The Effect of Phonological Context on the Perception of Strong Place Assimilation in Nasal and Stop Consonants
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The process of spoken word recognition involves the incremental mapping of speech sounds to lexical candidates. However, variability in the production of speech sounds can result in ambiguity at the level of lexical selection. One common source of such variability involves phonological processes such as place assimilation. For example, in English the place of articulation (PoA) of a coronal nasal or stop consonant can assimilate to a following labial sound such as [b], thus ‘phone box’ is perceptually similar to ‘foam box’ ([n] → [m]). Previous studies have suggested that listeners can compensate for the effects of assimilation when a triggering context is present (e.g., when the sound precedes a labial/velar consonant; Gaskell & Marslen-Wilson, 1996; Gow & McMurray, 2007). However, a question remains as to whether only general auditory mechanisms are responsible for compensation for assimilation (feature parsing account; Gow, 2002) or if higher level phonological knowledge is also involved in the recognition process (phonological inference account; Gaskell, 2003). The current study focuses on the role of the phonological context in listeners’ compensation for place assimilation during lexical access by comparing the findings within and across the two groups of sounds that are affected by this process, namely nasal and stop consonants.

We conducted two forced choice identification experiments and two eyetracking experiments combining a visual world methodology with a priming paradigm. In all experiments, English native speakers viewed displays containing five buttons that were each labelled with a printed word. On critical trials, the array of buttons contained a “prime” word (‘lean’), a target word (‘dine’), a competitor for the target differing only in place of articulation of the final sound (‘dime’), and two unrelated distractor words. In the identification experiments (Expts 1 & 2), listeners heard recorded words that were manually clipped out of their original carrier sentences and played in isolation, and pressed on the button corresponding to the perceived word. Each participant heard two words per trial: a prime word and a subsequent target word. In both cases the final consonant was varied (unassimilated or assimilated to a labial PoA). Expt 1 examined nasal consonants (as exemplified above) and Expt 2 examined stop consonants (e.g., prime ‘root’, target ‘cat’). In Expts 3 (nasals) and 4 (stops), we used the same visual displays and recorded prime/target words from Expts 1 & 2; however, this time listeners heard the words within their original carrier sentences (e.g., prime instruction: Click on the ‘lean’ button, subsequent target instruction: Now click on the ‘dine’ button). Critically, the initial sound of ‘bution’ creates a phonological context where coronal-to-labial assimilation is viable, potentially boosting the correct identification of the underlying place of articulation of a preceding assimilated nasal or stop consonant. Prime sentences were included to test if the recent act of compensating for assimilation can facilitate a similar process during the comprehension of the target sentence. For each pair of experiments, we used a comparatively large stimulus set (48 critical and 72 filler item sets) balanced for lexical frequency and orthographic complexity.

In Expts 1 and 2 (Fig. 1a, green/darker columns), listeners strongly tended to select the competitor (e.g., ‘dime’, ending in a labial consonant) over the target (e.g., ‘dine’, ending in a coronal) when the final sound in the target word was assimilated. This was the case for both nasals (8% target selection) and stops (21%), suggesting that assimilation was perceptually strong/complete and that listeners were taking the surface acoustics (labial PoA cues) at face value. In Expts 3 and 4 (Fig. 1a, yellow/lighter columns), the provision of the assimilation-triggering phonological context resulted in a marked increase in listeners’ tendency to select a word ending in a coronal as the target (~27% increase for both nasal and oral stops). Interestingly, however, complete compensation was not achieved, especially for words ending in nasal consonants, even with the triggering context present. There were no priming effects reflected in listeners’ overt choices. However, an examination of the online comprehension patterns based on the eye movement data in the latter two experiments showed a priming effect for nasals (Fig. 1b): When listeners had heard and identified an assimilated prime word
(compared to an unassimilated prime) before they heard an assimilated target word, they increased their visual consideration of the target item ending in a coronal (e.g., ‘dine’) relative to the competitor, within a time window starting from the onset of the following context sound /b/ until 600 ms after. Thus a recent act of compensating for assimilation seems to facilitate on-line perceptual processing of a subsequent word-final assimilated nasal. However, this effect was not observed in Expt 4 for word-final stop consonants.

Overall the results suggest that complete compensation for assimilation may be less likely to occur than previously assumed: In absolute terms, listeners tended to identify assimilated coronals (particularly nasal consonants) as labials even when an assimilation-triggering context was present. However, despite the absence of the residual acoustic cues to the underlying PoA (due to strong/complete degree of assimilation), contextual information clearly shifted listeners’ perception of the PoA of the assimilated consonants toward a coronal interpretation, supporting the role of phonological context in compensation for assimilation. Further, the effect of priming, which was only observed for nasals, suggests that the precise nature of compensation may vary according to the characteristics of the particular sound class that is affected by the assimilation process (see Mitterer, 2011). We argue these findings are inconsistent with accounts that appeal to general auditory processing and instead suggest that phonological inference mechanisms play an important, if sometimes weak, role in the recognition of assimilated words.

References