

The Acoustics of Somali Geminate

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0. The acoustic properties of Somali (Cushitic, Afroasiatic) consonants are still understudied, and the studies available in the literature rely on qualitative / auditory approaches (Barillot 2002) and/or are based on data collected in uncontrolled environments (Armstrong 1934, Farnetani 1981, Edmonson *et al.* 2003). In this article, we investigate the acoustic characteristics of Somali singleton and geminate consonants on the basis of a controlled corpus. Indeed, a great variability in the realization of singleton voiced stops and of their geminate counterparts has been reported. In particular, two issues emerge: i) the phonetic correlates of gemination: it is unclear whether closure duration is the primary cue distinguishing geminate and singleton stops ; ii) the realization of word-initial stops: word-initial gemination has been reported, however the context in which it takes place is not clear.

1. Methodology. Singleton consonants are attested in all contexts, while geminate consonants are attested in intervocalic position, only. In order to specify the primary cue of the length contrast for voiced stops, we examine the acoustic properties of intervocalic singleton (LexC) and geminate (LexCC) /b, d, g/ in morphologically simplex nouns. In order to analyze the realization of word-initial voiced stops, we consider Noun1 Noun2 sequences, in which the test stop /b, d, g/ is the initial consonant of Noun2. We investigate 3 different syntactic and prosodic contexts: compounds (Cmp), genitives (Gen) and subject-object sequences (Ind). The corpus consists of 83 sentences, in which the serial position, and the surrounding vowels of the test segment within the carrier sentence are kept constant. Moreover, neither Noun1 nor Noun2 was under focus [1]. We report the results obtained for 4 Somali native speakers constituting a homogeneous group. Each sentence was produced 3 times by each speaker. We examine 3 temporal parameters (closure duration, release duration, duration of the vowel preceding the test stop) and 4 non-temporal parameters (presence/absence of release, devoicing of the test stop, stop closure amplitude, stop release amplitude). These parameters correspond to the acoustic correlates that most frequently oppose singleton and geminate consonants in the world's languages (Ridouane 2003).

2. Results ([2]-[3]-[4]-[5])

2.1. The phonetic correlates of gemination. Word-internal /b, d, g/ are characterized by a short duration, absence of burst release, absence of frication noise, and a high level of energy. Adopting Martínez-Celdrán & Regueira (2008)'s terminology, we conclude that they are realized as "open approximants". Word-internal /bb, dd, gg/ are always realized as stops with a clear release burst. They show no devoicing, no shortening of the preceding vowel, and most strikingly, their closure duration (72.7-88.7ms) corresponds to that attested for singleton, and not geminate, stops cross-linguistically. Lexical geminates in Somali are not realized as geminate stops, but as singleton stops. We conclude that the underlying contrast "singleton" vs "geminate" is realized as the manner contrast "open approximant" vs "singleton stop".

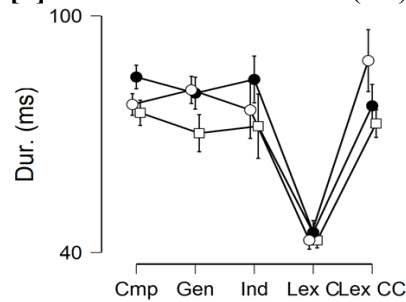
2.2. The realization of word-initial stops. The acoustic properties of word-initial /b, d, g/ clearly differ from those of word-internal /b, d, g/: their closure duration is longer and they are realized as voiced stops in all contexts. Word-initial singleton stops pattern with lexical geminates: same closure duration, same level of energy, same specification for voice, and a clear release burst. This result holds true irrespectively from the syntactic/prosodic context: compounds, genitives and subject-object sequences pattern together with lexical geminates with no significant difference. This suggests that the realization of word-initial voiced stops is independent of the prosodic/syntactic constituency: the "strong" realization of word-initial /b, d, g/ cannot straightforwardly be analysed as a case of word-initial strengthening triggered by the prosodic hierarchy and/or syntactic constituency.

3. To conclude, we discuss the implications of these results on the phonological representation of Somali geminates and word boundaries.

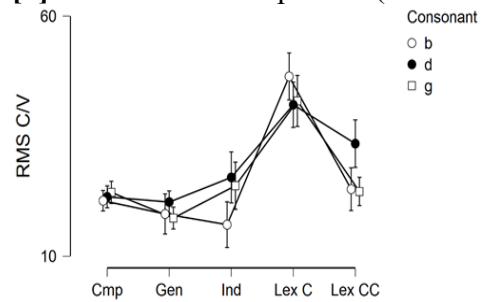
[1] Examples of the carrier sentences used for /b/ (*waxaa* focalizes the last NP of the sentence.)

LexC	<i>Sanad ka hor libaaxyo</i>	<i>waxay dileen Diiriye.</i>
	a year ago lions	FOC killed Diiriye
	“Lions killed Diiriye a year ago.”	
LexCC	<i>Abubakar dhibbaannadiisii</i>	<i>wuxuu ku daaweeyey jeermitire.</i>
	Abubakar wounds.his	FOC with treated disinfectant
	“Abubakar treated his wounds with disinfectant.”	
Cmp	<i>Wasiirku cilmi -baaris</i>	<i>wuxuu ku bixiyay siddeed milyuun oo doollar</i>
	minister-the science-research	FOC on spent eight million dollars
	“The minister spent eight million dollars on scientific research.”	
Gen	<i>Saaka bateri baabuur</i>	<i>waxaan ka soo iibasaday Kulmiye.</i>
	This morning battery car	FOC from bought Kulmiye
	“This morning I bought a car battery from Kulmiye.”	
Ind	<i>Berrito Cali Batuulo</i>	<i>wuxuu bari doonaa Gadiid.</i>
	Tomorrow Ali Batuulo	FOC introduce will Gadiid
	“Tomorrow Ali will introduce Gadiid to Batuulo.”	

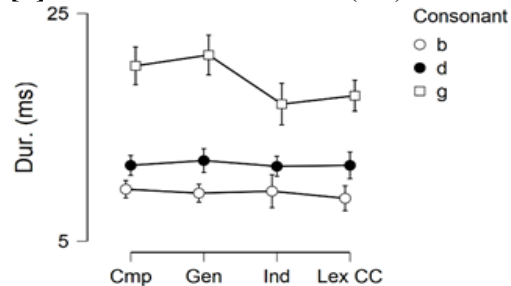
[2] Mean closure duration (ms)



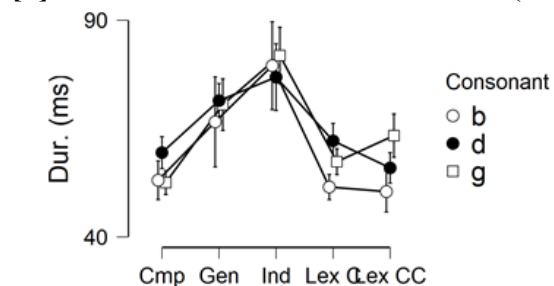
[3] Mean closure amplitude (RMS %)



[4] Mean release duration (ms)



[5] Mean vowel duration before test C (ms)



(LexC does not appear because singleton /b, d, g/ display no release burst).

Selected References

- Armstrong, L. 1934. The phonetic structure of Somali. *Mitteilungen des Seminars für orientalische Sprachen zu Berlin* 37(3), 116–161.
- Barillot, X. 2002. *Morphophonologie gabaritique et information consonantique latente en somali et dans les langues est-couchitiques*. Paris: Université Paris 7, thèse de doctorat.
- Edmondson, J. A., J. H. Esling & J. G. Harris. 2003. *Supraglottal cavity shape, linguistic register, and other phonetic features of Somali*. ms.
- Farnetani, E. 1981. Dai tratti ai parametri: introduzione all’analisi strumentale della lingua somala. *Fonologia e Lessico*, ed. by G. R. Cardona & F. Agostini, 27–108. Studi Somali 11. Roma: Ministero degli Affari Esteri.
- Martínez-Celdrán, E. & X. L. Regueira. 2008. Spirant approximants in Galician. *Journal of the International Phonetic Association* 38, 51–68.
- Ridouane, R. 2003. *Suites de Consonnes en Berbère: Phonétique et Phonologie*. Paris: Université Paris 3, thèse de doctorat.