

Acoustics without articulation: A case study of Tashlhiyt schwa-like elements

This study reports on ongoing research on the status of schwa-like elements ([@]) that are sometimes present in the acoustic record of Tashlhiyt underlying consonantal clusters (e.g. in [t@b@d@g] “it is wet”). Where do these vocalic elements come from? Are they epenthetic vowels or mere transitional stages of no structural relevance? This is a fundamental question, especially in a language like Tashlhiyt which has particularly long consonantal clusters and consonant-only words. Indeed, if one argues, as we do, that these elements have no structural relevance, this would imply that a form like /tbdg/ has obstruent-only syllables with stops acting as nuclei. In two previous studies (Ridouane 2008, Fougeron & Ridouane 2008a), we provided various arguments showing that these vocalic elements are not manipulated by phonological grammar, do not act as syllable peaks, and do not occur within voiceless consonantal sequences. In this work, we provide additional data tending to show that there are no temporal specifications associated with them and that their distribution depends on specific adjustments between laryngeal and supralaryngeal gestures.

Does [@] have a time slot of its own?

If this vowel-like element were a segment, one would expect it to have a specific time slot, and thus adds some duration to the CC sequence where it is realized (Davidson & Roon 2008). To test this, we recorded 5 speakers while producing 23 items containing CC sequences. The target C1C2 sequences vary in terms of laryngeal specifications, mode of articulation, and order of place of articulation (see table 1). Different measurements were taken for each sequence: duration of [C1(@)C2] sequence, duration of C1, duration of C1 release (if present), duration of @ (if present), duration of C2, and duration of C2 release (if present). Results showed that C1C2 sequences have the same duration ($p=.1$) whether there is a vowel-like element within the sequence or not (see figure 1). In addition, the duration of the C1C2 sequences is not correlated with the duration of the vocalic element ($r2=.001$, $p=.6$).

Can the distribution of [@] be predicted by the phonetic properties of the CC sequences?

We examined acoustic and electropalatographic data and showed that three conditions should be met for a transitional vocoid to surface within a CC sequence. First, at least one of the two consonants of the sequence should be voiced. Vocalic elements are more frequent when C2 is voiced (figure 2). Second, C1 release and C2 constriction have to be sufficiently spaced in time. Indeed, no vocalic element is acoustically present within homorganic sequences. In items of the type [tntltnt] “she hid them”, the speaker never moves the tongue away from the alveolars, a gesture necessary to produce a vocalic element (see also Fougeron & Ridouane 2008b). Third, vocal tract should be sufficiently open during the transition from C1 to C2. Vowel-like elements are more frequent in stop-stop sequences (figure 3). This is most probably related to the fact that stops have to be released for the perceptual recovery of C1 place of articulation. In addition, we show that occurrence of vowel-like elements depends on the amount of overlap between the alveolar and velar gestures. In other words, their presence is favoured when there is less overlap in linguopalatal contact between the two consonants (figure 4).

Conclusion

To sum up, in Tashlhiyt, phonetic implementation creates what looks like a schwa vowel in some consonant sequences but in fact is not, at least of the phonological sort. This element is rather a transitional stage with a vocoid configuration (i.e. voicing and formant structure) conditioned by the specific adjustments between laryngeal and oral gestures of the consonants.

Table 1. List of items produced by 5 speakers (5 to 6 repetitions) for the acoustic study. The items were embedded in the following carrier sentence [inna ... bahra] ‘he said ... a lot’

	[+vd,+vd]		[-vd,+vd]		[+vd,-vd]	
	Fr_Bk	Bk-Fr	Fr_Bk	Bk-Fr	Fr_Bk	Bk-Fr
<i>Stop-Stop</i>	bdiɣ	gdiɣ	tgim	kdiɣ	bqiɣ	gtinn
<i>Stop-Fric</i>	bziz	gziɣ	tɰiɣ	--	bsiɣ	ddfiʃ
<i>Fric-Stop</i>	zgiɣ	zbiɣ	sgin	ɰbiɣ	zkiɣ	ʃtiq
<i>Fric-Fric</i>	zɰur	ɰziɣ	sɰiɣ	χzit	ʒhid	ʃfiɣ

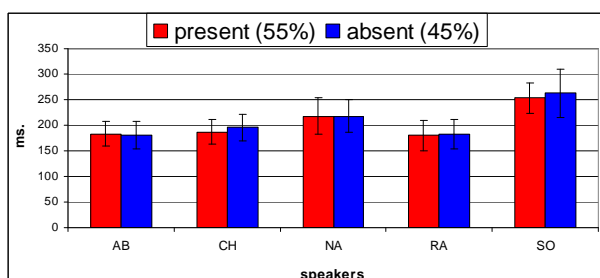


Figure 1.

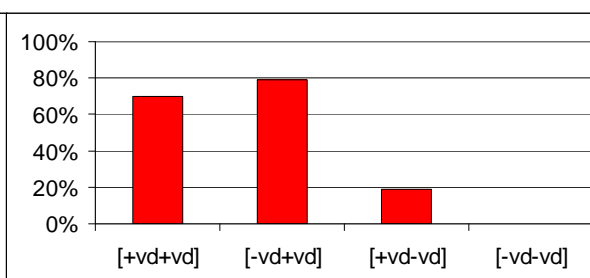


Figure 2.

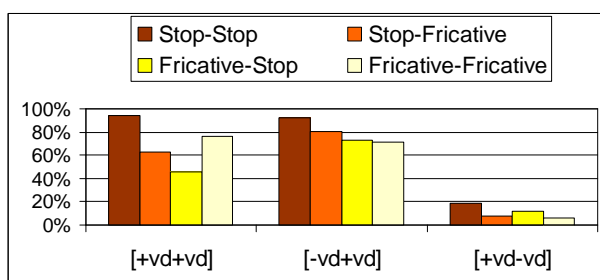


Figure 3.

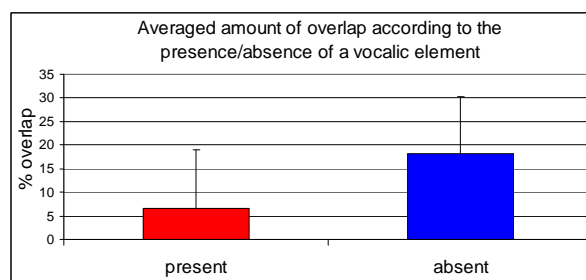


Figure 4.

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