An UTI study on Italian alveolar stops

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In this study I present a preliminary description of Tuscan Italian alveolar stops based on the Ultrasound Tongue Imaging (UTI) technique. In particular, the voicing contrast and the length contrast are analysed.

A few studies focused on the acoustic properties of gemination and voicing in Italian (Esposito, Di Benedetto, 1999) and even less so on the articulatory ones (Smith, 1995; Zmarich, Gili Fivela, 2005).

This study aims at investigating whether and how the constriction point and the overall tongue configuration vary in relation to length and voicing contrasts. I intended to verify for each contrast whether the tongue configuration and the constriction point vary together or not and whether and how the tongue configuration changes if the constriction point remains the same.

Both acoustic recordings and ultrasound images were collected. Tongue movements were captured by means of the Standard Mindray DP-6600 system, at the rate of ~60 frames per second.

The materials included 16 real disyllabic words with the structure ˈCVC(C)V(C) (*Bata*, *mota*, *batta*, *motto*, *pàtron*, *botro*, *Batman*, *Botman*, *Ada*, *body*, *Adda*, *bodda*, *Adria*, *Bodrum*, *admin*, *podcast*), where the target consonant could be /t d t: d:/ and the stressed vowel was /a o/. Each word was read in isolation by five young Tuscan speakers (19-32) for three times. The time-aligned audio and UTI data belongs to a larger corpus, developed for the research project “Gestural coordination and speech rhythm” (Celata et al., forthcoming).

A qualitative analysis of consonantal gestures was carried out by plotting average tongue profiles and standard deviations of the curves of each target consonant on a subject-by-subject basis.

The analysis is still in progress. For now the visual inspection suggests a tendency to uniformity in terms of constriction point between single and geminate stops on the one hand, and voiced and voiceless stops on the other hand.

On the contrary, the overall tongue configuration showed differentiated patterns for gemination and voicing. As for gemination, the tongue profile for /t:/ showed the tongue tip slightly raised as well as the dorsum, and the tongue root more advanced in comparison with /t/ (Fig.1-2). The comparison of the tongue configurations for /d/ and /d:/ was excluded due to the effects of coarticulation to following /i/. With regard to voicing, voiceless stops showed a slight tongue body raising and root retraction, whereas the tongue tip was lower.

Moreover, it seemed that the subjects showed individual preferences as far as lingual gestures (apical vs. laminal) and constriction point (alveo-dental vs. alveolar vs. post-alveolar) were concerned. Each subject consistently showed the same lingual gesture and the same constriction point across /a/ stimuli.

To conclude, it appeared that individual strategies of sound production determine tongue configurations for /t d t: d:/.

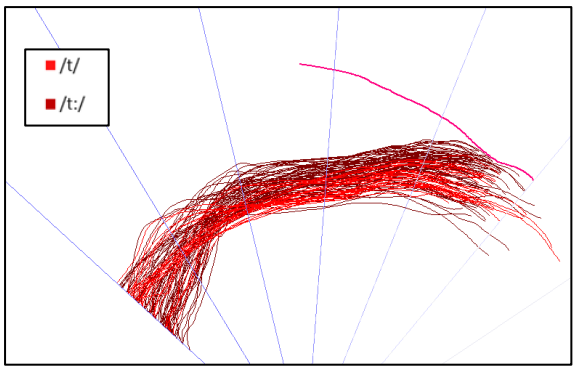

Figure 1. Speaker 1, tongue configurations across multiple repetitions of singleton /t/ and geminate /t:/; the pink, upper line represents the palate.

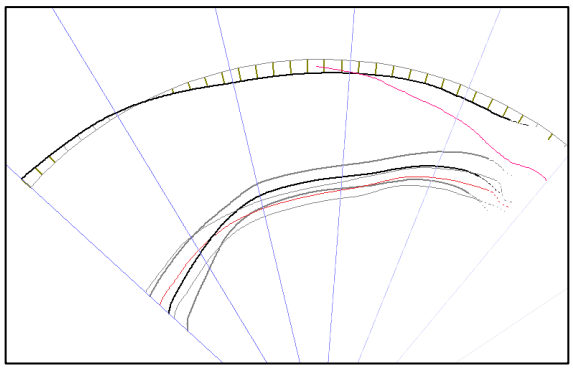

Figure 2. Speaker 1, average tongue profiles and standard deviations of singleton /t/ (red line) and geminate /t:/ (black line); the grey lines indicate the standard deviations. The pink line represents the palate and the upper line the statistical difference between the two mean tongue profiles.

CELATA, C., MELUZZI, C., MOOSMUELLER, S., HOBEL, B., BERTINI, C., [forthcoming] The acoustic and articulatory bases of speech timing: a cross-linguistic study. Paper presented at AISV 13, SNS, Pisa, January 25-27, 2017.

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