

Glottalisation as a voicing cue in phrase-medial and phrase-final positions

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Previous studies have found that glottalisation in Australian English (AusE) is a correlate of coda stop voicelessness and that it occurs less on high vowels. In addition, it has been shown that younger speakers produce more glottalisation than older speakers, consistent with this being a recent change to the variety (Penney et al. 2018, 2019). These findings, however, were largely based on single word utterances, raising the possibility that (some of) the glottalisation observed may have been prosodically conditioned rather than associated with coda stops (i.e. it may have been due to phrase-final creaky voice (PFCV)). In this study, we therefore examined the presence of glottalisation in voiced and voiceless coda stop contexts in both phrase-medial and phrase-final positions, in order account for possible effects of PFCV, which is unlikely to occur in phrase-medial position.

Data were collected from 77 native speakers of AusE (older–65+: $n=33$; 23f; 10m; younger–18-36: $n=44$; 37f; 7m). Recordings were made on a Marantz PMD661 solid-state recorder with an AKG C520 headset microphone as participants read 3 repetitions of 8 target words randomly presented in two phrase positions. Target words of the form /bVC/, in which V was one of the vowels /e:, ɐ, i:, ɪ/ and C was /t/ or /d/, were embedded in either phrase-medial or phrase-final position in the carriers *SAY <TARGET> ONLY ONE MORE TIME* and *NOW ONE MORE TIME SAY <TARGET>*, with participants instructed to accent the word following the target in the former and the initial word in the latter. Data were automatically segmented by WebMAUS (Kisler et al. 2017) and hand-labelled as glottalised if irregularity was visible in the waveform and spectrogram (Dilley et al. 1996; Huffman 2005). Items in which evidence of glottalisation extended more than halfway through the preceding vowel segment were labelled as creaky rather than glottalised, as PFCV generally extends across multiple voiced segments within a word or an utterance, while coda glottalisation is localised to a single segment (Garellek 2015).

Figure 1 illustrates the proportion of items glottalised in each coda voicing context and phrase position according to age group. This figure shows that rates of glottalisation were generally greater in phrase-final position, but in both phrase positions glottalisation occurred more frequently in voiceless coda contexts for both age groups. We fitted a generalised linear mixed model in *lme4* (Bates et al. 2015) to analyse effects of *voicing context*, *phrase position*, *age group*, *vowel length*, and *vowel height* on glottalisation. We found a significant three-way interaction between *voicing context*, *phrase position*, and *age group* ($p=0.0002$): both age groups showed a clear difference between voiced and voiceless contexts in each phrase position; however, in the voiceless context both groups produced a similar rate of glottalisation in final position but differed in medial position. We also found a significant interaction between *phrase position*, *age group*, and *vowel height* ($p=0.038$). Figure 2 shows that glottalisation occurred at similar rates on high and low vowels for both age groups in phrase-final position. However, in phrase-medial position, the younger group glottalised more than the older group, and more on low vowels compared to high vowels.

The results in phrase-medial position (where PFCV does not occur) reflect previous findings: glottalisation cues coda voicelessness; younger speakers glottalise more frequently; glottalisation is more likely on low vowels (for younger speakers). However, in phrase-final position, older and younger speakers produced similar rates of glottalisation. Though it is possible that some glottalisation in this position may be due to PFCV, this result suggests that glottalisation as an ongoing change to the variety may be more advanced in final position: older and younger speakers utilise glottalisation similarly in final position; younger speakers, as leaders of the change, appear to have generalised use of glottalisation to medial position, whereas the change is less advanced for older speakers for whom glottalisation is more prosodically restricted.

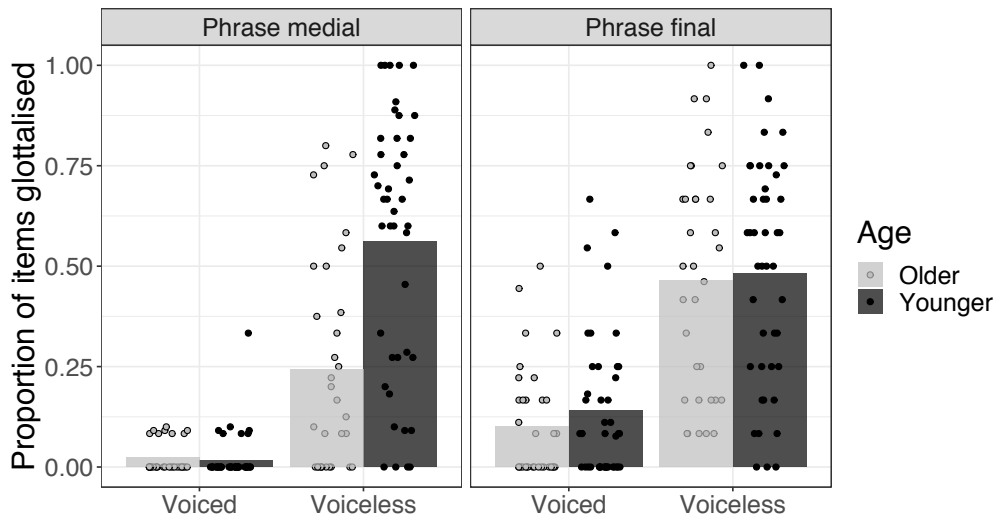


Figure 1. *Proportion of items glottalised according to coda voicing context, phrase position, and age group. Data points represent proportions of items glottalised for individual speakers.*

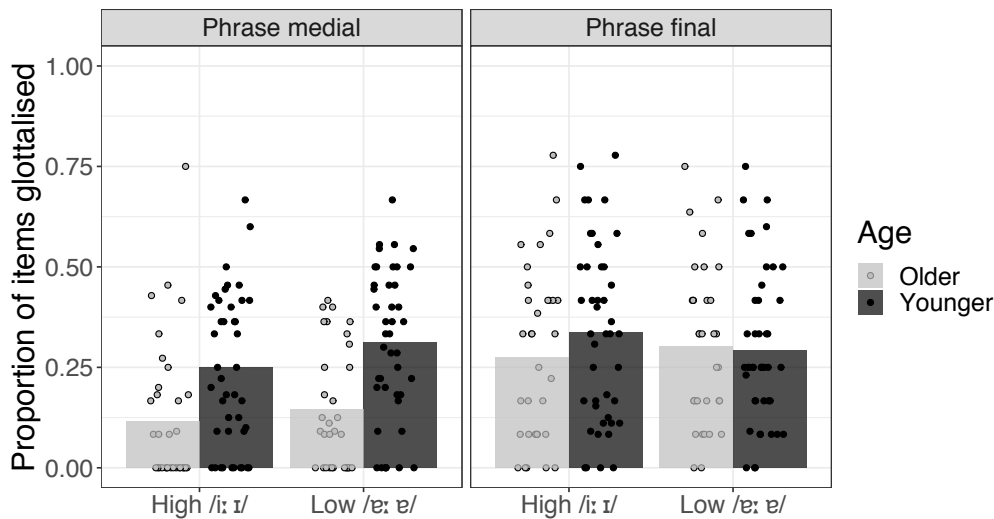


Figure 2. *Proportion of items glottalised according to vowel height, phrase position, and age group. Data points represent proportions of items glottalised for individual speakers.*

References

- Bates et al. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67, 1-48.
- Dilley et al. (1996). Glottalization of word-initial vowels as a function of prosodic structure. *Journal of Phonetics*, 24, 423-444.
- Garellek (2015). Perception of glottalization and phrase-final creak. *Journal of the Acoustical Society of America*, 137, 822-831.
- Huffman (2005). Segmental and prosodic effects on coda glottalization. *Journal of Phonetics*, 33, 335-362.
- Kisler et al. (2017). Multilingual processing of speech via web services. *Computer Speech & Language*, 45, 326-347.
- Penney et al. (2018). Glottalisation as a cue to coda consonant voicing in Australian English. *Journal of Phonetics*, 66, 161-184.
- Penney et al. (2019). Glottalisation of word-final stops in Australian English unstressed syllables. *Journal of the International Phonetic Association*.