Phonological patterns involving New Types of Complex and Contour Segments in Endangered Khoesan Languages

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The Khoesan languages were previously thought to comprise one language family (Greenberg 1966).

Recent research has suggested that the southern African click languages comprise at least three language families (The Ju–ǂHoan family, The Tuu family, and the Khoe family) (Güldemann 2006).

Nowadays, the term Khoesan refers to the non-Bantu and non-Cushitic languages that contain clicks.
Languages with new types of segments

- The South African Tuu language, **N|uu**, contains a new type of contour segment, **airstream contour segments** (Miller, Brugman et al. 2009, Miller 2010).

- The Namibian Ju–ǂHoan language, **Grootfontein !Xung**, contains a new type of complex segment, the **retroflex click [!!]***.

- The Namibian Ju–ǂHoan language, **Ekoka !Xung**, contains a new type of complex segment, a laterally released palato–alveolar click.
The new segment types tell us a lot about the synchronic and diachronic phonology of clicks.

- Synchronic – They help us determine the correct description of the Back Vowel Constraint (BVC), a C–V co–occurrence constraint.

- Diachronic – The retroflex click has been involved in two mergers in the Ju subgroup of the Ju–ǂHoan family.
Level of Endangerment

- N|uu < 10 remaining speakers South Africa
- Mangetti Dune !Xung (~ 1000 speakers)
- Grootfontein !Xung (~1000 speakers)
- Ekoka !Xung (~ 500 speakers)
Locations of Click Languages

Ju|'hoansi, !Xung

!Xóõ

N|u

Khoe family

≠Hoan

Nguni

S.Sotho
N|uu speakers
Grootfontein !Xung speakers
Mangetti Dune !Xung speakers
# N|uu Segment Inventory

**Table 4.** N|uu simple stops

<table>
<thead>
<tr>
<th>PULMONIC</th>
<th>Bilabial</th>
<th>Alveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Central</td>
<td>Lateral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop</td>
<td>p b</td>
<td>(t) (d)</td>
<td>c cʰ j</td>
<td>k kʰ g</td>
<td>Q</td>
<td>(?)</td>
</tr>
<tr>
<td>Nasal</td>
<td>m</td>
<td>n</td>
<td>j</td>
<td>jʰ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 5.** N|uu complex stops

<table>
<thead>
<tr>
<th>Lingual</th>
<th>Labial</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Palatal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Central</td>
<td>Lateral</td>
</tr>
<tr>
<td>Stop</td>
<td>⊙</td>
<td></td>
<td>h g</td>
<td>h g</td>
</tr>
<tr>
<td>Nasal</td>
<td>ŋ ŋʰ</td>
<td>ŋ ŋʰ</td>
<td>ŋ ŋʰ</td>
<td>ŋ ŋʰ</td>
</tr>
</tbody>
</table>


### N|uu Segment Inventory

**Table 7. N|uu contour stops**

<table>
<thead>
<tr>
<th>PULMONIC</th>
<th>Labial</th>
<th>Dental</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affricate</td>
<td>ts</td>
<td>ĉχ</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| GLOTTALIC        |        |        |         |       |        |
| Affricate        | ts'    | k̄χ'   | q̄χ'    |       |        |

| LINGUO-PULMONIC  |        |        |         |       |        |
| Labial           |        |        |         |       |        |
| Dental           |        |        |         |       |        |
| Alveolar         |        |        |         |       |        |
| Palatal          |        |        |         |       |        |
| Central          |        |        |         |       |        |
| Lateral          |        |        |         |       |        |
| Stop             | ʘ̃q    | ǀ̃q̃q̃ | ǃ̃q̃ | ǂ̃q̃ |        |
| Affricate        | ʘ̃χ    | ǀ̃χ    | ǃ̃χ | ǂ̃χ |        |

| LINGUO-GLOTTALIC |        |        |         |       |        |
| Affricate        |        |        |         |       |        |
|                  | ǀ̄χ    | ǃ̄χ | ǂ̄χ |        |        |
Table 1. Claimed contrasts in posterior place of articulation (L&T refers to Ladefoged and Traill 1994; L&M refers to Ladefoged and Maddieson 1996; Miller refers to Miller et al. 2009.)

<table>
<thead>
<tr>
<th>Place of Articulation</th>
<th>L&amp;T, L&amp;M</th>
<th>L&amp;T, L&amp;M</th>
<th>Miller</th>
<th>Miller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labial</td>
<td>[ʘk]</td>
<td>[ʘq]</td>
<td>[ʘ]</td>
<td>[ʘq]</td>
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<tr>
<td>Dental</td>
<td>[ǀk]</td>
<td>[ǀq]</td>
<td>[ǀ]</td>
<td>[ǀq]</td>
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<tr>
<td>(Central) Alveolar</td>
<td>[ǃk]</td>
<td>[ǃq]</td>
<td>[ǃ]</td>
<td>[ǃq]</td>
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<tr>
<td>Lateral Alveolar</td>
<td>[ǁk]</td>
<td>[ǁq]</td>
<td>[ǁ]</td>
<td>[ǁq]</td>
</tr>
<tr>
<td>Palatal</td>
<td>[ǂk]</td>
<td>[ǂq]</td>
<td>[ǂ]</td>
<td>[ǂq]</td>
</tr>
</tbody>
</table>
Acoustic Evidence for Airstream Contour Segments in N|uu
Articulatory Evidence for Place of Posterior Constrictions in N|uu clicks

Figure 7: Tongue traces of closures and releases for the central alveolar lingual [!] (top) and linguopalatinal [วาด] (bottom) stops, as well as the alveolar palatoglossic closure in the phrase sentence [maka  לך  טוקפ] I say... I say finished.

[!] and [วาด]

Figure 9: Tongue traces of closures and releases for the palatal lingual [วาด] (top) and linguopalatinal [วาด] (bottom) stops, as well as the alveolar palatoglossic closure in the phrase sentence [maka  לך  טוקפ] I say... I say finished. (Note that ‘א’ is used for ‘א’ in the plots.)

[วาด] and [วาด]
Airstream contour segments

(9)(a) Linguo-pulmonic stops (b) Linguo-glottalic stops (c) Linguo-pulmonic affricates

[lingual] [pulmonic] [lingual] [glottalic] [lingual] [pulmonic]

[-cont] [-cont] [-cont] [+cont]
Phonological evidence for place of articulation in N|uu airstream contour segments
A co–occurrence constraint found between certain consonants and front vowels.

Traill (1985) analyzed it as a co–occurrence constraint with the feature [back].

The N|uu patterns provide evidence for the place of articulation features associated with airstream contour segments.
PULMONIC CONSONANTS

piri (Western) (<Tswana)

sii  1 pl inclusive pron.  su’n’i  ‘sit’

yii  ‘tea’ (<Afr.)

ts’ii  ‘bite’  ts’uu  ‘blow (of the wind)’

ciβa  ‘turn self around’  cuu  ‘mouth’

ji’i’in  ‘tired’  ju’n’u’n  ‘skin’

kii  it (non-human, 3 sg. weak)  kuu  he, she, 3 sg., strong)

giriike  ‘to roll something’  gunu  ‘poison bulb plant’
PULMONIC CONSONANTS

\( \chi\text{ə}'\text{nǐ} \) ‘to defecate’  \( \chi\text{um} \) ‘strand of beads’

\( \text{qə}'\text{nǐ} \) ‘be startled’  \( \text{quə}'\text{i} \) ‘be famished’

\( \chi\text{ə}n\text{inki} \) ‘mother’  \( \chi\text{uu} \) ‘face’

\( \chi\text{ə}'\text{ni} \) ‘laugh’  \( \chi\text{ə}'\text{uu} \) causative marker
Velars are [+back], but they are not subject to the constraint – only uvulars are.
Medial pulmonic consonants

Medial sounds that have an [i] vs. [u] contrast following them

ǁχuri  ‘root of dawidjies’  ǀq’uru  ‘hip’

ǁuni  ‘be lost’

ǂχənu  ‘oryx calf’

χəmi  ‘to roll up’

ǃəβi  ‘to ride’  ŋ̊ǃʔəβu  ‘gun, rifle’
The Back Vowel Constraint: Pulmonic Consonants (Word Medial)

Figure 5. Co-occurrence of medial consonants and following front vs. back vowels in the 790 N|uu root database, CVCV and CVVCV roots
### LINGUAL CONSONANTS

<table>
<thead>
<tr>
<th></th>
<th>ii</th>
<th>‘to catch’</th>
<th></th>
<th>iiu</th>
<th>‘to boil’</th>
</tr>
</thead>
<tbody>
<tr>
<td>g</td>
<td>ii</td>
<td><em>Acacia hebeclada</em></td>
<td></td>
<td>uu</td>
<td>‘to tell a lie’</td>
</tr>
<tr>
<td>g</td>
<td>ii</td>
<td>‘look, see’</td>
<td></td>
<td>ucu</td>
<td>‘nose’</td>
</tr>
<tr>
<td>ǂ</td>
<td>ii</td>
<td>‘don’t’</td>
<td></td>
<td>uusi</td>
<td>‘fly’</td>
</tr>
<tr>
<td>ǂ</td>
<td>iβi</td>
<td>‘spoon’</td>
<td></td>
<td>ui</td>
<td>‘ears’</td>
</tr>
<tr>
<td>LINGUAL CONSONANTS</td>
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<td>--------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>!œi  ‘to run’</td>
<td>!umi  ‘mute person’</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>ґ!œi  ‘lay on’</td>
<td>ґ!uu  ‘large intestine’</td>
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<td></td>
</tr>
<tr>
<td>ŋ!œi  ‘big’</td>
<td>ŋ!u^nun  ‘dune’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‖œ^nïn  ‘climb up’</td>
<td>‖u  ‘not’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ґ‖œ^nïn  ‘hyena’</td>
<td>ґ‖uɾuke  ‘road’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There are two classes of clicks: those that co-occur with front vowels, and those that do not.
Linguo-pulmonic stops that have an [i] vs. [u] contrast

\[\text{\[\text{i}i\]} \text{ ‘person of the same age’ } \text{\[\text{u}\]} \text{ ‘tobacco’} \]

\[\text{\[\text{i}^h\text{i}\]} \text{ ‘hat (with a brim)’ } \text{\[\text{u}\]} \text{ ‘neck’} \]

(Linguo-pulmonic stops that have an [əi] vs. [u] contrast)

\[\text{\[\text{u}\]} \text{ ‘to lead’ } \text{\[\text{u}\]} \text{ ‘maize flour’} \]

\[\text{\[\text{u}\]} \text{ ‘gland’ } \text{\[\text{u}\]} \text{ ‘urine’} \]

Figure 6. Co-occurrence of front vs. back vowels with root-initial clicks with airstream contours in N/uu in the 790 Root database, CVV and CVVCV roots.
[i] vs. [əi] allophones of /i/
Table 7. Summary of C-V co-occurrence patterns in N|uu

<table>
<thead>
<tr>
<th></th>
<th>Occur with front &amp; back vowels</th>
<th>Occur with back vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pulmonic stops</strong></td>
<td>Labial, Alveolar, Palatal, Velar</td>
<td>Uvular</td>
</tr>
<tr>
<td><strong>Clicks</strong></td>
<td>Dental clicks, Palatal clicks</td>
<td>Labial clicks, Central and lateral alveolar clicks</td>
</tr>
<tr>
<td><strong>Clicks with airstream contours</strong></td>
<td>Dental clicks, Palatal clicks</td>
<td>Labial clicks, Central and lateral alveolar clicks</td>
</tr>
</tbody>
</table>
The Back Vowel Constraint

(Miller–Ockhuizen 2003)

\[ \{ [\text{pharyngeal}]_{\text{vplace}} [\text{coronal}]_{\text{vplace}} \} \]

[pharyngeal] and [coronal] can not be specified on the same or different v-place within a syllable.
Specification of posterior constrictions in Ju|’hoansi clicks

(Miller–Ockhuizen 2003)

Dental Click [ǁ] unmarked for pharyngeal
Central Alveolar click [ǃ] [pharyngeal]
Lateral Alveolar click [ǁ] [pharyngeal]
Palatal click [ǂ] unmarked for pharyngeal
Miller (2010) states the BVC in N|uu in terms of [RTR].

The dental [l], and palatal [?] clicks are unspecified, and the central alveolar [!], lateral alveolar [ǁ] and labial [ɔ] clicks are [RTR].
New Insights from N|uu

- The N|uu data provide information as to the posterior place of articulation of the labial click. It is both [dorsal] and [RTR].

- The N|uu data provide information as to the posterior place of articulation of the linguo–pulmonic clicks. The data suggest, like the phonetic ultrasound data, that these clicks do not have a second uvular posterior place of articulation involving tongue root retraction.

- Rather, the dental and palatal linguo–pulmonic stops are unspecified for [RTR], while the labial and alveolar clicks are specified for [RTR].
Is the labial click [RTR] phonetically? That is, does the rarefaction gesture for the labial click involve tongue root retraction?

Thomas–Vilakati (2008) has suggested that the tongue dorsum retraction in [!] may be due to the tongue tip retraction.

There is no known articulatory reason why labial clicks should involve retraction of the tongue root.
Evidence for Two new click types in the Ju subgroup of the Ju-Hoan language family
Genetic Relationships of Ju Languages

Ju–ǂHoan

Ju

ǂHoan

Northwestern Ju

Central Ju

Southeastern Ju

Mangetti Dune !Xung

Grootfontein !Xung

Ju–l’hoansi

Ekoka !Xung
Claims for a retroflex click

- Doke (1925) was the first to document a retroflex click
  - described !Xung spoken in Grootfontein area as having a 5th contrastive coronal click, the retroflex click
- Snyman (1997) survey of !Xung lects
  - also described !Xung spoken in Grootfontein area as having a 5th retroflex click
- König and Heine (2001) describe Ekoka !Xung as having four contrastive clicks: dental, alveolar, lateral, and retroflex (no palatal click)
  - admit that they do not know what the fourth click is phonetically
Claims against a retroflex click

- Currently, the IPA recognizes only 4 coronal clicks: dental, alveolar, lateral, and palatal

<table>
<thead>
<tr>
<th>Dental</th>
<th>Alveolar</th>
<th>Lateral alveolar</th>
<th>palatal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>!</td>
<td></td>
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</tbody>
</table>

- No petition has ever been made to include the retroflex click in the IPA.

- Heikenen (1986) described the !Xung spoken in the Ekoka area as having a palatal, rather than retroflex, click.

- In *Sounds of the World’s Languages* (1996) Ladefoged and Maddieson state they do not believe a retroflex click to exist, based on the lack of evidence.
Table 1: Egressive Consonants

<table>
<thead>
<tr>
<th>Bilabial</th>
<th>Alveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>central</td>
<td>post-alveolar</td>
<td>lateral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulmonic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop</td>
<td>p, pʰ, b</td>
<td>t, d, dʰ</td>
<td>tʰ</td>
<td>k, kʰ, g</td>
<td>?</td>
</tr>
<tr>
<td>Fricative</td>
<td>f</td>
<td></td>
<td></td>
<td>χ</td>
<td>ŋi</td>
</tr>
<tr>
<td>Affricate</td>
<td>tʃ, dχ</td>
<td>tʃ, dʒ</td>
<td>tʃχ, tʃʰ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasal</td>
<td>m, mʰ</td>
<td>n, nʰ</td>
<td>j</td>
<td>η</td>
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<td>Liquid</td>
<td></td>
<td>l</td>
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<td>Glide</td>
<td>w</td>
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<td>j</td>
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<td>Glottalic</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Affricate</td>
<td>tʃ’, dʒ’</td>
<td>dʃχ’</td>
<td>kχ’</td>
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</tr>
</tbody>
</table>

( ) = only attested in Bantu loan words
Based on König and Heine (2001)
Table 2: Ingressive Consonants

<table>
<thead>
<tr>
<th>Lingual</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Lateral</th>
<th>Retroflex</th>
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<tbody>
<tr>
<td>Stop</td>
<td></td>
<td>h g</td>
<td>g</td>
<td>h</td>
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<tr>
<td>Nasal</td>
<td>n</td>
<td>n</td>
<td>h</td>
<td>n</td>
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<tr>
<td>Fortis</td>
<td>k</td>
<td></td>
<td>k</td>
<td></td>
</tr>
</tbody>
</table>

**Linguo-Pulmonic**

| Affricate | | χ | !χ | ||χ | !!χ |

**Linguo-Glottalic**

| Stop       | | ’ ‘ | ’h | | ’ ‘ | ‘’h | ||’ ‘ | ’’h | | ’ ‘ | ‘’h | !!’ ‘ | ‘’h |
| Affricate  | | χ | g|χ | | χ | g|χ | | χ | g|χ | | χ | g|χ | !!χ | g|!!χ |

Based on König and Heine (2001)
Eckoka !Xung Clicks: BVC Patterns (Scott 2009)

(1) dental [l]¹
  a. |làlé| jackal
  b. |lù| boil, vi
  c. |lǐi| axe²
  d. |g|è come

(2) retroflex [!!]
  a. |!!àhù| run
  b. |!!ùú| place
  c. |!!hë| arm
  d. |!!èhì| be stupid
  e. |!!hì| many
  f. |n!!àē| men (irr. pl)
  g. |n!!áē| be angry

¹ All data are from König and Heine (2008) and König and Heine et al (2001).
² It is not clear from König and Heine’s orthography which vowels are short or long. They state that there is no length distinction and that some vowels are written doubly in order to be able to indicate contour tones (see 2b.). However, there are cases such as (1c.) where a vowel is written doubly even though the tone remains the same. Since it is not clear to me why vowels are written singly or doubly I have left vowels as König and Heine write them. It is possible that, as in a related language N|uu, roots are minimally bimoraic (Miller, in press), and therefore that single Vs in CV syllables are actually long. This is not crucial to my analysis.
Ekoka !Xung Clicks: BVC Patterns (Scott 2009)

(3) alveolar [!] 
  a. !àhà  run away  d. !ãè  village  
  b. !ò  short  e. !áí  carry on one’s shoulder  
  c. !ùm  dark 

(4) lateral [ǁ] 
  a. ǁàbà  enter  e. ǁáí  Ndonga people  
  b. ǁúm  leg  d. ǁãè  monkey  
  c. ŋǁò³líú  blood  
  d. ǁhòè  cup  
  
  f. ǁhè  yesterday, in free variation with ǁhãè  
  g. ǁé  die, in free variation with áè  
  h. ŋǁè kãû  stop, vi
(5) uvular fricative [χ]

a. !àχàdoctor
b. χāū now
c. χāī grind, rub tobacco
### Table 3: Co-occurrence of Vowels and Consonants

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>a</th>
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<th>ei</th>
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</table>

√ = co-occurrence attested
The “Retroflex Click”

- The “retroflex” click in Ekoka !Xung occurs freely with front vowels, and not with the lowered and retracted diphthong allophones.
<table>
<thead>
<tr>
<th>Region</th>
<th>Location</th>
<th>Pronunciation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>Grootfontein !Xung</td>
<td>gǂaa</td>
<td>'old'</td>
</tr>
<tr>
<td>Northern</td>
<td>Mangetti Dune !Xung</td>
<td>gǂaa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘old’</td>
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<tr>
<td>Northern</td>
<td>Ekoka !Xung</td>
<td>g‼aa</td>
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<td>‘old’</td>
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<tr>
<td>Southern</td>
<td>Ju</td>
<td>’hoansi</td>
<td>gǂaa</td>
</tr>
</tbody>
</table>
Ekoka

g!!a ‘to be old’

speaker DX
Grootfontein !Xung palatal click

\[ \text{g} \text{ǂa} \text{a} \text{ ‘to be old’} \]

speaker XT
Laterally Released Palatal Click

The Ekoka !Xung click transcribed by König and Heine (2001) as a !! Click, behaves like non-affricated palatal clicks in the other Juu languages, in that it occurs freely with front vowels.

- It is a laminal palatal click, with a fricated release.
Grootfontein !Xung is a central lect of the Juu–ǂHoan language family.

It has retained the *!! From Proto–Juu, and is the first language to be recognized to have a retroflex click synchronically (Doke 1926, Snyman 1997, Miller, Shah and Sands, 2008, Miller, Shah and Scott 2011).
Grootfontein !Xung Clicks

- **Dental**: |a ’spread out blankets to make a bed’
- **Lateral**: ||ah ’hat’
- **Alveolar**: g!u ’belly’
- **Palatal**: g=a ’to be old’
- **Retroflex**: g!!u ’water’
Grootfontein !Xung

<table>
<thead>
<tr>
<th>Word ( orIGIN)</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>glìi</td>
<td>‘to go out’</td>
</tr>
<tr>
<td>nǂi (from nǂi ǃhan)</td>
<td>‘to know’</td>
</tr>
<tr>
<td>ǂai</td>
<td>‘blind’</td>
</tr>
<tr>
<td>gǃəi</td>
<td>‘to carry on the shoulder’</td>
</tr>
<tr>
<td>gǁə’i</td>
<td>‘yesterday’</td>
</tr>
<tr>
<td>ǀəixa</td>
<td>‘to be sad, angry’ ( &lt;Khoekhoe)</td>
</tr>
<tr>
<td>!!əi</td>
<td>‘dead’</td>
</tr>
<tr>
<td>kili</td>
<td>‘blanket used to carry over baby on the back’ (not abacross, this goes above it)</td>
</tr>
</tbody>
</table>
The Grootfontein !Xung click is a retroflex click
The retroflex click does not co-occur with front vowels in Grootfontein !Xung.

This predicts that the click might involve tongue root retraction phonetically.

This hypothesis is under investigation.
Mid-sagittal Ultrasound (114 fps): Grootfontein !Xung [!!]

Δ 35.2 ms

Δ 61.6 ms

Δ 17.6 ms

Δ 26.3 ms
Table X. Click Inventory of Mangetti Dune !Xung

<table>
<thead>
<tr>
<th>Dental</th>
<th>Central Alveolar</th>
<th>Lateral Alveolar</th>
<th>Palatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ǀ</td>
<td>ǃ</td>
<td>ǁ</td>
<td>†</td>
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</tbody>
</table>

All four coronal clicks are recognized by the IPA
Mangetti Dune !Xung BVC: The BVC is not active with mid vowels

High Vowels:

ɡǀii ‘to exit’ ǂii ‘malaria’
ǃəi ‘to carry on shoulder’ ɡǁəi ‘tortoise’

Mid vowels:

ɡlee ‘to come’ ǂee ‘to fetch water’
ǃee ‘pounding block’ ǀlee ‘death’
My Hypothesis

- The BVC is a phonologization of the rarefaction gestures (the TR retraction gesture and tongue center lowering gesture) that expand the lingual cavity in order to rarefy the air trapped in the lingual cavity and create the popping sound characteristic of clicks.
How are clicks articulated?

1. Posterior Tongue raised to form the posterior constriction
2. Tongue body lowered & retracted to create a vacuum in the lingual cavity
3. Anterior tongue lowered to allow air to rush into the mouth
4. Posterior constriction released

1. Anterior tongue (tip or blade) raised to form the anterior constriction
Collected mid-sagittal ultrasound data for four speakers of Mangetti Dune !Xung using the CHAUSA method, at 114 fps (an image of the tongue every 8 thousandths of a second).

Wordlist

kininu ‘pill, medicine’
glii ‘to exit, go out’
ǂii ‘malaria’
ǃǝi ‘to carry on the shoulder’
ɡǁǝi ‘tortoise’
ǁee ‘death’
CHAUSA Method Ultrasound Recording in Namibia
Rarefaction gesture displays tongue body lowering, but not tongue root retraction. Thus, the BVC does not apply to this click.
There is tongue body lowering. Although the posterior constriction is far back, there is no retraction of the root proper during the rarefaction gesture. Thus, the BVC does not apply to this click.
Alveolar click – Rarefication gesture

Tongue traces for the click in the word lai ‘to carry on shoulder’

Rarefication gesture involves simultaneous tongue body lowering & Tongue root retraction between Trace 3 and Trace 5. Thus, the BVC applies to this click.
Rarefaction gesture displays both tongue body lowering and tongue root retraction. Thus, the BVC holds for this click.
Rarefaction gestures

- The alveolar [!] and lateral alveolar [ǁ] clicks involve both tongue root retraction and tongue center lowering.

- The dental and palatal clicks only involve tongue center lowering.

- The rarefaction gestures for [ǁ] are different from those in IsiZulu, where the lateral click only displays tongue center lowering (and not tongue root retraction, Thomas–Vilakati 2008).
There were five coronal click types in Proto-Juu.

The *!! Click merged with the lateral click in Northern lects.

The *!! Click merged with the alveolar click in Southern lects.
The retroflex click [‼‼] and the lateral alveolar click [ǁǁ] both have a lateral frication component.

The change from the retroflex click [‼‼] to an alveolar click [‼] in Southern lects is an articulatory simplification.
Conclusions

- The endangered language N|uu is the only surviving member of the !ui branch of the Tuu language family.

- N|uu is one of three languages alive today that contains labial clicks (along with !Xóõ and !Hoan).

- N|uu is only one of 4 languages alive today that contain linguo–pulmonic contour segments that are stops.
The N|uu lexical database recorded by our NSF project has shed light on the articulation and correct phonological specifications of the once thought to be ‘uvular’ clicks.

The phonological evidence supports the analysis of these sounds as airstream contour segments – linguo–pulmonic stops.
Conclusions

The Juu languages provide evidence for two new types of complex segments – retroflex clicks [‼‼] and laterally released palato-alveolar clicks [ǂǂ].

Preliminary lexical data shows that the retroflex click is specified for [RTR], and the laterally released palato–alveolar click is not specified for the feature [RTR].
Conclusions

- The Back Vowel Constraint found in Tuu and Ju-ǂHoan languages is a phonologization of the rarefaction gestures (tongue root retraction and tongue center lowering) found in clicks.

- BVC patterns with mid vowels are still under-described. Mangetti Dune !Xung is different from closely related lects in that the BVC does not apply to mid vowels.

- The retroflex click [!!] in the endangered language Grootfontein !Xung is the only language known to have retained the *!!.
Conclusions

- The fricated lateral retroflex click has merged with the fricated lateral alveolar click in the Northern Ju lects.

- The retroflex click has been articulatorily simplified in the merger with the alveolar click in the Southern Ju lects.
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**Ekoka !Xung**: Hi||han Tu’e (HT), Djem lxaia (DX), l||ami lumea (NN), Tu’e lumea (TN), !ha glaqm (HG)
References


References


