Why Indo-Aryan languages adapt English alveolars as reṭroflexes: Acoustic evidence from Punjabi

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1. Introduction

In Indo-Aryan languages, English loanwords containing the alveolar /t/ are always adapted as retroflex /ʈ/ [1]. It is argued that English alveolars share the cues of release burst with the retroflexes in Indo-Aryan languages [2]. However, no quantitative acoustic evidence is provided by [2] as to what acoustic cues of English alveolars are important for the speakers of Indo-Aryan languages to adapt the English alveolars as retroflexes. We provide quantitative acoustic evidence from Punjabi, an Indo-Aryan language that contrasts dentals, retroflexes and palatals. Retroflexes have short burst duration compared to dentals [3]. Furthermore, the significant concentration of energy in the burst spectrum is around 3000 Hz for the retroflexes and 4000 Hz for the dentals [5]. The acoustic cues investigated in the current study are burst duration, 1st spectral moment and 2nd spectral moment of the burst [4]. Given previous findings of [1 2], we predict that Punjabi speakers' productions of the English alveolar /t/ will be similar to the native Punjabi retroflex /ʈ/ than dental /t̪/.

2. Methodology

Ten male trilingual Punjabi speakers (22-28 years, M=25.2 years) participated in the experiment. They were presented with eight CVt real English loanwords, nine CVʈ and nine CVt̪ real Punjabi words, preceded by the three vowels /i a u/. The participants were shown the pictures to elicit the target words in a Punjabi carrier sentence [kɛ___ədʒ] 'say___today'. The pictures of the target words were randomized and presented in eight different blocks. All productions were recorded at 44.1 K with a Zoom digital voice recorder. The burst duration of the total 2061 were measured by manual identification of spectra and waveforms. The burst release was labelled as one strong vertical spike in the waveform, signaling the abrupt release of a stop consonant. The first spectral moment and second spectral moment of the burst were measured using the power spectrum [4].

3. Results

We used repeated-measures ANOVA with the burst duration, first spectral moment and second spectral moment as dependent variables, place (English alveolar, Punjabi retroflex and Punjabi dental) and preceding vowels (/i a u/) as within-subject factors. As predicted, the results of burst duration showed that there were no significant differences between the Punjabi speakers' productions of the English alveolar /t/ and Punjabi native retroflex /ʈ/ ($F(1,9)=3.029$, $p=.116$). But the burst duration of dentals was significantly different from English alveolars ($F(1,9)=44.850$, $p<.001$). The results of 1st and 2nd spectral moment showed similar patterns where the English alveolars were similar to Punjabi retroflexes (1st spectral moment: $F(1,9)=.359$, $p=.564$; 2nd spectral moment: $F(1,9)=2.181$, $p=.174$). Dentals were significantly different from the English alveolars in terms of 1st ($F(1,9)=9.705$, $p=.012$) and 2nd spectral moment ($F(1,9)=58.195$, $p<.001$). Average burst duration, 1st and 2nd spectral moments are shown in Figures 1-3 below.

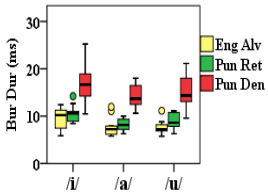

Fig. 1. *Burst duration*

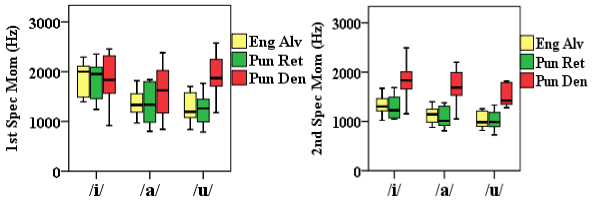

Fig. 2. *1st spectral moment* Fig. 3. *2nd spectral moment.*

4. Discussion

The results of this acoustic study suggest that Punjabi speakers' productions of English alveolars share the cues of release burst with the native Punjabi retroflexes. This would therefore help Punjabi listeners to map the English alveolars to Punjabi retroflexes. These results are also consistent with the studies of other Indo-Aryan languages which report that English alveolars are perceived as retroflexes [1].

References

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