Nasalization of /æ/ and sound change in Australian English

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In Australian English (AusE), a phonetic lowering of the short front series of vowels /æ, e, i/ (TRAP, DRESS, KIT) is currently in progress. This change began with /æ/ (Cox, 1999) which was previously located in the vicinity of cardinal 3 [ɛ] but now occupies the extreme open position of the inverted triangular vowel space (Cox & Palethorpe, 2007). We would expect this change to encompass the various contextually based realizations through a shift in the exemplar distribution (Pierrehumbert, 2003). According to exemplar theory, words and contexts that have a high probability of occurrence (token frequency) skew the distribution in the direction of the change (Bybee, 2004). Therefore, the lowest /æ/ variants should occur in high frequency words. High frequency phonotactic sequences (type frequency) might also affect distribution skewness (Hay et al., 2003). One highly probable phonotactic environment for /æ/ is the pre-nasal context (Vitevitch & Luce, 2004) which is also the context most likely to inhibit lowering of this vowel. Numerous studies have shown that nasalized /æ/ is phonetically raised relative to its oral counterpart (Beddor, 1993).

In the current AusE /æ/ category, the opposing forces of nasalized raising combined with the probabilistic lowering of the change may create a pull in different directions and could result in an elongated distribution representing an increase in the gradient of realizations for this vowel from the phonotactically probable nasal through to the most lexically frequent oral tokens.

Based on predictions from exemplar theory, speakers should exhibit phonetically open distributions of /æ/ across contexts as a result of the sound change and high frequency words containing non-nasal consonants should occur at the lower edge of the distribution. We would also expect words containing vowels in nasal contexts to have phonetically closer realizations in line with research on nasalization. We would expect the distribution to be contained within the general /æ/ space to maintain contrast with /e/, however gradient expansion resulting from antagonism between type frequency and the direction of the change is predicted.

In order to examine these predictions, we conducted an acoustic analysis of the vowels /æ/ and /e/ in the speech of 15 lower middle class AusE speaking female university students from Sydney’s northern districts. All were speakers of General AusE and under 25 years of age. Recordings were made in a sound treated studio in the Centre for Language Sciences at Macquarie University. Speakers read from a computer screen, three times in random order, the 12 monophthongs of AusE in the standard hVd frame and also the vowels /æ/ and /e/ in the monosyllabic and disyllabic contexts /CVn, CVd, CVnd, CVda, CVna, CVnda/ where C was a range of consonants with differing place, manner and voicing characteristics including /p, b, t, d, k, h, s/. A subset of the data containing the CVn and CVd words has been selected for this analysis. The formant frequencies of F1 and F2 as well as vowel durations were extracted using standard procedures described in Cox (1999). The values for the three repetitions of each word were averaged for each speaker to overcome the problem of artificially inflating the dataset. Mixed model analysis was used to examine the effect of word type and nasality on the formant and duration values.

Results show that word type did not affect formant values indicating that lexical characteristics were not responsible for the distributions. All speakers produced open oral /æ/ and phonetically more raised, nasalized /æ/. However, only one third of the speakers had a gradient oral to nasalized /æ/ within the /æ/ category space as predicted. The majority produced a categorical distinction in phonetic height between the oral and nasalized vowel such that the nasalized /æ/ patterned with /e/. Cluster analysis confirmed the presence of two groups of speakers: those who substantially raised nasalized /æ/ (categorical group) and those who did not (gradient group). Figure 1 illustrates these effects for syllables containing onset /b/. Results also show that duration is used to maintain the contrast between the nasal allophones of /e/ and /æ/.
This recent sound change in AusE /æ/ appears regular as no evidence of lexical diffusion was found in the analysis. Phonetic context rather than lexical effects were shown to have the major influence. These results support Labov’s (2006) findings for North America that such vowel shift changes are not influenced by lexical frequency.

Figure 1: Oral and nasalized /æ/ ellipses for speakers who produce gradient distributions (left panel) and those who produce categorical distinctions (right panel).

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References