PREVELAR MERGER IN PRODUCTION VS. PERCEPTION

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ABSTRACT

Prevelar merger in Pacific Northwest English describes merger of /ɛ, e/ before /g/ and variable raising of /æg/, so BEG, VAGUE, and sometimes BAG rhyme. Variation in merger production has been discussed previously, but only one study has examined categorical prevelar perception [4]. It found less BAG-raising and a lower spectral location for BEG–VAGUE merger, but common methods of calculating F1xF2 overlap were unsuitable for the data. Thus, there has been no direct comparison between production and perception. This study compares the advancement of prevelar merger in production vs. perception within the same speakers using a simple overlap metric developed for use with both data types. Overall, BEG–VAGUE merger was more complete in perception, while BAG-raising was more advanced in production. BAG-raising was absent in perception, and younger speakers did not produce raised BAG, suggesting it is more socially marked than BEG–VAGUE merger.

Keywords: vowel merger, sound change, Pacific Northwest English.

1. INTRODUCTION

A feature of Pacific Northwest American/Canadian English is prevelar raising/merger, a sound change in progress in which the low-front vowels /æ, ɛ/ are produced as raised diphthongs before voiced velars /ŋ, g/ [1, 6, 20]. In addition, mid-front prevelar /e/ is lowered and merged with the raised /ɛ/ at a spectral F1xF2 location between the two non-prevelar counterparts, so that BEG and VAGUE rhyme [be̞ɪg, ve̞ɪg] [3, 15]. Raising is advanced and stable before the velar nasal, with /æŋ, ɛŋ/ merged at the same /ɛg–eg/ location (e.g., *length*, *thanks* [le̞ɪŋkθ, θe̞ɪŋks]) [6, 21], and BEG–VAGUE merger is also advanced in most communities [1, 15, 20], but the height of /æg/ is more variable, with higher positions – and sometimes three-way BAG–BEG–VAGUE merger – found in urban, white, middle-aged, and male speakers, in northern regions, casual speech, and frequent words, and in younger speakers with traditional local orientations [1, 3, 7, 15, 17, 19, 20, 22]. With lower and more variable positions for both /æg/ and /ɛg/ found in older generations [14, 15, 21], the advancement seen in middle-aged speakers suggests a change progressing over time, but the variation among younger speakers points to social meaning, particularly for the newer and more frequently criticized BAG-raising [1, 3, 7].

The only report of phonemic prevelar perception found slightly different patterns [4]. When presented with synthetic /b_/ "half-words" with front-vowel formant values but no codas, Northwesterners reported hearing *beg* for values that included the entire distributions of both [bɛ] as in *bed* and [be] as in *bayed*. The distribution heard as coming from *bagel* was similar to the typical location of /eg/ in production, but only a third of participants accepted [bɛ] or [be] as coming from *bag*, resulting in a group pattern without BAG-raising. Thus, BEG–VAGUE merger appeared to be more advanced than BAG-raising in categorization as well as production, but BAG-raising was less advanced in perception than production, a pattern often found for stigmatized variants [10]. However, these patterns have not been confirmed with direct comparisons between production and perception.

The aim of the present study was to compare the advancement of merger in production vs. perception by examining patterns among the same speakers. However, merger production and perception data are rarely assessed using the same metric, making them difficult to compare directly [8]. Most common methods for quantifying merger in production report a numeric or statistical measure that can be applied to accompanying visualizations of the vowel space [9, 13]. In contrast, perception studies of mergers (and splits) frequently use statistical tests to report distances between vowel categories or the likelihood of merger [13]. This study compared the two data types with a simple overlap metric that calculates the percentage of the distributions of two vowels that overlap in F1xF2 space.

2. METHOD

2.1. Participants

Participants were 20 native English-speakers living in the Seattle area who grew up in the American Pacific Northwest (Washington, Oregon, Idaho). They fell into three age groups, (20s, 40s, 60s, Table 1) and participated in two sessions that took place over one year (2013–2014) in a sound-attenuated booth on the University of Washington campus in Seattle. All procedures were approved by the university's institutional review board.

Table 1: Participants by age group and gender.

Age Group	F	M	Total
Younger: 20s (21–28)	4	2	6
Middle: 40s (43–49)	1	4	5
Older: 60s (60–70)	7	2	9
Total	12	8	20

2.2. Procedures and Data

As part of a project that collected an audio database of problem-solving conversation [5], 17 of the participants completed collaborative tasks with a partner. One task involved arranging a list of household items on a grocery store floor plan; the other involved discussing which of the items would be most useful in a cold-weather survival scenario.

All 205 low-front prevelar vowels from the two tasks were extracted for the present study, as well as a comparable number per speaker before coronals, preferably /d/ when available. This averaged to 12 prevelars (range 3–33) and 17 pre-coronals (range 9–31) per speaker, totalling about 29 tokens per speaker (range 14–56), 490 overall.

In separate solo sessions 2–12 months later, all 20 participants completed a categorization task and read a word list. For the categorization task, audio stimuli were created in SynthWorks [16] to synthesize an initial /b/ followed by 24 front-vowel formant value combinations (F1xF2) with no offglide or coda transitions. F1 values consisted of 8 steps between 250 and 775 Hz, 75 Hz apart, and F2 values consisted of 8 steps between 1500 and 2550 Hz, 150 Hz apart. The selected values fell on a diagonal that covered the front vowel space of a male Northwestern speaker recorded reading a word list for a separate study [3].

Participants were told that each stimulus was the first part of a word that had been cut off in the middle, and they indicated which word they heard with a button press. In the first three blocks of randomized stimuli presentation, the word choices were in the shape b_d: *bad, bed, bayed, bid, bead*; the second three blocks used the same randomly-presented stimuli (unbeknownst to participants), but the word choices were b_g: *bag, beg, bagel, big, beagle*. This design was intended to encourage mental lexical access during the task, as participants must imagine they heard words. The task resulted in 72 responses per block (pre-g/pre-d) per participant, with only responses for non-high front vowels reported here (see [4] for high-vowel responses).

Following the categorization task, participants read a word list that included the same 10 /b_/ words from the categorization task, plus one additional prevelar, one /h_d/, and one /d_d/ word for each front vowel. Participants read each word three times, resulting in 6 tokens for each prevelar vowel /æg, ɛg, eg/ (*bag, sag, beg, egg, bagel, vague*) and 9 monosyllabic tokens for each pre-coronal, totalling 45 tokens per speaker, 900 overall.

A previous study [7] found no substantial difference in raising/merger patterns between productions in the word list and conversational tasks, so all tokens from both sources were combined for the production data in this study, yielding 11.6 tokens per speaker per vowel-context on average (range 6–26), for a total of 1390 tokens.

2.3. Plots and Calculations

Past prevelar merger studies have frequently plotted productions in F1xF2 space with probabilistic ellipses of one or two standard deviations around vowel means. Many studies represented the amount of overlap between two prevelar vowels via the Spectral Overlap Assessment Method (SOAM) [18], which calculates the proportion of the smaller ellipse that is overlapped by the larger ellipse. However, these methods do not work well for discrete distributions like the categorization data in this study. Some probabilistic ellipses under-represented overlap by curving short of frequently-chosen options in the corners of the vowel's distribution, and some over-represented overlap by extending over responses that were not selected.

Instead, both data types were visualized with contour plots, which use kernel density estimation to illustrate the edges and densities of vowel distributions [23]. These plots draw more accurate distribution shapes than ellipses, and density information allows quick identification of central tendencies and bimodal distributions needing further inspection [2]. They work well for sparse, skewed, or imbalanced data, alone or in comparison with more robust distributions, and for evenly-spaced or discrete data like the perceptual categorization results in this study [8]. Distribution shapes are not directly comparable, but relative densities and amounts of overlap are.

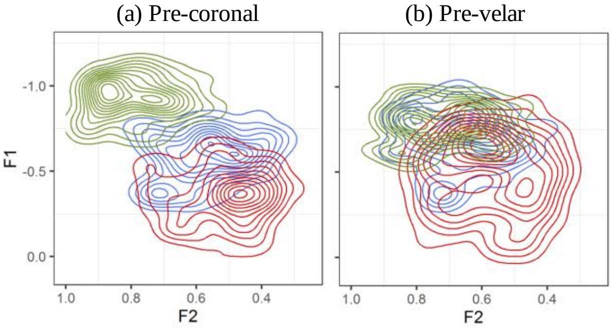
To compare the production and perception data directly, a simple overlap metric was developed. First, midpoint formant values for production data were normalized with all speakers and all vowels together using the Nearey 2 equation in phonR [11]. The resulting F1 scores ranged from −1.15 to 0.09, and F2 ranged from 0.28 to 0.98. These scores were then discretized into a 7x8 grid by rounding F1 to the nearest 0.2 increment (−1.2 to 0.0) and F2 to the nearest 0.1 increment (0.3 to 1). This was similar to the 8x8 stimulus grid used in the categorization task. Tokens of two vowels were considered overlapping if they shared a cell in the production or categorization grid. Amount of overlap between two vowel distributions was calculated as: the sum of tokens of both vowels in all cells with overlap, divided by the sum of all tokens of both vowels. This describes the percentage of the entire two-vowel system that showed overlap.

3. RESULTS

3.1. Production

Figure 1 shows all participants' productions of low-front vowels at midpoint in (a) coronal and (b) velar contexts, and Table 2 shows overlap percentages for each pair of vowels in production and perception, with all participants pooled and each age group separately.

Figure 1: Production distributions. Red = /æ/, blue = /ɛ/, green = /e/.



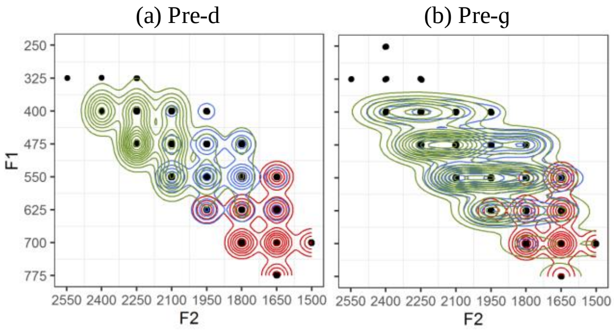
As seen in Figure 1, /ɛg/ (blue) and /eg/ (green) shifted to meet in the middle, increasing /ɛ–e/ overlap from less than half in coronal contexts to near-total prevelar merger (Table 2). The distribution of /æg/ (red) expanded upward from /æ/, resulting in about 50% /æg–eg/ merger. However, with the upward shift of prevelar /ɛg/, /æ–ɛ/ overlap remained similar between conditions.

The expanded range of /æg/ reflects variation in the community; in fact, the group was split into half "BAG-raisers" and half "non-raisers," with the youngest age group plus one middle-aged male and three older females showing little /æg/ raising, resulting in no /æg–eg/ overlap and little plain–prevelar change in /æ–ɛ/ overlap for the younger group. In addition, half the younger group did not merge /ɛg–eg/, resulting in a bimodal distribution and only moderate overlap with all younger speakers combined. Middle-aged and older speakers followed the general pooled pattern, but older speakers began with greater /æ–ɛ/ separation.

3.2. Perception

Figure 2 shows participants' responses to (a) b_d and (b) b_g "half-word" stimuli (black dots). Pre-d responses mirrored production, with some overlap between classes. /æg/ (red) responses did not differ from /æd/ for any age group, but /ɛg/ (blue) and /eg/ (green) distributions were expanded and merged around the location of /ɛd/, overlapping /æg/.

Figure 2: Categorization distributions. Red = /æ/, blue = /ɛ/, green = /e/, black dots = stimuli.



With substantial overlap between all three pre-d classes, especially /ɛd–ed/ (Table 2), percentages of overlap were less informative for all participants combined than for separate age groups. However, the downward expansion of /eg/ substantially increased /e–æ/ overlap.

Table 2: Percentages of vowel overlap for all participants and each age group.

	All participants			Older (60s)			Middle (40s)			Younger (20s)		
	_d	_g	change	_d	_g	change	_d	_g	change	_d	_g	change
Production												
æ–ɛ	73	75	2	67	68	1	73	59	−14	55	43	−12
ɛ–e	44	91	47	12	91	80	31	85	55	19	54	35
æ–e	12	52	40	4	43	39	3	56	53	0	0	0
Perception												
æ–ɛ	82	85	3	73	74	1	59	56	−3	52	65	13
ɛ–e	92	97	4	77	84	7	90	88	−2	67	97	30
æ–e	64	97	33	54	96	43	30	27	−3	15	78	63

Older participants followed the overall pattern, but middle-aged participants showed less overlap in general and did not change their responses between pre-d and pre-g conditions. Younger participants began with much less overlap among pre-d responses, and the expanded and merged /ɛg–eg/ were fairly evenly distributed throughout the space, resulting in greater increases in overlap.

3.3. Production vs. Perception

With all participants combined, there was more prevelar merger in perception than production (Table 2). However, due to the high amounts of overlap for non-prevelar vowels in perception, it was important to consider differences between prevelar and non-prevelar overlap, which indicated a clear difference in vowel systems in production. /æ–ɛ/ overlap did not change much in either production or perception, but in production, the shifts in /ɛ/ and /e/ increased their overlap from less than half non-prevelar to near-total prevelar merger, and the upward shift of /æ/ increased its overlap with /e/ from very little non-prevelar to about half prevelar. In contrast, the downward shift of /e/ in perception increased its prevelar overlap with the static /æ/.

Older participants followed the overall pattern. Middle-aged participants showed similar amounts of prevelar /æg–ɛg/ and /ɛg–eg/ overlap in production and perception, but they accepted much less /æg–eg/ merger in perception than they produced. Younger participants accepted much more merger in perception than they produced, particularly due to the expanded /eg/ covering the entire perceptual space, including /ɛg/ and most of /æg/.

4. DISCUSSION

The variation in prevelar raising/merger within the Northwestern speech community has interesting implications for change in apparent time. As in past work [1, 3, 12], younger speakers raised /æg/ very little, suggesting either merger reversal or avoidance due to stigma [1, 4, 7, 17]. In addition, half the younger group did not merge /ɛg–eg/. This is in contrast to prior work in Washington [3, 15, 22], which has found robust BEG–VAGUE merger, but in line with work in Oregon and British Columbia [1, 12, 17], which has found less BEG- and BAG-raising in younger speakers. However, all younger speakers in this study were from Washington (mostly the Seattle area), including one merged speaker from Vancouver, Washington, a suburb just across the state border from Portland, the largest city in Oregon. On the other hand, younger participants accepted high amounts of overlap in perception. This suggests that they were used to hearing merger in the community, but they avoided producing the pattern themselves, particularly BAG-raising [4, 7].

Similar to past work [3, 15, 22], all middle-aged and older speakers merged /ɛg–eg/, and most raised /æg/, but in perception, the only substantial shift was a downward expansion of /eg/ for the older group. In production, /eg/ typically does shift downward, but it does not even reach as low as /ɛd/ [3, 15]. This tentatively suggests that the older group was used to hearing three-way merger, but they might have been unaware of the phonetic value of the merged sounds.

It is most surprising that middle-aged participants did not differ in how they categorized any vowels between conditions, given that most of them raised /æg/ substantially in production, and in past work, middle-aged speakers produced more raising and merger than both older and younger generations [1, 3, 12, 19, 21].

4.1. Limitations and Future Work

Information on prevelar perception is lacking, both in terms of phonological categorization and attitudes. The present study only examined midpoint formant values, but prior work has reported /ɛg/ as shorter in duration than other prevelars [3] and all three prevelars as upgliding diphthongs [3, 15, 19], which may allow listeners to distinguish them from non-prevelars and possibly each other.

Given the variation within groups and possible reversal or avoidance of raising/merger found among younger participants, more work is needed on the social meanings of these prevelar shifts. Some work has found less BAG-raising in more formal contexts [7, 22], and some has suggested that prevelar raising/merger is not socially salient or stigmatized [1], but a more direct examination of attitudes [17] has found greater nuance, with more BAG-raising among speakers with traditional, local orientations to their hometowns. These and other social factors should be explored further.

4.2. Conclusion

In sum, prevelar merger may be more advanced in perception than production. BEG–VAGUE merger was complete in both production and perception for all but half the younger participants, who did not merge them in production. Most older and middle-aged participants raised BAG in production, but younger speakers did not, and no group accepted raised BAG in perception. This suggests that BEG–VAGUE merger is well established but possibly socially marked for some young people, while BAG-raising is more clearly marked throughout the community, particularly for young people, who may be used to hearing it but avoid producing it.

5. REFERENCES

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