myself, was unable to collect any traditional stories or productive interaction solely conducted in Tumʔi. The data therefore consists mainly of individual lexical items which do not appear to display any derivable morphological information. Further conditioned by the context of endangered language research there appears to be extensive phonetic, phonological and semantic variation across the lexical items. Within this research framework, variation of this nature is attributed to the lack of any documented norm as many endangered languages such as Khoisan are historically spoken and not written. Ultimately, the limitations on elicitation and the collected data have directly constrained the type of linguistic analysis realizable for the documentation of this language variety.

4. Phonological system

4.1 Click inventory

The click inventory of Tumʔi as spoken today is limited to four distinct click types and three accompaniments. Two of the three accompaniments are attested across most click languages, which provides little evidence of exclusivity or typological distinctiveness (Ladefoged & Traill 1984, Ladefoged et al. 1999). However, the third accompaniment discovered in the inventory of Tumʔi is the audible uvular stop accompaniment which is rarely reported in the documentation of click languages (Miller 2007). This accompaniment is particularly unusual in that the resulting click is composed of two noise bursts. Reports of this click accompaniment are limited to a select number of languages most of which are classified as belonging to the Tuu family, hence the presence of this accompaniment in Tumʔi is a typologically remarkable find.

Table 1: The Tumʔi click inventory

Click Types → Accompaniments ↓	dental	lateral	palatal	alveolar
plain	ǀ	ǁ	ǂ	ǃ
uvular stop	ǀq	ǁq	ǂq	ǃq
nasal	ŋǀ	ŋǁ	ŋǂ	ŋǃ
velar fricative	ǀx			ǃx

The plain clicks presented above are the most under-utilized of the click segments transcribed across this data set. Generally, the speakers produce clicks with some form of accompaniment The most common is the pulmonic uvular accompaniment which constitutes a second distinct noise burst. A similar distribution of this lingual pulmonic segment has been reported for the languages !Xóõ and ǀGui, in which the uvular position appears to be exploited more frequently than predicted (Güldemann 2001). This unexpected distribution may reflect the speaker's intention to retain the unique features of the language by extending the use of the infrequently attested uvular accompaniment. Together the nasal and uvular stop accompaniments are the most frequently occurring posterior release types. However, the audible uvular accompaniment is what sets the click inventory of Tumʔi apart as typologically complex. The velar fricative accompaniment occurs infrequently throughout the data set, however, this accompaniment is clearly audible and phonetically distinct in particular lexical items such as ǀxei 'give birth' and !xara 'female genitals-type'.

4.2 Clicks in Khoisan varieties

Click segments are a unique class of sounds defined by the rarefaction of air concealed by two articulatory closures (Ladefoged & Maddieson 1996:246). Numerous descriptions of clicks are presented throughout the literature on Bantu and Khoisan languages, and are generally concerned with the phonological oppositions between different clicks. In-depth phonetic analyses of the click systems of particular Khoisan languages have provided evidence for extending these phonological distinctions and identifying more fine-grained differences between the articulation of different clicks (Ladefoged & Traill 1984). The general acoustic analysis of clicks is concerned with the waveform and spectra which align with the release of the anterior closure. The analysis of this closure release provides a phonetic interpretation of the sound produced as a result of the articulators separating and the rapid change in the configuration of the vocal tract (Ladefoged & Maddieson 1996:257).

The release of the posterior closure is generally described as a voiceless velar accompaniment which is not reflected in the acoustics, or a velar nasal accompaniment depending on the position of the velum (Ladefoged & Traill 1994). However, the stance adopted in this paper is one proposed by Miller (2007) which states that the place of articulation of the posterior release is uvular, with possible contrasts in voicing and discrepancies relating to the position of the anterior closure. The proposition that the posterior release is positioned at the uvula and not the velum is based on the analyses of ultrasound data collected from speakers of N|uu. The

importance of this claim is related to the discovery of the lingual-pulmonic click, which is acoustically remarkable in that it produces two noise bursts (Miller 2011:420). The latter burst displays the features of a uvular stop. Following the assumption that this is a voiced counterpart to the general posterior release, both accompaniments are described as uvular (Miller et al. 2009, Miller 2007).

As click sounds are indigenous to Khoisan languages, it is challenging to distinguish between particular languages and dialects based solely on their click inventories. Comparative studies of representative languages belonging to different Khoisan language families discuss the differences and similarities between these click inventories, with the general diagnosis that languages of the Tuu family contain a larger variety of clicks and accompaniments (Childs 2003). However, results of areal typological analyses have reported the effects of language contact on click inventories to be extensive, with Khoekhoe languages exhibiting a similar reliance on click segments as observed in Tuu languages (Güldemann 2006). Therefore, the distribution of click types within a linguistic inventory, and the functional load of click segments across collected data sets may not be sufficient to distinguish between the phonological typologies of Khoisan varieties classified within different lineages.

4.3 Consonant inventory

Consonant phonemes are generally described by the characteristics of place of articulation and manner of articulation. As indicated by the columns in table 2 below, the articulators involved in producing egressive consonants in Tumʔi include the lips, the tongue positioned at the alveolar ridge or velum, and the closure of the glottis. The consonant inventory of Tumʔi also consists of different manners of articulation. This includes seven plain plosives produced with complete closure of the vocal tract, followed by a release burst. The aspirated alveolar plosive is the only aspirated segment and is phonetically distinct from the plain voiceless plosive [t]. The voiceless alveolar plosive is the only segment proven to consistently exhibit a contrast in aspiration. The consonant inventory also includes three nasal stops produced with complete closure of the oral cavity at either the bilabial, alveolar or velar places of articulation, with a lowered velum allowing airflow through the nose. Sounds with close approximation of articulators but not complete closure include the six fricatives and single affricate, as well as the labio-velar and lateral approximant presented in the inventory below. Finally, this consonant inventory also includes an alveolar trill which is produced with continuous tapping of the tongue-tip against the alveolar ridge.

Table 2: The Tumʔi non-click consonant inventory

	Bilabial	Lab-dental	Lab-velar	Alveolar	Velar	Glottal
Plosive	p b			t d t^h (t^j)	k g	ʔ
Ejective				(t’)		
Fricative	(β)	f v		s	x	h

Affricate				(tʃ)		
Nasal	m			n	ŋ	
Approximant			w			
Lateral approximant				l		
Trill				r		

The /t/ phoneme is one of the most frequently used plosives, occurring word initially, word medially, and word finally (see table 3 below). This is also the only phoneme which may be produced with additional aspiration, or as distinctly unaspirated. Though the degree of aspiration has been exhibited to vary across tokens of the same lexical item, [tumʔi] 'speak', the aspirated segment [tʰ] is produced consistently in tokens of the lexical item [tʰi!qo] 'God', while the unaspirated [t] is consistently produced in tokens of the lexical item [tərəŋtərəŋ] 'crazy'. /k/ exhibits the most frequent distribution across the non-click consonants, occurring both in the word initial and word medial position. The final voiceless stop /p/ occurs both word initially and in word final position, indicating that the voiceless stop consonants are more widely distributed than the voiced stops, /d/, /b/, and /g/, which occur in either the word initial or word medial position and are each transcribed in no more than three lexical items.

Table 3: Frequency of each consonant type in each word position

Phoneme	Word initial	Word medial	Word final
p	3	1	4
b	3	-	-
β	-	1	-
m	2	21	9
f	-	1	-
v	2	4	-
w		11	
t	12	7	2
d	2	-	-
s	8	6	11
tʃ	-	1	-
n	2	6	4
l	-	4	2
r	-	31	3
k	4	32	-
g	1	2	1
x	10	11	-
ŋ	-	10	3
ʔ	-	1	-
h	3	-	-

The fricatives /s/, /f/, and /v/, are limited to either word initial position, or word medial position. The phoneme /h/ also occurs both word initially and medially, however it appears to only precede the low vowel /a/. /x/ appears to be the most frequently occurring and unrestricted fricative, extending to the accompaniment of clicks in variations of particular lexical items. The bracketed phoneme /β/ is transcribed in medial position of tokens of a single lexical item [taβa] 'handiwork'. This bilabial fricative appears to alternate with the phonemes /v/ and /w/ across tokens of this particular lexical item. The nasal phoneme /n/ is frequently transcribed across the data set, however it occurs mainly as an accompaniment to one of the four click types. The actual phoneme /n/ as well as the phoneme in the form of a click accompaniment appear in both the onset and coda position of the syllable, however in the word initial position the phoneme /n/ is only present as a click accompaniment. The other pulmonic egressive nasal phonemes /m/ and /ŋ/ share similar wide-spread distributions, however the phoneme /ŋ/ is clearly more restricted in its distribution than /m/, occurring only in coda position of words.

Particular phonemes recorded infrequently and inconsistently include /l/, /tʃ/ and /tʲ/. The lateral approximant /l/ is recorded solely in the Afrikaans borrowing [vələ] 'wild' from the Afrikaans word 'wilde' (vəldə), which is used in reference to different types of medicinal plants. This includes lexical items like [vələals] and [vələ-kier], which both refer to unspecified plants used for medicinal purposes. The phonemes /tʃ/ and the /tʲ/ are among those bracketed in table 1, which means though these segments have been transcribed, their phonemic contrastiveness cannot be verified. The segments [tʃ] and [tʲ] are both transcribed in tokens of the lexical item [kut͡ʃaka]/[kutʲaka] 'go out'. Consequently, these phonemes are bracketed and not definitively proposed as phonemes of the consonant inventory, due to alternating production across tokens of a single lexical item, and their absence in any of the other lexical data.

4.4 Non-click consonants in Khoisan varieties

Generally, a consonant inventory of this size is not commonly observed across Khoisan dialects, with most exhibiting a limited number of egressive consonants. However, there are segments which are commonly observed across the phonological systems of Khoisan languages but are not attested in Tumʔi, including the affricates /ts/ and /kx/ (Beach 1938:65-67, Güldemann 2006:11, Killian 2009:27). Based on previous typological analyses the consonant systems of Khoekhoe and |Xam are similar in overall organization. The major difference between these systems concerns the size of the inventory, which in turn is a typological consequence of an extended variety of distinctive features attested in Tuu languages (Güldemann 2006).

Khoekhoe languages lack laryngeally marked stops including both aspirated egressives and ejectives; observations across the inventories indicate that these segments have been replaced with aspirated and ejective fricatives. The same laryngeally marked stops are however also unattested in the consonant inventory of |Xam which is considered typologically unusual (Vossen 2013:211). Previous analyses attribute this shared lack of complex stops to the phonological process of affricate lenition (Beach 1938, Vossen 2013:211). Also lacking from the phonological inventories of Khoekhoe varieties is a voicing distinction. Egressive segments with the feature [+voice] are absent from Khoekhoe varieties with the exception of !Ora and |Gui (Güldemann 2006, Vossen 2013:153). Therefore, any evidence of the laryngeally marked stops, such as those discussed above, or a phonological voicing distinction would naturally align with the phonological typology of Tuu languages.

4.5 Vowel system

Distinctions in vowel quality are generally determined by three aspects including vowel height, vowel backness, and lip rounding. These aspects are reflected in the acoustic properties of vowels, the most prominent of which are the formants (Ladefoged & Maddieson 1996:104). Vowel height is proportional to the inverse of the frequency of the first formant (F1), while vowel backness is proportional to the frequency of the second formant (F2), or the difference between the frequencies of the first and second formants. Finally, the degree of lip rounding is generally indicated by the lowering of the second and third formants (F3) (Ladefoged & Johnson 2014:217). The vowel charts presented in figures 1 & 2 below do not include F3 values, therefore degrees of lip rounding are not a central aspect of this analysis and are based solely on the articulatory features reported in the production of each vowel. The F1 and F2 measures are precisely arranged along the axes to provide the most informative phonetic view of the vowel distributions. The F2 measures are indicated along the horizontal axis, with the value increasing from right to left. The F1 measures are presented along the vertical axis, with the value increasing downward. Plotting the formant measures according to this scale provides a visual representation of the acoustic features of the vowel that correspond roughly to the articulatory dimensions of the vocal tract (Ladefoged & Maddieson 1996:131).

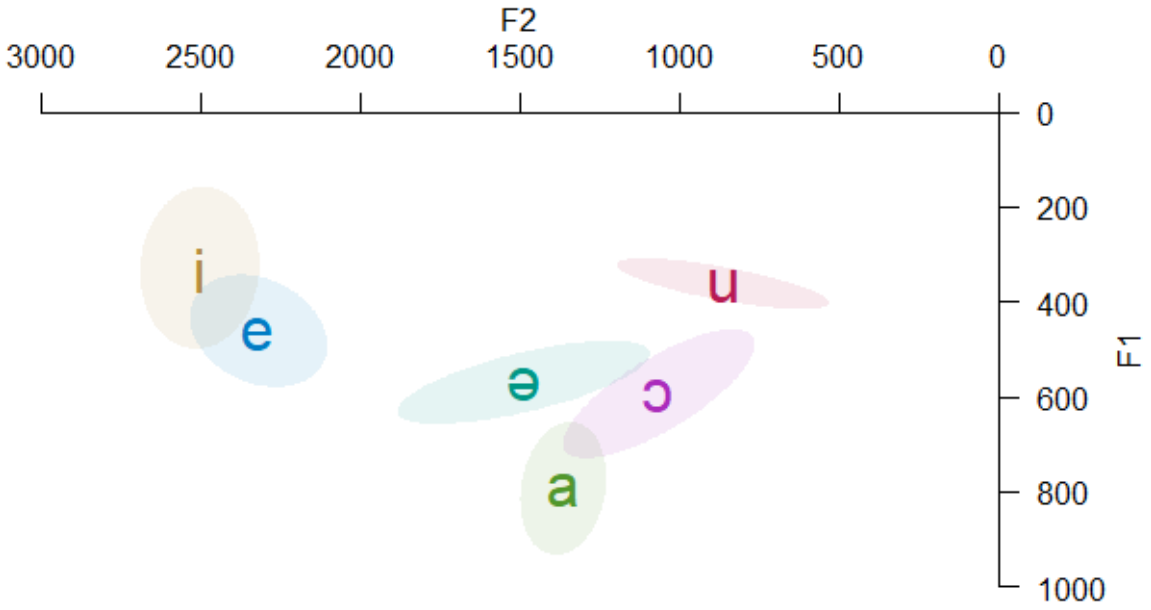

Figure 1: Formant plots of Tumʔi monophthong vowels. The ellipses are drawn according to the covariance calculated for the tokens, and a default confidence interval ellipse.

4.6 Monophthongs

The phonemes /i/ and /u/ constitute the high vowels of Tumʔi. /i/ is produced as a close front unrounded oral vowel with little variation across tokens. The phoneme /u/ is articulated as a close back rounded vowel and exhibits a wider distribution than its front counter-part /i/. /u/ occurs mainly as the first vowel in the initial syllable in a word, indicating that it may be a vowel phoneme designated to particular roots. This distribution may be explained by the fact that lexical roots ending in /u/ and /i/ are commonly observed in Khoisan languages (Beach 1938:42). The mid-vowels identified in the inventory include the phonemes /e/, /ɔ/ and /ə/. The

phoneme /e/ is articulated as a half-closed front unrounded vowel and appears to occur mainly in word-final position, or as the nucleus of the final syllable. The back mid-vowel counterpart to /e/ is articulated as the open rounded vowel [ɔ], which appears frequently as the nucleus of the first and second syllable. Based on the vowel chart in figure 1 above, the mid-back vowel is positioned both lower and more centralised within the vowel space than the mid-front vowel [e]. These disparities further indicate that the mid-back vowel is generally positioned closer to the 6th cardinal vowel and is hence transcribed as [ɔ] and not [o] (Ladefoged & Johnson 2014:218).

Finally, the phoneme /ə/ is articulated as an unstressed central vowel. The schwa in Tumʔi generally appears in the second or final syllable, only observed in the first syllable of [|qəri] honey beer, [pəri] 'goat', [məkəs] 'upper thighs', and Afrikaans loan words such as [vələ] 'wild' from the Afrikaans word 'wilde' (vəldə). The phoneme /a/ is articulated as a low central unrounded vowel, distributed evenly and frequently throughout the data. This unrestricted distribution in position and co-occurrence with other vowel phonemes would align with attested distributions of the low vowel /a/ in other Khoisan languages (Beach 1938:39, Güldemann 2006:Appendix 1).

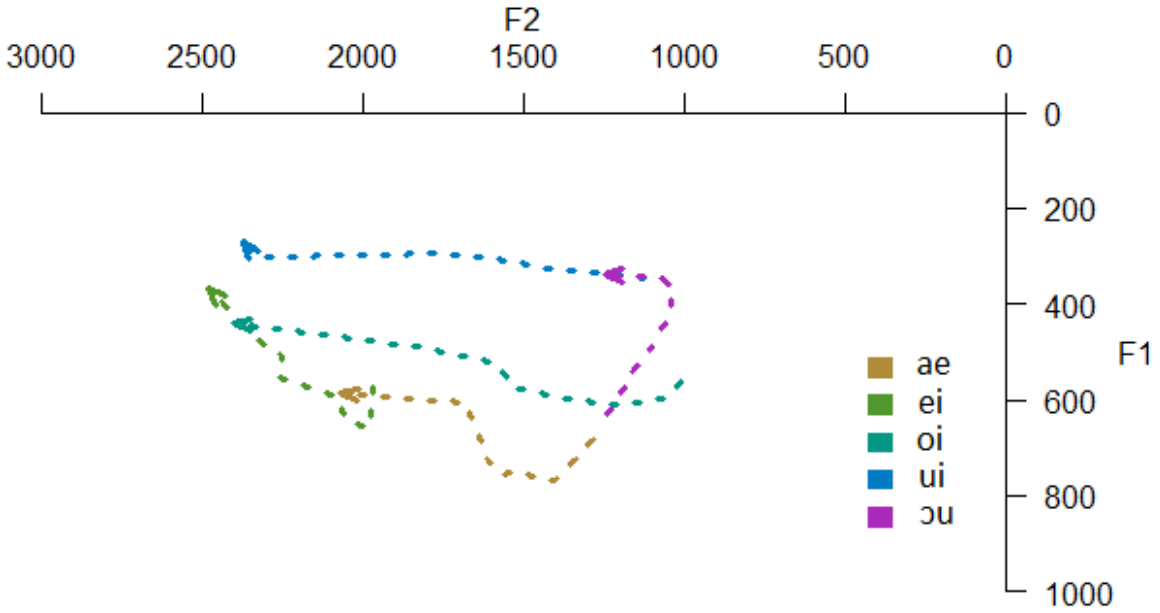

Figure 2: Formant plots of Tumʔi diphthong vowels. The line segments connect the mean values of the formants retrieved at multiple time points throughout the vowel.

4.7 Diphthongs

The vowel system of Tumʔi includes a total of five diphthongs, all of which end with a high vowel, preceded by a low, mid or back vowel. This is a significantly large collection of 'unlike vowel sequences' (Güldemann 2006:384), which appear to be unrestricted in terms of position within the word as well as in terms of co-occurrence with other vowel phonemes. The phonemes /ei/, /oi/ and /ui/ all reflect a shift to the high vowel /i/. The vowel chart in figure 2 above displays three diphthongs which glide to /i/ and end at the same general height and front position. The diphthong /ae/ which could be perceived as the higher ending sequence [ai] appears to glide to a distinctly lower front position. The phoneme /i/ in the diphthong /ai/ is generally expected to be articulated as more open and flatter than when produced as a

monophthong (Beach 1938:36), hence the end point of the low diphthong in the chart above is most accurately transcribed as [ae] and not [ai].

4.8 Vowel systems in Khoisan varieties

The vowel systems of Khoekhoe dialects are defined by three distinctive features: the limited number of vowel phonemes, the lack of diphthongs except in instances of very rapid speech, and the phonemic presence of both oral and nasal vowels (Beach 1938:35). The vowel systems of northern Khoekhoe languages as well as !Ora are reported to include the five basic vowels /i e a (ə) o u/, with the mid-central vowel generally considered neutral and non-phonemic. These five vowels are each reported to have a nasal counterpart, with the exception of the mid-front vowel /e/. Furthermore, laryngeal phonation and related vowel colourings are not reported as distinctive features in any of these varieties (Vossen 2013:150). Southern Khoisan varieties, though generally reported to exhibit the same basic five vowel system, additionally exhibit attested nasalized vowel contrasts, as well as distinctively laryngealised vowel contrasts (Garellek 2019, Miller et al. 2009, Vossen 2013:208).

Based on data collected by Ziervogel & Potgieter, and Dorothea Bleek, a phonetic triangulation of the Tuu language ǁX'egwi, reports: a vowel system with a phonemic oral-nasal distinction, variation in openness across mid-vowels [o] and [e], as well as what are referred to as 'true diphthongs', including [oa] and [əu] (Hastings 2001). Analyses of other purportedly extinct Tuu varieties such as N|uusaa and |Xam report consistent occurrences of diphthongs as VV sequences of unlike vowels (Güldemann 2006:384, Appendix 1). These transcribed sequences include the combinations [ai] and [ui] observed in the words [tai] 'to leave', and [!ui] 'man', which form strong cognates with the same lexical items found in |Xam, |Auni, N|u, and N|uusaa. Wide-spread analyses of the vowel systems documented for different Tuu varieties therefore report a general presence of diphthongs as well as contrastive phonation, which both appear to be rarely attested in varieties of the Khoekhoe lineage (Vossen 2013).

Table 4: Lexical comparison

	Tuu					Khoekhoe	
Gloss	|Xam (Bleek & Lloyd Dic.) (Guldemann 2005 & 2006)	|Auni (Hastings 2001)	N|u (Miller et al. 2009)	N|uusaa (Guldemann 2006)	Tumʔi	Nama (Beach 1938, Killian 2009)	!Ora (Beach 1938, Killian 2009)
woman	!kui tait	|kẽ/|ʌn		|'ati	!qoita	Taras	taras
man	!kui		ǂoo	!ui	|qui	khoep	khoep
child	!khwãa	Θpwa			|qxwa̰		õa'i
drink	kwa	k'a:a	kx'ai	kx'ũ	|qxwa̰	aa	kx'a
speak	tanʔi/ ǂagen		cu	ǂagen	tumʔi	ǂxən	koba
listen	tum-i	tu:ho			tumʔi		komsen
knife	!gwara	gõä	nǂona		gwa̰ra		kõas
rest/sleep	ten	Θpwa	Θun	Θuin	tḛŋ	nǁau!a	ǁ'om
Leave/ walk	ta̰ḭ	tãi	!ai	ǁai/ǁ'ai	ta̰ḭ		!ũ

run	!'uuxe			!'uuxai	ǀquxai		!huekx'ãi
bread	bori/bere		peresi		bəri	pere	bereb
eat	ãa	ã	aa	hã	hą̈ą̈	ǂu	ǂ'ũ
handywork	tɑba	ǁkari			taβa	tava	
head	nǀa	nǀa:	nǀa	nǀã	nǀã	Tanas	bi !'ap
eyes	Taxm/ tsʼaxaiten	ts'a:-xu	ts'əxəm	ts'axen	xaikən	muku	mũb
nose	nǀu-ru	ǀnu:/nǀõ		nǀudu	nǀuɹu		ǂuib
stomach	ǀkoa	ǂke:			ǀgɐ̯i̯		n!aab
beard	nǀum	nǀum			n!uku	nǀumbi	nǀum

5. Non-phonemic features

The observations here are distilled from a larger unpublished MA thesis (Kilian 2020). Distinct differences in the phonation of particular vowel segments have been observed across the utterances of Tumʔi speakers. However, unlike the phonemic distinctions presented in the sections above, the phonation contrasts observed in Tumʔi are not the result of controlled variation. The majority of the previous phonation analyses have reported the resultant difference in voice quality as contrastive, serving as a distinguishing feature between particular vowel and nasal segments. However, there are instances such as in the language Hmong in which differences in phonation occur as idiosyncratic features exhibited only by particular speakers (Huffman 1987).

The phonetic characteristics of each phonation type are captured primarily using an acoustic analysis of the H1-H2 spectral slope parameter, and information extracted from the contrasted Harmonics to noise ratio (HNR) measures, as conducted across previous phonation analyses (Garellek 2019, Gordon & Ladefoged 2001, Miller 2007). Physiological characteristics, such as the medial thickness of the vocal folds and their aperture at the time of vibration can be interpreted by the H1-H2 spectral slope parameter (Garellek 2019:3, Huffman 1987:502). The HNR measure is reported to indicate the presence of any aspiration noise due to the glottis opening, as well as the distribution of irregular voicing (Garellek 2019:3)

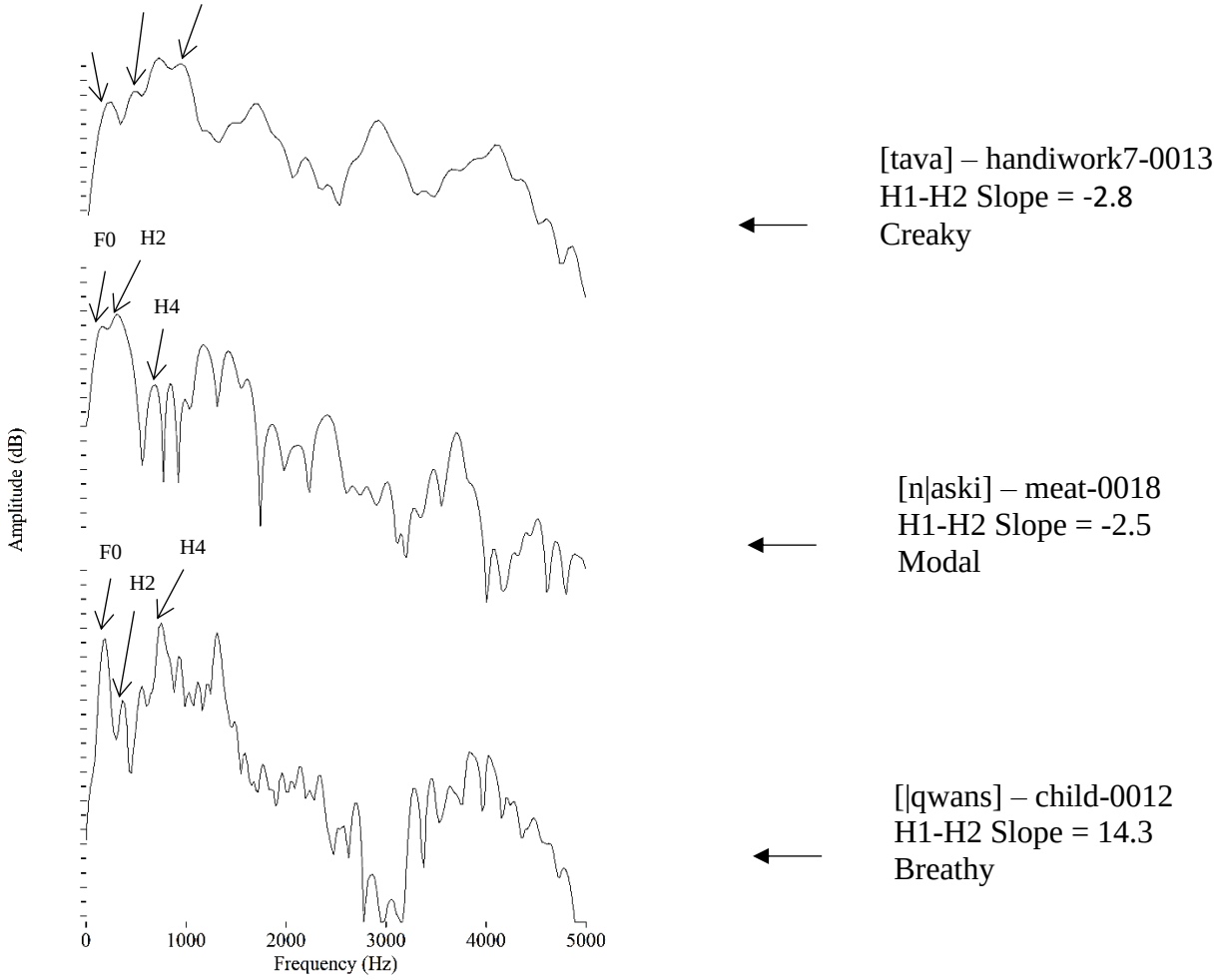

Figure 3: Spectra calculated across four glottal pulses for three low vowel segments. The initial vowel in tava 'handywork'; n|aski 'meat'; |qwans 'child'.

Individual spectral samples of tokens produced by Elsie and Francina displayed in figure 3 above provide evidence of three possible phonation types based on the H1-H2 slope, as well as the difference in spectral tilt across each sample. There is a clear discrepancy between the H1-H2 slopes across the tokens representing each phonation type. The steepest slope is visible in the breathy spectrum with a value of 14 dB. Both the modal and creaky tokens display a negative H1-H2 spectral tilt. The spectral tilt of the creaky segment is only slightly steeper than that of the modal segment with a value of -2.8. A negative spectral tilt is expected for segments articulated with creaky phonation as well as segments produced with modal phonation (Gordon & Ladefoged 2001). The most distinguishing factor is the spectral slope and the degree at which the intensity drops as the frequency of the harmonics increases. The token representing breathy phonation has a steeper negative slope than either of the other tokens. The modal token exhibits a less steep slope, while the creaky token exhibits only a slightly negative slope. Repeated instances of each spectral tilt are observed across the measured tokens which include all lexical items with the low vowel [a].

Spectral tilt most explicitly reflects the distribution of energy at different frequencies. Breathy vowels are characterized by a high degree of energy in the fundamental frequency, which corresponds to the first harmonic, or H1, while the higher harmonics e.g. (H2 & H4) are

characterized by less energy, as the glottal waveform is more sinusoidal due to smoother opening and closing phases. Alternatively, the sharp glottal closure and opening formed in the production of creaky voice corresponds to more energy in the higher frequency harmonics, with relatively less energy in the fundamental frequency, or first harmonic. The expectation is therefore that the H1-H2 spectral tilt should reflect a significantly steeper gradient for breathy vowels in comparison to creaky and modal vowels. The reverse effect is expected for creaky vowels, in which case a greater negative H1-H2 spectral tilt would best distinguish the creaky segment from the modal voice segment. Statistical results from previous phonation analyses provide evidence that the mean HNR for modal voice is expected to be significantly higher than other phonation types (Gordon & Ladefoged 2001, Miller 2007). However, in comparison to creaky voice, breathy segments are expected to have a higher HNR mean due to their limited glottal constriction and resultant noisy energy.

Table 5: Results of H1-H2 slope t-test

t = -3.1806, df = 51, p-value = 0.002
sample estimates:
mean of non-modal = 9.492613
mean of modal = 13.813818

Table 6: Results of HNR t-test

t = 2.525, df = 51, p-value = 0.014
sample estimates:
mean of non-modal = 9.219355
mean of modal = 3.759091

The results of the two-sample t-tests presented above provide evidence of a significant disparity between both the H1-H2 slope measures, as well as the HNR measures of the modal and non-modal phonation groups. Overall, the results indicate a greater H1-H2 gradient for the non-modal segments, but a smaller HNR measure. Translated, these results indicate that non-modal phonation is attested in Tumʔi, and the non-modal segments most likely consists of breathy segments rather than creaky. Furthermore, it must be reported that the eldest speaker who consistently produced particular words with non-modal phonation herself explicates the distinct form of articulation as “Die verskil kom van agter af, jy moet tril as jy dit sê” (the difference comes from the back of the throat, your articulators must trill when you say it). The speaker explains that the sound must be produced at the back of the throat with a consistent trill-like mechanism. Not only is there acoustic evidence of a non-modal phonation type, but this special phonation is recognised by the speakers.

The analyses above are most certainly constrained by the modicum of data available for the investigation of phonation contrasts. However, the statistical analyses of the spectral data provide evidence of a significant disparity in the phonation of low vowel segments produced in Tumʔi. The results of the t-tests show that the Harmonics and the HNR measures are successful in distinguishing between the modal and non-modal phonation groups. The mean values of these measures do not entirely align with the general expectations reported in previous phonation analyses, however the results are applicable when compared to the measures reported for particular phonation types identified in !Xóõ. Comparison of the slope and HNR measures above with those reported for the pharyngealized breathy and modal segments in !Xóõ indicate

that the non-modal segments observed in Tumʔi may be similar to the breathy pharyngeal phonation type observed across multiple Southern Khoisan languages (Vossen 2013). Overall, the results of this analysis definitively tell us that speakers produce some form of non-modal phonation.

6. Conclusion

The various phonemic and non-phonemic contrasts presented above come together to form a complex sound inventory consisting of unique features generally unattested in Khoisan varieties with less typologically complex phonological systems.

Table 7: Comparative summary of phonological characteristics

Phonological characteristics	Tumʔi	Tuu	Khoekhoe
Vowel Phonation contrasts	Yes	Yes	No
Uvular click accompaniment	Yes	Yes	Attested in one variety
Aspiration	Yes	Yes	Undergone affricate lenition
Ejectives	Yes	Yes	No

The vowel system consists of six monophthongs and five diphthongs, excluding indications of possible voice quality distinctions. The monophthong system is comprised of the five basic high, low, and mid vowels. However, the disparity in openness between the corresponding mid vowels causes an irregularity, which results in an asymmetric quadrilateral vowel space. This observation introduces the question of whether a phonemic contrast in openness had previously existed as part of the vowel system. That would suggest that the vowel inventory of Tumʔi consisted of seven vowels, which would align with many Bantu varieties and a select number of Khoisan varieties, generally not within the Khoekhoe family. A similar distinction is introduced with the identification of diphthongs, which appear frequently throughout the data set. Furthermore, though vowel phonation does not constitute a distinctive feature in Tumʔi at present, the statistical evidence of a non-modal voice quality distinction might be a remnant of a more complex phonological system.

The uniqueness of the sound system of Tumʔi is further indicated by the observation of phonemic laryngeal contrasts. While phonemic distinctions in aspiration have undergone fricative lenition in most varieties of Khoekhoe and even some of the Tuu family, the speakers of Tumʔi have retained or re-gained a controlled use of at least one aspirated segment. Hence, the sound system of Tumʔi exhibits a feature no longer attested in any of the Khoekhoe languages with the exception of !Ora. Another laryngeal distinction discovered in Tumʔi is the use of the glottalic egressive airstream mechanism. The results of the phonetic study suggest that ejectives are phonemically contrastive in the sound system of Tumʔi. As is the case with a few of the other distinctive features identified above, the ejective is only attested in Khoisan varieties with more complex phonological typologies. Overall, the egressive consonant inventory observed in Tumʔi may be described as extensive relative to other Khoisan varieties.

Finally, the click system observed in Tumʔi possibly contributes the major part of the complexity to the sound system, with the identification of the uvular click accompaniment. This particular click accompaniment is unique to Tuu varieties, including N|uu and !Xõó (Miller 2007). Hence, this unique click efflux provides the most obvious indication of a typological similarity to particular Khoisan varieties, including among others !Xóõ, N|uu, ǂHoan, and |Auni,

which all form part of the Tuu lineage. Interestingly, this accompaniment constitutes one of the two click accompaniments most frequently observed in Tumʔi, the other being the nasal accompaniment. Overall, the click inventory is comprised of a total of 15 clicks, including the four click types and accompaniments. Considering the size of click inventories in Khoisan languages such as !Xõó and ||Xegwi, an inventory of 15 clicks would appear relatively small. However, the distribution of these clicks across the data set is extensive, which indicate that clicks may have carried a heavy functional load in this Khoisan variety. There are few words in the lexical inventory of Tumʔi which do not include a click segment. Hence, based on observations across the data set, clicks in Tumʔi represent the most important consonant-like segments in the sound system. Setting aside consequences of language contact, this is a feature more commonly associated with the Tuu lineage as opposed to Khoekhoe.

While arguments have been made for the untenability of Khoisan language family distinctions and lineages, comparative research provides evidence of linguistic relations which cannot be ignored. The investigation of the phonological typology of this Khoisan variety was initiated based on evidence of strong lexical correspondences and cognates. The resultant phonological inventory and main findings are useful for filling the typological gaps within the areal isoglosses. Furthermore, similar to southern Khoisan varieties including those within the Tuu lineage, Tumʔi exhibits remnant features of what would be described as a typologically complex sound system.

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Appendix

Key: Click type
Dental = Den
Alveolar = Alv
Lateral = Lat
Palatal = Pal
Key: Accompaniment
Uvular = Uvu
Nasal = Nas
Velar = Vel
Voiced = Voi

Index	**Lexical inventory**	**Influx & Efflux**	**Gloss**
	Click initial		Total = 63
1	ǀœʊ	Den	get water
2	!oitəs	Alv	Laugh
3	!wa̰ra̰	Alv	Tease
4	ǀɔrise	Den	policeman
5	!ɔrise	Alv	how are you?
6	!uŋka/ !uŋkaha̰	Alv	play dead
7	!ukən	Alv	punish
8	!ɔŋgas	Alv	big container
9	ǁap/ gap	Lat	veld food (recognized by thorns)
10	!uku	Alv	irritable/ argumentative
11	!ukuxãã	Alv	pregnant/ full belly
12	!eipsexat	Alv	medicine for child's stomach
13	!anirki	Alv	jackals' knee
14	ǀaiki/ ǁaiki	Den	bat-eared fox
15	ǂamku	Pal	happy heart
16	!uŋka	Alv	medicinal powder
17	!uŋkaha̰a̰	Alv	grind/ mix
18	ǀeina	Den	ouch
19	ǂama:kʰu/ ǂxama:ku	Pal	thank you
20	ǂamaku	Pal	medicine
21	ǁɔmi/ ǁxɔmi	Lat Vel	pregnant/ full figure
22	ǀquxai / ǁquxai	D/L Uvu	leave-death
23	!qoita	Alv Uvu	woman
24	ǀqui (singular) ǀquis (plural)	Den Uvu	man
25	ǀqxwa̰/ gwa̰	Den Uvu	baby
26	ǀqəri/ ǀgəri	Den Uvu	honey beer
27	!qam/ !qami/ kam	Alv Uvu	pee
28	!qɔwa / !qɔva	Alv Uvu	medicinal plant
29	ǀqoi/ ǀqo̰i/ ǀqwai/ ǀxa̰i	Den Uvu	pregnant
30	!qɔra	Alv Uvu	knife/something sharp
31	ǂqwara/ ǀqarɔk/ gwa̰ra	Pal Uvu	knife

32	ǀqwaka	Den Uvu	stink
33	ǀqœʊ	Den Uvu	tell
34	ǀqœʊ/ ǂqœʊ	D/P Uvu	youngest
35	!quruam	Alv Uvu	tasty
36	ǀgǝ̰i̯/ ǀqǝ̰i̯/	Den Voi	sheep
37	ǀqǝ̰i̯	Den Uvu	people
38	ǀgǝ̰i̯	Den Uvu	stomach
39	ǂqam	Pal Uvu	grip
40	ǀqɔm/ !xɔm	D/A Uvu	tenderize
41	ǀqɔmər/ !xɔmər	D/A Uvu	tenderizer
42	ǀquhą̰ą̰	Den Uvu	weak bladder
43	ǀqara/ tara	Den Uvu	word
44	ǀgams	Den Voi	sickness/ STD
45	ǀgeip	Den Voi	skunk
46	ǀqwa/ ǀqwą̰i/ !qup	D/A Uvu	female genitals
47	!qxu	Alv Uvu	pee-type
48	ǀqxa	Den Uvu	leave it
49	nǀu (singular) nǀuns (plural)	Den Nas	white man
50	nǀu	Den Nas	red stone
51	nǀa/ nǀã	Den Nas	head
52	nǀuɹu	Pal Nas	nose
53	nǂuɹuku	Pal Nas	snout
54	nǀaski	Den Nas	meat
55	n!oɹo/ n!oɹa	Alv Nas	drunk
56	nǀara/ nǀari	Den Nas	comfort
57	nǀoi boom	Den Nas	tree with yellow flowers
58	nǀeitɔ	Den Nas	word used to calm a baby
59	nǀeitœʊ/ nǀeitɔ	Den Nas	nightmare
60	n!ukukwa/ n!ugukwa	Alv Nas	wipe clean
61	n!ɔvɔ	Alv Nas	sugar snack
62	ǀxei	Den Vel	give birth
63	!xara	Den Vel	female genitals-type
	Click initial & click medial		Total = 9
64	ǀuŋǀwa/ !uŋ!a/ !uŋka	D/A Nas	big bum
65	ǂinǀama/ ǀqeinǀqama	P/D Nas	naughty
66	ǂiɹiǁuxa	Pal-Lat	jackal
67	ǀqeiǁkara	Den Uvu	sheep-type
68	!qum!qum/ ǀqumǀqum	A/D Uvu	coffee
69	n!œ̱ʊ̱!a/ n!œʊ!wa	Alv Nas	understand
70	!qara!quru	Alv Uvu	swear word
71	ǀqamǀqu/ ǀqamku	Den Uvu	tasty-type
72	nǀa!qoi/ n!uku/ na!oi	D/A Nas	look
	Consonant initial		Total = 39
73	tumʔi		speak/understand
74	hą̰ą̰/ hą̈ą̈		eat
75	hą̰ą̰/ hą̈ą̈		food

76	xaikən (singular) saigəns (plural)		eye
77	saigəns		face
78	tɛ̯ŋ		rest/ sleep
79	tą̯i̯		leave-type
80	bəri/ bə̯ri (singular) brə̯kə̯ti (plural)		bread
81	tʰą̯va/ tʰą̯βa/ tawa		handywork
82	tʰą̈ŋą̈/ tʰaŋa/ taŋa		pain
83	mafuta/ məfuta		oil/ fat
84	kut͡ʃaka/ kutjaka		go out
85	bip/ dip		milk
86	tərəŋ tərəŋ		crazy
87	tʰaŋa		crazy-type
88	surte		give
89	xumxama/ xumama		meat-type
90	xorkies		smaller type veld food
91	xəmi		dig/ hide
92	xəmi		grind-type
93	xuma		be quiet/ stay silent
94	xɔm		hardened sap
95	tumtum		big toe
96	kuxa		baby jackal
97	pəri		goat/ buck
98	para		donkey
99	vələ als		medicinal ingredient
100	vələ kiər		medicinal ingredient
101	duːɪ		expression of distance
102	xɔra xat		waterhole
103	paka		bury
104	trul		hair
105	bala/ tɪəl		male genitals
106	məkəs		inner thighs
107	xana		a type of weed
108	kama		dagga/ marijuana
109	xɔnjas / tɔŋgas		eye dirt
110	kaiəŋs		fatty parts of the animal
111	skroi		burn
	Consonant initial & click medial		Total = 8
112	sein|ama/ seinkama	Den Nas	sugar water
113	sein‡ama	Pal Nas	crush
114	sumn|um/ sumn!um	D/A Nas	chew
115	tʰi!qo	Alv Uvu	god
116	sein|eŋ	Den Nas	jail
117	nuku|ən	Den	whisper
118	nuku!wa	Alv	get ready
119	sin|e/ si|e	Den Nas	cut

	Vowel initial		Total = 4
120	ixwa		now/truth
121	asa		see
122	œʊtəre		ask
123	eisevarkmag		ingredient for hotnots powder
	Vowel initial & click medial		Total = 2
124	ukuǁən / hukuǁən	Lat	I don’t know
125	aritamsumnǀa	Den Nas	big thank you