Adaptation to accents in a polysystemic perceptual framework: a role for morphological structure

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Familiarity with a talker or accent is known to facilitate speech perception, but it is not clear what underlies this phenomenon. Previous research has focused primarily on whether listeners can learn to associate novel phonetic characteristics with low-level units such as features or phonemes. However, this neglects the potential role of phonetic variation at many other levels of representation, such as prosodic structure, grammatical function, and pragmatic and emotional meaning. As a step towards understanding plasticity within a polysystemic perceptual framework, the present experiment tested the hypothesis that listeners are able to adapt to phonetic information that is systematically associated with the morphological structure of words. In order to maximise the relevance of the research to speech perception in everyday listening situations, relatively natural stimuli and tasks were used.

The experiment comprised familiarisation and assessment phases. During familiarisation, 112 monolingual English speakers (aged 18–31) from the UK listened to ten short stories read by a male phonetician with a Standard Southern British English (SSBE) accent. Two versions of each story were recorded. 56 subjects heard the 'Control' version, in which all *re-* prefixes were realised as [ri:], as is usual in SSBE; and 56 listeners heard the 'Accent' version, in which all *re-* prefixes were realised as [rɪ] (e.g. *re-think* is pronounced [rɪθɪŋk]).

Perceptual learning was assessed using an intelligibility-in-noise task, comprising 18 experimental sentences and 60 fillers read by the same talker as the stories. Subjects were required to type what they thought they heard. Each experimental sentence contained one instance of /ri:/ realised as [rɪ], either in a Prefix (9 sentences) or a NonPrefix word (9 sentences). Prosodic differences were minimised by using Prefix-NonPrefix sentence pairs that shared many segmental properties and were matched in foot structure, nuclear stress position and F0 contour, e.g.

Prefix sentence: *He aimed to **re-supply** the cocaine by Tuesday*
NonPrefix sentence: *They claimed the **recent** violent campaign was stupid*

Sentences were masked with 12-talker British English babble. To ensure keyword (e.g. *re-supply, recent*) intelligibility between 20% and 70%, the SNR was determined separately for each experimental sentence through piloting.

To monitor learning, the experiment was divided into two halves: 5 familiarisation stories and half the assessment sentences; then the remaining stories and assessment sentences.

Keywords were scored as correct or incorrect. A mixed model analysis was performed, with fixed factors of Familiarisation group (Accent, Control), Experiment Half (First, Second), Morphological Type (Prefix, NonPrefix) and all interactions, and random factors of Subject and Item. Factors were removed incrementally until the most parsimonious model was found.

Figure 1 shows that intelligibility was higher for Accent than Control subjects for both Prefix ($p < 0.00001$) and NonPrefix words ($p < 0.02$), but this difference was significantly greater for Prefix words (18.5% vs. 9.2%, $p < 0.04$). Figure 2 shows that both Accent and Control subjects found Prefix words more intelligible in the second half of the experiment ($p < 0.003$), but there was no change in intelligibility for NonPrefix words.

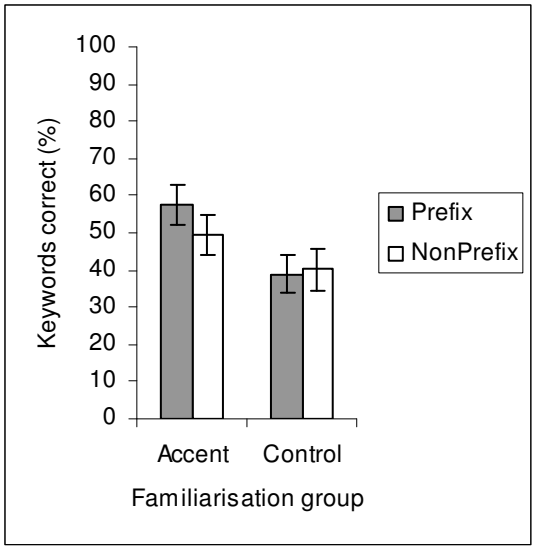

Figure 1. Percentage of keywords correct for Prefix and NonPrefix words for Accent and Control subjects. Error bars show the 95% confidence interval of the mean.

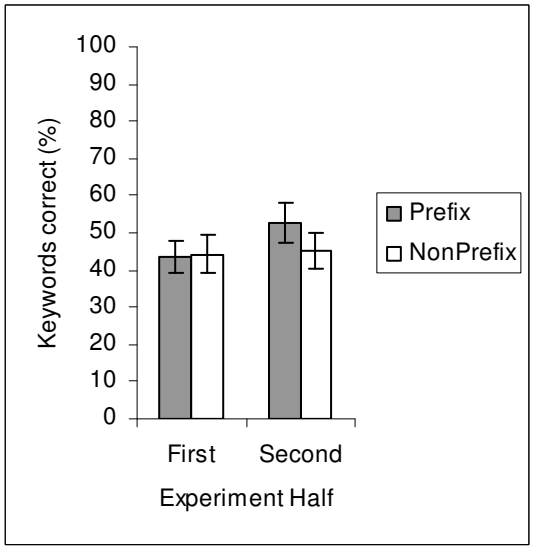

Figure 2. Percentage of keywords correct for Prefix and NonPrefix words for the First and Second halves of the experiment. Error bars show the 95% confidence interval of the mean.

This intriguing pattern of results has significant implications for models of perceptual learning. The intelligibility advantage for Accent subjects for Prefix words demonstrates that, as predicted, perceptual learning was (at least partially) specific to prefixes. This implies that modelling adaptation to accents solely in phonemic or featural terms is inadequate because listeners can adapt to phonetic detail that relates systematically to higher levels of linguistic structure.

Higher scores of Accent subjects across both Prefix and NonPrefix words indicate that perceptual learning to some extent generalised to NonPrefix words. This may be due to Accent subjects adopting a more 'tolerant' approach to all atypical pronunciations. Alternatively, there may be concurrent adaptation of categories at different levels of structure (e.g. /ri:/ syllables and /ri:/ prefixes). That is, Accent listeners heard all *re-* prefixes pronounced as [rɪ] during familiarisation, but, by definition, they were also exposed to a proportion of /ri:/ syllables pronounced as [rɪ], and this may have induced learning of a weaker secondary association. Because the embedding of smaller units within larger ones is pervasive in speech, simultaneous adaptation at multiple levels of structure is potentially a powerful learning mechanism within a dynamic model of speech perception.

Control subjects' adaptation to the atypical pronunciation in prefixes was presumably due to exposure to it during the intelligibility-in-noise tasks. However, Control subjects also heard /ri:/ as [rɪ] in NonPrefix words in this task, but there was no significant change in intelligibility for NonPrefix words. This suggests that the consistent meaning of the *re-* prefix may have facilitated learning of the systematic phonetic association, and therefore the 'coherence' of a category or unit on multiple levels (e.g. semantic and phonological) should be considered when investigating accent adaptation.