Merger within an individual

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ABSTRACT

The merger of vowels in a language over time has been a productive area of study, yet how these changes arise remains an ongoing matter of debate. A generally accepted hypothesis is that mergers arise within individuals, who are thought to become merged over time as a result of contact with other merged individuals. A further prediction states that unconditioned mergers, such as the low back merger of /a/ and /ɔ/ in American English, are particularly vulnerable to change, whereas conditioned mergers, such as pre-velar raising of /æ/ before /g/, where the vowels of *bag* and *beg* are similar, are more resistant to change within the individual.

Neither prediction has been tested against longitudinal data from the same speakers over time. Here, a study is reported showing some support for the predictions of change over time, but with a caveat: individuals are more likely to show change related to unconditioned mergers than conditioned ones, opposite the expected pattern.

Keywords: Diachronic change, merger, sociophonetics

1. INTRODUCTION

The Twin Cities of Minneapolis/St. Paul in the U.S. state of Minnesota has been thought to exhibit characteristic features of the Northern Cities Shift: the presence of general /æ/-raising and the relative absence of low back merger, where the vowels in *cot* and *caught* are identical [10]. Recent reports of the greater Twin Cites area, however, have shown an increased incidence of low back merger as well as a higher incidence of raising of /æ/ in conditioned environments, particularly before voiced velars (so that *bag* sounds more like *beg*) [1, 2, 7, 12]. The presence of the low back merger in the area is thought to result from pressure from dialect regions west of the Twin Cities [10], and pre-velar raising of the low front vowel is thought to result from pressure from dialect regions to the east, in Western Wisconsin [2].

Despite observation of the fact of ongoing change in the region, the mechanism of how these apparent changes emerge within an individual remains an ongoing matter of debate. One often-cited proposal predicts that individuals are likely to become merged over time as a result of contact with other merged individuals [4]. A further prediction states that unconditioned mergers, such as the low back merger, are particularly vulnerable to change, whereas conditioned mergers, such as pre-velar raising, are more resistant to change within the individual [9]. Neither hypothesis has been tested against longitudinal data from the same speakers over time. The current study tests these claims about merger directly.

Here, preliminary data is presented of a longitudinal study of 67 adolescent speakers in suburban Minneapolis, sampled each year over a period of three years, resulting in a dataset of 16,080 vowel tokens. Overall, there is some support for the predictions of change over time, but with a caveat: individuals are more likely to show change related to unconditioned mergers than conditioned ones, opposite the expected pattern.

Results show that a few speakers who had no low back merger at the start of the study did in fact lose the F1, F2, and length distinction between the two vowels over time. In addition, while a number of speakers showed evidence or pre-velar raising at the onset of the study, there was no evidence for any change in the number of speakers to show pre-velar raising over time.

Thus, vowel distinction of unconditioned low back vowels in the Twin Cities may be corruptible over time, but the low front space, particularly conditioned before velars, is more or less stable.

2. LONGITUDINAL STUDY

2.1 Participants and location

The study was conducted among a population beyond the acquisition period but also of an age most likely to be vulnerable to change during adulthood—that is, just past puberty [6, 8]. Yet, this age group is capable of maintaining the fine-grained acoustic trajectories of segments of the local speech community [5].

Sixty-seven native speakers of English from a junior high school in suburban Minneapolis participated. Forty of the 67 participants are male, and 27 are female. According to records obtained from the school, 55 participants are listed as White

(33 male, 22 female), eight are African-American (four male, four female), three are ethnically Asian (two male, one female), and one is Native American (male).

2.2 Materials

A list of 94 words was prepared for participants to read. The set contained (mostly) monosyllabic words with /æ/, /æg/, /ɛ/, /a/, and /ɔ/. Words with /æ/, /æg/, and /ɛ/ form the basis for detecting signs of /æ/-raising and pre-velar raising. Words with /a/ and /ɔ/ words form the basis for detecting low back merger. Classification of whether a word contains /a/ or /ɔ/ is based on the most common categorization found in studies of low back merger (e.g., all studies assume "cot" has /a/ and "caught" has /ɔ/ among the set of unmerged speakers). The words were ordered randomly on two sheets of paper, with each word appearing in the sentence frame *Say_____again*.

2.3 Equipment and procedure

The study was conducted at a junior high school in suburban Minneapolis. Recording sessions took place in a quiet room during regular school session.

In the study, participants read the list of 94 sentences. Acoustic recordings were made using a Sure SM10A-CM head worn microphone attached to a Marantz PMD 670 digital solid-state recorder and sampled at 44 kHz. Recording samples were obtained once each year, for a period of three years, during the winter term. Social network data was collected but is not reported here.

2.4 Measurement and analysis

Following the study, vowels were extracted from the onset of voicing following (or occurring simultaneously with) release of the initial consonant, to the point of closure of the following consonant, either to where voicing subsides or where formants make known transitions (e.g., acoustic lowering for laterals, presence of a nasal formant, and so on). Beginning and end points of the vowel were determined by visual inspection of the waveform and spectrogram. Mispronounced words were removed from the dataset.

Several acoustic measures were made: (1) Vowel Length, and (2) F1 and F2 at 20%, 50%, and 70% vowel duration. Measurements were made automatically in Praat [3] using one of two scripts based on the standard settings for estimating formants—a window length set to 0.025 seconds, looking for 5 formants under 5,550 Hz with a 30 dB dynamic range. The first script was used for longer files, above 8 KB, and it measured the duration of each vowel, as well as F1 and F2 at the nearest sample to 20%, 50%, and 70% vowel duration. The second script was used for shorter files, 8 KB and below, with (generally) fewer than three samples. It measured the duration of each vowel, as well as F1 and F2 at the nearest sample to 50% vowel duration (typically the only sample) and used that figure for the values at 20% and 70%. The average length for the shorter files was 73ms, and the average length for the longer files was 126ms, with the difference being significant, $t(6506)=81.27$, $p<0.01$. Output from both scripts was examined for anomalies and subsequent measurements were done by hand. This represented less than one percent of the dataset.

Analysis of vowels was performed on the raw formant values. Vowels were not normalized for several reasons. First, normalization techniques are generally used to make comparisons across sample populations. However, the primary interest here is in change within each speaker, and normalization would likely obscure results that might indicate change. Second, normalization techniques generally assume a heterogeneous sample population. However, the participants were all approximately 12 years old at the onset of the study (short, compared to any adult), and normalization techniques would likely conflate any existing variation in the population. Third, normalization techniques generally require a full set of vowels to be used for comparison. However, data was collected for only on a subset of vowels.

Pre-velar raising was found when a participant's F1 average values for /æ/ before /g/ were significantly different from /æ/ in other phonological environments throughout the duration of the vowel, as determined by t-tests for independent samples.

Low back merger was diagnosed by whether F1 and F2 differed between the set of words historically associated with /a/ and the one with /ɔ/ [7, 8, 11]. Those participants whose F1 and F2 were mostly significantly different at 20%, 50%, and 70% vowel duration were considered "merged." Those whose formant values across the duration of the vowel were mostly alike were considered "unmerged," and those whose values showed some, but not complete, significant difference were considered "in between."

3. RESULTS

Overall results show the conditioned merger of pre-velar raising remains stable over time: no speaker acquired or lost pre-velar raising over the study period. In contrast, the unconditioned merger of the low back vowel did show some change over time: a
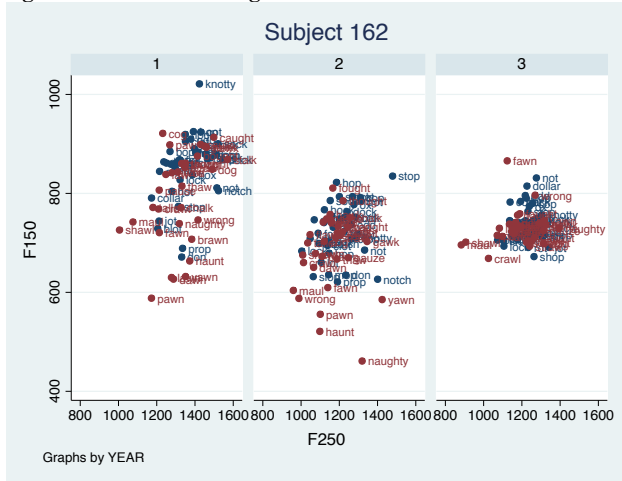
few speakers became merged over the course of the study, and one speaker became unmerged.

3.1 Pre-velar raising

Overall, 42 speakers exhibited pre-velar raising and 25 showed no pre-velar raising at the start of the study. That number remained the same at the end of the study, and there was no interaction between Year and Vowel for F1, F2, duration at 50% and 70% Vowel Duration for pre-velar /æ/ and general /æ/ or /e/. Figures 1 and 2 below show typical speakers with and without raising. Thus, pre-velar raising appears to be fixed within the population: no one gains or loses conditioned /æ/-raising over time.

Figure 1: Typical speaker with pre-velar raising

Figure 2: Typical speaker without pre-velar raising

3.2 Low back merger

Most of the participants (53) showed no evidence of low back merger, and no change over time: there was a significant difference between the two low back vowels for each participant for F1 and F2 at 50% and for Vowel Length at the p<0.05 level, and there was no interaction for Year. Figure 3 shows

data from a typical speaker without low back merger.

Figure 3: Typical speaker without low back merger

A few participants did become merged over time. Fourteen participants showed interaction between F1 or F2 and Year at 50% Vowel Length at the p<0.05 level. These participants were either "merged" or "in between" (e.g., Figure 4). Among the set of "in between" speakers, three participants who showed significant difference between F1, F2, and Vowel Length at Year 1 showed no significant difference between these sets of variables at Year 3 at the p<0.05 level, as shown in Figures 5 and 6.

Figure 4: Typical speaker with low back merger

Casualness may play a role in results for one of these three speakers who evidence apparent merger over time: Subject 162 spoke faster in Year 3 than in Year 1, and there was a significant interaction between Vowel Length and Year at the p<0.05 level (Figure 5). The other two speakers showed no interaction between Vowel Length and Year.

In sum, an individual may exhibit low back merger over time, but the absolute number of individuals to do so in the dataset is quite low.

Figure 5: Low back merger over time

Subject 162

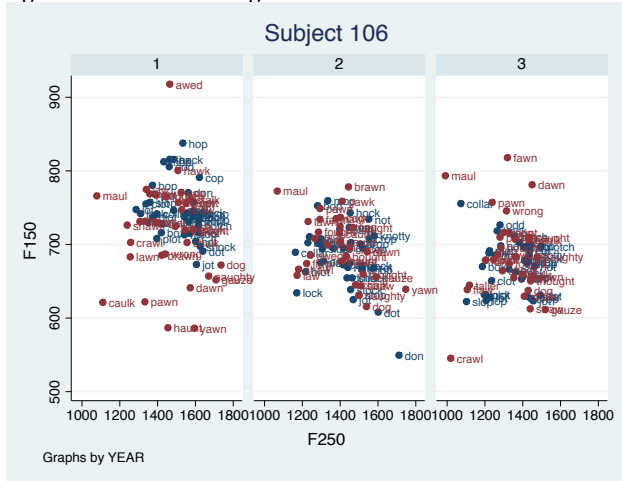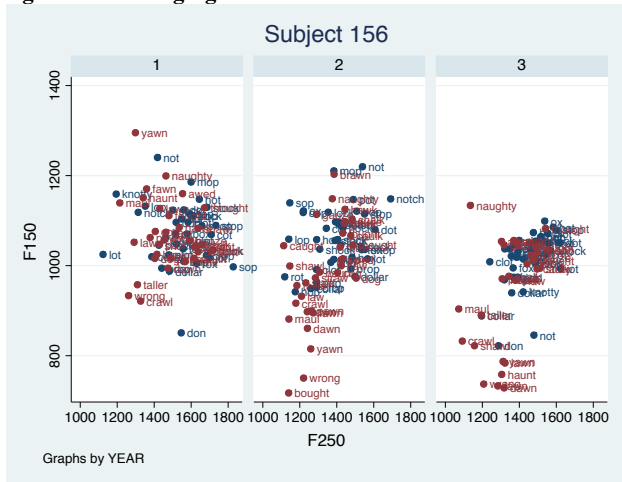**Figure 6: Low back merger over time**

Subject 106

Figure 7: Unmerging over time

Subject 156

In addition, one participant who was merged at Year 1 showed no merger in Years 2 and 3 (Figure 7). Casualness does not play a role: there was no interaction between Vowel Duration and Year. The lexical source of this "unmerging" appears to be due to raising of the vowel in words historically associated with /ɔ/ (e.g., *wrong*, *bought*, etc.). Unmergings are not expected [8], so this may

suggest further revision to an understanding of the mechanism of mergers.

4. CONCLUSION

Overall results show the conditioned merger of pre-velar raising remains stable over time: no speaker acquired or lost pre-velar raising. In contrast, the unconditioned merger of the low back vowel did show some change over time: a few speakers became merged over the course of the study, and one speaker became unmerged. This would appear to be the first documented case of a merger within an individual over time, consistent with some predictions of how mergers are thought to spread [9]. Yet, merger within the individual is not only sparse in this dataset, but it is also only seen in unconditioned mergers, which is not consistent with the prevalent view of how mergers spread. Thus, the merger hypothesis is only partially supported.

5. REFERENCES

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