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Plasticity in speech production and perception: A study of accent change in young adults

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Introduction

When speakers of different accents come into contact with each other (e.g., in multidialectal environments), they often avoid variants that are markedly regional or unusual in order to facilitate communication (Trudgill, 1986) and to appear cosmopolitan (Foulkes and Docherty, 1999). However, they also retain some regional variants in order to show their allegiance to particular social or geographical groups (e.g., Foulkes and Docherty, 1999; Trudgill, 1986).

Evans and Iverson (2004) investigated if listeners adapted perceptually to this kind of variation. They investigated whether listeners from different accent backgrounds changed their vowel categorization decisions when listening to speech produced in a northern and southern English accent. The results demonstrated that northern and southern listeners, who had experience of living in a multidialectal community, changed their vowel categorization decisions when listening to a non-native accent. These patterns of normalization corresponded closely with the changes in production that speakers tend to make due to sociolinguistic factors when they live in multidialectal environments. However, listeners from the north of England, who had no previous experience of living in a multidialectal environment, did not adjust their vowel categorization decisions when listening to Standard Southern British English (SSBE), even though they were highly familiar with this accent. Evans and Iverson (2004) hypothesized that these listeners did not normalize for accent because they had no experience of modifying their own speech in order to fit in with a new environment.

This paper reports a study that examines changes in speech production and perception among university students from the north of England, as individuals adapt their accent from regional to 'educated' norms. Students were tested before beginning university (Time 1), 3 months later (Time 2), and on completion of their first year (Time 3). At each testing session they completed three experiments. Experiment 1 investigated whether subjects changed their speech production as a result of living in a multidialectal environment. Experiment 2 investigated whether subjects changed their vowel categorization processes, and whether these changes were linked to changes in speech production. Experiment 3 investigated whether changes in subjects' spoken accent and vowel category representations had an effect on word recognition. At the end of the final testing session, subjects were also interviewed about their attitudes to regional accents.

Method

Subjects. 23 subjects, aged 17-18 years at Time 1. All were native, monolingual English speakers who had been born and raised in Ashby de la Zouch, a near-homogenous accent community where the local accent is a variety of northern English very similar to that spoken in Sheffield. The variety differs from SSBE in two ways: it does not have the SSBE [ʊ] – [ʌ] contrast, (e.g. *book, buck*) and the short open vowel [a] is used in words such as *bath* where SSBE uses [ɑː].

Experiment 1: Production. Subjects recorded a set of test words, covering the whole of the vowel space, and a phonetically balanced reading passage. The test words were the same as those used in Experiment 2.

Experiment 2: Best exemplar locations. The stimuli and procedure were the same as that described in Evans and Iverson (2004; Iverson and Evans, 2003). Subjects found best exemplars for synthesized vowels in the phonetic environments bVd, bVth, and kVd embedded in natural recordings of the carrier sentence *I'm asking you to say the word _____ please*. Carrier sentences were recorded in northern and southern English accents (Sheffield English and SSBE) by a single male speaker, and subjects found best exemplars for each accent. On each trial, subjects heard the synthesized vowel embedded in a carrier sentence, and rated whether it was close to being a good exemplar of a vowel that was defined by a word printed on the computer screen (e.g., *bath, could, bead*). The computer program used a parabolic minimization algorithm to adjust the vowel parameters (i.e., F1, F2, F3, and duration) on successive trials in order to maximize goodness.

Experiment 3: Spoken word recognition. Subjects completed two tasks, a sentence recognition task and a word recognition task. The sentence recognition task used an adaptive procedure to find subjects' noise threshold for northern and southern English. Stimuli produced by speakers of northern and southern English were presented at varying signal-to-noise ratios (SNRs); noise was presented at a fixed level of 71 dBÃ, and an adaptive procedure varied the SNR of the stimulus and noise until the subject's threshold was found. In the word identification task, subjects identified CVCs produced in northern and southern English accents in the phonetic environments bVd, bVth, and kVd. Stimuli were embedded in continuous talker babble at a SNR of –12 dB and presented for identification in a randomized order.

Experiment 1
Production

Accent Ratings

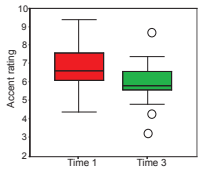


Fig. 1. Boxplot to show accent ratings from five phonetically trained listeners for all subjects (N=23). A rating of '10' means that the speaker was judged to sound 'very northern' and a rating of '1' means that the speaker was judged to sound 'very southern'.

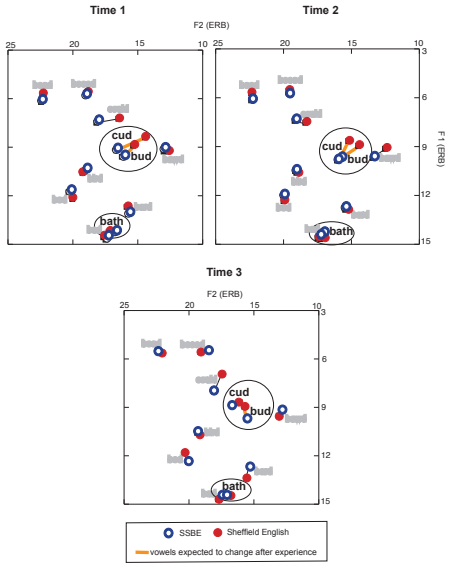
Results

Change in Accent Rating. All subjects changed their accent after a year at university (Fig. 1); subjects changed their accent so that it was more southern at Time 3, $F(1,20) = 24.34$, $p < 0.001$. An acoustic analysis demonstrated that this change was significantly correlated with the change in F1 and F2 for *bud* (F1, R2 = -0.566, $p < 0.01$; F2, R2 = -0.464, $p < 0.05$).

Idiolect differences. Some subjects were judged to have a more southern accent at Time 1 and Time 3 (Fig. 1) . An acoustic analysis demonstrated that these differences were significantly correlated with subjects' average F1 and F2 for *bud* and *cud* at Time 1, Time 2 and Time 3 (Bud F1, R2 = -0.666, $p < 0.001$; Bud F2, R2 = -0.568, $p < 0.01$; Cud F1, R2 = -0.638, $p < 0.001$; Cud F2, R2 = -0.508, $p < 0.01$).

Experiment 2
Best exemplar locations

Average vowel formant frequencies (N=22)



Results

Accent change. Subjects did not change their best exemplars greatly over time. Moreover, changes in best exemplar locations did not correlate with the observed changes in spoken accent. Subjects were divided into two groups according to the amount of change in their spoken accent rating; those whose accent rating was greater than or equal to the median change in accent rating, and those whose accent rating was less than the median change in accent rating. Subjects who changed their spoken accent more changed their best exemplar location for *could*, $F(1,17)=14.64$, $p < 0.01$, but changed their production of *bud* and *cud*. There was also little evidence to suggest that these subjects were learning to normalize: the amount of normalization was actually greater at Time 1 than Time 3, $F(1,17) = 8.08$, $p < 0.05$. Subjects who changed their spoken accent less did not change their best exemplar locations and there was no evidence that these subjects were learning to normalize for accent.

Idiolect differences. Subjects were divided into two groups based on an average of their accent rating at Time 1 and Time 3; those who had an average accent rating that was greater than or equal to the median average accent rating (i.e., were judged to sound more southern overall), and those who had an average accent rating that was less than the median average accent rating (i.e., were judged to sound more northern overall). A repeated measures MANOVA showed that subjects who were judged to have a more southern accent overall chose different best exemplars for *bud* and *cud* in southern and northern English sentences, $F(1,17)=4.99$, $p < 0.05$. These differences occurred predominantly in the F1 dimension; in the southern context they chose a lower vowel (i.e., higher F1), but in northern English sentences they chose a higher vowel (i.e., lower F1). There were no changes for any other vowels. Subjects who were judged to have a more northern accent overall did not significantly change their best exemplar locations for *bud* and *cud*, or for any other vowels $p > 0.05$.

Experiment 3
Spoken word recognition

Sentence recognition

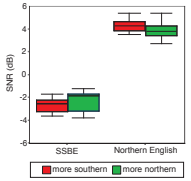


Fig. 2. Boxplot to show subjects' average SNR threshold (N=23) for SSBE and northern English sentences, averaged over Time 1, Time 2, and Time 3, and grouped according to overall accent rating.

Results

Accent change. All subjects performed better with the SSBE speaker, $F(1,18)=75.15$, $p < 0.001$. However, there was no change in performance over time and no correlation with the change in subjects' accent rating over time; subjects who changed their spoken accent more over time to sound more southern did not show any advantage for processing SSBE speech.

Idiolect differences. Sentence recognition correlated with spoken accent. Subjects who were judged to have a more southern accent overall were better at identifying speech produced in SSBE than those who were judged to have a more northern accent (Fig. 2). Likewise, subjects who were judged to have a more northern accent overall performed better with northern speech.

Word recognition

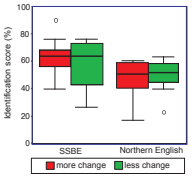


Fig. 3. Boxplot to show subjects' percentage correct identifications for *bud, cud,* and *could* in SSBE and northern English accents, grouped according to the amount of change in their spoken accent rating.

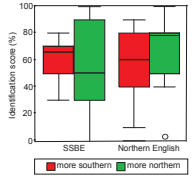


Fig. 4. Boxplot to show subjects'percentage correct identifications for *bud, cud,* and *could* in SSBE and northern English accents, grouped according to their overall spoken accent rating.

Results

Accent change. There was a relationship between the amount of change in subjects' spoken accent and their ability to recognize words in noise in SSBE (Fig. 3). Subjects who changed their spoken accent to sound more southern were better at identifying *bud*, *cud* and *could* in SSBE, $F(1,18) = 4.39$, $p < 0.05$. However, this was a small effect; although subjects who changed their accent less show more variability in their SSBE responses, subjects who changed their accent more do not appear to have any clear advantage.

Idiolect differences. There was a relationship between subjects' overall accent rating and their ability to identify words in noise in SSBE and northern English accents (Fig. 4). A repeated measure MANOVA demonstrated that there was a significant interaction between stimulus accent and overall accent rating for *bud*, $F(1,21) = 6.42$, $p < 0.05$: Subjects who were judged to have a more southern accent overall were better at identifying *bud* in SSBE, and subjects who were judged to have a more northern accent overall were better at identifying *bud* in northern English.

Conclusions 1
Accent Change

Subjects are able to change their production at a late stage in their linguistic development. Subjects changed their production of the vowels in words like *bud* and *cud* after experience of living in a multidialectal environment. This shift occurred in both the F1 and F2 dimension; subjects produced a more fronted and lower vowel in these words at Time 3. However, these changes were small.

Changes in production did not match changes in perception. Subjects changed their production of words like *bud* and *cud*, but they changed their best exemplar location for *could*. They chose a more central vowel with a higher F1 in SSBE sentences that was closer to the vowel they chose for *bud* and *cud* in SSBE sentences. This is surprising as SSBE speakers produce *could* with the same vowel as northern English speakers, the high-back vowel [ʊ]. It is possible that these subjects are over-generalizing this central vowel to all instances of their native [ʊ] category, even if this does not match how southerners produce these words. However, there was also little evidence to suggest that subjects were learning to normalize; subjects chose similar vowels in SSBE and Sheffield English sentences.

Changes in production did not clearly affect word recognition processes. Subjects who changed their accent did not show any advantage for SSBE speakers in the sentence recognition task. There was a possible advantage in the word identification task, but this effect was only small.

Changes in production and perception appeared to be linked to sociolinguistic factors. Subjects who were highly motivated to fit in with and identify themselves with their new university community changed their production and perception more. These subjects had friendship groups that were predominantly made up of SSBE speakers, and reported that they felt it was important to change their accent to fit in with this new community.

Conclusions 2
Idiolect differences

Subjects were judged to have different accents. All subjects had been born and raised in Ashby and were from similar backgrounds. However, even within this apparently homogenous accent community, there were differences in spoken accent; some subjects were judged to have a particularly southern accent overall, and others were judged to have a strong northern accent. An acoustic analysis demonstrated that these differences correlated with the way in which subjects produced words like *bud*; subjects who had a more southern accent produced this word with a more central vowel that is closer to how southerners produce this word.

Differences in idiolect corresponded with differences in perception. Subjects who produced more southern vowels overall also chose more southern vowels for *bud* and *cud* in SSBE carrier sentences (Experiment 2). These subjects chose more central vowels for *bud* and *cud* that match how northerners typically produce these words when interacting with SSBE speakers (Trudgill, 1986). Subjects who sounded more southern overall also had a greater degree of normalization for the vowel in *bud*. However, there was no change in the amount of normalization over time.

Differences in idiolect corresponded to differences in word recognition performance. Subjects who had a more southern accent performed better with SSBE speech in both the sentence recognition and the word recognition task than those who had a more northern accent. Likewise, subjects who had a more northern accent performed better with northern speech in the word recognition task than did those with a more southern accent.

References

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