Phonetic Grounding of Voicing in Coronals

Marzena Zygis (Zentrum für Allgemeine Sprachwissenschaft, Berlin)

Goal:

An examination of the UPSID database containing 451 languages reveals that (i) voiceless obstruents are less frequent than voiced ones and that (ii) voiced affricates are the least frequent phonemes among coronal obstruents. While the first conclusion is well established and phonetically accounted for, the second has not been motivated thus far.

The goal of this paper is to propose an account of (ii) by taking into consideration experimental evidence.

Evidence:

It will be shown that in several Slavic as well as in Germanic, Bantu and other languages, a phonemic gap is attested: voiced coronal affricates do not occur, while their voiceless counterparts are part of the phonemic inventories. In several of these inventories, stops and fricatives create a contrast with respect to voicing as well, see e.g. Russian, Czech, Bulgarian, and Slovenian. The avoidance of voiced affricates is also supported by phonological processes in which the existing voiced affricates change to other sounds, especially voiced fricatives, see e.g. Florentine Italian (Gianneli & Savoia 1979) or Chitwan Tharu (Leal 1972).

Explaining the avoidance of voiced affricates is a challenge for any phonological theory. Several phonological approaches to voicing contrast, including those dealing with features, are not able to account for this gap; see e.g. Lombardi (1994, 1999), Iverson & Salmons (1995, 2003), Steriade (1997), Avery & Idsardi (2001), Wetzels & Mascaro (2001),and Kehrein (2002).

The present study seeks to explain why fricatives and stops often maintain a voicing contrast while affricates tend to avoid it. It will be argued that articulatory and especially aerodynamic differences between stops and fricatives on the one hand, and affricates on the other, are responsible for the voicing disparities between them.

First, it will be shown that in general, voiced segments are articulatorily more complex than their voiceless counterparts due to additional articulatory movements which are required for the cavity enlargement. These include e.g. tissue compliance, muscularly actuated enlargement of the supraglottal cavity, the opening of the velopharyngeal port as well as jaw movements, see Westbury (1983).

Second, it will be shown that for the production of voiced sibilant fricatives, conflicting but also very precise aerodynamic requirements for maintaining voicing frication have to be met, see Ohala (1983). In the case of affricates, it is argued that the aerodynamic requirements for voicing frication are even more complex due to different conditions accompanying the stop release.

Finally, the conclusions are supported by the results of an acoustic-aerodynamic experiment in which voiced affricates were compared to voiceless ones as well as to voiceless and voiced coronal fricatives and stops. Four native speakers of Polish participated in this experiment. The acoustic parameters included: (i) duration of fricatives; (ii) duration of stop phase and release phase, (iii) duration of stop and frication phase. The airflow parameters comprised (i) airflow peaks and (ii) air pressure peaks in stops, fricatives, and affricates.

The results show that voiced affricates have a significantly shorter frication phase than their voiceless counterparts as well as fricatives. Air pressure peaks appear to be higher in the frication phase of the voiced affricates than in single voiced fricatives, which indicates that the former are apt to undergo devoicing more easily than the latter. In summary, it is argued that the conflicting air pressure

requirements necessary to maintain voicing are difficult to meet. In particular, the air pressure released in the stop component of the affricate is too high to maintain voicing.

Conclusion:

This paper shows that the occurrence frequency of coronals in phonemic inventories is not accidental but related to the phonetic properties of these sounds. It is argued that the fact that voiced affricates are the least frequent sounds among coronal obstruents must be attributed not only to the inherent properties of voicing, but also to the articulatory-aerodynamic complexity of affricates, as supported by experimental results.

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