

CHAIN SHIFTING AND CENTRALIZATION IN CALIFORNIA VOWELS: AN ACOUSTIC ANALYSIS

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ABSTRACT: This article documents the acoustic properties of the vowels of young adults from various regions of California, with special attention to a chain shift that lowers short front vowels /ɪ/ (as in *kit*), /ɛ/ (as in *dress*), and /æ/ (as in *trap*). It also tracks the centralization of /ow/ (as in *goat*). Quantitative analysis of subjects' formants shows a consistently lower set of front vowels and a consistently centralized /ow/ relative to baseline comparisons drawn from Labov, Ash, and Boberg's 2006 *Atlas of North American English*, suggesting a recent diachronic emergence of both phenomena. A small gender effect is observed, suggesting women are further advanced than men in the chain shift. These findings suggest that the chain shift is not clearly a pull-chain brought about by the low-back merger of /ɔ/ (as in *lot*) and /ɑ/ (as in *thought*) and may have occurred independently as a push-train.

IN THIS ARTICLE, we document and analyze the phonetic and phonological properties of two characteristics of the California vowel space: the centralization of the nucleus of the vowel /ow/, referred to here as the GOAT vowel, and a chain shift affecting the short front vowels, referred to here as the KIT, DRESS, and TRAP vowels. Using *The Atlas of North American English* (Labov, Ash, and Boberg 2006) as a baseline comparison, we argue that our subjects illustrate a recent diachronic emergence of these two accent features in a region not previously associated with them. Quantitative acoustic analysis of interviews and elicitation data from 13 subjects shows a consistently centralized nucleus for GOAT. In addition, the lowering of the short front vowels is clearly established in the speech of our subjects, but some speakers exhibit some of the chain shift while maintaining the LOT vowel in a conservative low-central position. We also find a small gender effect in the vowel of TRAP. Our data, thus, have important implications for theories of the initiation and diffusion of chain shifts.

This article is organized as follows: In section 1, we review previous studies dealing with accent features of California English and discuss some media examples that illustrate an awareness of the variety from a folk linguistic perspective. In section 2, we develop our hypotheses regarding phonetic properties of vowels in California English. Section 3 outlines the methodol-

ogy implemented, and section 4 presents the results of our study. Finally, section 5 highlights the implications of our findings and situates our study in terms of the existing literature.

1. CALIFORNIA ENGLISH

We use the term *California English* to refer to the regional variety of English spoken in (but not necessarily limited to) the state of California. We acknowledge that the English of California is by no means uniform, as its population is large and ethnically diverse. Waves of migration have brought nonnative English speakers from other nations, as well as speakers of regional varieties from many other English-speaking regions of North America. Thus, from its earliest European and English-speaking settlement, it has been dialectally heterogeneous, as lexical isoglosses and settlement patterns (Bright 1971) and earlier accent studies (Decamp 1958–59) demonstrate. Meanwhile, ethnic and social stratification have maintained distinct varieties of African American English in the urban agglomerations of Los Angeles (Legum et al. 1971; Baugh 1979, 1983a, 1983b) and the San Francisco Bay Area (Mitchell-Kernan 1971; Rickford et al. 1991), as well as varieties of Chicano English (Metcalf 1972; Godinez and Maddieson 1985; Veatch 1991; Fought 1999; Mendoza-Denton 2008), a first-language variety often associated with Hispanic Californians, distinct from other varieties of California English and from second-language accented English.

This social and ethnic diversity has proven to be a fruitful locus of sociolinguistic research, touching upon perceptual dialectology (Fought 2002; Bucholtz et al. 2007), ethnic and regional stereotypes (Hinton et al. 1987; Luthin 1987; Lance 1999), gender and age-graded variables (Blyth, Recktenwald, and Wang 1990; Dailey-O’Cain 2000), and language attitudes (MacKaye 1990; Orellana, Ek, and Hernandez 1999; Barker and Giles 2002, 2004). Despite this, many basic phonetic dimensions of California English as a regional variety have received less analytical attention. Indeed, although the fronting of its long back vowels and the chain-shifted lowering of its short front vowels are notable properties of California English, they are not included in standard descriptions of it.

For example, Wells (1982, 118) includes California as a part of General American, a catch-all term for varieties of English spoken outside the American South and Northeast regions. While acknowledging that regional variation within General American no doubt exists, Wells does not note any properties that distinguish California from other varieties of American English.

1.1. THE ATLAS OF NORTH AMERICAN ENGLISH AS A COMPARISON POINT. Labov, Ash, and Boberg (2006) identify the West as home to a developing variety, defined as the region in which “the low back merger predominates” (i.e., LOT and THOUGHT tend to have the same vowel)¹ and in which GOOSE but not GOAT has a centralized nucleus. This definition is based upon a continent-wide sample of data collected between 1993 and 2001. Labov, Ash, and Boberg’s sample includes 91 residents (with a mean age of 47 years at the time of data collection) from the West, a region of the contiguous United States roughly consisting of New Mexico, Colorado, Wyoming, and Montana and everything else westward. The sample includes 22 Californians. Given the combined distance in real and apparent time between Labov, Ash, and Boberg’s sample of California and ours, we conservatively estimate an age gap of about one generation between their subjects and ours (with a mean age of 22 in 2008). We thus rely on Labov, Ash, and Boberg’s portrait of California as an earlier diachronic stage relative to our data.

Labov, Ash, and Boberg do not include the shifting of the short front vowel space or the centralization of GOAT as characteristics of California or any part of the West in general. Nevertheless, they do identify the downward shifting of short front vowels (i.e., KIT, DRESS, and TRAP) in Canadian English, and thus refer to the phenomenon as the Canadian Shift, following Clarke, Elms, and Youssef (1995). The Canadian Shift involves the lowering and retraction of KIT, DRESS, and TRAP due to the merging of the LOT-THOUGHT lexical classes. We note that Labov, Ash, and Boberg do identify 9 speakers within their sample of the West who fit their definition of the Canadian Shift, none of whom were residents of California.

Despite similarity in form between the two chain shifts, we describe the California Shift as an independently occurring phenomenon.

1.2. SOCIOLINGUISTIC APPROACHES TO CALIFORNIA ENGLISH. The centralization of GOAT and GOOSE and the shifting of the front vowel space have been identified by sociolinguists as features of California English. Hinton et al. (1987) use a perceptual methodology to document the shifting front vowel space in the speech of several Bay Area residents, while Luthin (1987) discusses fronting of the mid-back vowel /ow/. Fought (1999) tracks the diffusion of fronted /u/ (i.e., the GOOSE vowel) into the speech of Los Angeles area Chicano English speakers. Nevertheless, these studies portray such vowel features as aspects of youth-based subcultures rather than as general regional properties of California English.

More recently, Hall-Lew (2009) characterizes the fronting of the high and mid back vowels as aspects of both Asian and European Americans for younger and older speakers in the Sunset district in San Francisco. While GOOSE fronting is particularly widespread in North American varieties of

English (Labov, Yaeger, and Steiner 1972), Hall-Lew notes that for her data, GOOSE is “particularly advanced, possibly at the point of completion for many speakers” (201). She also finds that a fronted pronunciation of GOAT is strongly correlated with age in Asian Americans, indicating a change in progress in apparent time. Additionally, she suggests that GOAT may have already stabilized in a central position for European Americans. These findings are especially important for the current research, as they lend weight to the notion that these variables are aspects of general California speech patterns.

Other descriptions of these phenomena exist but either lack quantitative acoustic data or do not portray them as regional properties. For example, Gordon (2006) provides qualitative descriptions of the California Shift but does not cite supporting acoustic data. By contrast, Eckert (2004) provides formant plots of the relationships between /uw, i, æ/; however, she does not employ formant plots to characterize the short front chain shift. Conversely, Ladefoged (2006) and Hagiwara (2005) illustrate the acoustic properties of shifted vowels among Californians without much comment on them as regional phenomena.

We therefore suggest that an updated quantitative phonetic and phonological description of the vowel space of California English is currently lacking. Our study uses the methodology of Labov, Ash, and Boberg (2006) to document the vowel space of California English, with particular attention to the position of the short front vowels and the nuclei of the long mid back vowel. We argue that /ow/ centralizing and the short-front chain shift are basic regional properties of young adult speakers of California English.

These phenomena do appear in some exaggerated parodies of California speech, notably in Moon Zappa’s spoken-word contribution to Frank Zappa’s 1982 song “Valley Girl,” in Sean Penn’s performance of drugged-out “surfer dude” Jeff Spicoli in the film *Fast Times at Ridgemont High* (1982), and in Alicia Silverstone’s role as ditzy “valley girl” Cher Horowitz in the film *Clueless* (1995). Anecdotally, we report that young Californians themselves are aware of these phonetic and phonological properties, but like other Americans, may believe they are only used by “valley girl” and “surfer dude” stereotypes and not by the population more generally.

2. VOWELS

We use the lexical sets established by Wells (1982) to refer to categories of vowels instead of abstract phonemic symbols. Thus, we refer to the long back vowels as GOOSE and GOAT rather than /uw/ and /ow/, and we refer to the short front vowels as KIT, DRESS, and TRAP rather than /ɪ/, /ɛ/, and

/æ/. The use of lexical sets has several advantages over phonemic notation when discussing regionalism. First, each vowel category has a multitude of regionally dependent realizations, but the categorical dimensions of frontness, height, and tenseness are too coarse to capture such fine distinctions in some cases, and simply inaccurate in other cases. Second, the low vowel symbols are especially confusing when discussing regional variation, since [a] may be appropriately used as the phonetic symbol for the TRAP lexical set in some varieties and for the LOT set in others.

By using lexical sets, we avoid statements such as “/ɪ/ is lowered in California English” in favor of “KIT has a lower vowel in California English.” However, we do use phonetic symbols to describe the phonetic manifestation of lexical sets, as this allows us to describe the California Shift as one that maps KIT to [ɛ] and DRESS to [æ].

We assume that a speaker of American English who does not exhibit chain shift behavior in the short front vowels will have [ɪ] as the phonetic realization of KIT and [ɛ] as the phonetic realization of DRESS (see table 1). In contrast, a speaker who does exhibit chain shift behavior will have [ɛ] as the phonetic realization of KIT, [æ] as the realization of DRESS, and either lowered [æ̃] or retracted [a] as the vowel of TRAP.

The hypothesized distribution of the short front lexical sets and the long back lexical sets within the context of other vowels is shown in table 2, for both nonshifted and shifted vowel inventories. In particular, this illustrates that the short front lexical sets KIT, DRESS, and TRAP are each lower in California English vowel space than their corresponding positions in the non-Californian vowel space. Likewise, the lexical sets GOAT and GOOSE exhibit diphthongs with centralized nuclei in California. Note that table 2 is not meant to imply that the lowering of front vowels and the centralization of GOAT are connected events.

Our study tests the position of KIT, DRESS, and TRAP in several quantitative ways. First, in relative terms, we test whether the vowels of these lexical sets in California English occupy lower regions of the vowel space, in comparison to the conceptually tense front vowels of the FLEECE and FACE sets. This relativized approach is similar to the analysis of /u/-fronting (i.e., GOOSE-fronting) by Fought (1999), who derives a measure of centralization by comparing the

TABLE 1
Phonetic Realizations of Vowels for Speakers with and without the California Shift

<i>Lexical Set</i>	<i>No Chain Shift</i>	<i>Chain Shift</i>
KIT	[ɪ]	[ɛ]
DRESS	[ɛ]	[æ]
TRAP	[æ]	[æ̃] or [a]

TABLE 2
Hypothesized Distribution of Lexical Sets in Backness × Height Dimensions
for Speakers with and without the California Shift and GOAT-Fronting:

		<i>Nonshifted Speaker</i>		<i>Shifted Speaker</i>	
		<i>Front</i>	<i>Back</i>	<i>Front</i>	<i>Back</i>
<i>High</i>	FLEECE	GOOSE		FLEECE	GOOSE
	KIT	FOOT			FOOT ^a
<i>Mid</i>	FACE	GOAT		FACE	GOAT
	DRESS	THOUGHT		KIT	
<i>Low</i>	TRAP	LOT		DRESS	LOT-THOUGHT
					TRAP

- a. We have observed anecdotally (and see also Eckert 2004 and Hall-Lew 2009) that the FOOT lexical class may also have a more centralized position in the backness dimension in innovated California English, but as we have not tracked it here, we leave it in a back position.

front-back dimensions of each subject's GOOSE and GOAT vowels. Second, we test whether the vowels of DRESS and TRAP satisfy the general criteria by which Labov, Ash, and Boberg (2006) define the Canadian Shift, which affects the same vowel categories. More precisely, subjects meet the definition of the Canadian Shift if they have (1) F1 of DRESS greater than 650 Hz, (2) F2 of TRAP less than 1825 Hz, and (3) F2 of LOT less than 1275 Hz (Labov, Ash, and Boberg 2006, 217–18).²

We apply the same two-pronged approach to the vowel of the GOAT lexical set. Relatively, we test whether its nucleus is advanced to a position anterior to the LOT vowel. While other within-subjects comparisons could be done, each introduces an additional analytical problem. For example, comparison of GOAT with STRUT is problematic given the risk that STRUT itself may be centralized or fronted in the speech of some Californians. Likewise, comparison of preobstruent GOAT with the same vowel before /l/ is problematic given that many young Californians show a smaller contrast space before /l/. Anecdotally, we observe a convergence of the vowels of PULL, HULL, and POLE in certain speakers.

We additionally test whether GOAT meets the criteria established by Labov, Ash, and Boberg (2006) for being considered centralized: in particular, nuclei of vowels in the GOAT lexical class are considered centralized if they have F2 greater than 1278 Hz.

While centralization of GOOSE is also observable in California English, we do not analyze this phenomenon here, as it appears to be a more established feature of the variety. Nevertheless, we do include tokens of GOOSE in our plots as reference points.

3. METHOD

Thirteen subjects were recorded in total (5 males, 8 females), all but one of whom were undergraduates attending the University of California, Santa Barbara, and residents of the Isla Vista neighborhood of Santa Barbara County. All subjects were native Californians from either the Bay Area (San Francisco), the Central Coast (San Jose, Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara) or Southern California (Los Angeles, Orange County, Irvine, San Diego, and Redlands). The subject not living in Isla Vista was a 57-year-old male living in north Los Angeles County.³ All other participants were between the ages of 19 and 29 (mean: 22). Table 3 summarizes the demographics of our subjects.

Subjects were chosen using a snowball sampling method, whereby existing participants were used to help recruit new participants. Whether they were perceived by the researchers as exhibiting any of the phonological phenomena was not a determining factor for their inclusion in the study. Subjects were informed that they were participating in a study about the speech of Californians. All recordings were conducted by the second author.

Data collection was designed to elicit target vowels without the focus of vowel pronunciation being obvious to the subject. Subjects were recorded in four conditions: providing background information about themselves, responding to a questionnaire, reading a passage, and participating in an open-ended interview. Each condition was designed to produce words with the vowels of the lexical sets FLEECE, KIT, FACE, FLEECE, GOOSE, GOAT, TRAP, and LOT.⁴

TABLE 3
Subject List

<i>Subject</i>	<i>Sex</i>	<i>Age</i>	<i>Origin within California</i>
1	F	22	Redlands
2	F	23	San Luis Obispo
3	F	23	Santa Barbara
4	F	22	San Diego
5	F	29	Los Angeles
6	F	21	Los Angeles
7	F	22	Monterey
8	F	21	Los Angeles
9	M	21	Orange County
10	M	25	Irvine
11	M	20	San Jose
12	M	19	San Luis Obispo/San Francisco
13	M	57	Los Angeles

In the first part of the data collection, subjects were given a set of questions aimed at eliciting information about their background (e.g., “Where were you born, and where have you lived since then?”). In the questionnaire section, a survey was used with questions asking the subject to differentiate particular pairs of lexical items and to complete sentences, following methodology similar to that of Labov, Ash, and Boberg (2006). Both kinds of tasks were designed to elicit tokens containing vowels of the lexical sets of interest. The following are examples of the latter two tasks:

Differentiation task: “What’s the difference between a *BED* and a *COT*? ”

Completion task: “What is something you ‘place’ in Las Vegas?” [BET]

During this portion of the study, the desired target words (e.g., the above *bet*) were sometimes not immediately identified by subjects. In this case, the interviewer prompted the subject toward the desired answer with further clues without producing the word itself. This was performed until the desired token was uttered.

In the reading condition, the subject was recorded while reading the Rainbow Passage (Fairbanks 1960). To minimize phonological self-monitoring, subjects wore headphones during this task through which they heard a looped recording of rainfall.

In the interview condition, subjects discussed and responded to a number of predetermined topics under the guidance of the interviewer.

Subjects were recorded in a quiet sound-dampened room using a Microsoft PC directional microphone connected to an HP Pavilion laptop computer. The recordings were then sampled at 44.1 kHz with an input filter of 80 Hz to eliminate noise from mains hum and encoded as .wav files using Audacity 1.3. Test items were extracted from these recordings and imported to Praat 9.1 for acoustic analysis. All spectrographic readings were conducted in Praat.

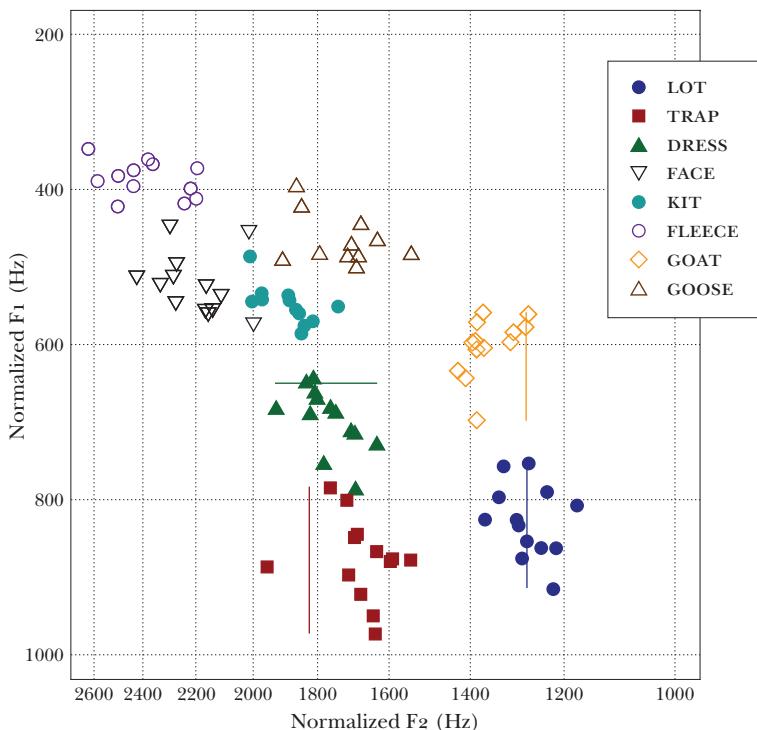
Data in this study were drawn from both the questionnaire and the reading condition. To avoid the potential effects of following liquids or nasals, only vowels in preobstruent or utterance-final positions were measured. Each token was measured for its F₁ and F₂, and all measurements were obtained at the first quartile of the duration of the vowel; we excluded preceding and following formant transition slopes from the duration of the vowel. A total of seven tokens per item per subject were measured, and measurements for F₁ and F₂ for each item were averaged within subjects. Approximately half of the total data points came from the questionnaire, while the other half were extracted from the reading condition. These data were subsequently normalized across subjects using log-mean normalization (Nearey 1978; Labov, Ash, and Boberg 2006; Boberg 2008), which allowed meaningful comparison of formant values across subjects.

4. RESULTS

Figure 1 illustrates vowels from all subjects plotted for F1 against F2. We follow Ladefoged (1975, 2006) in using a logarithmic scale for the F2 dimension along the x-axis and place the origin at the upper right of the formant plot, so that the plot more closely resembles articulatory dimensions of height and backness. Each data point represents one subject's average formant values for all tokens of a given lexical set. Data points farther to the left indicate more forward tongue positions, while those to the right indicate more retracted positions.

We also have included indications of each relevant benchmark from Labov, Ash, and Boberg (2006) for comparison: a vertical line at 1278 Hz for detecting GOAT centralization; a vertical line at 1275 Hz to indicate retraction of LOT; a vertical line at 1825 Hz to indicate retraction of TRAP, and a horizontal line at 650 Hz to indicate lowering of DRESS.

FIGURE 1
Formant Plots: All Subjects



Initial inspection of figure 1 indicates highly advanced nuclei for GOOSE, centralized nuclei for GOAT, and lowered vowels for the short front lexical sets of KIT, DRESS, and TRAP. We provide a quantitative analysis below.

4.1. RELATIVE POSITIONS OF VOWELS. We performed an analysis of variance on the normalized vowel formants across subjects. Overall, our data show a main effect of vowel category on formant values. Two-way ANOVAs showed that both F_1 ($F_{\text{VOWEL}}(7,519) = 355.9, p < .0001$) and F_2 ($F_{\text{VOWEL}}(7,519) = 311.58, p < .0001$) differ significantly across vowels. These results are not surprising, as we expect different vowel categories to have significantly different formant values. Nevertheless, this result confirms that the formant data are distributed in a principled way.

The real utility of the ANOVA is that it enables post-hoc testing along both formant dimensions. Tukey post-hoc tests were used to compare formant values between each pair of vowels, which allows us to test our hypotheses about the relative positions of vowels within Californian vowel space.

Nearly every pair of vowels is distinct by both dimensions, except the following three pairs: KIT and FACE are not different by F_1 (i.e., height), while GOOSE-TRAP and GOOSE-DRESS are not distinct by F_2 (i.e., backness). While many of the other significant differences are not surprising (e.g., the F_1 of FACE is higher than that of FLEECE), some provide crucial support for our hypotheses, as they allow us to discern the relative height and backness of any two vowels.

While the fact that KIT has an F_1 so close to that of FACE might suggest a lowered tongue height, we would not necessarily expect KIT to have a significantly lower F_1 (and concordantly more closed tongue position) in a nonshifted vowel space. These vowels still occupy distinct regions of the vowel space, since KIT also has a significantly lower F_2 , indicating retraction relative to FACE. Likewise, F_1 of DRESS is higher than F_1 of KIT, and F_1 of TRAP is higher than F_1 of DRESS, but this would also be true of unshifted vowel systems. Of more interest is the result that DRESS has a significantly higher F_1 and is thus more open relative to GOAT, despite both being considered phonologically “mid” vowels. Meanwhile, the nucleus of GOAT has a higher F_2 and is thus significantly more advanced than that of LOT, but not nearly as advanced as the nucleus of GOOSE.

4.2. COMPARISONS WITH BENCHMARKS. A comparison of our results with general benchmarks established in Labov, Ash, and Boberg (2006, 217–18) also supports our hypotheses. First, because the California Shift, like the Canadian Shift, involves DRESS, TRAP, and LOT, we measured subjects against Labov, Ash, and Boberg’s quantitative definition of the Canadian Shift: (1) F_1 of

DRESS greater than 650 Hz, (2) F₂ of TRAP less than 1825 Hz, and (3) F₂ of LOT less than 1275 Hz. All subjects meet the first two criteria except for the 57-year-old, but the F₂ values of LOT for our subjects cluster around the threshold of 1275 Hz. We believe the position of LOT is quite relevant, as it suggests that the California Shift is a different phenomenon from the Canadian Shift.

Second, most subjects also meet Labov, Ash, and Boberg's criterion for centralized nuclei in the GOAT lexical class (F₂ greater than 1278 Hz). This adds to our conclusion from the relative analysis in 4.1 that GOAT can be considered to have a central nucleus in California English among younger speakers.

4.3. A NOTE ON GENDER. There is a small gender difference in a subset of the data: significantly lower tongue position in the vowel of TRAP for women. Testing overall for main effects of gender and vowel category, there is a marginal effect of gender when all vowel categories are included in the analysis ($F_{\text{VOWEL}}(7,511) = 312.19, p < .001$; $F_{\text{GENDER}}(1,511) = 3.42, p = .065$). Pairwise post-hoc tests of this analysis reveal that men and women differ by F₁ in TRAP (F₁ for women = 903.59 Hz, F₁ for men = 841.26 Hz, diff = 62.33 Hz, $p = .0028$), but not in any other lexical set.

The main effect for gender on F₁ reaches significance when the data are truncated to a subset comprising only the conceptually front vowels of FLEECE, KIT, FACE, DRESS, and TRAP ($F_{\text{VOWEL}}(4,346) = 542.36, p < .001$, $F_{\text{GENDER}}(1,346) = 7.15, p = .0078$). Even in this subset of data, however, post-hoc tests again show only TRAP to differ significantly by F₁.

Men and women did not show any difference in F₂ within any of the vowel categories.

5. DISCUSSION

This study establishes quantitatively that the vowel space of California English is marked by a chain shift affecting the short front vowels KIT, DRESS, and TRAP, as well as a centralization of the vowels of both the GOOSE and GOAT lexical sets. We have used acoustic measurements to illustrate these phenomena, employing analyses of both relative and absolute positions of vowels within the dimensions of tongue height and backness. Our quantitative results thus support our hypotheses regarding the properties of both the short-front chain shift and the centralization of back vowels.

In our relative analysis, the traditionally and conceptually high vowel of KIT is phonetically realized as mid, while the traditionally mid vowel of DRESS

is realized phonetically as low. Likewise, the traditionally and conceptually back vowel of GOAT has a nucleus relatively central when compared with LOT. In our comparison with benchmarks, the short front vowels of California meet most of the criteria of the Canadian Shift, while GOAT meets the criteria of centralization laid out in Labov, Ash, and Boberg (2006).

While our use of normalized data directly allows a comparison against Labov, Ash, and Boberg's benchmarks, it also strengthens the relative analysis we employ. We emulated Fought (1999) in comparing the position of one vowel against another, but expanded on it by comparing items across subjects. By using normalized data, there is no need for a derived within-subject measurement of relative frontness.

5.1. DIACHRONY OF THE PHENOMENA. As we mention in section 1.1, Labov, Ash, and Boberg (2006) define the West as the region in which LOT and THOUGHT tend to have the same vowel and in which GOOSE but not GOAT has a centralized nucleus. This definition is based upon data collected between 1993 and 2001 from a sample of 91 speakers, 22 of whom are from California. Given the combined distance in real and apparent time between Labov, Ash, and Boberg's sample of California and ours, we conservatively estimate an age gap of about one generation between their subjects and ours.

This distance in time accounts for at least some of the discrepancy between Labov, Ash, and Boberg's picture of California and ours. In their data, GOAT centralization is inconsistently scattered across California, with only a few data points showing the degree of centralization exhibited by our subjects, while the Canadian Shift is not observed for any Californians. In contrast, we find a more established centralization of GOAT and a shift of the short front vowel space that parallels the Canadian Shift.

Consequently, these differences may reflect a diachronic shift, where the data collected by Labov, Ash, and Boberg are indicative of California in a state before GOAT centralization and the short-front vowel shift took hold. This explanation is further acceptable as Hinton et al. (1987) report a sharp distinction between the fronted GOAT exhibited by Californians under 30 in comparison with older speakers.

5.2. INDEPENDENCE OF THE PHENOMENA. The two phenomena studied here are apparently independent of each other, as each has analogues in other varieties of North American English. The fronting of the GOAT vowel resembles a trait of the Southern and mid-Atlantic regions of the United States. Meanwhile, the chain shift among short front vowels resembles a similar phenomenon in the English of nonmaritime Canada. Indeed, linguists have attributed the chain shifts in both varieties to the low-back merger of the LOT and THOUGHT

lexical sets. Eckert (2004), Hagiwara (2005), and Gordon (2006) attribute the California Shift to the retraction of the merged LOT-THOUGHT vowel to [ɑ].⁵ The reasoning is that the LOT-THOUGHT merger induced a retraction of LOT, allowing TRAP to retract to a central position, in turn making room for DRESS and KIT both to be lowered.

While this scenario makes sense for Canadian English, in which the merged LOT-THOUGHT vowel is quite retracted, the same explanation is not as obvious for California English. In particular, the F2 values of LOT show that, instead of demonstrating a clear retraction, many of our subjects maintain a fairly central position for this vowel, while TRAP is both clearly lowered and retracted.⁶ This relationship suggests that the lowering of the short front vowels in California English is not necessarily a result of the retraction of LOT, as not all speakers seem to have undergone it. In other words, even if the LOT-THOUGHT merger is firmly established, it has converged in the low-central region of the Californian vowel space and has not created room for TRAP to retract. Instead, TRAP has lowered and retracted, occupying a space much closer to a more centralized LOT vowel.

5.3. INITIATING CHAIN SHIFTS. The relative proximity of TRAP and LOT in the given data set then reopens the question of the impetus for the short-front chain shift. Given that approximately half the speakers interviewed did meet the requirements for a retracted LOT vowel, it is safe to say that at least some speakers of California English exhibit a shift similar to that of the Canadian Shift. However, the remaining subjects are somewhat of a mystery.

One potential explanation for the occurrence of the chain shift with a proximity of TRAP and LOT is that the chain shift itself is not a pull chain in progress initiated by the merging of LOT and THOUGHT, but a push chain precipitated by the lowering of KIT. Due to the lowering of KIT in the vowel space, DRESS and subsequently TRAP are also incited to lower and retract. The final part of the chain is then the retraction of LOT, which, given the current data set, does not seem to be fully instantiated in all of our speakers. Thus, the current data may reflect a push chain that has not been fully realized in all of our subjects' speech. The fact that men and women have similar F1 values for KIT and DRESS, but women have a higher F1 (and thus more open vowels) for TRAP is consistent with this scenario and matches the claim that women lead linguistic change (Trudgill 1972; Milroy and Milroy 1985; Labov 1990; Coates 1993). In other words, the chain shift has taken root in KIT and DRESS for all speakers, but women have surged ahead in their lowering of TRAP.

Alternatively, it is possible that the chain shift was not initiated by the lowering of KIT or the merging of LOT and THOUGHT, but rather that one

of the inner links of the chain motivated the chain shift. For example, it is possible that TRAP was the first to lower and retract, which then motivated the lowering and retraction of the remaining short front vowels. If TRAP had been the first to shift, LOT might not have been involved in the chain shift at all, potentially explaining why LOT appears in a low-central position. Nevertheless, the gender difference in TRAP does not support this scenario.

Another explanation for the difference between the California Shift and the Canadian Shift is that they may simply manifest in different ways, with LOT in Canadian English being more retracted than it is in California English—and likewise, even the smaller degree of retraction of LOT in California is enough to precipitate the rest of the short-front lowering chain shift. There are analogous scenarios in other chain shifts, where a common set of vowels moves in a parallel direction in two different varieties, but with different incidental results. For example, Australian and New Zealand English both have undergone raising of TRAP, DRESS, and KIT (with retraction of KIT in New Zealand), but while Australian DRESS is realized with a tense [e] (Wells 1982, 598), New Zealand sees it realized as [i] (607).

A third more speculative explanation is that the LOT-THOUGHT merger in California English did converge in the low-back region of the vowel space, precipitating the short-front shift as a pull-chain, but that some speakers have acquired a hybrid system in which the effects of the merger (the short-front shift) are present but LOT-THOUGHT is still central.

Finally, it may be that the short-front shift in California is unrelated to the low-back merger. The gender difference in TRAP is consistent with this: it suggests that the chain shift affecting KIT, DRESS, and TRAP began with KIT, and the lowering of TRAP is the most recent step in this sequence. Given that the low-back merger is already established in our subjects, the loss of contrast between LOT and THOUGHT might not be responsible for the movement of TRAP if the latter is instead attributable to a push chain from vowels higher in articulatory space. Consider also that Hall-Lew (2009) demonstrates that the LOT-THOUGHT merger is not fully instantiated even in her contemporary California data: this would cast further doubt on attributing the California short-front shift to the low-back merger.

6. CONCLUSION

This study has provided quantitative evidence for the existence of a centralized GOAT vowel as well as a set of lowered and retracted short front vowels (i.e., KIT, DRESS and TRAP) in young adult speakers of California English. Furthermore, we have provided evidence for a difference between the

California short-front shift and the Canadian short-front shift, primarily by highlighting the difference in the F₂ of LOT.

Further research on the phonetic properties of California English is certainly warranted. We may ask whether particular regions within the state are more or less disposed toward engaging in either phenomenon discussed here and to what extent other factors, such as the age of the speaker, the formality of the setting, and other indexical features of the speaker's identity, play a role in the manifestation of the chain shift. The data presented in this study fit a small but significant piece into the puzzle of defining a "California style" in a larger context.

NOTES

This article has benefited greatly from feedback and discussion from many colleagues and audiences. The authors express their thanks to Mary Bucholtz, Katie Drager, Lauren Hall-Lew, Bill Labov, two anonymous reviewers for *American Speech*, and audiences at the 2009 LSA annual meeting in San Francisco, the University of Pennsylvania, and Vox California at the University of California, Santa Barbara. All errors remain our own.

1. Labov, Ash, and Boberg (2006) do find some relics of the low-back contrast in parts of Northern California (cf. Hall-Lew 2009), but the low-back merger is a general tendency of the West in their data.
2. These criteria are derived from natural breaks in the data collected for *The Atlas of North American English* (Labov, Ash, and Boberg 2006). Furthermore, while the California Shift also affects KIT, there is no benchmark for this vowel in Labov, Ash, and Boberg to sort it into lowered and nonlowered groups.
3. Despite the obvious greater age of the 57-year-old subject relative to the other subjects, he was not intended to represent a different age group for measuring differences across apparent time, nor did we intend to use him as an example of a baseline or unshifted variety of California English.
4. Because our subjects all appeared to have a merger of the THOUGHT and LOT lexical sets, we grouped items from both classes under LOT. Even so, the only items from THOUGHT were tokens of the word *caused*, which varied across speakers in its F₂ relative to words of the LOT class. Some speakers had a more retracted vowel in *caused* relative to words of the LOT class, while others had a more advanced vowel.
5. We transcribe this as [a] for California English as the merged vowel is not rounded, unlike the merged [ɒ] of Canada and Eastern New England.
6. Only the 57-year-old speaker demonstrates a nonretracted TRAP; we note also that the same speaker has lowered vowels in KIT and DRESS.

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