Anthony Traill and the holistic approach to Kalahari Basin sound design[1]

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Abstract

Anthony Traill (notably 1985) is widely known for having produced the first comprehensive phonetic and phonological analysis of the so-far most complex sound system in the Kalahari Basin and possibly among the world's languages, viz. of the Taa language complex, specifically its East !Xoon variety. In a number of articles (e.g., 1980, 1992, 1995, 2001) he also laid the foundation for the phonological comparison of the diverse languages of this area. It is in particular this fruitful combination of language-specific facts with cross-linguistic and universal patterns that characterizes his important contribution to African linguistics as well as to general phonetic-phonological theory. Since his groundwork the knowledge on individual Kalahari Basin languages has grown tremendously. In this paper we will explore several theoretical issues addressed for the first time by him and show how his academic oeuvre is still up-to-date in view of these modern data.

1 Introduction

It is a widespread and certainly justified perception that clicks are complex and quirky speech sounds and that click languages in general are among the phonetic-phonologically most complex ones on the globe. Acknowledging this has nurtured a notable tendency to accept any quantitative and qualitative difference in sound design and complexity between a language with and without clicks. In particular, the early research implies two major typologically unknown peculiarities of click languages, namely that they possess two disjoined consonant classes of clicks and non-clicks, and for languages with more complex systems, that they display abnormally large consonant inventories.

This early frame for the phonetic-phonological analysis of the sound structure of so-called "Khoisan" languages was first of all provided by Beach's (1938) ground-breaking

[1] Since Anthony Traill was in several ways a decisive and inspiring mentor for both of us, we are very grateful to the organizers of his memorial conference for inviting us to participate and to contribute to this volume. We would also like to acknowledge and express our gratitude for the funding provided to us by the "Deutsche Forschungsgemeinschaft (DFG)" and the "Japan Society for the Promotion of Science (JSPS)" KAKENHI (grant numbers 23652082, 25300029). We also thank our colleagues for the fruitful collaboration within the collaborative project "The Kalahari Basin area: a 'Sprachbund' on the verge of extinction" (cf. http://www2.hu-berlin.de/kba/) and our student assistants A. Vakhromeev, A. Vossler, and B. Winkhart for assistance in connection with §2.3.

description of Khoekhoe (Khoe, Khoe-Kwadi) - a work that can be said to mark the first revolution in this research domain. Another major step forward, but largely in the confines of Beach's framework, was Snyman's (i.a., 1975) detailed treatment of Ju|'hoan (Ju, Kx'a), a language variety that displays a far greater complexity than Khoekhoe and is more representative for the overall areal profile of Kalahari Basin languages.

Traill's research, which not only provided a detailed description of !Xóõ (= East !Xoon variety of Taa) (e.g., 1985) but also included a first survey of phonetic-phonological variation in the Kalahari Basin (e.g., 1980, 2001), can count as a second revolution in that it represents the first HOLISTIC approach to the phonetic-phonological study of Kalahari Basin languages - holistic in the sense of being an innovative and combined assessment of language-specific facts, areal cross-language comparison, diachronic change, and universal typological considerations about human language in general. It thus covers the entire range of relevant phenomena from individual segments over paradigmatic and syntagmatic systemic patterns to a broader typology of Kalahari Basin languages in particular and language as a human capacity in general.

Before illustrating in the main part of this article Traill's innovative approaches and their relevance for modern research by means of three focal topics, a few preliminaries about the concept of "Khoisan" are in order. Against the common perception of non-specialists and even certain survey sources like the Ethnologue, "Khoisan" is not a language family established by historical-comparative methodology. It rather comprises with the current state of knowledge two independent languages in eastern Africa and three independent language families in southern Africa. These are given in Figure 1 (cf. Güldemann 2014 for more detailed discussion). This implies that the term, if used in a linguistic sense, does not bear any implication for the genealogical relation among the languages at issue.

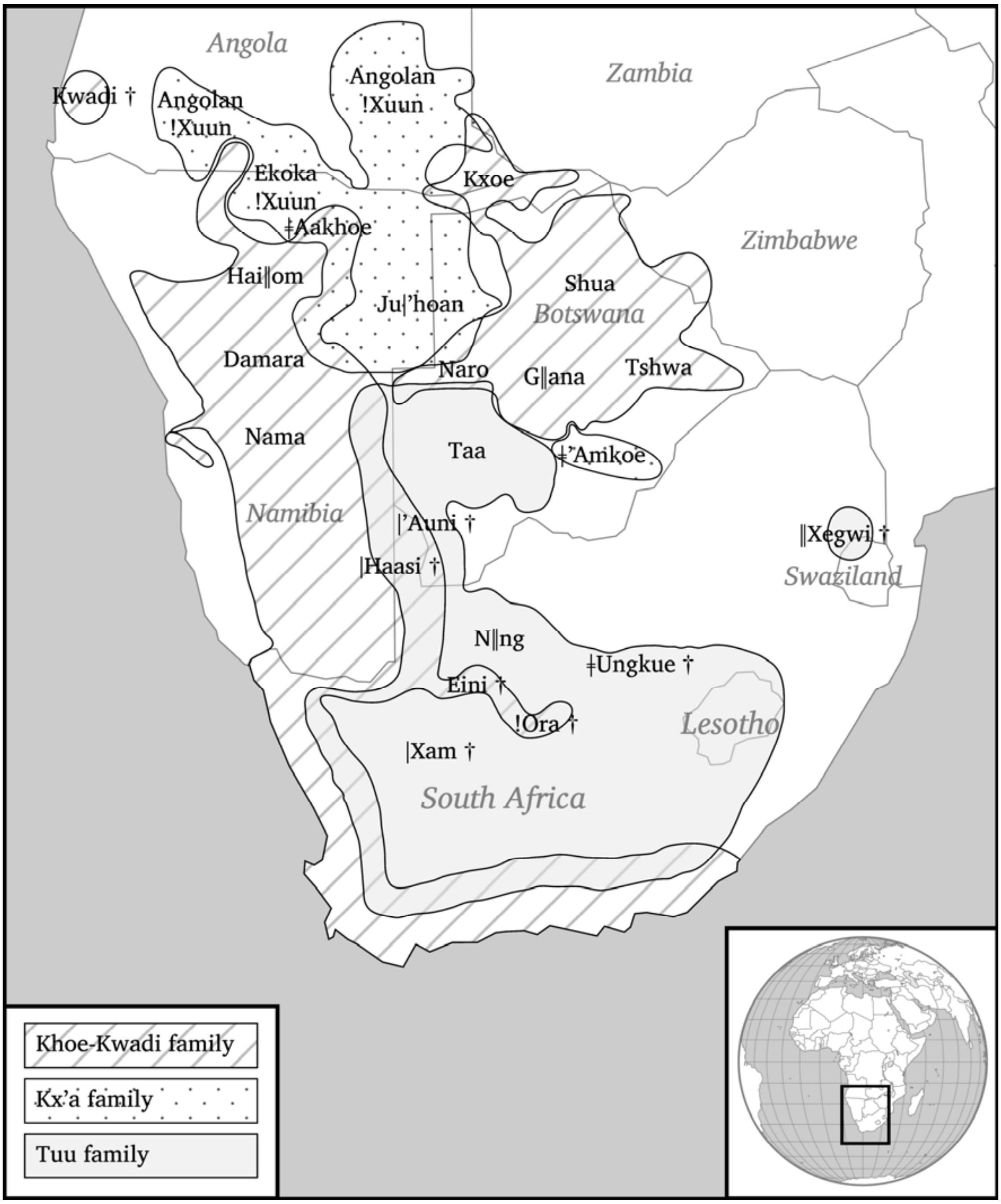
The following discussion will be confined to the relevant languages in southern Africa, whose distribution is shown in Map 1 - this for several reasons. First, they show the greatest amount of complexity in need of explanation. Second, crucial languages are very well researched from a phonetic-phonological perspective. Last but not least, these languages were the primary field of study for Anthony Traill, to whom this contribution is dedicated.

Apart from the genealogical history of the southern African languages, as recorded in Figure 1, there is an increasing amount of data that give evidence for a dynamic and complex history of linguistic contact, which underlies the areal concept "Kalahari Basin" (see Güldemann (1998, 2001) and Güldemann and Fehn (forthcoming) for more detailed discussion). For this reason, the areal term "Kalahari Basin languages" replaces here Greenberg's genealogical notion of "South African Khoisan".

Separate lineages *(Sub)branches*	**Languages (L) or language complexes (LC)**	**Selected dialects and dialect groups**
(1) Hadza	single L	
(2) Sandawe	single L	
(3) Khoe-Kwadi		
Kwadi	single L†	
Khoe		
Kalahari		
East	Shua:	Cara, Deti, |Xaise, Danisi, et al.
	Tshwa:	Kua, Cua, Tsua, et al.
West	Kxoe:	Khwe, ǁAni, Buga, et al.
	Gǁana:	Gǁana, G|ui, et al.
	Naro:	Naro, Ts’ao, et al.
Khoekhoe	(Cape K.)† LC	
	(!Ora-Xiri) LC	
	(Eini)† LC	
	Nama-Damara LC	
	Haiǁom	
	ǂAakhoe	
(4) Kx’a		
Ju	single LC:	North: Angolan !Xuun varieties
		North-central: Ekoka !Xuun, Okongo !Xuun, et al.
		Central: Grootfontein !Xuun, et al.
		Southeast: Tsumkwe Ju|’hoan, Epukiro Ju|’hoan, et al.
ǂ’Amkoe	single LC:	West: ǂHoan, N!aqriaxe
		East: Sasi
(5) Tuu		
Taa-Lower Nossob		
Taa	single LC:	West: West !Xoon, (N|uǁ’en)
		East: East !Xoon, ’N|oha, (N|amani), (Kakia), et al.
Lower Nossob	(|’Auni)†	
	(|Haasi)†	
!Ui	Nǁng:	N|uu = (ǂKhomani) = (N|huki), (Langeberg), et al.
	(|Xam†):	Strandberg, Katkop, Achterveld, et al.
	(ǂUngkue†)	
	(ǁXegwi†)	

Note: † = extinct, (older data sources)

Figure 1: Five lineages subsumed under “Khoisan” and their internal composition



Map 1: Kalahari Basin languages (aka "South African Khoisan")

2 Problems of Kalahari Basin sound structure

In the following, we will discuss three areas of research to which Traill has crucially contributed or which he even established as topics of investigation in the first place. These are the paradigmatic structure of sounds and their distinctive features within larger systems (§2.1), the syntagmatic structure of sounds within words (§2.2), and the cross-linguistic structural distribution of these sounds as determined by universal, genealogical and areal factors (§2.3).

2.1 Cluster analysis and consonant systems

In Kalahari Basin languages, the paradigmatic structure of sounds and their distinctive features within a larger system of elements concern in particular the underlying basis of the enormous complexity compared to other languages in the world. One of Traill’s crucial contributions here relates to the status of complex consonants as phonological units or clusters. In his detailed phonetic-phonological description of the East !Xoon dialect of Taa (Traill 1985) he starts out from a traditional feature analysis summarized in Table 1.

Feature	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	!	!g	!n	’!n	!n̥	!q	N!G	!qh	!h	!x	!kx’	!q’	!’	g!h	g!x	g!kx’
Uvular	-	-	-	-	-	+	+	+	-	+	+	+	-	-	+	+
Friction	- -	- -	- -	- -	- -	- -	- -	- -	- -	- +	- +	- -	- -	- -	- +	- +
Voice	-	+	+	+	-	-	+	-	-	-	-	-	-	+	+	+
Aspirated	-	-	-	-	-	-	-	+	+	-	-	-	-	+	-	-
Glottal	-	-	-	+	-	-	-	-	-	-	+	+	+	-	-	+
Ejected	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+
Nasal	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-

Table 1: List and feature classification of clicks in East !Xoon (Traill 1985: 206)

However, on the last few pages (ibid.: 208-11), he entertains an hitherto novel alternative approach in that a number of more complex consonants, particularly clicks, can also be described as consonant clusters.

> It is abundantly clear in the entire discussion ... that the intractability of the !Xóõ consonants is a function of the assumption that clicks and their accompaniments and the non-click clusters are phonological units. ... it is necessary to question the assumption ... and to explore the consequences of an alternative analysis in terms of clusters. (Traill 1985: 208)

> These proposals that a cluster analysis provides the most adequate description of the !Xóõ consonantal complexes represent a break with traditional Khoisan linguistic descriptions. However, there is a great deal of evidence in its favour and it can be extended to the other Khoisan languages. (Traill 1985: 211)

For quite a while this proposal received little attention in other relevant studies on Kalahari Basin languages. Following Traill’s typologically oriented spirit and based first of all on his data from Taa, having so far the most complex sound system, his new proposal was taken up by Güldemann (2001) who proposed a new phonological approach. The central innovative features of this work are summarized in the following:

(i) full integration of egressive consonants with ingressive consonants aka clicks
(ii) non-traditional organization of features tailored to Kalahari Basin phonology
(iii) partly different phonological treatment of clicks
(iv) application of analysis to other simpler Kalahari Basin languages

Phonological similarity of lingual ingressives aka clicks to other non-click consonants had been noted previously (cf., e.g., Traill (i.a. 1997: 104), Elderkin (1989: 37), Snyman (forthcoming: 3, 10ff)) but without any serious consequences for the overall phonological description of the languages. The two consonant classes are fully integrated by Güldemann (2001) in view of the parallel features operating on both simple egressives and ingressives (aka clicks). These features are [±nasal], [±voice], [±aspiration], [±glottalization] (in oral stops, involving also glottalic egressives aka ejectives, as well as nasal stops in the form of pre-glottalized segments), and [±posterior coarticulation] in the form of /χ/ and /q͡χ'/.[2]

Güldemann's (2001) new approach also entails a non-canonical feature organization in line with local phonological patterns in the Kalahari Basin. The horizontal feature axis no longer comprises just different places of articulation but instead three classes of segments or features not usually treated together, namely places of articulation, affricates and all basic click types aka "influxes". The vertical feature axis is organized according to three basic feature dimensions, taking care of, among other things, all so called "effluxes" or "accompaniments" of clicks. One dimension distinguishes four basic consonant classes, viz. stops, nasal sonorants, fricatives, and non-nasal sonorants; the "plain" segment in each class is unmarked without any co-articulation. The second dimension captures the binary distinction in terms of voice-setting which can be extremely pervasive (as in Ju and Taa); for nasals, the plain segment is the voiced one in line with cross-linguistic markedness patterns. The third dimension refers to what is called "elaboration", differentiating in stops and nasals between three degrees of elaboration called "simple", "complex", and "cluster". "Simple" segments are the plain sound and its counterpart on the voice dimension. "Complex" segments are aspirated and glottalized (including ejectives). Finally, and most importantly for the overall analysis, the highest degree of elaboration is represented by bipartite consonant "clusters" consisting of two phoneme units, an "onset" and an "offset".

Related to the previous analyses is a quite different phonological treatment of most click types. First, the plain click aside, voicing and nasality as phonologically relevant features of clicks are different from all other accompanying gestures, first of all because of their distinct timing; the relevant clicks all fall in the class of simple segments. Second, phonologically nasal clicks are viewed to be parallel to nasal egressive stops; this correlates

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[2] In some languages with prenasalized stops, which are overall untypical for Kalahari Basin languages, it might even be possible to identify a distinct type of prenasalized click as the phonological counterpart of such egressive segments.

with the observation that across the Kalahari Basin they are attested as plain, preglottalized, and voiceless segments. Finally, the identification of three elaboration classes in particular yields a new classification of clicks, whereby in some languages the clusters can make up more than half of the entire click inventory.

The viable application of the above analysis to other Kalahari Basin languages leads to the development of a cross-Kalahari Basin consonant chart. The cross-linguistic comparison allows the proposal of several implicational hierarchies of consonant types which can be ordered along the scale of consonant strength entertained by Traill (1985). It also feeds an attempted general definition of clusters typical for Kalahari Basin languages. Finally, the comparison confirms the possibility to bring the languages as a whole more in line with cross-linguistic levels of complexity. The different consonant inventories resulting from a traditional unit analysis and a novel cluster analysis can be compared in Table 2.

Language (dialect)	**Family**	**Non-clicks**	**Clicks**	**Total in unit analysis**	**Clusters**	**Total in cluster analysis**
Taa (East !Xoon)	Tuu	43	83	126	52	74
N‖ng (ǂKhomani aka N|uu)	Tuu	23	41	64	16	48
Ju (Ju|'hoan)	Kx'a	44	48	92	31	61
G|ui	Khoe-Kwadi	38	52	90	36	54
Khwe	Khoe-Kwadi	33	36	69	14	55
Khoekhoe (standard)	Khoe-Kwadi	12	20	32	4	28
Sandawe	Isolated	29	15	44	0	44

Table 2: Consonant inventories under unit and cluster analysis (Güldemann 2001)

In the spirit of Traill (1985) and Güldemann (2001) a detailed analysis of G|ui (Kalahari Khoe, Khoe-Kwadi) is provided by Nakagawa (2006). One of the important new findings compared to the two earlier studies is the identification of a novel and systemically crucial distinction in clicks with a glottal gesture presented in Table 3, viz. between a complex click ejective and a click cluster with a glottal stop as cluster offset which among other things is characterized by the non-phonemic phonetic detail of nasalization. This click pair parallels the previously established opposition between a complex click aspirate and a click cluster with a glottal fricative offset which is known as so-called "delayed aspiration".

Glottal feature	**Complex click**	**Click cluster**
Stop	/!ˀ/ = ejective	/!ʔ/ [ŋ̊!ʔ] = plain + /ʔ/
Fricative	/!ʰ/ = aspirated	/!h/ [ŋ̊!h] = plain + /h/ "delayed aspiration"

Table 3: Two pairs of clicks with glottal gestures according to Nakagawa (2006)

This particular discovery alone leads to an important realignment and regularization of some click types compared to Güldemann’s (2001) earlier assessment, implying also the reanalysis of some language-specific clicks and their place in the system. In view of some languages like Namibian Khoekhoe and N‖ng, which have the cluster types /!ʔ/ [ŋ̊!ʔ] and /!h/ [ŋ̊!h] (right column of Table 3) but not also ejective and/or aspirated clicks (left column of Table 3), clusters do not seem to imply the presence of complex segments, pace Güldemann (2001). Nakagawa (2006) also provides a new generalization on cluster offsets as being specifically uvular or glottal.

The most recent application of the novel approach to Kalahari Basin consonants initiated by Traill is Naumann’s (forthcoming) in-depth analysis of West !Xoon. By building on the previous work this study generally confirms the overall findings by Traill, Güldemann and Nakagawa and extends and refines particularly the description of Taa in several crucial ways. Notably, it identifies a yet larger consonant inventory than Traill for East !Xoon, particularly with respect to clicks with glottal gestures, based on the predictions by Nakagawa (2006) mentioned above.

	Anterior egressives			**Ingressives (clicks)**					**Posterior egressives**			
	Labial	Alveolar	Alveolar-Affricate/Palatal	Labial	Dental	Alveolar	Palatal	Lateral	Velar	Uvular	Uvular-Affricate	Glottal
Oral stops												
Plain (voiceless)	p	t	t͡s	ʘ	ǀ	!	ǂ	ǁ	k	**q**		**ʔ**
Voiced	b	d	d͡z	ʘ̬	ǀ̬	!̬	ǂ̬	ǁ̬	g	**ɢ**		
Voiceless aspirated	pʰ	tʰ	t͡sʰ	ʘʰ	ǀʰ	!ʰ	ǂʰ	ǁʰ	kʰ	**qʰ**		
Voiced aspirated	bʰ	dʰ	d͡zʰ	ʘ̬ʰ	ǀ̬ʰ	!̬ʰ	ǂ̬ʰ	ǁ̬ʰ	gʰ	**ɢʰ**		
Voiceless ejective	p'	t'	t͡s'	ʘ'	ǀ'	!'	ǂ'	ǁ'	k'	**q'**	**q͡χ'**	
Voiced ejective			d͡z'		ǀ̬'	!̬'	ǂ̬'	ǁ̬'	g'	**ɢ'**	**ɢ͡ʁ'**	
Nasal stops												
Plain (voiced)	m	n	ɲ (?)	ʘ̃	ǀ̃	!̃	ǂ̃	ǁ̃	ŋ			
Voiceless					ǀ̥̃	!̥̃	ǂ̥̃	ǁ̥̃				
Glottalised	ˀm	ˀn		ˀʘ̃	ˀǀ̃	ˀ!̃	ˀǂ̃	ˀǁ̃				
Fricatives												
Plain (voiceless)	f	s								**χ**		**h**
Sonorants												
Approximant	w ?		j									
Lateral approximant		l										
Tap		ɾ										

Note: **bold = 7 potential cluster offsets**, ? = uncertain due to insufficient data

Table 4: Phonemic consonant units of West !Xoon of Taa (after Naumann forthcoming)

Since Naumann's study is the most up-to-date account of the new framework and deals with the so far largest segment inventory, it will also serve here to exemplify the systemic cross-Kalahari Basin overview of consonants in general and clicks in particular. Table 4 presents the phonemic consonant units of West !Xoon with an inventory size of between 85-90 segments, including nine click series involving 43 segments. It also identifies the seven potential cluster offsets at the uvular and glottal places of articulation (the [±voice] parameter does not add more phonemic distinctions, as it is also relevant for the cluster onsets). As predicted by the overall framework, these seven (abstract) phonemes are indeed all attested as cluster offsets, especially for clicks, but the two segments /χ/ and /q͡x'/ also with anterior egressive consonants.

The resulting complete click inventory of Taa, comprising 9 unit series and 14 cluster series is presented in Table 5, including their previous phonological analysis by Traill (1985) as well as their orthographic representation in other relevant sources.

Current cluster analysis			**Traill (1985)**			**Traill (1994)**	**L&M (1996)**
	Description		Accompaniment description	Cluster analysis			
1	Plain	!	1 Unaspirated voiceless velar st.	Basic	!	!	k!
2	(+ voice)	g!	2 Voiced	Voiced	!g	!g	g!
3	Ejective	!'					
4	(+ voice)	g!'					
5	Aspirated	!h					(k!^{h})
6	(+ voice)	g!h	15 Voiced and aspirated	Voiced + /h/	g!h	g!qh	g!h
7	Plain nasal	n!	3 Voiced nasalized	Voiced nasal	!n	!n	ŋ!
8	(+ voice)	nh!	5 Voiceless nasalized	Voiceless nasal	!n̥	!n̥	ŋ̊!
9	Glott. nasal	'n!	4 Preglottalised and nasal	Basic + /'m, 'n/	'!n	'!n	ʔŋ!
10	Plain + q	!q	6 Voiceless uvular stop	Basic + /q/	!q	!q	q!
11	(+ voice)	g!q	7 Vd. uv. st. with prenasalisation	Basic + /ɢ/	ɴ!ɢ	!ɢ	ɢ!
12	Plain + qh	!qh	8 Aspirated uvular stop	Basic + /qh/	!qh	!qh	k!^{h}
13	(+ voice)	g!qh				ɢ!qh	ɢ!h
14	Plain + q'	!q'	10 Ejected uvular stop	Basic + /q'/	!q'	!q'	q!'
15	(+ voice)	g!q'					
16	Plain + x	!x	9 Uvular fricative	Basic + /x/	!x	!x	k!^{x}
17	(+ voice)	g!x	14 Voiced and uvular fricative	Voiced + /x/	g!x	g!x	g!kx
18	Plain + qx'	!qx'	11 Ejected uvular affricate	Basic + /kx'/	!kx'	!kx'	k!'q'
19	(+ voice)	g!qx'	16 Vd. and ejected uv. affricate	Voiced + /kx'/	g!kx'	g!kx'	g!q'
20	Plain + '	!''	13 Glottal stop	Basic + /'/	!'	!'	k!ʔ
21	(+ voice)	n!''					
22	Plain + h	!hh	12 Delayed aspiration	Basic + /h/	!h	!h	ŋ̊!^{h}
23	(+ voice)	n!hh					

Note: L&M = Ladefoged and Maddieson, st. = stop, uv. uvular, vd. = voiced, shaded cell = consonant cluster

Table 5: Comparative overview of click series in Taa (exemplified for alveolar !) (after Naumann forthcoming)

Based in particular on the detailed phonetic and phonological data on Taa, N‖ng (both Tuu); Ju|'hoan, ǂ'Amkoe (both Kx'a); G‖ana-G|ui, and Khoekhoe (both Khoe-Kwadi), but also on the phonological inventories of other relevant Kalahari Basin languages the overall analytical approach turns out to be applicable across the entire area, leading to the possible establishment of a cross-Kalahari Basin consonant chart. Table 6 summarizes the findings by Güldemann (2001), Nakagawa (2006), and Naumann (forthcoming).

	Anterior egressives				Ingressives (clicks)					Posterior egressives			
	Labial	Alveolar	Alveolar-Affricate	Palatal	Labial	Dental	Alveolar	Palatal	Lateral	Velar	Uvular	Uvular-Affricate	Glottal
Oral stops													
Plain	p	t	t͡s	c	⊙	ǀ	ǃ	ǂ	ǁ	k	**q**		**ʔ**
Voiced	b	d	d͡z	ɟ	⊙̬	ǀ̬	ǃ̬	ǂ̬	ǁ̬	g	**ɢ**		
Ejective	p'	t'	t͡s'	c'	⊙'	ǀ'	ǃ'	ǂ'	ǁ'	k'	**q'**	**q͡χ'**	
Voiced ejective			d͡z'	ɟ'	⊙̬'	ǀ̬'	ǃ̬'	ǂ̬'	ǁ̬'	g'	**ɢ'**	**ɢ͡ʁ'**	
Aspirated	pʰ	tʰ	t͡sʰ	cʰ	⊙ʰ	ǀʰ	ǃʰ	ǂʰ	ǁʰ	kʰ	**qʰ**		
Voiced aspirated	bʰ	dʰ	d͡zʰ	ɟʰ	⊙̬ʰ	ǀ̬ʰ	ǃ̬ʰ	ǂ̬ʰ	ǁ̬ʰ	gʰ	**ɢʰ**		
Nasal stops													
Plain (voiced)	m	n		ɲ	⊙̃	ǀ̃	ǃ̃	ǂ̃	ǁ̃	ŋ			
Voiceless					⊙̬̃	ǀ̥̃	ǃ̥̃	ǂ̥̃	ǁ̥̃				
Glottalised	ˀm	ˀn			ˀ⊙̃	ˀǀ̃	ˀǃ̃	ˀǂ̃	ˀǁ̃				
Stop clusters													
Plain + /q/					⊙q	ǀq	ǃq	ǂq	ǁq				
Voiced + /q/					⊙̬q	ǀ̬q	ǃ̬q	ǂ̬q	ǁ̬q				
Plain + /q'/					⊙q'	ǀq'	ǃq'	ǂq'	ǁq'				
Voiced + /q'/					⊙̬q'	ǀ̬q'	ǃ̬q'	ǂ̬q'	ǁ̬q'				
Plain + /qʰ/					⊙qʰ	ǀqʰ	ǃqʰ	ǂqʰ	ǁqʰ				
Voiced + /qʰ/					⊙̬qʰ	ǀ̬qʰ	ǃ̬qʰ	ǂ̬qʰ	ǁ̬qʰ				
Plain + /χ/		tχ	t͡sχ	cχ	⊙χ	ǀχ	ǃχ	ǂχ	ǁχ				
Voiced + /χ/		dχ	d͡zχ	ɟχ	⊙̬χ	ǀ̬χ	ǃ̬χ	ǂ̬χ	ǁ̬χ				
Plain + /q͡χ'/	pq͡χ'	tq͡χ'	t͡sq͡χ'	cq͡χ'	⊙q͡χ'	ǀq͡χ'	ǃq͡χ'	ǂq͡χ'	ǁq͡χ'				
Voiced + /q͡χ'/		dq͡χ'	d͡zq͡χ'		⊙̬q͡χ'	ǀ̬q͡χ'	ǃ̬q͡χ'	ǂ̬q͡χ'	ǁ̬q͡χ'				
Plain + /ʔ/					⊙ʔ	ǀʔ	ǃʔ	ǂʔ	ǁʔ				
Voiced + /ʔ/					⊙̬ʔ	ǀ̬ʔ	ǃ̬ʔ	ǂ̬ʔ	ǁ̬ʔ				
Plain + /h/					⊙h	ǀh	ǃh	ǂh	ǁh				
Voiced + /h/					⊙̬h	ǀ̬h	ǃ̬h	ǂ̬h	ǁ̬h				
Fricatives													
Plain (voiceless)	f	s		ç							**χ**		**h**
Sonorants													
Approximant	w			j									
Lateral approximant		l											
Tap		ɾ											

Table 6: Cross-Kalahari Basin consonant chart (not exhaustive)

With more data, especially on other Ju and Kalahari Khoe varieties, this chart has to be extended. Some languages maximize possible differences on the horizontal axis like Ju varieties having palatal affricates. Ju has also been shown to possess other click types like retroflex /‼/ (cf. Doke 1925: 148; Snyman 1997; Miller, Shah and Sands 2009). Other languages like Khwe possess prenasalized clusters (possibly in egressives AND ingressives). However, these and other additions known so far do not challenge the basic analytical framework, particularly the interpretation of numerous complex segments as clusters.

As opposed to alternative approaches, both traditional and recent, the cluster analysis has a number of merits concerning phonetics, phonology and typology. First the cluster analysis and its systemic logic is compatible with major phonetic facts observed in relevant segments across different languages, such as:

(i) recorded and audible second posterior release burst in click clusters with stop offset vs. its absence in units, despite the necessary posterior constriction for the production of clicks (cf., e.g., Ladefoged and Maddieson 1996: 335),

(ii) silence between the bursts of the lingual cluster onset and the pulmonic or glottalic cluster offset (cf., e.g., Miller, Brugman and Sands 2007: 769),

(iii) longer duration of many clusters as opposed to units (cf., e.g., Traill 1993; Miller, Brugman and Sands 2007: 769),

(iv) comparable spectral properties (i.e. centers of gravity and two spectral peaks) between simplex obstruents and their corresponding offsets in assumed clusters (cf., e.g., Miller et al. 2009: 770-772),

(v) phonetic detail of nasalization in the voiced uvular egressive stop /ɢ/ and the click cluster voiced plain + /q/ (cf., e.g., Traill 1985),

(vi) phonetic detail of nasalization triggered by the glottal place of articulation of both /h/ and /ʔ/ as click cluster offsets vs. its absence in the complex aspirated and ejective clicks (cf., e.g., Traill 1991, Nakagawa 2006, Naumann forthcoming).

From a phonological perspective, the cluster analysis explains the language-internal and cross-linguistic structure of phoneme inventories in an elegant way. The inventory of cluster is a function of the inventory of egressives available as cluster offsets. It has even proven to have some predictive power in that the two pairs of clicks with glottal gesture identified by Nakagawa (2006) in G|ui (cf. Table 3) were also expected systemically in Taa and ǂ'Amkoe, and were indeed found in a detailed and targeted phonetic analysis (Naumann forthcoming and Gerlach p.c., respectively). The analysis also accounts for the parallelisms between egressive and ingressive subinventories as a single phenomenon, notably all the parallel co-articulations (involving even such clusters as /tχ/ vs. /!χ/) as well as the parallel gaps in the egressive and cluster offset inventories (e.g., /kx'/ in northern Khoekhoe varieties). Traill (1980) and Güldemann (2001) have also started to identify patterns in the cross-linguistic differences of the language-specific systems in the Kalahari Basin.

Last but not least, the cluster analysis leads to an account much more in line with the global cross-linguistic variation, because it dramatically reduces the “hyper-large” consonant inventories of such Kalahari Basin languages as Taa, Ju, ǂ’Amkoe, and G|ui. Table 7 shows the extreme difference between unit and cluster analysis: the so far most complex system in the Kalahari Basin, viz. that of West !Xoon of Taa, represents under the unit analysis an overly extreme typological outlier without a parallel in the opposite minimal size range; the same system under the cluster analysis ceases to be such an exception - it may still render the globally attested maximum but is nevertheless quite comparable to Ubykh, the next candidate for the “consonant phoneme world record” outside the Kalahari Basin.

<table>
<tr><th>Size range</th><th>Number</th><th colspan="2">Language</th><th>Source</th></tr>
<tr><td>Minimum</td><td>6</td><td colspan="2">Rotokas (West Bougainville)</td><td>Maddieson (2005)</td></tr>
<tr><td>Average</td><td>22 ± 3</td><td colspan="2"></td><td>Maddieson (2005)</td></tr>
<tr><td rowspan="3">Extremely large</td><td>ca. 80</td><td colspan="2">Ubykh (Abkhazo-Adyghean)</td><td>Catford (1977)</td></tr>
<tr><td>ca. 85</td><td>Cluster analysis</td><td rowspan="2">West !Xoon of Taa</td><td rowspan="2">Naumann (forthcoming)</td></tr>
<tr><td>ca. 160</td><td>Unit analysis</td></tr>
</table>

Table 7: World-wide range of consonant phoneme inventories

We argue that the advantages of the unit analysis are also not compensated by the novel unit analysis of clicks in terms of “airstream contours” (see Miller, Brugman and Sands 2007, Miller et al. 2009). A full treatment of this complex issue is a topic in its own right and cannot be undertaken duly in this context. Suffice it here to mention the most important arguments in favor of the cluster analysis after outlining briefly Miller et al.’s approach.

Traditional descriptions of clicks use a distinction of velar vs. uvular for the posterior click closure. This is challenged by Miller et al. because of two phonetic observations in the moribund Tuu language N‖ng (aka “N|uu” after its currently most prominent dialect): (i) the posterior constriction in plain click stops is postvelar (cf. Sands, Maddieson and Ladefoged 1996: 180-1), and (ii) this constriction place is not qualitatively different from “uvular” clicks. This leads to a re-analysis of more complex clicks in terms of a novel phonetic parameter called “airstream contour”. Click articulation is explained then by a three-way distinction of different airstream mechanisms, as shown in Table 8 (exemplified by alveolar /!/); the so-called “linguo-pulmonic” and “linguo-glottalic” clicks are analyzed as contours.

Airstream mechanism	**Affricate**	**Stop**	**Nasal**
Lingual	-	/!/, /!ʰ/, /ᶢ!/	/ŋ̊!ˀ/, /ŋ̊!ʰ/, /ᵑ!/
Linguo-pulmonic	/!͡χ/	/!͡q/, /!͡qʰ/	-
Linguo-glottalic	/!͡qχ’/	-	-

Table 8: Three airstream mechanisms in click articulation (Miller et al. 2007, 2009)

It is a well-known fact that the more complex clicks like /!͡χ/, /!͡qχ'/ etc. combine more than one airstream mechanism. Under the cluster analysis, this phenomenon is simply the result of combining two phonemes which among other things can differ in airstream mechanism. Miller et al. propose that the different airstream mechanisms in the relevant clicks are joined within a so-called "contour", which generally refers to the phenomenon within unary speech sounds of a GRADUAL internal transition from one feature value (of pitch, vowel quality, manner, etc.) to another. That is, such clicks are viewed as parallel to, say, a "manner contour" in affricates, hence the term "airstream contour". However, while attractive at first glance, the purported "airstream contour" in clicks is quite different from the concept of contour in traditional phonetic-phonological theory.

In general, airstream mechanisms are defined by two independent parameters: (i) airflow direction, viz. egressive vs. ingressive, and (ii) airflow initiation/articulation, viz. pulmonic vs. glottalic vs. lingual. A crucial observation against the attractiveness of the idea of airstream contours is that, opposed to canonical contour segments, the different values involved in both airflow direction and airflow initiation shift CATEGORICALLY rather than gradually. The concept "airstream contour" is thus not only unprecedented in the languages of the world and thus novel in phonetic-phonological theory but also untypical for the canonical concept of contour in physiological terms.

Apart from this central drawback there are other problems associated with Miller et al.'s particular unit account of complex consonants. For one thing, they down-play problems for the airstream contour approach in languages other than N‖ng. Thus, pace Miller et al. (2009: 153-4), x-ray data from the East !Xoon dialect of Taa do attest for a difference in posterior constriction between /!k/ and /!q/ (Traill 1985); in other words, the non-difference recorded for N‖ng, as one of the primary argument for the contour analysis in the first place, has not been shown yet to be universal. Also, languages like G|ui, Taa, and ǂ'Amkoe attest for a click system with a four-way distinction of /!ʔ/ vs. /!'/ vs. /!q'/ vs. /!qχ'/ (cf. Tables 5 and 6). In the current version of the airstream contour analysis, however, only two of them appear to be accounted for.

A few remarks are in place regarding Miller et al.'s (2009) and Miller's (2011: 425) limited engagement with the cluster analysis, which must be seen as a serious competitor of the unit analysis, be it the traditional approach or one in terms of airstream contour.

One point, restricted to data from N‖ng, is the claim that the assumed cluster offsets do not all have the required status as independent phoneme. Suffice it to say here that restricted data from a single language, all the more a moribund one, do not preclude an analysis for a whole group of diverse and often more complex languages, and that the empirical details and/or their analysis in the case of N‖ng are actually unclear and partly controversial among the authors themselves.

Another, more general caveat against the cluster analysis is that clusters in most Kalahari Basin languages are only of the obstruent–obstruent type. This goes against the pattern attested so far cross-linguistically, viz. that this cluster type implies obstruent–sonorant clusters, largely absent in the Kalahari Basin (Miller 2011: 425). While this non-conformity to an apparently universal implication is considered by Miller (2011: 436) to be a crucial argument against the cluster analysis, we prefer to see it as yet another of so many cases in typology where implicational universals have exceptions; at best, it is as quirky as an airstream contour - both appear to be restricted to Kalahari Basin languages.

Accounts for/ is in line with	**Cluster analysis**	**Airstream-contour unit analysis**	**Traditional unit analysis**
Phonetics	YES	(YES)	YES
Phonology	YES	NO	(NO)
Typology	YES	NO	NO
Unique Kalahari Basin feature	obstruent-obstruent as only cluster type	contours of airstream mechanisms	?

Table 9: Comparsion of different approaches to Kalahari Basin consonants

Table 9 gives a brief synoptic comparison between the different analyses of the more problematic consonants found in the Kalahari Basin. We conclude that a partial account in terms of clusters as entertained for the first time almost 30 years ago by Anthony Traill remains the most viable approach today.[3]

2.2 Phonological features and phonotactic template

The second research domain to be discussed here are the word phonotactics of Kalahari Basin languages. The investigation of this area started with Beach's (1938) classic study of Khoekhoe sound structure. Over forty years later, this research field eventually made further progress with Traill (1979, 1985), where a close examination of East !Xoon data lead to important generalizations for Kalahari Basin languages, in general, notably preferred phonotactic patterns of roots and the so-called "Back Vowel Constraint". For reasons of space, we will only cover here the first topic.

In his pioneering description of Khoekhoe phonology, Beach (1938: 35-52) identified four classes of lexical morphemes, his so-called "strong roots". His findings are summarized in Table 10 (Class-1 roots are grammatical morphemes and are excluded here from the discussion). He demonstrated that Khoekhoe exhibits a highly skewed phoneme distribution in such roots, which holds especially for consonant slots: while the root-initial position contrasts all obstruents and nasals, including clicks, the root-medial and root-final positions have extremely limited consonant inventories, i.e. /m, n, p, r/ and /m, n/, respectively.

[3] This does not imply that there are no other theoretically possible analyses (cf., e.g., Elderkin's (2014) account in terms of "prosodies"), which, in the future, may also challenge the cluster analysis.

Regarding vowels, oral and nasal segments only contrast in Root classes 2 and 3, because vowel nasality is assumed to derive from reconstructed nasal consonants in the medial position. In general, his Root classes 2, 3 and 4 are all interpreted as deriving from Root class 5 by his historical analysis commonly known as the “Decomposition theory”. Finally, Beach (1938: 270) states that the occurrence of [o] and [u] in V1 position is predictable from the vowel height of V2: the vowel [u] occurs only if V2 is a high vowel, and [o] only if V2 is a non-high vowel; he further considers the possibility that [o] and [u] in V1 are the same phoneme. His insight into the contrast reduction in V1 will be important for developing the phonotactic template for Kalahari Basin languages in general.

Root class	**Examples**	**“Initial”**	**“Final”**		
Class 5 (Basic)	*!?uri* ‘white’, *|ore* ‘pray’, *ǂama* ‘brown’	**C**	**V1** a, o, u (oral)	**C** m, n, p, r	**V2** i, e, a, o, u (oral)
Class 4	*|am* ‘two’, *ǂan* ‘cover’, *ǂom* ‘believe’	**C**	**V** a, o (oral)	**N** m, n	**Ø** (V apocope)
Class 3	*ŋǁae* ‘sing’, *!hoa* ‘crooked’, *!hui* ‘explode’	**C**	**V1** a, o, u (oral/nasal)	**Ø** (C loss)	**V2** i, e, a, o, u (oral/nasal)
Class 2	*ŋ!a:* ‘in’, *|xu:* ‘tremble’, *ǁxã:* ‘moon’	**C**	**V1** (=V2)	**Ø** (C loss)	**V2** i, e, a, o, u (oral/nasal)

Table 10: Khoekhoe root structure (after Beach 1938)

C1	**V1**	**C2**	**V2**
stop	short	nasal	short
(click)	oral	liquid	oral
(nonclick)	back	voiced stop	
	(a, o, u)	(m, n, l, b)	
⇓		⇓	
Stronger		Weaker	
than C2		than C1	

Figure 2: Preferred segment class distribution in lexemes (after Traill 1985)

Beach’s generalizations were crucially elaborated further by Traill (1979, 1985), based on his data on Taa, particularly the East !Xoon dialect. The generalized phonotactic pattern of lexical morphemes of Kalahari Basin languages implied by Traill (1985: 96-7, 164-6) is summarized in Figure 2. Traill’s stem phonotactics is essentially the same as that of

Beach's Class 5, i.e. CVCV. In order to account for the asymmetric distribution of phonemes, especially in C1 and C2, he entertained universal tendencies which are subsumed under the "Strength hierarchy". Beach's and Traill's most important points on the basic form of lexical morphemes in the Kalahari Basin are summarized in Figure 3.

C	**V**	**C**	**V**
⇓	⇓	⇓	
Unconstrained occurrence	Contrast reduction	Highly constrained occurrence	

Figure 3: Skewed phonotactics in the Kalahari Basin (after Beach 1938, Traill 1985)

In the following, we show that this pattern can be fruitfully developed further, as discussed in detail by Nakagawa (2010). The study starts out from three phonotactic root templates essentially introduced already in Table 10, which, together with a set of vowel features to be introduced later, form a comprehensive framework for analyzing the distribution of phonemes within lexical morphemes in Kalahari Basin languages (O = onset, Cm = medial consonant):

(i)	Basic template:	OV1CmV2	
(ii)	Derived template:	OV1V2	historically from: OV1~~Cm~~V2
(iii)	Derived template:	OV1N	historically from: OV1N~~V2~~

Most lexical roots in Kalahari Basin languages comply with these templates (e.g., 96% of lexical items in G|ui). As already argued by Beach (1938), the templates in (ii) and (iii) are derived from the basic one in (i). The segment and feature distribution in the basic OV1CmV2 is thus expected to reflect the core structure of the Kalahari Basin phonotactics. Using this set of templates new data are currently analyzed regarding phonotactic patterns across the Kalahari Basin. Below we report on first results of this research.

The new data fully confirm Beach's and Traill's findings regarding consonant distribution in that root onsets contrast all obstruents and nasals (including clicks), as given in the Cross-Kalahari Basin consonant chart in Table 6, while the root-medial consonant only displays a small number of weak consonants excluding clicks, typically /b, r, m, n/.

The analysis of vowel distribution offers additional insights into the skewed Kalahari Basin phonotactics. While the following generalizations on vowel distribution are based on the case of G|ui (Nakagawa 2010), the interpretation applies to a wider range of Kalahari Basin languages. The restricted inventory for V1 in G|ui is as follows:

/A/ = [a e i ã ĩ] (predictable from O, Cm, V2)
/U/ = [o u ũ] (predictable from O, V2)
/aˤ/ = [aˤ ãˤ] (predictable from V2)
/uˤ/ = [uˤ ũˤ] (predictable from V2)

The abstract phoneme /A/ is an unrounded vowel phoneme with allophones [a e i ã ĩ], whose height, backness, and nasality are predictable from the relevant features of O, Cm and V2. The second abstract phoneme /U/ is a rounded vowel phoneme with allophones [o u ũ] whose height and nasality are predictable from O and V2. The other two pharyngealized vowels have their nasalized allophones, which are predictable from the nasality of V2. In summary, these four vowel phonemes occurring in V1 are underspecified for [±high, ±low], [±back] and [±nasal], and their phonetic realizations are fully predictable from their phonetic environment.

The V2 slot has a fuller inventory with straightforward allophones. It contrasts the five plain vowels /i e a o u/ and three nasal vowels /ĩ ã ũ/. The only allophonic rule is that if V1 is a pharyngealized vowel, then V2 is more or less pharyngealized phonetically. In other words, optional pharyngealization of V2 is predictable from V1.

The same analysis can be applied to other Kalahari Basin languages. Therefore, the constraints on vowels in the OV1CmV2 template can be stated in terms of the following distinct features, whose distribution within the basic template is shown in Figure 4.

(i) V1 only contrasts in terms of the lip-position feature [± round] and the guttural features [±pharyngealized], [±glottalized] and/or [±breathiness].
(ii) V2 only contrasts in terms of vowel height [± high, ±low], backness [±back], and nasality [±nasal].

O	**V1**	**Cm**	**V2**
	[±round]		[±high, ±low]
	[guttural]		[±back]
			[±nasal]

Figure 4: Distribution of distinctive features in V1 and V2

The distinctive features are grouped into two classes that are mutually exclusive in their templatic slot. From this analysis at least two questions arise, which are discussed briefly on the basis of our ongoing research: (i) How do vowels vary cross-linguistically within this template? (ii) How can this skewed and asymmetric distribution be explained?

Regarding the first question of cross-linguistic variation, our current generalization is that vowel phonemes in V1 only vary across Kalahari Basin languages in the guttural features, as shown in Table 11.

Feature	Taa	ǂ'Amkoe	Kalahari Khoe*	Khoekhoe
[±round]	YES	YES	YES	YES
[±pharyngealized]	YES	YES	YES	
[±glottalized]	YES	YES		
[±breathy]	YES			

Note: * = G|ui, G‖ana, Naro, ǂHaba

Table 11: Presence of possible V1 features across Kalahari Basin languages

Since the four patterns of feature co-occurrence are predominant patterns in our sample languages, an implicational hierarchy can be established tentatively: breathiness implies glottalization, which in turn implies pharyngealization.[4] All vowel features other than the guttural features are universal across Kalahari Basin languages.

The second question concerning the underlying causes for the mutually exclusive feature distribution in V1 and V2 can be addressed in terms of a hypothesis that refers to the place-of-articulation feature [dorsal]. The distinctive features [±round] and [guttural] in V1 concern non-dorsal places of articulation, while vowel-height and backness features in V2 both concern the dorsal place. Moreover, recall from above that the root onset is the slot for all click distinctions and clicks are particularly frequent in the lexicon in Kalahari Basin languages. Since click articulation is characterized by the lingual ingressive airstream, requiring complex tongue-body movement that involves essentially DORSAL gestures.

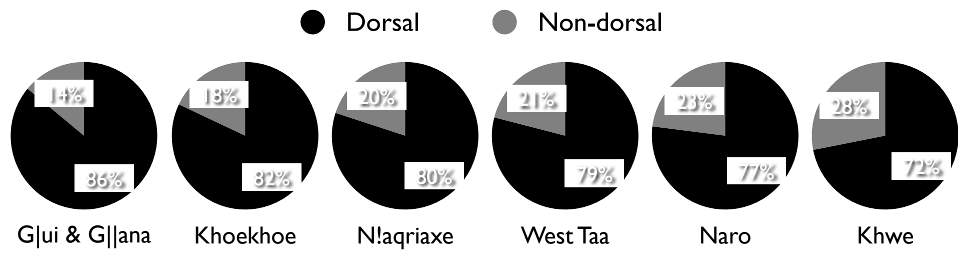
If we re-examine the two consonant slots, onset and medial, in general from this perspective, another asymmetry of [dorsal] distribution can be established. First, dorsal sounds clearly outnumber non-dorsal ones in onsets across Kalahari Basin languages with respect to the language-specific inventory, as illustrated in Table 12. In contrast, non-dorsal sounds predominate as medial consonants, typically being /b, r, m, n/).

Language	Dorsal onsets	Non-dorsal onsets
Khwe	**47 (64%)**	27 (36%)
G‖ana	**68 (76%)**	21 (24%)
G|ui	**68 (77%)**	20 (23%)
Naro	**40 (70%)**	17 (30%)
Khoekhoe	**23 (74%)**	8 (26%)
West !Xoon	**129 (87%)**	20 (13%)

Table 12: Dorsal/non-dorsal ratio in onsets across Kalahari Basin languages

4 A possible exception to this generalization is South Kua; it has strident vowels, which may be interpreted as [+pharyngeal, +breathy], but lacks glottalized vowels (Traill 1980).

The same dorsal predominance in onsets is evidenced by lexical frequencies. Figure 5 shows the proportion of dorsal and non-dorsal onset consonants in seven Kalahari Basin languages. In all of them, the dorsal class outranks the non-dorsal one by a wide margin.



Other sources: Khoekhoe - Haacke and Eiseb (2002), Khwe - Kilian-Hatz (2003), Naro - Visser (2001), N!aqriaxe - Gerlach (p.c.), West Taa - Naumann (p.c.)

Figure 5: Lexical frequency of dorsal consonants

Joining these observations with the occurrence of vowel features given in Figure 4 leads to an overall feature distribution across lexical roots shown in Figure 6.

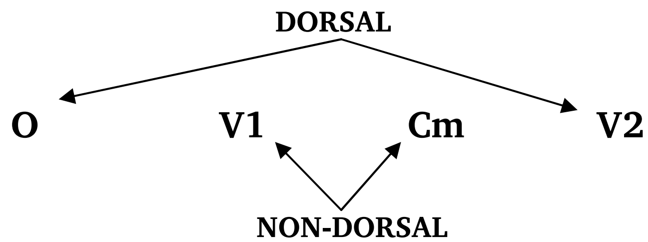


Figure 6: Dorsal feature dispersion in roots

This overall phonotactic pattern shows a symmetric configuration of dorsal features, representing a typologically marked trait of the Kalahari Basin. It is plausibly explained in terms of avoiding the crowding of dorsal articulatory adjustments. In other words, the highly skewed distribution of distinctive features can be understood in terms of dissimilatory constraints. What we call here the “Dorsal feature dispersion” hypothesis is the logical outcome of the ground-breaking research by Beach (1938) and Traill (1979, 1985).

2.3 Comparative consonant systems: inventory and lexicon

A third research domain pioneered by Anthony Traill concerns the comparison of phoneme systems across Kalahari Basin languages. In his earliest treatment of this topic he writes:

> ... I should like to explore aspects of the phonetic and phonological diversity of the Khoisan languages for a number of reasons. Firstly, in order to contribute to our knowledge of the phonetic abilities of man by drawing on a unique and complex linguistic area. Secondly, in order to cast some light on how such a situation might have arisen and, derivatively, to advance our understanding of linguistic change in the Khoisan area. (Traill 1980: 167)

This first study contains a comparison of consonant inventories and their underlying phonetic features from eight languages (mostly from Botswana) which represent all three relevant families. One major finding is that the languages display considerable diversity according to various parameters, viz. inventory size, click/non-click ratio (by type), and presence vs. absence of a wide range of distinctive phonetic-phonological features.

Language (dialect)	Family	Clicks	Non-clicks	Total	Click/non-click ratio
Nama	Khoe-Kwadi	20	15	35	1,3
!Ora	Khoe-Kwadi	24	17	41	1,5
Kua (North)	Khoe-Kwadi	30	36	66	0,8
G‖abake	Khoe-Kwadi	32	40	72	0,8
G|ui (Khute)	Khoe-Kwadi	43	31	74	1,3
Kua (South)	Khoe-Kwadi	39	40	79	0,9
ǂ’Amkoe (ǂHoan)	Kx’a	59	34	93	1,7
Taa (East Xoon)	Tuu	82	32	114	2,5

Table 13: Consonant phoneme inventories of some Kalahari Basin languages (after Traill 1980: 169-70)

The results for the first two parameters are shown in Table 13. As discussed by Traill, it shows on the one hand that there are dramatic differences between languages. Thus, the largest inventory of East Xoon is more than three times as large as the smallest one of Nama. Likewise, the highest click/non-click ratio, again of East Xoon, is more than three times the value of the smallest one in G‖abake and North Kua. On the other hand, both parameters seem to be, at least partly, independent: Nama with the smallest inventory size has an intermediate click/non-click ratio.

Traill also compares the languages with respect to individual phonetic-phonological “transformations” involving increase and loss of features and causing the emergence of more complex and simpler systems, respectively. Various changes inform the characterization of speech sounds and also attest for correlations between consonant and vowel features, e.g. between uvular consonants and pharyngealized vowels (ibid.: 184-6). He also concludes that structural isoglosses are recurrently not distributed along genealogical but rather areal lines, and partly have different historical causes. Palatalized egressives, e.g., which widely occur all over central Botswana either go back to the palatalization of alveolars or to the replacement of palatal clicks (ibid.: 178-82).

Traill’s typological spirit is also evident in his later works, e.g., Traill (1995), where he uses partly deficient data collected and interpreted in the late 19th century in conjunction with cross-linguistic patterns recorded to date for reconstructing a more plausible phoneme inventory for the extinct Tuu language |Xam.

In another cross-linguistic analysis, which is yet more fine-grained, Traill (2001) compares two language varieties, viz. East !Xoon (Taa, Tuu) and Tsumkwe Ju|'hoan (Ju, Kx'a), regarding the cross-lexicon distribution of their different phoneme types in the initial consonant position of lexical roots. Two dimensions are ascertained, viz. different classes of consonants (contained in the horizontal axis of the cross-Kalahari Basin consonant chart of Table 6), and his so-called "click accompaniments" (included by the vertical axis of this chart, exemplified here by /!/). The results are given in Figures 7[5] and 8, respectively.

East !Xoon ‖ ≥ ! > ǂ > | > T > K > TS > S > N ≥ P > L
Tsumkwe Ju|'hoan ! > ǂ > ‖ ≥ | > K > T > TS ≥ S > P ≥ N > L
click > dorsal/coronal obstruent > labial stop + nasal sonorant > oral sonorant

Figure 7: Cross-lexicon frequency hierarchy of root-initial consonant classes in East !Xoon and Tsumkwe Ju|'hoan (after Traill 2001: 445)

East !Xoon ! > n! > g! > !' = !kh > !h = !x > !kx' > g!x = g!kh = g!kx'
Tsumkwe Ju|'hoan ! > n! > g! > !' > !x > !h > !kx' > !kh > g!x > g!kx' > g!kh
simple > complex + cluster > voiced cluster

Figure 8: Cross-lexicon frequency hierarchy of root-initial click accompaniments in East !Xoon and Tsumkwe Ju|'hoan (after Traill 2001: 445)

While there are numerous differences in detail between the two language varieties, a number of similarities can be observed, some of them summarized in the shared abstract hierarchy at the bottom of the two figures. These commonalities can be explained in terms of various factors. Such frequency hierarchies as {clicks > egressive stops > sonorants} and {voiceless > voiced} clearly correlate with what Traill (1985) has discussed in connection with the strength hierarchy, which is a universal phenomenon. Universal markedness within the area-specific trend of extensive posterior consonant "elaboration" seems to be involved in the fact that plain simple clicks /!/, /n!/, and /g!/ without accompaniment, as the least elaborated segments, predominate by quite a wide margin. Some findings, however, seem to reflect area-specific traits only, e.g. the frequency pattern {posterior affricates/fricatives > labial stops}; the latter consonant class even lacks /p/ - a common segment across the globe (cf. Maddieson 2005: §18). Similar to the last factor, Traill's central explanation for the considerable overlap in the two frequency hierarchies of segments is historical:

---

5 Traill's (2001: 444-5) symbols for sound classes, which abstract from further differentiations like click series, voice distinction, glottalization, and partly even place of articulation, are as follows: K = all velar plosives, L = /l/, N = all nasals, P = all labial plosives, S = all alveolar fricatives, T = all dental plosives, TS = all alveolar affricates, X = /x/, | = all dental clicks, ! = all alveolar clicks, ǂ = all palatal clicks, ‖ = all lateral clicks.

> A … suggestion that is consistent with the facts is that underlying the synchronic !Xóõ [= East !Xoon] and Zhu [= Tsumkwe Ju|'hoan] lexicons is an ancient identity that has been preserved in the typological details described above. Notice that this is not a claim of genetic relationship based on classic comparative evidence and reconstructed forms. Instead, the evidence draws attention to a localised affinity which has persisted diachronically. It is difficult to be more precise about the conditions that might have led to this situation, and one must concede that the above suggestion is speculative. (Traill 2001: 448-9)

He observes himself that one of the main problems for any interpretation of the empirical facts in just two languages is the possibility of greater generality of certain patterns:

> … it is certainly not the case that the remaining SAK [aka Kalahari Basin] languages are all typologically entirely remote from them [= !Xóõ and Zhu]. … it remains to be seen whether such languages [as Kua and G|ui] follow the lexical distribution found in !Xóõ and Zhu. (Traill 2001: 449)

Precisely such questions have been the topic of the recent collaborative project "The Kalahari Basin area: a 'Sprachbund' on the verge of extinction" in which both of us participated. In the following, we report on first, still very preliminary research results from an analysis similar to that in Traill (2001) but across a larger language sample. The varieties considered here are the West !Xoon dialect of Taa (Tuu); the N!aqriaxe dialect of ǂ'Amkoe (Kx'a); and the Khoe varieties Caprivi Khwe, G‖ana, G|ui, Naro (all Kalahari Khoe); and Standard Khoekhoe (Khoekhoe). Since the outcome of our provisional analysis is quite likely to change in some respects after more extensive research we do not explain in more detail the data base, the methodology behind counting segment classes, etc. We only intend to reiterate the great potential of such research for cross-linguistic phonology in general and the synchronic profile and history of the Kalahari Basin in particular.

One important result of our wider comparison is that individual languages may deviate strongly from the patterns observed in East !Xoon and Tsumkwe Ju|'hoan, which confirms Traill's suspicion about some kind of historical link between the two languages studied by him. Indeed, Khoekhoe (particularly its northern Namibian varieties) has been known for a long time to differ in certain respects quite dramatically from other Kalahari Basin languages. Foreshadowed by the analysis of phoneme inventory sizes (cf. Table 13 above), this fact can be observed again at its frequency hierarchies in Figure 9.

Consonant types: ! > | > ‖ > ǂ > K > *S* > T > *X* = *N* = TS > P
Click accompaniments: ! > *!ʔ* > *!h* > n! > !x

Figure 9: Cross-lexicon frequency hierarchy of root-initial consonant classes and click accompaniments in Namibian Khoekhoe

Comparing Figure 9 with Figures 7 and 8, some differences are striking; most deviant segments are shown by italics. E.g., its hierarchy for click accompaniments shows that even such basic generalizations like the apparent primacy of simple clicks (/!/, /n!/) over all other clicks cannot be viewed as universal, because frequency is also subject to language-specific history that can counter even strong cross-linguistic trends. The high frequency of /!ʔ/ in Namibian Khoekhoe, e.g., is at least partly due to the specific historical sound change of /kx'/ to /ʔ/ as both phoneme and cluster offset which neutralized the distinction of /!kx'/ vs. /!ʔ/ still attested in !Ora (cf. Beach 1938). This also explains a phenomenon that is not shown in Figure 9 (like other similar cases not considered in Traill's and hence our figures), viz. the high frequency of plain /ʔ/ which is the same as that of /s/.

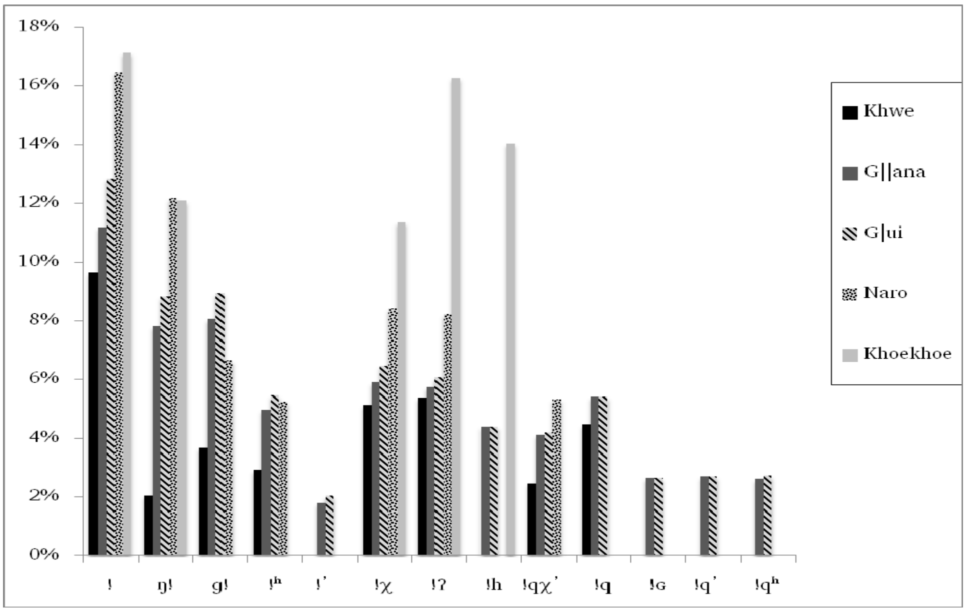


Figure 10: Cross-lexicon frequency of click accompaniments in Khoe languages

Figure 10 gives the relative frequency of click accompaniments of five related Khoe languages. It shows that considerable variation can even be found within a genealogical language group, and is also not restricted to just Khoekhoe. From this intra-family comparison and from Traill's (2001) comparison of two unrelated languages one can conclude that the phonological profiles at issue do not necessarily give a strong genealogical signal but are subject to other factors, notably geographical proximity.

A similar perspective arises from the comparison across our entire sample which also comprises the two non-Khoe languages Taa (Tuu) and ǂ'Amkoe (Kx'a). Tables 14 and 15 give the phonological proximities between language pairs in terms of Spearman's rank correlation coefficients, which are calculated from the ratio of the number of lexemes with each initial consonant type[6] to the total number of lexemes with the initial consonant types shared by each language pair.

[6] In addition to the consonant types used by Traill (2001: 445, as cited here in Figure 7 and footnote 3), the following four consonant types are considered in our counts: palatal stops (/c, ɟ, cʰ, c', cχ, cqχ'/), uvular stops (/q, ɢ, qʰ, q', qχ', ɢ', ɢχ'/), glottal stop (/ʔ/) and glottal fricative (/h/).

	Khwe	*G‖ana*	*G|ui*	*Naro*	*Khoekhoe*	West !Xoon
N!aqriaxe	0.44	0.87	0.89	0.81	0.72	0.76
West !Xoon	0.55	0.91	0.92	0.96	0.86	
Khoekhoe	*0.39*	*0.75*	*0.71*	*0.86*		
Naro	*0.59*	*0.95*	*0.95*			
G|ui	*0.57*	*0,98*				
G‖ana	*0.67*					

Note: *Italic = genealogically related Khoe*

Table 14: Proximity for cross-lexicon distribution of root-initial consonant classes

	Khwe	*G‖ana*	*G|ui*	*Naro*	*Khoekhoe*	West !Xoon
N!aqriaxe	0.02	0.63	0.64	0.46	0.70	0.68
West !Xoon	0.07	0.80	0.85	0.64	0.31	
Khoekhoe	*0.80*	*0.20*	*0.20*	*0.40*		
Naro	*0.39*	*0.75*	*0.75*			
G|ui	*0.36*	*0.99*				
G‖ana	*0.40*					

Note: *Italic = genealogically related Khoe*

Table 15: Proximity for cross-lexicon distribution of root-initial click accompaniments

First, both tables confirm that languages of the Khoe family are not all similar in their overall frequency of phoneme classes. An unambiguously coherent group emerges only with G‖ana and G|ui having consistent proximity values of 90 and more, with Naro joining them especially in the count for consonant classes (marked by grey shading); both Khwe and Khoekhoe hold a kind of outlier position.

Far more remarkable is that non-Khoe languages can display a proximity to certain Khoe languages as great as, or even greater than, that among Khoe languages themselves. This finding is particularly clear for West !Xoon of Taa (Tuu family) with respect to G‖ana and G|ui, and for consonant classes, also Naro (marked by grey shading). Given the geographical proximity of all these varieties, this finding would reflect a strong areal affinity in the Central Kalahari across genealogical boundaries (cf. Traill and Nakagawa 2000). This ties in well with more general historical scenarios for certain areas in the Kalahari Basin which, in line with Traill's (2001: 448-9) ideas expressed in the above quote, entertain deeper non-genealogical links between languages, involving in particular language shift and resulting substratum effects (Güldemann 2008, Pickrell et al. 2012).

What can also be discerned from these two tables is that proximity values for different parameters, here consonant classes and click accompaniments, do not necessarily correlate strongly. This observation shows that, apart from the preliminary nature of the above data, a fuller assessment of these research questions will be a much more complex issue that can only be addressed after a comprehensive documentation of the languages involved and a fine-grained multifactorial analysis of the attained data, following the path opened up more than 30 years ago by Traill's (1980, 2001) studies.

3 Conclusion

In summary, we have attempted to show above that Anthony Traill's research questions, empirical findings and conclusions are still highly relevant today - this in spite of the hugely increased empirical data base. He has thus inspired scholars of diverse disciplinary fields and theoretical persuasions in many different ways. His innovative capacity is also evidenced by the fact that he identified and designed paths of research which still today remain barely explored. The following quote transpires a research spirit that impacted his contemporaries, and will certainly continue to do so with future researchers:

> The question is whether this is potentially of deeper linguistic interest. Is the search for a linguistic explanation appropriate or does one merely note the facts and leave it at that?
>
> I have succumbed to my curiosity and have explored a possible explanation of these phenomena in terms of a hypothesis involving the maximization of universal tendencies (in intrinsic structure of the syllable ...) Application of these theoretical constructs to !Xóõ enables one to explain the above distributional details as natural phenomena, and to a certain extent it places a perspective on the uniqueness of Khoisan languages which allows them to be seen as a variation on a universal theme. (Traill 1985: 166)

What he wrote specifically in the context of discussing the "back vowel constraint" reflects his general approach as a scholar and as a person. Scientifically, he established a holistic approach to Kalahari Basin sound structure on various dimensions - his oeuvre spans phenomena between single segment and overall system, between synchrony and diachrony, and finally between the language-specific and the universal. His focus on the universals of language in the particular field of "Khoisan" studies also reflects his deeply human approach, viz. by "demystifying" languages, and hence their speakers, which are conventionally subsumed under a concept that is loaded with stereotypes, both popular and scientific.

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