Vowel lengthening in syllables without vowels

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There is a unique pragmatic context in Tashlhiyt, we dub the ‘of-course’ response, which provides a context where vowel lengthening plays an important prosodic role. The ‘of-course’ response is used by the responder when he/she believes that the information/answer is already known (or should be known). Tashlhiyt speakers show this by an exaggerated lengthening of the duration of the final vowel (e.g. [ifkaːː] ‘he gave’; where [aːː] indicates an exaggerated lengthening of [a]). The final vowel in such cases can be more than 500 ms long! Our research questions are the following: what is lengthened in items where final syllables are composed of consonants only? And what are the parameters that account for this lengthening? These questions bear on the general issue of Tashlhiyt syllable structure. More specifically, answering them will allow for a better understanding of the role played by sonority and syllable weight and will shed light on the status of schwa as a phonological or phonetic phenomenon.

Data collection
We recorded five Tashlhiyt speakers producing a list of 23 verbs having an iC.CX structure (where ‘.’ indicates a syllable boundary and X a syllable nucleus) and the same 23 verbs having a coda consonant in the final syllable (i.e. iC.CXt structure, where /t/ is ‘DO.3ms’). In order to investigate the role of sonority, stimuli were selected to cover the entire range of nucleus types, which were organized into the following groups: lexical vowels (e.g. [if.ka] ‘he gave’), laterals (e.g. [in.itl] ‘he hid’), nasals (e.g. [ik.fm] ‘he came in’), voiceless fricatives (e.g. [in.lt] ‘he winked’), voiceless fricatives (e.g. [if.itl] ‘he opened’), voiceless stops (e.g. [iʕ.tq] ‘he saved’). The 23 verbs ending with a coda allowed to investigate the interaction of weight as a determining factor in lengthening. Subjects were instructed to ask a question and then to answer using the ‘of-course’ response (e.g. is ifka brahim? ifkaːː ‘did Brahim give? (of course) he gave’). Each speaker produced the 23 separate utterances in 8 different sessions. Four sessions were produced with the no-coda condition, and the last 4 sessions were produced with the coda condition.

Results
Our findings can be presented from two perspectives: the syllable where lengthening occurs and the type of segment lengthened. We ran a 2-way ANOVA to test if nucleus type (voiced fricatives, voiceless fricatives, voiceless stops, liquids, nasals and vowels) and syllable weight (heavy and light) have an effect on speaker’s preference for lengthening the 2nd syllable. Nucleus type has a significant effect $F(6,24)=188.9$, $p<0.001$; but not syllable weight $F(1,4)=5.838$, $p=0.081$. The interaction of nucleus type and syllable weight is significant $F(6,24)=10.49$, $p<0.001$; syllable weight being significant only when the nucleus is a sonorant (liquid or nasal) consonant ($t(9)=4.69$, $p<0.001$). These results show that the location of lengthening is determined by a number of factors, leading to a probabilistic distribution. In addition to the systematic lengthening of the final syllable when its nucleus is a vowel, the following three patterns emerge from our data: (i) lengthening occurs in 100% of utterances on the final heavy syllable when its nucleus is a liquid or nasal, (ii) lengthening occurs in 48% of utterances on the final light syllable when its nucleus is a heavy syllable, (iii) lengthening occurs in 20% of utterances on the final syllable when its nucleus is an obstruent. The competition amongst these factors leads to the following hierarchical distribution: $CV(C) = CC^{+}sonC > CC^{+}son > CC_{son}(C)$.

Considering the perspective of which segment is lengthened, our findings show that in the absence of a lexical vowel in the final syllable, three different strategies are used by native speakers, (i) lengthening is anticipated and realized on the initial vowel (i.e. on [i], this occurs in 60% of utterances), (ii) lengthening is realized on a schwa-like element within the consonantal string of the final syllable (36% of utterances), or (iii) lengthening is realized on a nucleus consonant of the final syllable (4% of utterances).

Discussion
Our findings are grounded in an ongoing debate on Tashlhiyt syllable structure and how it relates to sonority, weight and the status of schwa vowels. The analysis of Tashlhiyt syllable structure gives a
fundamental role to the sonority (Dell & Elmedlaoui, DE 2002). The analysis assigns the syllable nucleus to the most sonorous segments in a sequence, according to the following sonority scale: low vowels > high vowels > liquids > nasals > fricatives > stops. Whereas in DE (1985), voiced obstruents were more sonorous than voiceless obstruents, this was not the case in DE (2002). The facts gathered in this study showed that syllables with obstruent nuclei didn’t display a significantly different behavior in terms of voicing ($t(5)=2.033$, $p=0.977$). No significant differences were observed, however, between syllables with liquids and syllables with nasals ($t(5)=0.91$, $p=0.403$), since both types of syllables attracted lengthening in the same way. There were also no significant differences between fricatives and stops ($t(5)=0.930$, $p=0.395$).

Applying a sonority-based analysis, a less fine-grained sonority scale is enough to account for our findings: vowels > sonorant consonants > obstruents.

Syllable weight is another important parameter that plays a relevant role in the syllabic system of Tashlhiyt (for example in versification). According to DE (2002), if one puts aside the special case of hinged codas, rimes with one slot are light and all other rimes are heavy. In this view, the weight of syllables does not depend on the feature content of their nuclei. For Jebbour (1999), however, any syllable whose nucleus is not a full vowel is light. Our findings, namely that CC_{son} and CC_{son}C didn’t pattern in the same way whereas CC_{son} and CC_{son}C did, calls for an intermediate analysis: closed syllables with a sonorant nucleus are heavy, all other syllables are light. This analysis can be accounted for on phonetic grounds by assuming, following Gordon (2002), that it is the overall prominence of the rime that acts as a predictor of weight criteria for syllable lengthening. It can also be accounted for on phonological ground by assuming that Weight-by-Position (Hayes 1989) may also depend on the segmental content of the nuclear segment.

Our findings make another important addition to the theoretical debate about the status of schwa and syllabic consonants in Tashlhiyt. DE (2002) and Ridouane & Fougeron (2011) argue that schwa is a mere transitional element which does not play any role in syllable structure. In a recent study by Grice et al. (in press), which examined F0 peak placement in different types of words, it was shown that the F0 peak was sometimes on a schwa element within the consonantal string of the target word. Following from our results, schwas may also be lengthened and thus signal the ‘of-course’ responses. Taken together, these results may be taken as evidence against a phonetic account of schwa. However, the lengthening of these elements may still be accounted for on phonetic grounds, reflecting the pressure to highlight the pragmatic function of the ‘of-course’. This can be achieved by lengthening part of the signal within the final syllable which is periodic enough and loud enough to make the lengthening perceptible. The phonetic interpretation of schwa is backed up by two important findings from this study. First, in cases where final syllables displayed schwas, these schwas did not attract lengthening as consistently as full vowels did: out of 801 occurrences within the final syllable, 24% were not lengthened; the vowel /i/ of the first syllable was lengthened instead. Second, the lengthening of the sonorant consonant within a homorganic cluster (e.g. on [n] in [if.țg(ț)]) suggests that the presence of schwa was to some degree dependent on articulatory properties of the surrounding consonants. In this context, the tongue was not moved away from the alveolar ridge, which was a necessary gesture for schwa to surface acoustically.

**References**


