Geminate glides in Eastern Nilotic: Evidence from Lopit

Rosey Billington
School of Languages and Linguistics
University of Melbourne, Australia

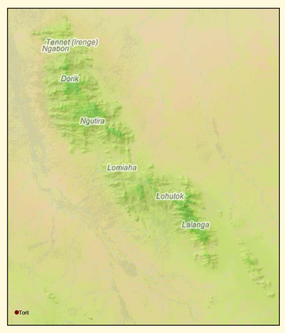
1. Introduction

Studies of consonant gemination reveal enormous diversity crosslinguistically (Blevins 2008), but certain patterns have also emerged, for example that segments such as stops are among the most preferred for consonantal quantity contrasts (e.g. Thurgood 1993, Dmitrieva 2012, Kawahara 2007). Quantity contrasts for glides are typologically unusual, but attested in a range of language families (Maddieson 2008), and are probably more common than typological surveys reveal, e.g. in under-described linguistic regions of Africa. However, phonetic explorations of the characteristics of singleton and geminate glides are very limited.

This poster presents the results of a phonetic investigation of proposed singleton and geminate palatal and labiovelar glides in Lopit, a language of South Sudan. This study is part of a wider documentation project underway with a small community of Lopit speakers in Melbourne. Results provide supporting evidence for such a contrast; constriction duration is a major correlate, but appears to also be supported by other acoustic cues.

2. The Lopit language

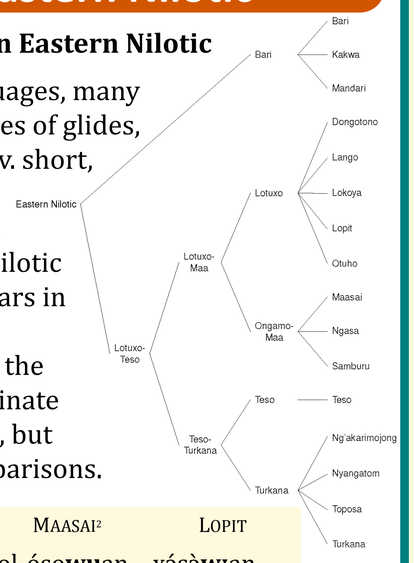
- Eastern Nilotic (Nilo-Saharan)
- Lopit Mountains, South Sudan.
- Minority language, ~ 50,000 speakers (Lewis 2009)
- Diaspora groups in Africa (esp. Kenya), and in North America, UK, and Australia.
- Six dialects: Ngabori, Dorik, Ngutira, Lomiaha, Lohutok, and Lalanga.
- Very limited previous work.



3. Glides in Eastern Nilotic

Long/strong consonants in Eastern Nilotic

- Among Eastern Nilotic languages, many are said to contrast two series of glides, described variously as long v. short, strong v. weak (e.g. Vossen 1982).
- Other long/strong contrasts are uncommon in Eastern Nilotic (but some among e.g. alveolars in Lotuxo sub-group).
- Some cognates indicate that the long/strong glides may originate from stop + glide sequences, but limited lexical data for comparisons.



Gloss	Teso[1]	Maasai[2]	Lopit
buffalo	e-koso**bw**an	ol-óso**wu**an	xɔ́sɔ̀**w:**an
arrows/bow	a-ka**bw**a	ɛnk-á**wu**o	xà**w:**àʔ

[1]Loyola 2007, [2]Tucker & Mpaayei 1955. 'Strong' glides are written as /wu/ in Maasai.

Glides in Lopit

- Lopit consonants include /t:, d:, n:, l:, r, w:, j:/ contrasting with /t, d, n, l, ɾ, w, j/. In the current project, the former have been called geminates, based on impressions of length (similar impressions noted by Turner 2001, Stirtz 2014, Vossen 1982).
- Geminates, including geminate glides, occur word-initially as well as word-medially, e.g. /**w:**òr/ 'bathing hole', /**w**ór/ 'valley'. But, they are less common initially.

Lopit	Gloss	Lopit	Gloss
xà**w**àʔ	sweet potatoes	té**j**ɛ̀	hold.IMP
xà**w:**àʔ	arrows	té**j:**ɛ̀t	pull.IMP

- No phonetic work on Lopit /w, w:/, /j, j:/ until now.

Question: Is there a distinction between proposed singleton glides /w/, /j/ and proposed geminate glides /w:/, /j:/? If so, what are the phonetic cues to the contrast?

4. Methods and materials

Participants and experimental materials

- For this experiment – 3 male participants (Dorik Lopit).
- Experimental materials: large set of lexical data, nouns and verbs (mostly 2 syllables, some 3 syllables). Chosen for medial (not initial) geminates, flanked by mostly non-close vowels. Range of tonal patterns on words.
- Each word recorded 5 times in isolation, following English prompt (simultaneously shown on laptop screen).
- Recorded at 44.1kHz/16-bit in quiet room - Zoom H4N, MixPre-D pre-amp, AudioTechnica AT892c headset mic.
- 981 tokens: /j/=240, /j:/=271, /w/=182, /w:/=288 (more to come).

Procedures and analysis

- Segmenting and labelling in Praat – glides identified by drop in amplitude, weakened upper formants, F1-F3 structures.
- Acoustic data extracted in Emu. Querying and plotting in R (`emu`); measures incl. duration of C, and of preceding V (ms), F1, F2, F3 (Hz), and intensity (dB-RMS).
- Data tested with Linear Mixed Effects Models (`lme4`) and post-hoc tests (fixed effect: consonant/vowel, random effects: speaker, word, onset tone, preceding vowel).

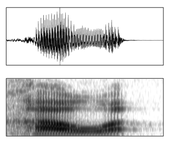


Figure 1: xà**w**àʔ (500ms)

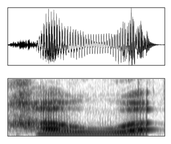


Figure 2: xà**w:**àʔ (500ms)

5.1. Results: Duration of glides, and preceding vowels

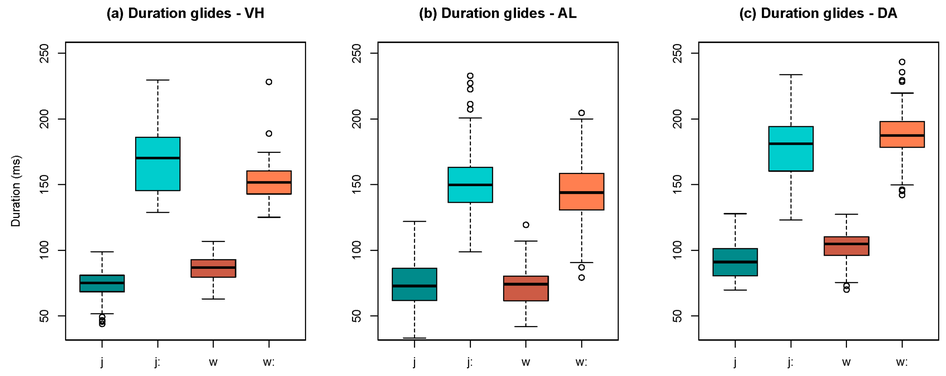


Figure 3: Duration (ms) of singleton and geminate glides, for each speaker.

Table 1. Mean duration values (ms) for each glide, and averaged across singleton and geminate glides.

glide	mean dur (ms)
j	79.36
j:	163.28
w	85.67
w:	157.89
C	82.52
C:	160.59

C to C: = 1 to 1.95

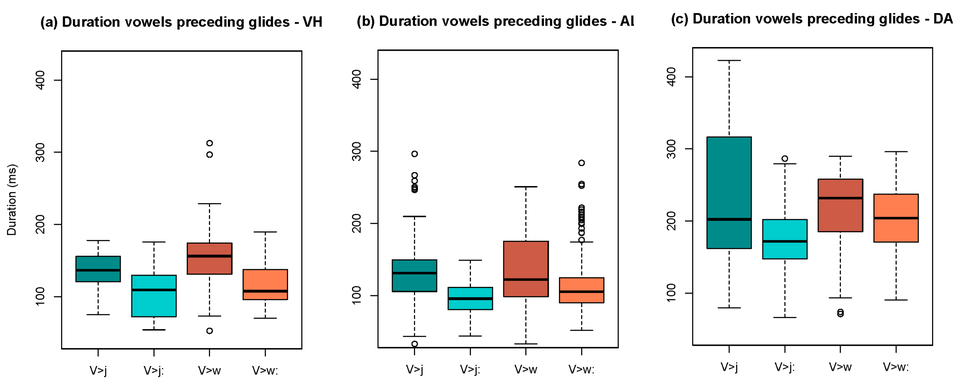


Figure 4: Duration (ms) of vowels preceding singleton and geminate glides, for each speaker.

Table 2. Results of statistical comparisons between singleton and geminate glides for acoustic and durational measures (***=p<0.001, **=p<0.01, *=p<0.05, - = NS).

measure	j ~ j:	w ~ w:
C duration	***	***
Preceding V duration	***	-
Intensity (midpoint)	***	***
F1 (midpoint)	***	***
F2 (midpoint)	***	***
F3 (midpoint)	***	-

5.2. Results: F1/F2 glides, intensity (glide midpoints)

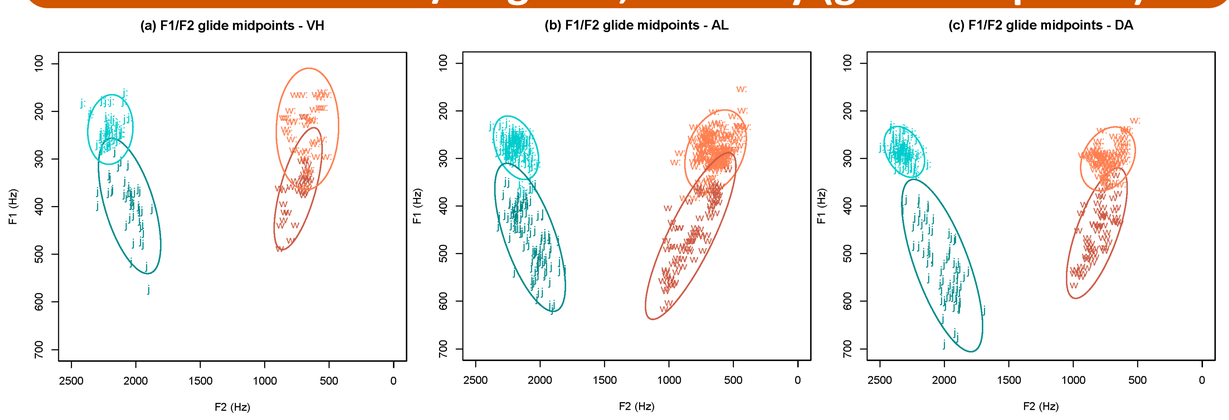


Figure 5: First and second formants (Hz) at midpoint of singleton and geminate glides, for each speaker (95% confidence intervals).

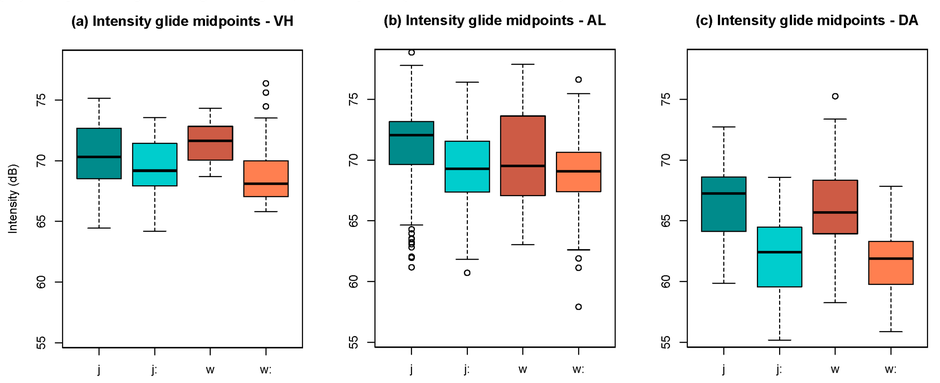


Figure 6: Intensity (dB-RMS) at midpoint of singleton and geminate glides, for each speaker.

- Results for the constriction duration (Fig. 3) show that proposed geminate glides are significantly longer than their singleton counterparts; almost **twice as long** on average (Table 1).
- Vowels preceding geminate glides tend to be shorter than vowels preceding singletons (Fig. 4), but this is only significant for the palatals (Table 2).
- More speaker variation for preceding vowel duration.
- F1/F2 results show geminate glides have a significantly **closer** and somewhat more peripheral quality than singletons (Fig. 5, Table 2.); suggests narrower constriction (perhaps more time to reach targets). F1/F2 more variable for singletons (likely greater influence of surrounding vowels).
- Results for F3 (not shown) show significant differences between /j/ and /j:/ only.
- Geminate glides have significantly **lower intensity** than singleton glides.

6. Discussion and Conclusions

This study has tested the validity of proposing a contrast between singleton and geminate palatal and labiovelar glides in Lopit, and found strong evidence that the language does have two distinct series of glides. Findings indicate that constriction duration is robust correlate of glide category, with proposed geminate glides being approximately twice as long as singleton glides, and remarkably consistent results for the three participants in this study. Lower duration values for vowels preceding geminates may provide supporting cues, though vowel duration differences were only significant for the palatal glides.

However, duration is unlikely to be the only perceptual cue to geminate category; acoustic measures reveal significantly lower intensity for geminate glides, and formant results indicate that there are also differences in the articulation of singleton and geminate glides, with the closer quality of geminate glides suggesting a narrower constriction, but tightly controlled; only one token in the data had to be excluded due to the presence of frication. These additional acoustic findings raise interesting questions about the characterisation of the contrast between these glides, and about the characterisation of similar segments in other Eastern Nilotic languages. If these 'long/strong' glides did arise from stop + glide sequences, it may be that some articulatory traces remain, but these may be implemented differently across the language family. Further work investigating the timing of characteristics across the glides will be enlightening.

These results of this experiment shed light on a typologically unusual and poorly understood class of geminates, and suggest that there are intriguing features of Eastern Nilotic consonant inventories which warrant further phonetic investigation.

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THE UNIVERSITY OF MELBOURNE · ARC CENTRE OF EXCELLENCE FOR THE DYNAMICS OF LANGUAGE · ASSTA

rbil@unimelb.edu.au

@roseybillington