

## Spoken, whistled, drummed, and fluted Kinande: an asymmetry for encoding pitch and rhythm

This paper presents novel experimental data on Kinande (Bantu, DRC) in four modalities: speech, whistle, drum, and flute. The overarching question this paper addresses is how, if at all, phrase-level prosody is encoded in the whistled, drummed, and fluted implementation of Kinande compared to the spoken baseline. A mechanical difference arises between the two fixed pitches of the drum, the five separate notes of the wooden flute, and the gradient pitch range of bilabial whistling. Such differences between surrogate capabilities has led researchers to demonstrate that users of languages with multiple surrogate registers like Akan-Twi do not seem to employ a single surrogate system for all registers, but rather adapt to the capability of each medium and encode varying types of phonological information (McPherson & Obiri-Yeboah 2022; Barnes, Batchelder-Schwab & Oppong 2023). This predicts similar findings for other languages like Kinande, where different speech surrogates are bound by their mechanical constraints concerning pitch and rhythm.

Several African languages are known for their surrogate modalities like Akan-Twi (Ghana: Kaminski 2008 for ivory trumpet; McPherson & Obiri-Yeboah 2022 for *seperewa* lute; Nketia 1971 for drumming; Nketia 1962:5 and Barnes, Batchelder-Schwab & Oppong 2023 for whistling); Sambla (Burkina Faso: McPherson 2018 for the balafone); and Moba (Togo: Rialland 2005 for whistling). The extent of productivity and intelligibility of these ‘talking drums’ and ‘whistle languages’ varies, but can approach the level of speech (Meyer 2015:145).

In this paper, I provide what may be the first attestation of such surrogate registers for Kinande. Whistled, drummed, and fluted Kinande registers conform to established typological predictions whereby languages with contrastive lexical tone tend to spawn registers in which the pitch corresponds at least primarily to the tone contour of the utterance (Meyer 2005; Busnel & Classe 1976; James 2021). Kinande has two lexical tones (H,L) (Mutaka 1994), and each modality examined in this paper demonstrates surface faithfulness to these tones, where phonemic high tones are produced at systematically higher pitch than phonemic low tones.

The experiment consists of 32 sentences stratified by syllable count, question/statement modality, and tonal contour of the utterance (all H tone, all L tone, alternating HL, alternating LH), based on a design for prosodic examination of a similarly-two tone system in Akan-Twi (Genzel 2013). The Kinande experiment was run in July of 2023 with twelve participants who sequentially ran the experiment whistling then speaking in Butembo; with one trained drummer in Lukanga; and with one shepherd flutist outside Lukanga. All participants are adult L1 speakers of Kinande.

This design tests three main prosodic details which are non-phonemic in Kinande: penultimate syllable lengthening, declination, and lookahead raising. Syllable lengthening in Kinande predictably falls on the penultimate syllable of an utterance (Mutaka 1996) and moves rightward as sentences lengthen in syllable count. Declination is the decrease in  $F_0$  over the course of an utterance, and seems to apply universally (Ladd 1984:64) as an independent phonetic effect, even to languages with other pitch-oriented prosodic effects like tonal downstep and final lowering (Genzel 2013). Lookahead raising involves an effect where speakers start longer sentences with higher  $F_0$ , ostensibly in anticipation of declination (Barnes et al. 2023).

Results suggest that rhythmic effects are more susceptible to maintenance across different surrogates than pitch effects, as penultimate lengthening is maintained in all four modalities. Compared with the relative average syllable length (ms) for each surrogate modality, penultimate syllables are 34% longer for drumming, 41% longer for flutes, 30% longer for whistling, and 33% longer for speaking. The maintenance of this rhythmic phenomenon across all speakers and all modalities suggests that syllable length remains accessible and replicable across different surrogate modalities.

Declination, on the other hand, is not represented in the flute or drum modalities. However, in spoken Kinande, utterances average 35Hz declination, or about 4.6 semitone fall from beginning until end of utterance. This contrasts with whistling, which has an average of 116Hz in declination per utterance, or about a 1.3 semitone fall from beginning until end of utterance. Although this shows a systematic similarity in pitch declination between spoken and whistled Kinande, the pitch range (in semitones) of

whistled Kinande seems to be narrower than in spoken Kinande, mirroring findings for Akan-Twi (Barnes et al. 2023).

Finally, lookahead raising is not represented on flute or drum, which maintain static pitches for phonemic tones. However, whistling shows a Pearson correlation coefficient of 0.23 for the relationship between the average pitch of the first syllable and the syllable count of the corresponding utterance. This is higher than the spoken coefficient of 0.078. It is not yet clear why whistling would demonstrate more significant lookahead raising than speaking, and further analysis is underway to investigate this question.

The four modalities of Kinande (spoken, whistled, fluted, drummed) show variation in the reproduction of fine phonetic details of phrase-level pitch and rhythm. Penultimate lengthening is faithfully maintained across all modalities in a comparable way, with the penultimate syllable lengthened to about 30-40% longer than the average syllable. Whistling reproduces the fine-grained pitch details found in spoken Kinande, including both declination and lookahead raising, while the flute and drum modalities do not represent such information. In theory, a drum with flexible pitch (i.e. a talking Yorùbá drum) or the Kinande flute with a number of distinct notes should be able to at least approximate such differences, even though the Kinande instrumental surrogate languages do not.

This phonological analysis of Kinande speech surrogates provides further evidence to prior facts established for Akan-Twi (McPherson & Obiri-Yeboah 2022; Barnes et al. 2023). Whistled surrogates reproduce prosodic information in great detail, in both pitch and rhythm; instrumental surrogates encode prosodic rhythmic information, but not the fine-grained phonetic effects of declination and lookahead raising on pitch. This is argued to stem from mechanical constraints on each instrument, suggesting that non-phonemic prosodic features are maintained in surrogate languages whenever possible, despite not contributing to maintaining functional load.

#### References Cited

- Barnes, Jonathan, André Batchelder-Schwab & Okrah Oppong. 2023. Phrase-level prosody of Akan-Twi in spoken and whistled modalities. *Phonetics and Phonology Europe*
- Busnel, René-Guy & André Classe. 1976. *Whistled Languages*. New York: Springer.
- Genzel, Susanne. 2013. Lexical and post-lexical tones in Akan. University of Potsdam: PhD Dissertation.
- James, Lucas. 2021. *Towards a typology of speech surrogates*. BA Honors Thesis, Dartmouth College.
- Kaminski, Joseph S. 2008. Surrogate Speech of the Asante Ivory Trumpeters of Ghana. *Yearbook for Traditional Music* 40. 133.
- Ladd, Robert. 1984. Declination: a Review and some Hypotheses. *Phonology Yearbook* 1. 53-74.
- McPherson, Laura. 2018. Musical surrogate languages in the documentation of complex tone: the case of the Sambla *balafon*. 6th International Symposium on Tonal Aspects of Language.
- McPherson, Laura & Michael Obiri-Yeboah. 2022. Akan tone encoding across surrogate modalities. 53rd Annual Conference on African Linguistics.
- Meyer, Julien. 2005. Description typologique et intelligibilité des langues sifflées, approche linguistique et bioacoustique. University of Lyon: PhD dissertation.
- Meyer, Julien. 2015. *Whistled Languages: A Worldwide Inquiry on Human Whistled Speech*. Berlin: Springer.
- Nketia, J.H. Kwabena. 1962. *African Music in Ghana: A Survey of Traditional Forms*. Accra: Longmans.
- Nketia, J.H. Kwabena. 1971. Surrogate languages of Africa. *Current Trends in Linguistics* 7. 699-732.
- Rialland, Annie. 2005. Phonological and Phonetic Aspects of Whistled Languages. *Phonology* 22(2). 237-271.