Articulatory-Acoustic Timing relationships in Australian English vowels

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1. Introduction

The relationship between acoustic and articulatory landmarks in vowel production is not isomorphic [1, 2, 3, 4]. In AusE [2] and German [1], short vowels are 60% the acoustic duration of long vowels. However, lip and tongue movement associated with short vowels are approximately 90% the duration of long vowels [1, 2]. Similarly, in AusE, the acoustic duration of long and short vowels preceding voiceless codas is 75% those preceding voiced codas, but lingual movements associated with vowels in these contexts do not differ in duration from their long equivalents [3].

Little research has investigated the relationship between acoustic and articulatory landmarks in vowels and how it is affected by vowel length and coda voicing. We investigated the temporal acoustic-articulatory relationships in pVp vs. pVb syllables containing /ɐː-ɐ/.

2. Methods

Synchronous acoustic and electromagnetic articulatory data was obtained for 8 female AusE speakers. 11 randomized elicitations of /ɐː-ɐ/ in /pVp/ and /pVb/ syllables (*parp, pup, parb, pub*) were recorded embedded in a carrier phrase. Acoustic onset (AcOns; Fig. 1), acoustic target (AcTarg), acoustic offset (AcOffs), articulatory onset (ArtOns), articulatory target (ArtTarg) and articulatory offset (ArtOffs) were obtained. AcTarg = max. F1 value between AcOns and AcOffs (excl. the first 20 and final 20 ms). ArtTarg = lowest vertical position of tongue dorsum (TD) sensor between ArtOns and ArtOffs. Onset lag = Lag between AcOns and ArtOns, Offset lag = lag between AcOffs and ArtOffs. We also calculated the percentage of tokens where ArtTarg was within a 40ms window of AcTarg (AlignedTarg %). LMEs equation = Dep. Var ~ Vlength (short = 0) * Cvoicing (voiceless = 0) + (1 + Vlength + Cvoicing | spkr). We examined how vowel length and coda voicing influence 1) Onset lag, 2) Offset lag, 3) AlignedTarg%. Interactions did not improve model fit for Onset lag or AlignedTarg%.

3. Results and discussion

Onset lags were positive, indicating acoustic onset occurred after articulatory onset (Fig. 2). Onset lag duration did not differ with vowel length (Fig. 2; p = .869) or coda voicing (p = .287). Offset lags were negative, indicating acoustic offset occurred before articulatory offset. There was a length by coda voicing interaction for Offset lag duration (Fig. 2; F = 6.96, p = .009). Post-hoc analysis confirmed: Offset lags were longer for short vowels preceding voiceless than short vowels preceding voiced codas (β = 48 ms, p = .009). Finally, there was no effect of length (Tab. 1; p = .720) or coda voicing (p = .285) on AlignedTarg%.

Fig. 1. *Red: Acoustic landmarks. Black: Articulatory landmarks. Red shaded: 40 ms window centred on AcTarg*

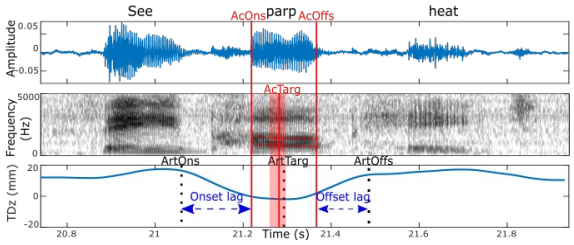

Fig. 2. *Onset lag (left) and Offset lag (right) for /ɐː-ɐ/ preceding voiced (Vd) and voiceless (VL) codas. Horizontal blue line indicates lag = 0.*

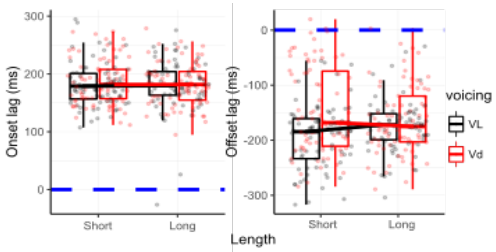

Table 1. *Tokens where AcTarg and ArtTarg aligned.*

Word	AlignedTarg (n)	Total (n)	AlignedTarg (%)
PARP	37	87	43
PARB	39	79	49
PUP	41	84	49
PUB	41	82	50
Total	**158**	**332**	**48**

Our findings suggest that relationships between acoustic and articulatory onsets and offsets are somewhat sensitive to vowel length and coda voicing. Short vowels preceding voiceless codas had earlier AcOffs (relative to their ArtOffs) than short vowels preceding voiced codas. This suggests that differences in laryngeal-supralaryngeal coordination may enhance coda voicing duration contrast in short vowels in AusE [3]. AcTarg and ArtTarg were aligned for 48% of tokens; this was not affected by vowel length or coda voicing.

4. References

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