SUPRALARYNGEAL AND LARYNGEAL GESTURES DURING THE PRODUCTION OF CONSONANTS AND CONSONANTAL CLUSTER.

Rachid Riduoane

Berber is a language spoken in North Africa. Tashlhit Berber, spoken in the southern part of Morocco, allows an unusually rich combination of voiceless sounds and different types of geminates, heteromorphemic and tautomorphemic, in initial, medial and final positions. In view of these linguistic features, this language represents a very welcome addition to the list of languages studied with fiberoptic and transillumination techniques, and makes clear how important it is to look beyond the more extensively studied languages (essentially a group of Germanic languages, plus Japanese).

The aspect of our research with the most far-reaching ramifications both for phonological theory and for the area of speech motor control is undoubtedly that of voiceless words. Berber presents a typologically unique phenomenon: words may have no vowel or vowel-like segments nor even voiced segments; they may consist entirely of voiceless obstruent consonants (t-ss-kʃf-t=stt " *you dried it"*). A whole sentence may also be entirely voiceless (t-ftk-t=stt t-fk-t=stt " *you sprained it (and) gave it"*). In terms of laryngeal adjustments, analysed by means of fiberscopy and photoelectroglottography, it was very interesting to see that the glottis does not simply remain open for these voiceless words, but rather that the glottal aperture is continuously modulated in a manner that can be related quite systematically to the individual segments in the voiceless sequence. This gives a compelling demonstration how intimately laryngeal and oral articulations are linked: in a completely voiceless utterance one might have expected that the so-called "devoicing gesture" might be regarded by the speaker as superfluous and simply eliminated. The results clearly show that sequences of voiceless consonants display smooth transitions from the target for one consonant to the next. They indicate that glottal opening is characterised by a one-, two, or three-peaked pattern according to the nature of the voiceless obstruents and the way they are combined. A good predictor of the number of glottal opening gestures occurring is that in a voiceless sequence, each fricative and geminate, unless adjacent, requires a single separate glottal abduction. The variation in laryngeal adjustments seems to be related to segmental properties of a sequence. Voiceless geminate stops and fricatives, requiring a high rate of oral air flow and build up of oral air pressure, are produced with a separate glottal opening gesture. These results are in general agreement with those obtained using the same method on Berber fricative-stop clusters separated by word boundaries. They are also in general agreement with the results obtained using the same method and the same linguistic material in English and Swedish.

Voiceless words raise some intriguing questions and offer a number of avenues that it would be very fruitful to explore. It would be very interesting to consider the behaviour of such words in a wider range of communicative contexts and consider how and whether the prosodic structure of speech remains functional. This data can also help settle between the actual models of co-articulation, for example the model "target-and-interpolation" (Pierrehumbert & Beckman, Keating) and the "gestural overlap" model (Browman & Goldstein, Munhall & Löfqvist). Another possible modelling could be a more aerodynamic simulation, by keeping the glottis open in an in vitro model (cf. Xavier Pelorson) coupled to a vocal tract whose shape is changing - depending on the different phonemes. One important question would then be to determine if the vocal tract changes (which produce differences in airflow) would be able to produce the modulations observed in larger voiceless clusters.