Empirical Assessment of an Information-Theoretic Approach to Nasal Place Assimilation

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The ‘information-theoretic’ approach to language has a long history, generally regarded as beginning with Shannon’s (1948) important insights regarding communication through a noisy channel. He showed that efficient and error-free communication could be achieved by manipulating the amount of redundancy in a message: redundancy is minimized in low information (high predictability) contexts, while it is increased in contexts with high information (low predictability). While such insights are foundational to the field of computational linguistics, they have only more recently been applied to the study of sound systems (e.g. Aylett and Turk, 2004; Baker and Bradlow, 2009; Hume and Mailhot, 2011; Jurafsky et al., 2001; Goldsmith and Riggle, 2011; Surendran and Niyogi, 2006), despite early efforts to make use of information theoretic concepts and tools in phonology (Cherry et al., 1953; Hockett, 1955).

While the effects of decreasing redundancy have been well studied in processes of reduction and deletion, less work has been done on other processes, such as assimilation. In this talk we suggest how concepts from information theory can be applied to the study of nasal place assimilation, such as Japanese nasal coda place assimilation (e.g. /san+/ban/→[samban] ‘number three’). To the extent that speakers are sensitive to the information content of phonological elements, we would expect to observe its effects in nasal place assimilation. Assimilation is of particular interest since redundancy in the form of phonetic cues is both decreased and increased. In the above example of Japanese, the presence of the labial onset’s place cue on the nasal can be regarded as an increase in redundancy by adding an additional cue to the onset’s identification. The loss of distinctive place on the nasal, on the other hand, can be seen as a decrease in information about the nasal, i.e. a decrease in redundancy. From an information-theoretic perspective, such redundancy manipulations are predicted to follow from the predictability of the segments involved. For example, we predict the target of assimilation (the nasal) to have lower information than the trigger (the stop). By spreading some of the stop’s perceptual cues onto the less informative nasal, information is more evenly distributed, arguably enhancing communicative efficiency (Aylett and Turk, 2004; Levy and Jaeger, 2007).

In this paper, we provide evidence from Japanese from the phonemically-annotated NTT corpus (Nippon Telegraph & Telephone; Amano and Kondo, 2000) which supports the prediction that the trigger of the assimilation has a higher information content than the target. We are also testing these predictions on the Buckeye Speech Corpus and anticipate being able to provide similar results for American English. It is hoped that this study will contribute to the role of concepts from information theory to the study of sound systems, in addition to providing illuminating directions for future research.
References


