Empirical analyses of sound change.

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The talk is concerned with understanding how variation in speech communication is connected with historical sound change. This is a long-standing issue (e.g. Paul, 1886) that was given new impetus in the second part of the 20th century through pioneering experimental approaches that led to a better understanding of the phonetic conditions that give rise to sound change (Ohala, 1993) and the forces that govern its spread around a speech community (Labov, 2001). One of the main aims in this talk is to suggest ways of unifying these important insights from research on the origin and spread of sound change by capitalising on at least the following recent advances in research on speech processing. Firstly, there is evidence that the association between the lexicon, phonology, and speech signals differs slightly across individuals (Pierrehumbert, 2003) even of the same accent community: this could itself be a potential source of sound change because listeners do not always agree on how to parse speech dynamics into phonological units (e.g. Beddor, 2009). Secondly, episodic models of speech (Goldinger, 1998 and studies of imitation (Babel, 2012) suggest that lexical and phonological knowledge are updated as individuals communicate with each other: this provides a cognitive basis to the idea that sound change and the first stages of new accent formation are moulded by communication density i.e. by who speaks to whom and how often (Trudgill, 2008). Thirdly, new approaches to the stochastic modelling of speech dynamics and to visualising how the vocal organs are coordinated in real time are highly relevant for understanding sound change, because sound change so often arises from dynamic processes such as coarticulation and hypoarticulation.

I will then consider how such advances in speech processing are relevant for understanding different types of sound change, based on three case studies. The first applies functional data analysis (Gubian et al, 2015) to test for evidence of a merger of the falling diphthongs *hear*/*hair* in a large speech corpus of New Zealand English (Warren, 2002). The advantages of FDA are that multiple time signals (in this case the formants) can be simultaneously analysed; and there is also no need to identify vowel targets. The next concern is with the phonologisation of vowel nasalisation. The new approach is to use real-time magnetic resonance imaging (Carignan et al, 2019) applied to 35 speakers of German to test whether there is an association between coarticulatory vowel nasalisation and the reduction of the following nasal consonant, which is assumed to constitute the origins of phonological vowel nasalisation (Beddor et al 2013). The final study is concerned with using an agent-based computational model (Harrington & Schiel, 2017) to predict phonetic changes when individuals from heterogeneous accent backgrounds are isolated and in regular contact with each other for a prolonged period of time. The speakers in this case were members ('winterers') of the British Antarctic Survey recorded before and during an Antarctic winter. Comparisons were then made between the observed phonetic change in Antarctica and those predicted from the computational model in which each agent was initialised with speech information from a winterer prior to the stay in Antarctica.

The general conclusion from these studies is that sound change is latent in the very act of speaking. Sound change is also stochastic because it depends on which individuals happen to talk to each other: only certain constellations of speaker variability combined with how phonological categories happen to be positioned in relation to each other in a phonetic space are likely to lead to change.

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