

Contrastive Lateral Clicks and Variation in Click Types

Amanda Miller-Ockhuizen (amiller@ling.ohio-state.edu)
The Ohio State University

and

Bonny E. Sands (Bonny.Sands@nau.edu)
Northern Arizona University

Abstract

We report on a new click type found in Mangetti Dune !Xung (M.D. !Xung) - a forward released denti-alveolar lateral click, transcribed [ǁ]. We present acoustic data showing that ǁ is distinct from the "typical" lateral (post-) alveolar ǁ, and the central (post-) alveolar !, a conclusion supported by synchronic and diachronic analyses of Northern Khoisan [8, 12].

We use Adaptive Dispersion [6] to account for acoustic differences seen between ǁ in !Xung and Ju|'hoansi, a related language without the ǁ click.

The ! click is distinct from both ǁ and ǁ lateral clicks in rise time till peak intensity [4, 5], burst duration and peak burst frequency, while ǁ and ǁ differ primarily in terms of rise time and peak intensity.

1. Introduction

The International Phonetic Association currently recognizes 5 contrastive click types in the languages of the world, though clicks are only a regular feature of Southern African, and East African languages. The five recognized click types are given in the chart in (1) along with their phonetic labels [3].

(1) 5 Currently Recognized Click types

Bilabial	Dental	Palatal	Alveolar	Lateral Alveolar
⊙		≠	!	ǁ

All of these click types except for the bilabial click are present in both Northern Khoisan languages discussed in this paper. The existence of an additional contrastive click type in the Northern Khoisan language M.D. !Xung has also been noted [8, 12]. The click type is described as a forward released lateral click, and it is transcribed with the symbol [ǁ]. The data in (2) give an illustrative minimal triple showing the contrast between the [!], [ǁ] and [ǁ] click types in M.D. !Xung. In Ju|'hoansi there is only a two-way contrast between the [!] and [ǁ] click types.

(2) Minimal Pairs between [!], [ǁ] and [ǁ] click types in Mangetti Dune !Xung

Ju 'hoansi	!Xung	English Gloss
ŋǁàŋ	ŋǁàŋ	'Tylosema'
ŋ!àŋ	ŋǁàŋ	'eland'
ŋ!áŋ	ŋ!áŋ	'inside'

The acoustic attributes of this new click type will be discussed in this paper, and the contrast between this click type and the most similar other click types in the same language, the central alveolar and the lateral alveolar click types, will be motivated.

The acoustic attributes of the central alveolar and lateral alveolar click types in Mangetti Dune !Xung and Ju|'hoansi are similar to the attributes of these click types in Xhosa [10], in the Southern Khoisan languages [4, 5, 15] and in central Khoisan languages [2]. This new click type is important to phonetics and phonology, in that it motivates a new contrastive sound which phonological theories will need to account for. The recognition of this click type also aids in the historical reconstruction of Northern Khoisan click types, where correspondences are found between the alveolar and the lateral alveolar click type in different languages. [8, 12]

2. Method

We collected cognate sets of words which had been transcribed by previous researchers [13] as having a lateral alveolar click in Mangetti Dune !Xung and a central alveolar click in Ju|'hoansi. Through its auditory properties and visual cues attesting to different articulations, as well as native speaker intuition, we determined that the lateral clicks in these words were different from the lateral clicks in the words that correspond to lateral clicks in Ju|'hoansi.

In order to investigate the acoustic differences between the two lateral clicks in M. D. !Xung, we recorded 20 cognate sets that both contained central alveolar clicks, 10 cognate sets that both contained lateral alveolar clicks, and 12 cognate sets that

also significant at the level of $p < .05$, but there was no significant difference between the burst durations of [!] and [||] in M.D. !Xung. For the Ju'hoansi data, the difference in burst duration between [||] and [!] was significant as shown by an ANOVA at the level of $p < .01$, with a significant interaction between speaker and click type, and speaker. The difference between the burst durations of [!] and [||] were also highly significant at the level of $p < .01$, with no significant effect of language, but a significant interaction between language and click type.

Rise time to peak intensity has also proven to be a useful measure of contrastive click types in !Xóǝ [4,5]. This measure also shows a robust difference for the three M.D. !Xung click types investigated here. The mean rise times until peak intensity in M. D. !Xung are given in (5) for all three click types under study, as well as for the two click types produced by four Ju'hoansi speakers. Standard deviations are given in parentheses. The Ju'hoansi rise times are similar to the !Xung ones:

(5) Rise Times to Peak Intensity (msec.)

!			Speaker
1.3 (0.4)	8.8 (5)		DX (Ju)
1.9 (2.2)	10.74 (4.6)		DK (Ju)
1.6 (0.7)	9.69 (6.7)		KK (Ju)
1.4 (0.8)	9.54 (7.3)		NC (Ju)
1.4 (0.7)	12.1 (9)	4 (2.7)	SR (!Xung)

The graph in Figure 2 illustrates the differences in rise time to peak intensity in M.D. !Xung:

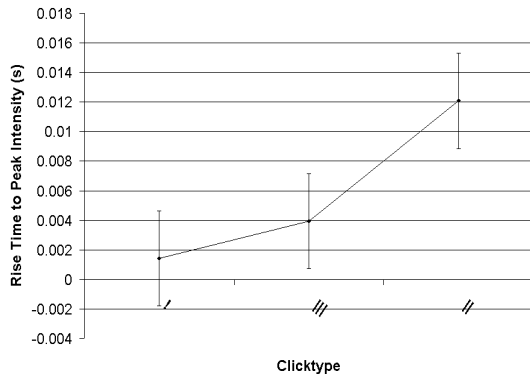


Figure 2: Rise Time Until Peak Intensity for all Three Alveolar Click types in Mangetti Dune !Xung

The M. D. !Xung [||] click type has a much faster rise time to peak intensity than the [|||] click type does, and the [||] click

type is slower than [!] click type. A t-test showed a significant difference between the alveolar and forward released lateral clicks, as well as between the alveolar and lateral post-alveolar clicks [||] at the level of $p < .01$ ($t=10.8$ and $t=8.0$), as well as a significant difference at the level of $p < .05$ ($t=2.548$) between the two lateral click types in M.D. !Xung. There was no significant difference for any of the two like click types when grouped by language.

4. Discussion

The results show that there are two types of contrastive lateral clicks in M. D. !Xung. The newly introduced forward released denti-alveolar lateral click type has a longer burst duration than the further back released lateral alveolar click type, and a longer rise time until peak intensity, though the peak frequency is about the same as the further back lateral alveolar click type found in Ju'hoansi and M. D. !Xung. We have shown in previous work [8, 12] that this additional click type also aids in the historical reconstruction of clicks in Proto Northern Khoisan. The synchronic status of the [|||] click type motivates plausible acoustically and articulatorily based changes in click type within the various Northern Khoisan languages.

Little work has focused on phonetic differences among click types in the different languages where they occur. There are indications that there is quite a bit of variability among click types cross-linguistically, particularly with regards to lateral clicks. Researchers have noted that the lateral click type in Hadza has a much more laminal articulation [11] than is typically found in Khoisan languages. [2, 4, 5, 14, 15]. Beach also shows palatograms indicating more laminal articulations in Xhosa and Khoekhoegowab [1]. Khoekhoegowab lateral clicks also pattern phonologically with dental and palatal clicks in allowing contrasting following front and back vowels, and not with the alveolar click type which co-occurs only with back vowels, as it does in other Khoisan languages. [7, 14]

The burst durations reported in this study for M.D. !Xung show that the lateral click is significantly shorter in this language than it is in the related language Ju'hoansi. Rise time until peak intensity is also slightly longer for the lateral alveolar [||] click type in M.D. !Xung than it is for any of the four Ju'hoansi speakers, though there was no significant difference by language. While we cannot completely rule out the possibility of the burst durations being an individual speaker difference, the lack of difference in the temporal domain of the articulation of the [!] click in the two languages, and the lack of variation in the duration of [||] bursts within the four Ju'hoansi speakers studied here, indicates that this is a linguistic difference. It is likely that the difference in burst duration of [||] between the two languages is due to Adaptive Dispersion [6], where smaller contrastive sets are more spread out over the acoustic space than larger contrastive sets on a given dimension. Since there is no contrastive information in the burst spectrum, the temporal cues are particularly important, and should be maximally distinct in order to be perceptible to the listener.

Clicks are often thought of as unusual speech sounds, but we have added to the growing literature on clicks [2, 3, 4, 5, 10, 11, 14, 15] showing that they can be characterized acoustically using similar measures used in describing pulmonic consonants. While it is marked among the languages of the world to have two contrastive lateral sounds, many Australian languages have this property. The two contrastive lateral clicks in M.D. !Xung can be distinguished by rise time, a measure which is often used to show the difference between pulmonic plosives and affricates.

5. References

1. Beach, Douglas M. (1938). *The Phonetics of the Hottentot Language*. W. Heffer, Cambridge.
2. Kagaya, Ryohei. (1978). "Soundspectrographic analysis of Naron clicks: A preliminary report." *Annual Bulletin of the Research Institute of Logopedics and Phoniatrics*, Faculty of Medicine, University of Tokyo 12: 113-125.
3. Ladefoged, P. and I. Maddieson. (1996). *The Sounds of the World's Languages*. Oxford: Blackwell.
4. Ladefoged, P. and A. Traill. (1984). "Linguistic Phonetic descriptions of clicks." *Language* 60: 1-20.
5. Ladefoged, P. and A. Traill. (1994). "Clicks and their accompaniments." *Journal of Phonetics* 22: 33-64.
6. Lindblom, Bjorn. (1990). "Models of phonetic variation and selection." *PERILUS (Phonetic Experimental Research, Institute of Linguistics, University of Stockholm)* 11: 65-100.
7. Miller-Ockhuizen, Amanda. (1999). "C-V Coarticulation and Complex Consonants: Evidence for Ordering in Click Place Gestures" In Fujimura, Osamu, Brian Joseph & Bohumil, Palek, Ed. *Proceedings of LP '98: Item Order in Language and Speech* Prague: Charles University Press.
8. Miller-Ockhuizen, Amanda and Bonny E. Sands. (1999). "!Kung as a linguistic construct". *Language and Communication* 19/4. June 1999. pp. 401-413.
9. Nartey, Jonas N.A. (1982). "Fricative Phones and phonemes: Measuring the phonetic differences within and between languages". *UCLA Working Papers in Phonetics* 55.
10. Sands, Bonny E. (1991). "Evidence for click features: Acoustic characteristics of Xhosa clicks". *UCLA Working Papers in Phonetics* 80: 6-37.
11. Sands, Bonny, Ian Maddieson and Peter Ladefoged. (1993) "The phonetic structures of Hadza". *UCLA Working Papers in Phonetics* 84. 67-88.
12. Sands, Bonny E. and Amanda Miller-Ockhuizen. (2000). "Comparative Evidence for New Click Types in Northern Khoisan". Paper presented at the 74th Annual Meeting of the Linguistics Society of America. Chicago, Illinois.
13. Snyman, J. W. (1997). "A Preliminary classification of the !Xüü and the Zu|'hōasi dialects". In *Namibian Languages: Reports and Papers*. Haacke, Wilfred and Edward Elderkin. (eds.) Köln: Rüdiger Koppe.
14. Traill, Anthony. (1985). *Phonetic and Phonological Studies of !Xóǒ Bushman*. (Quellen zur Khoisan-Forschung 5). Hamburg: Helmut Buske Verlag.
15. Traill, Anthony. (1997). "Linguistic phonetic features for clicks: articulatory, acoustic and perceptual evidence". In R. K. Herbert, Ed. *Proceedings of the First World Congress of African Linguistics*.