Simulating language change – the example of Tswana

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This study describes work concerning phonetic simulations of unintuitive voicing behavior in Tswana. We present a hybrid multi-agent modeling framework '*Kamoso*' (from Tswana 'in the future') which facilitates investigation into sound change by combining the sociophonetic model of Nettle (1999) and the exemplar-based model of Wedel (2004) into a single unified model. *Kamoso* enables simulation scenarios of different social networks with varying interaction schemes and social distances between the speaking/listening agents. The goal of this framework is to allow examination of competition between different phonetic forms. According to studies conducted by Coetzee and Pretorius (2010) and Solé et al. (2010), languages from the Sotho-Tswana group of Bantu languages demonstrate unintuitive voicing behavior in devoicing of post-nasal voiced plosives (/mb/ → [mp]) – unintuitive in that greater articulatory effort is required to terminate voicing than to maintain it (Westbury and Keating, 1986). Nasals preceding stop consonants are said to have appeared in Bantu languages in order to facilitate production of voicing during the stop segment and were lost later during language evolutionary changes in languages like Swahili, Sotho or Duala (Meinhof, et al. 1932). Current studies on Tswana and Shekgalagari (Coetzee and Pretorius, 2010; Hyman, 2001; Solé et al., 2010) however, demonstrate that nasal segments remained in those languages – surprisingly not only before voiced stops but also before voiceless ones. Adapting Nettle's (1999) Social Impact Theory model, we simulate the /mb/ → [mp] transition over populations where interacting individuals pass through five lifestages before death. The goal of the simulation is to examine the complex interplay between social influence, social bias, frequency of occurrence and functional biases (e.g. ease of speech production/discrimination), in how they might account for this unintuitive phonetic transition. The learning process is based on competition between the two variants where individuals learn one variant or move gradually (in terms, for example, of small modifications to acoustic parameters such as VOT, nasal durations, and stop-closure duration) towards the other variant during their lifecycle. The impact of social biases, frequency, and functional biases can all be manipulated, across generations, in the model. In this way, we can establish the kind of influences that would lead to a gradual/abrupt /mb/ → [mp] transition. The model simulates the emergence and maintenance of contrast in the context of speaker/hearer interactions and a production/storage loop where exemplar-based categories compete for assignment and storage of incoming percepts and the production process is biased towards gesture re-use. By employing this model we can ascertain, via simulation, how the contrasting realizations can emerge and stabilize within a generation, inspect the selection processes which yield these realizations, and examine the acoustic changes which bring about the contrast.

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