An R Package for Agent-Based Modelling: soundChangeR

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Decades of research have established that sound changes are rooted in phonetic variation [1] and transmitted in interactions between individuals [2, 3]. However, the exact interplay between the intra- and extralinguistic factors that may contribute to sound change remains poorly understood. This is because it is impossible to know beforehand whether a sound change is going to take place, so as soon as the change is underway, it is too late to capture the circumstances which may have triggered it. Computational agent-based models (ABMs) offer an artificial world and controlled environment in which the role of cognitive, social, and linguistic factors in sound change can be explored. The ABM `soundChangeR` is the first of its kind that was implemented as a publicly available R package and comes with a full documentation of the code (`https://github.com/IPS-LMU/soundChangeR`). It is based on the interactive-phonetic (IP) model in which sound changes can emerge when a phonetic bias is magnified through cumulative phonetic imitation [4]. Phonetic biases like coarticulation are usually directional [5], e.g. in many English varieties, retracted /u/ is more likely to front than fronted /u/ is to retract, especially in adjacency to coronal consonants [6]. This stable bias can be turned into phonetic change when conservative speakers imitate more innovative speakers, i.e. when the former adjust their speech characteristics to match those of the latter [7]. The input to `soundChangeR` is a dataset of real speech consisting of a number of speakers that have produced words that contain the sound(s) under investigation, as well as the acoustic parametrisation that adequately captures the characteristics of the sound(s). In the ABM, each agent is initialised with the data from an actual speaker in the input dataset before the agents start to interact, i.e. produce and perceive traces of speech (exemplars). Much like in episodic models of speech [8, 9] and their computational implementations [10, 11, e.g.], when an agent listener memorises a new exemplar, it causes an update to the agent's exemplar clouds and phonological categorisation which in turn affects the agent's speech production. So in `soundChangeR`, "sound change can emerge from the stochastic interactions between heterogeneous agents [...] given the mechanics of their production-perception feedback loop and organisation of phonological information" [12]. So far, `soundChangeR` (and previous versions of the ABM) have been used successfully to model phonetic shifts such as /u/-fronting [13], as well as sound changes with phonological components such as the merger of /ɪə, eə/ in New Zealand English [14]. The presentation will demonstrate some of the model's core mechanisms and encourage the audience to try `soundChangeR` on their own data.

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