Segment Constants and Speaker Constants in English Coronal Obstruents

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This paper examines the articulation of coronal obstruents (/t, s, θ, tʃ, ʃ/). We provide evidence that there are two types of constants in the articulation of these obstruents: segment constants and speaker constants.

We recruited ten female native speakers of Australian English, and recorded them in a sound-attenuated testing room. We asked them to listen to pre-recorded sentences and then to repeat each sentence five times. We placed each target word in the carrier sentence “Please, utter X publically”. The target words were tack, sack, Thack, Chack and shack, and with the target sounds /t, s, θ, tʃ, ʃ/ in onset position, respectively. All target sounds were therefore flanked by the vowels, /əʊ/ and /æ/. We recorded ultrasound images on tape and then we extracted the tongue contours by using EdgeTrak.

For each target sound, we focused on the dynamics of three sections of the tongue: the body, the blade, and the tip. For each sound, we located the frame which corresponded most closely to maximum constriction (MC), and then analysed tongue movement into and out of MC. In the MC frame, we analysed the position of the tongue body in relation to the front sections: the blade and the tip. We tracked three frames prior to MC and analysed which portion of the tongue moved to form MC. Following MC, we tracked two frames to analyse the transition movement from MC into the vowel /æ/.

Results showed that two types of constants can be distinguished, namely, segment-dependant (Seg-D) constants and speaker-dependant (Sp-D) constants. For each place of articulation, there was a constant pattern of movement into MC. In the case of /t/ and /s/, the tip moved upwards and forward to attain MC. In the case of /θ/, the blade moved forward to attain MC. In the case of /tʃ/ and /ʃ/, the blade moved upwards to attain MC. Then depending on the place of articulation, there was inter-speaker variation in the positioning of the tongue body at MC. For /tʃ/ and /ʃ/ there was no variation – the tongue body was always raised. For /t, s, θ/ there was inter-speaker variation in whether the tongue body was raised or not. There was no intra-speaker variation – an individual speaker either raised or lowered consistently. For seven speakers the body was raised (See Figure 1), and for three speakers the body was lowered in relation to the front part of the tongue (See Figure 2).

The critical factor conditioning inter-speaker variation appears to be whether the characteristic movement into MC requires also raising the tongue body or not. Raising the blade requires raising the body, and so /tʃ/ and /ʃ/ show no inter-speaker variation. The characteristic movements to MC for the other coronal obstruents do not require raising the body. Consequently, there is no segmental conditioning on the position of the tongue body. Our data shows that tongue body position for these coronals does not vary randomly, but is rather a speaker-constant.