

Why are voiced affricates avoided cross-linguistically? Evidence from an aerodynamic study.

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Phonemic inventories of the world's languages show various types of systematic gaps which are accounted for by appealing to the phonetic properties of the sounds under question. These properties are in turn inevitably connected with the anatomy and functioning of the human vocal tract during speech production.

The present investigation expands the list of sounds which are avoided cross-linguistically. It shows, namely, that voiced sibilant affricates ([dʒ], [dʒ̥]) tend to be eliminated from phonemic inventories. At the same time, their voiceless counterparts [tʃ], [tʃ̥] show a different behavior: the affricates are stable and create a part of many phonemic inventories. This observation also holds for languages with a complete voicing contrast in coronal stops and fricatives, as e.g. in many Slavic languages.

The goal of this paper is twofold. First, it is shown that several typologically unrelated languages (Slavic, Germanic, Bantu and others, cf. Zygis 2006) share the tendency to avoid voiced sibilant affricates. The avoidance of voiced affricates is also supported by phonological processes in which the existing voiced affricates change to other sounds, especially voiced fricatives.

Second, this tendency is explained by appealing to the phonetic properties of these affricates. It is argued that (i) complex articulation and (ii) conflicting aerodynamic relations are responsible for the lack of voiced affricates in phonemic inventories. The latter point is supported by results of an aerodynamic experiment involving parallel recordings of airflow, intraoral pressure, and acoustics.

Four German and four Polish speakers participated in this study producing a series of voiced and voiceless stops, fricatives and affricates. German and Polish differ with regard to the occurrence of voiced affricates in the native vocabulary and also with respect to the realization of voicing contrast: phonologically voiced obstruents are realized as fully voiced segments in Polish but voiceless and unaspirated in German while phonologically voiceless obstruents are unaspirated in Polish and aspirated in German.

The main difference we found is that in voiceless affricates the intraoral pressure rises quickly (steep slope), whereas in voiced affricates it rises relatively slowly during the stop portion of the affricate, but can often reach a similar pressure peak during the fricative as in its voiceless counterpart. We suppose that the different pressure slope values mirror laryngeal-oral coordination. In voiceless affricates glottal opening starts with a short delay after closure onset (Hoole et al. 2003) and the pressure can rise very quickly. In contrast, for the voiced affricate the glottis seems to be closed during large parts of the stop portion, which allows maintaining the transglottal pressure difference and therefore voicing. However, in the fricative part of the affricate we often found devoicing and a high intraoral pressure peak necessary for the realization of frication, which rather speaks for a laryngeal abduction.

On the basis of experimental evidence it is argued that the conflicting air pressure requirements for maintaining voicing are difficult to meet. In particular, the air pressure released from the stop component of the affricate is too high to maintain voicing during the fricative.

References:

- Hoole, P., Fuchs, S. & Dahlmeier, K. (2003): Interarticulatory timing in initial consonant clusters. Proceedings of the 6th Speech Production Seminar, Sydney 101-106.
Zygis, M. (2006). Contrast Optimisation in Slavic Sibilant Systems. Habilitationsschrift. Humboldt-Universität zu Berlin.

