What changes in language change? A deflationary model of the emergence of intrusive and linking /r/ in nonrhotic varieties of English

Matthew Isaac Harvey[1] **and Jens Koed Madsen**[2]

1 Abstract

Agent-based models are an underutilized investigative tool in linguistics, largely because their application has been misunderstood. Their abstraction is often confused for a simple lack of external validity, and structural correspondence between a model and modeled phenomena is easily misunderstood as nothing more than the results of interpretive bias on behalf of the modeler. In the present paper we pursue two goals: first, we attempt to outline what we see as the most immediately fruitful use of modeling to elucidate linguistic findings and suggest further avenues of linguistic research, and second, we offer a model that we hope serves as an example of our recommended strategy, which builds on previous models with several crucial changes. We conclude by highlighting the many ways our model can be expanded to address additional aspects of the phenomena that serve as its real-world counterpart.

On our view, the most persuasive applications of ABM in linguistics to date have used it as a deflationary tool with respect to complex mentalist explanations for linguistic findings. The goal in these cases is not to produce a model that accurately captures all aspects of the relevant situation (i.e., grammatical, semantic, and phonetic structure as well as environmental, social, and cultural pragmatic constraints on speech). Rather, it is to accurately reproduce extremely narrow aspects of linguistic behavior whose explanation has ben taken to require complex, agent-internal cognitive systems, such as the putative mechanisms taken to underly grammatical generativity. A good example of this kind of work is De Boer's (1997, 2000, 2001) work on vowel systems. The narrow aspect of linguistic behavior in question is the distribution of vowel system types among human languages - how many languages include 5-vowel systems with two front vowels, two back vowels, and one high mid vowel, for instance - which has typically been explained in terms of innate human predispositions for certain system-features, such as dispersion and feature conservation (see e.g., Lindblom, 1986; Schwartz, et al., 1997). De Boer's models effectively deflate the need for explanations of this kind, by creating populations of mobile agents whose interactions (consisting of "vowel" utterances and feedback about the success or failure of "vowel" recognition) gradually produce population-general similarities in the "vowel"-inventories of the member agents. He found that under a wide range of initial parameters, populations of this kind stabilize their collective vowel inventories - that is, their population-wide "vowel systems" - at equilibria that closely resemble human vowel systems in number of elements and distribution within the available feature space. They do this, moreover, without any innate predispositions.

The present paper borrows De Boer's overall investigative strategy as well as his basic thesis, namely, that inter-agent interactions (provided these are geographically constrained and have some kind of success/failure criterion) produce population-wide patterns of utterance activity which match observed patterns in human populations along several specific dimensions. It is worth noting that the same strategy has been pursued, with positive results, by Stanford and Kenny (2013, working with Labov's description of the Northern Cities vowel shift) and Oudeyer (2005b) as well as Zuidema and De Boer (2009), both working with the emergence of minimal combinatoriality in phoneme systems.

Our target phenomenon is the persistent emergence of /r/-sandhi phenomena in non-rhotic varieties of English. Many English dialects and idiolects are mostly or completely non-rhotic, such that their speakers only reliably produce /r/ phonemes in word-initial positions. These varieties very often display 'linking' and 'intrusive' /r/s, however, which labels denote the addition of /r/ phonemes at word and morpheme boundaries that are followed by vowels. The two terms are equivalent except that 'linking' /r/s occur at locations that are orthographically appropriate (i.e., where there is also a written "r"), whereas 'intrusive' /r/s are not orthographically marked. Thus a speaker of standard British English (which is non-rhotic) who articulates "car

alarm" with an audible /r/ on the end of "car" displays linking /r/, whereas one who articulates "ma and pa" with an audible /r/ after "ma" displays intrusive /r/. Together, linking and intrusive /r/ comprise /r/-sandhi phenomena.

A structuralist explanation for /r/-sandhi is necessarily one that assumes homogeneity of articulatory behavior within a particular variety of English, with each variety characterized by a specific set of 'contexts' (that is, sequences of adjacent phonemes) in which intrusive and linking /r/ appear. Such an explanation can then account for the observed contexts of occurrence of /r/-sandhi in a given variety by proffering a set of phonological rules that predict, or generate, a matching set of contexts.

Of course, observed instances of /r/-sandhi are not homogeneous within varieties of English, or indeed in the speech of individual speakers. In addition, Hay and Sudbury (2005) report in their overview of the sociolinguistic literature that many communities are in fact variably rhotic rather than simply non-rhotic (see e.g., Williams & Kerswill, 1999). While most non-rhotic varieties of English display both linking and intrusive /r/, some display only or primarily linking /r/ (as in the case of some speakers of RP British English, see Wells, 1982), and others display neither (Southern American English as well as - possibly - South African English, see Harris, 1994; Trudgill & Hanna 1982). This variability of /r/-sandhi phenomena even within highly localized varieties and within idiolects means that a probabilistic, tendency-based explanation for their distribution is more parsimonious than an explanation in terms oh phonological rules plus production errors on the part of individuals, as the former comes with appropriate variability "built in", so to speak.

With this in mind, our model explores the relation between spatial distribution and interaction rate in creating apparently-phonological variability. The model is initialized by placing locating agents in a scale-free network structure to create community-like spatial clusters. Agents are individually initialized with an internal list of 5 articulation-items ("phonemes", although the label isn't significant) and 5 values on a continuous internal scale, each associated with a single articulation item ("contexts"); contexts are generated with a high-variability Gaussian distribution, to create a situation with significant variability among agents that has no direct relation to "community" placement. Agents then interact with one another, randomly selecting partners within their spatial "reach" and exchanging phoneme utterances, attempting to categorize partner utterances by comparing them to the agent's own internal phoneme-context pairings. If the "listening" agent identifies the uttered phoneme as matching one of its own phoneme-context pairs, then it provides feedback to its partner that the utterance was successful; the categorization mechanism introduces a probabilistic element to the success or failure of interactions, which agents then use to update their internal phoneme-context pairings. The model also includes birth and death, with progeny added periodically, initialized in close proximity to a parent, with unweighted phoneme-context pairs, and with reduced interaction reach, such that they tend to assume pairing-weights typical of their communities rather than weights typical of agent-clusters further away. The preliminary results from the model show that agents tend to develop similar sets of phoneme-context pairings within their spatially clustered communities, despite the random priors, the presence of inter-cluster interaction, and the lack of any difference between the agents of different clusters.

The most significant implication our model has for the study of /r/-sandhi phenomena is that a rule-based explanation is probably not needed to account for observed patterns of intrusive and linking /r/. Rather, specific patterns of /r/-sandhi, on both individual and community levels of analysis, can - in principle - be attributed to effects of interaction rate and small-scale details of individual cognitive and linguistic biases, which, in aggregate and via generalization though feedback-rich, pattern-sensitive interaction, produce trends on the scale of whole populations. This style of explanation is naturalistically plausible, invites exploration and testing using increasingly rich and detailed models, and doesn't require the theoretical baggage of structuralist accounts.

REFERENCES

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