SECOND DIALECT ACQUISITION "IN REAL TIME": TWO LONGITUDINAL CASE STUDIES FROM YOUTUBE

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ABSTRACT: Longitudinal tracking of second dialect acquisition normally requires carefully planned data collection and years of patience. However, the rise of self-recorded public speech data on internet archives such as YouTube affords researchers with a novel way of tracking language change over time. This article presents two case studies of YouTube vloggers who have recorded their voices over the course of a decade (or longer) and have also relocated from different dialect regions of the United States to the West Coast. It reveals that, in addition to typical age-graded change such as a decrease in fundamental frequency over time, some vocalic aspects of their original dialects (Hawai'i English and Inland North English) shifted to become more in line with Western American English, while others did not. The disparity between the vowels that changed and those that did not for each speaker are discussed through the lenses of social salience, gender and race, and the audience design of YouTube vlogs.

KEYWORDS: California English, Hawai'i English, Western Vowel Shift, Northern Cities Shift, lifespan change

THIS ARTICLE REPORTS on changes in the vowel quality of two young adult speakers of American English from different dialect regions in the United States. The speakers are unique for having created public records of their voices through the medium of YouTube, spanning over a decade of speech change, and also for having moved from vastly different dialect regions to the Western continental United States, where the Western Vowel Shift can be found. One of the speakers is an Asian American, and the other is a White American. The two speakers are analyzed as case studies and are not necessarily representative of their speech communities. Nevertheless, a detailed longitudinal comparison of the ways in which their vowels may or may not have changed over time provides novel insight into the timecourse of second dialect acquisition (SDA).

The article is organized as follows: first I discuss SDA and the theorization of different linguistic and social factors that may contribute to acquisition of a second dialect in adulthood. Next I provide an overview of dialect and ethnolect research in the United States context, specifically focusing on vowel

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quality and various vowel shifts. After that I present the current study's methodology, including the use of YouTube as a source of longitudinal acoustic data and a description of the two case study subjects. This is followed by a detailed description of the results of data analysis and statistical models. The article concludes with a general discussion that highlights how gendered expectations of speech and differences in sociophonetic variables' social salience may affect individual adaptation to features of a second dialect.

SECOND DIALECT ACQUISITION

New findings in the field of SECOND DIALECT ACQUISITION (SDA), also known as dialect shift, are of interest to linguistic theory due to what the acquisition of a different variety in a speaker's lifetime communicates about the plasticity of a speaker's internal grammar. Although the boundary or relationship between "language" and "dialect" is culturally specific and can be politically motivated, what is generally understood to be SDA may differ in some ways from SECOND LANGUAGE ACQUISITION (SLA) in fundamental ways (Siegel 2010). For instance, learners of a second dialect do not have to acquire many new lexical items; with a shared lexicon between the first and second dialect, the phonological mappings between the two dialects may facilitate shift toward the new variety.

For the purposes of this study, the varieties spoken—California/Western American English, Inland North American English, and Hawai'i English—are considered regional dialects of American English, acquired by native speakers residing in specific geographic areas of the country, distinguished primarily by differences on the levels of phonetics and phonology, and mutually intelligible with one another. There are, of course, intersections of regional dialect with other social dialects such as ethnolects. The fact that a dialect is a socially constructed concept means that any linguistic variable or combination of linguistic variables that indexes a dialectal identity likely also indexes a host of other social demographic traits (including gender, race, and ethnicity), due to the expansive and interconnected nature of the indexical field (Fought 2006; Eckert 2008a).

In fact, SDA has long been characterized as a change in stylistic variation over time (Prince 1987). Here, STYLISTIC VARIATION is theorized as being a function of social factors, such as the desire or pressure for a speaker to be identified by listeners as a member of a certain group, as well as cognitive factors, such as a speaker's own attention to the particular variants they use. In addition, Bell (1984)'s AUDIENCE DESIGN model for stylistic variation in speech within the individual is relevant: a speaker may change their linguistic

output in response to changes in the identity of their audience or interlocutor. Over time, such changes may accrete until they become perceptually distinct from the speaker's original variety.

Dialect shift is not always a necessary outcome of inherent variation within a speaker. Some inconsistency in the SDA literature can be partially explained by the effects of age of acquisition and the language or dialect dyads in question (see Siegel 2010 for a review). Generally speaking, both children and adults can acquire features of a second dialect in naturalistic contexts, with children generally more able to acquire complex features and to do so with ease (Johnson and Nycz 2015; Nycz 2015). However, even child SDA occurs in varying degrees, as shown, for example, in Kohn (2013): age-graded variation may not affect all speakers in a community equally, and adolescence is a period of particularly idiosyncratic language shift regardless of the dialect or dialects being acquired.

Once an individual has reached adulthood, however, there are three factors that can lead to changes in their speech: aging, community-level sound change, and language contact.

The first factor is aging and its biological consequences on the vocal tract. As an individual ages in adulthood, fundamental frequency decreases (Russell, Penny, and Pemberton 1995; Reubold, Harrington, and Kleber 2010; Reubold and Harrington 2017) and the vowel space shifts to the periphery (Gahl and Baayen 2019; Sankoff 2004); this pattern occurs throughout adulthood but may change in old age. Although the onset of puberty is a period of rapid fundamental frequency decreasing due to growth in the larynx, adult voices may continue to "deepen" long after puberty-related maturation is complete. It is important to disassociate phonetic changes from the effects of age on fundamental frequency and vowel formant values, in particular F1 (Reubold and Harrington 2015).

The second factor is community-level sound change: people change when their community changes. Some evidence for this comes from a longitudinal case study of the voice of Queen Elizabeth II, who underwent a vowel shift called "happy-tensing" over a period of 50 years, alongside the rest of the Received Pronunciation–speaking population of England (Harrington 2006). Another study found that a "sizable minority" of Montreal French speakers substantially changed their pronunciation of the Canadian French rhotic consonant after the variable took on social significance (Sankoff and Blondeau 2007). In this case, the shift toward the newer, more dorsal variant occurred in late-adopting adult speakers as a result of an increase in its acceptability in Montreal. In other cases, a speaker's use of the sociolinguistically marked variant may trend in one direction for some years, and then in

another (Bowie 2015), which shows how the impact of sociocultural context on language change is not always straightforward.

The third and final factor that might influence phonological change in adulthood is language or dialect contact, which may lead to phonetic drift (Chang 2019). The Prince (1987) study was of a Yiddish folk singer in New York who, after immersion in a new linguistic environment, lost some aspects of her original Yiddish dialect but retained others. There have been many other longitudinal studies that document change in phonetic production (if not phonological organization) over time after immersion in a different language environment (Sancier and Fowler 1997; Chang 2012, 2013; de Leeuw 2019) or dialect environment (Munro, Derwing, and Flege 1999; Foreman 2003; Evans 2004; Nycz 2013; Shapp, LaFave, and Singler 2014). In the case of dialect shift, many of these studies focus on the influence of the speakers' social networks and social attitudes on what aspects of their phonology undergo change.

Indeed, SDA research is interested not just in the mechanism by which a speaker acquires the phonetic and phonological features of a second dialect but also in how the use (or nonuse) of certain features reflects personal and local attitudes toward one or both dialects. Recent advances in sociophonetics have established that social identity shapes language perception and use but also that language use is employed strategically by speakers to relationally construct and maintain identity (Bucholtz and Hall 2005). In the examination of a case of dialect shift, it is not just what changes but what does not change that is of interest as well as what each aspect of dialect shift may reflect about the speaker's identity and any personae they may inhabit as they speak.

The current study examines the impact of age and relocation on SDA using two case studies of speakers who self-recorded speech data over the course of a decade. The first speaker is a young Asian American speaker of Hawai'i English whose speech is marked as being both Asian American and Hawaiian. The study uses acoustic analysis to track change in this speaker's voice as he relocates from Hawai'i to Nevada, in the Western region of the United States. A comparison is made with a young White woman who has relocated from the Inland North to the West, specifically Los Angeles, California. The comparative analysis is important due to the speakers' specific differences (race, gender, and personality) and similarities (being young influential vloggers moving to the Western United States). The next section discusses the three dialect regions in question and past work on regional accents and ethnolects in the United States context.

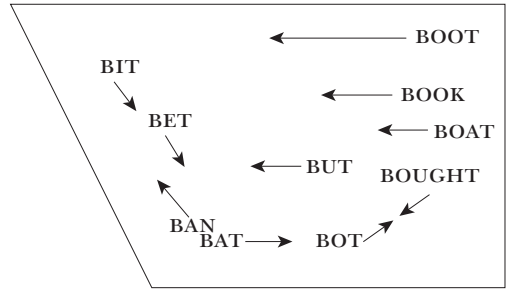
DIALECT AND ETHNOLECT RESEARCH IN THE UNITED STATES

Languages are always in a state of change, and recent research in American dialects has documented some ongoing changes that are occurring in the Western half of the United States. The most prominent example is the set of vowel shifts that are collectively called the California Vowel Shift (Kennedy and Grama 2012) or the Western Shift. Some of the vowels implicated in this shift include back vowel (BOOT and BOAT) fronting, short front vowel (BIT, BET, and BAT) backing and lowering in certain phonological contexts, and the BOT-BOUGHT merger (figure 1).

The California Vowel Shift has been described variously as a chain shift (Kennedy and Grama 2012) or as the result of holistic vowel space compression (D'Onofrio, Pratt, and Van Hofwegen 2019). It has been linked to specific personae or social stereotypes that are also associated with California, such as the Valley Girl and Surfer Dude types (Fought 2002a; Eckert 2008b), and with urban, progressive, and gay identities (Podesva 2011; Podesva et al. 2015). However, elements of the shift have been found outside of California, including up the West Coast in Oregon and Washington (Fridland et al. 2016) and inland in Nevada (Fridland and Kendall 2017) and the Rocky Mountain states, as well as in Canada, where it is called the Canadian Shift (Clarke, Elms, and Youssef 1995), or simply the "Elsewhere Shift" (Stanley 2020), as a nod to its broad geographic reach. There is thus evidence that "The West," despite its size, may be one broad dialect region (Labov, Ash, and Boberg 2006), although the socioindexical association of its acoustic characteristics with specifically Californian stereotypes remains strong.

Other names for these ongoing sound changes invoke the specific shifts that are being documented, as an abstraction away from the dialect

FIGURE 1
California Vowel Shift



regions they may or may not be found in, including the Low-Back-Merger Shift (Thomas 2019; Becker 2019) or the Short Front Vowel Shift (Boberg 2019). In this article, it will be referred to as the Western Shift, since the two subjects relocated from different dialect regions to California and Nevada, which are both Western states, and because multiple aspects of the shift are examined, including back vowel fronting, short front vowel backing, and the low back merger.

The Western Shift can be contrasted with the Inland North dialect, characterized mostly by the Northern Cities Shift (Labov, Ash, and Boberg 2006). This chain shift includes BAT raising (rather than lowering), BOT fronting (rather than backing), and BOUGHT lowering (where Western shifted vowels have a merger of BOT and BOUGHT). Similar to the Western Shift, BIT and BET are lowered and backed (Eckert 1988). Participation in this shift is influenced by speakers' class, race, and gender, in addition to where in the inland north (e.g., Madison, Chicago, Detroit, Clevelend, Rochester, etc.) the speaker grew up.

Finally, the third dialect considered in this study is Hawai'i English. Two early reports in the 1970s provided overviews of the several varieties of English spoken in Hawai'i (by people of any race or ethnicity), taking care to differentiate Hawai'i English from Hawaiian (the indigenous Austronesian language), Hawaiian Pidgin, and Hawaiian Creole English (Tsuzaki 1971a, 1971b). In terms of phonetics, Carr (1972) uses a few case studies of Hawai'i English speakers to posit an unstable lax/tense distinction for BIT versus BEET and BOOK versus BOOT.

The most in-depth look at the phonetics of Hawai'i English can be found in Drager et al. (2013) and Kirtley et al. (2016). Unlike Hawaiian Pidgin, which has no phonetic distinction between BEET and BIT nor between BET and BAT, Hawai'i English keeps all four vowels distinct. Backing and lowering of BIT, BET, and BAT is present, similar to the Western Shift. In addition, younger speakers have a more retracted BAT, but do not have what Labov, Ash, and Boberg (2006) call the nasal system: a raising-versus-backing split that differentiates BAT from BAN, which is found in Western English. Raised (and potentially diphthongized) BAT in younger speakers was also conditioned by whether they identify as speakers of Hawaiian Pidgin, such that Pidgin speakers had a raised English BAT onset that matched the quality of its corresponding vowel in Pidgin. Finally, the BAIT vowel was generally more fronted than BEET, but also lower, and monophthongized. Speakers who are bilingual in English and Hawaiian Pidgin had less monophthongized vowels than those who did not speak Pidgin. As for back vowels, Hawai'i English does have the BOT-BOUGHT (low back) merger and backed BOOT and BOAT,

which thus differentiates Hawai‘i English from California English and other Western states' vowel systems. The backed and monophthongal BOAT of Hawai‘i English was hypothesized to carry some sociolingustic meaning as an index of local identity.

Variationist research is also now paying closer attention to the breadth of ethnic varieties of American English, also known as ethnolects (Clyne 2000; Eckert 2008b). The most-studied examples in the United States context are African American English, which is spoken by African Americans and also has its own regional variants (Green 2002), and Chicano English, spoken by Mexican Americans (Fought 2002b). Asian American English, in contrast, is poorly understood, with little to no evidence of a pan-ethnic Asian American variety of English (Lo and Reyes 2009, though see Newman and Wu 2011). It is important to note that one of the case studies in this article is an American of Okinawan descent who grew up in a state that has a plurality of Asian, Native Hawaiian, and Pacific Islander residents. His baseline idiolect is assumed to be Hawai‘i English—as Hawai‘i English as described in earlier reports is spoken by residents across racial and ethnic groups—rather than any presumed specifically Asian English variety spoken in Hawai‘i. The dialect he may acquire, Western American English, has been studied mostly using data from White speakers, although a minority of research focuses on the advanced participation of Asian Americans and other ethnic minorities in various parts of the shift (Fought 1999; Hall-Lew 2009; Cheng, Faytak, and Cychosz 2016; Wassink 2016; D'Onofrio and Van Hofwegen 2020; Kim and Wong 2020).

HYPOTHESES. The overall hypothesis is that the speech of the Asian American Hawai‘i English speaker will demonstrate significant amounts of SDA as a result of his relocation to Nevada and that the White Inland North American English speaker will demonstrate similar amounts of SDA as a result of her relocation to Los Angeles. Dialect shift was measured in terms of changes in formant frequencies (tracked to changes in fundamental frequency) of specific target vowels as a function of time.

In light of the discussion of the various parts of the Western Vowel Shift, the specific predictions for the Asian American Hawai‘i English speaker were:

H1: Front vowel (BIT, BAIT, BET, and BAT) backing and lowering both in the past and in the present day, with no significant change over time.

H1.5: As an exception to H1, BAT raising specifically in the prenasal phonological context (i.e., BAN raising), increasing over time.

H2: High back vowel (BOOT and BOAT) fronting, increasing over time.

The specific predictions for the White Inland North American English speaker were:

H1: Front vowel (specifically BAIT and BAT) backing and lowering over time, as a kind of reversal of the Northern Cities Shift. BIT and BET may lower, but the speaker's original dialect may already have backed and lowered variants.
H2: High back vowel (BOOT and BOAT) fronting, increasing over time.
H3: A merger of BOT and BOUGHT over time.

METHODS

YouTube as a linguistic data source. The data collected for this study came from the public YouTube channels of two prominent American vloggers. This is an example of "found" panel data (similar to the *Up* corpus used in Gahl and Baayen 2019 and Sankoff 2004), which is roughly equivalent to longitudinally collected data, although its use is ideal for crossdisciplinary analysis (Wagner 2021). (See also Beaman and Buchstaller 2021 for more recent research using panel data.)

Since it was founded in 2004, the video-sharing platform YouTube has become a seemingly limitless repository of acoustic and visual records of its billions of users. Some of the most famous and established YouTube video bloggers, or "vloggers," have recorded video diaries for over 10 years. They use YouTube not just as a place to share about their lives in a public manner but also as an entertainment platform and virtual performance space. The establishment of the vlog as a widespread entertainment medium has accorded with the rise of the monetization of YouTube channels, which incentivizes users to create content that will generate more views and more advertising revenue for themselves (as well as for the platform's parent company).

Using publicly available YouTube videos as a data source has advantages and disadvantages. The advantages include the ability to access a large variety of different types of speech from the same speaker and from a very diverse pool of speakers. In addition, YouTube vlogs are a type of self-recorded data, which can capture a fuller range of phonetic variation and also help get around the researcher's Observer's Paradox (Hall-Lew and Boyd 2017; Van Hofwegen 2017). The disadvantages include the lack of demographic data that experimental sociolinguists usually require, such as age, region, or gender, which must then be inferred from context. Researchers must also consider the more complex dynamics of audience design (Bell 1984) when drawing conclusions about stylistic variation in vlogs: to whom is the vlogger speaking when recording a video to be edited and published in the future, and how might this differ from conversational speech or other "live" forms of discourse?

For phonetics research, additional disadvantages include a lack of control over audio quality (which usually changes over time, as consistent vloggers start off with amateur-level recording equipment and may upgrade to higher-quality tools) and the increasing use of post-processing on videos (e.g., cuts, sound effects, and background music), which creates obstacles for acoustic analysis of the voice. But from the perspective of sociophonetics or variationist approaches to speech, the analysis of speech on YouTube as its own genre, or specifically of the YouTube vlogger style, is a ripe area of future exploration. Schneider's (2016, 280) analysis of the metalinguistic commentary on YouTube styles underscores this idea, that "[s]peech in YouTube clips is not to be taken at face value, but rather to be accepted as text types of their own kind" (see also Beck 2015; Lee 2017 for analysis of YouTube style).

A final consideration when using YouTube as a data source for linguistic research is the tension between the Fair Use legal doctrine, one provision of which permits unlicensed use of copyright-protected work, such as videos on YouTube, for educational purposes, and the extra-legal considerations of what is ethical use of data from individuals who did not explicitly consent to have their speech analyzed. Linguistic research using found data or public records has been conducted extensively for decades; some examples use speech taken from documentaries, radio, and television shows (e.g., Gordon et al. 2004; Reubold, Harrington, and Kleber 2010; Boberg 2021) and governmental records, such as a corpus of the speech of Supreme Court justices (Yuan and Liberman 2008). In cases where the line between linguistic fieldwork and archival research begins to blur, it seems that what constitutes appropriate ethical research falls to the researcher, the scientific community, and the owners or originator of the data to decide. To that end, I contacted and obtained permission from one of the YouTube vloggers to use their data for this project; the other vlogger does not have any publicly listed contact information.

SUBJECTS. The two subjects for this project will be identified by pseudonyms. The first subject, "Nick," is an Okinawan Hawaiian YouTube vlogger. He was born in Hilo, Hawai'i, in 1990. He began making short videos and sharing them on YouTube in the early 2000s, before moving to Las Vegas, Nevada, to attend college. Since then, he has been active in both Las Vegas and Los Angeles, California, and collaborates with many other entertainers and content creators in the region, especially other Asian American entertainers. His official channel has been active since 2006, and it hosts over 400 total videos, mostly in the form of typical daily-life vlogs, comedic monologues, and music videos. His genre could be described as high-energy slapstick, with many videos employing fast monologues and quick cuts to silly, low-

budget sketches. In 2020, his subscriber count was about 21.5 million. In addition to his main channel, Nick is also involved in a podcast with other Asian Americans that began in 2019.

The second subject is "Jess," a White woman born in Rochester, New York, in 1986. She moved to Boston, Massachusetts, for college and began posting videos on YouTube in 2009, quickly amassing millions of subscribers. In 2011, she moved to Los Angeles, where she continued to create video content, including humorous "challenge" videos, makeup tutorials, and daily vlogs about her personal life. She is known for using a brash "potty-mouth" persona, using her platform to comment on and mock gender stereotypes, and for occasional outrageous and potentially socially condemnable content. Following some backlash to her early content, Jess stopped posting on her YouTube channel as well as other social media platforms in 2020. At that time, her channel hosted 250 videos and had 20.2 million subscribers.

Data was collected from the public YouTube channels of each speaker, with one WAV file per video. The videos were selected using the following criteria: there was little to no background music, the speaker was addressing the audience or performing a monologue (rather than talking to another person), and speech from performed sketches or music videos was excluded. Approximately one to two videos per year for the duration of each vlogger's career were chosen to balance the data set chronologically. From Nick's channel, excerpts from 27 videos spanning 11 years were sampled and analyzed, totaling about 34 minutes of speech. From Jess's channel, 16 videos spanning 10 years were sampled and analyzed, totaling about 86 minutes of speech. Table 1 shows a breakdown of each speakers' video data and number vowel tokens.

TABLE 1
The Two Subjects' Video Data and Number of Vowel Tokens

	Nick	*Jess*
Videos	27 (2008–19)	16 (2010–20)
Total duration	34 min	86 min
Vowel tokens		
BIT	912	1,385
BAIT	393	510
BET	518	805
BAT	582	859
BAN	116	247
BOOT	373	471
BOAT	437	635
BOT	341	510
BOUGHT	100	158

ACOUSTIC AND STATISTICAL ANALYSIS. The audio data used for this study was transcribed by hand and force-aligned using the Montreal Forced Aligner (McAuliffe et al. 2017). Novel words and speech disfluencies were added to a custom dictionary for their inclusion in the alignment process, but nonspeech sounds, such as laughter, were not included in the analysis. The acoustic measurements of fundamental frequency (F0) and the first and second formants (F1 and F2) were automatically extracted from each audio file, sampled at 16 Hz, using the ifcformant tool (Ueda et al. 2007), and a custom Python script matched the formant frequency data to each vowel. Formant frequency measurements were taken every 10 milliseconds.

For the statistical analysis, the variable was the F0 or formant measurement taken at the midpoint of each vowel. All vowel tokens were used for the F0 analysis, after outliers due to measurement error (e.g., fundamental frequency measurements of 0 Hz) and vowel length (greater than 1 second) were excluded. For the formant analysis, the following additional exclusion criteria were implemented: vowels without primary stress were excluded due to the effects of reduction, tokens that occurred before the segments /r/ or /l/ were excluded due to the effects of coarticulation, and tokens of BOOT that occurred after the alveolar obstruents /t, d, n, s, z/ were excluded due to the effects of coarticulation.

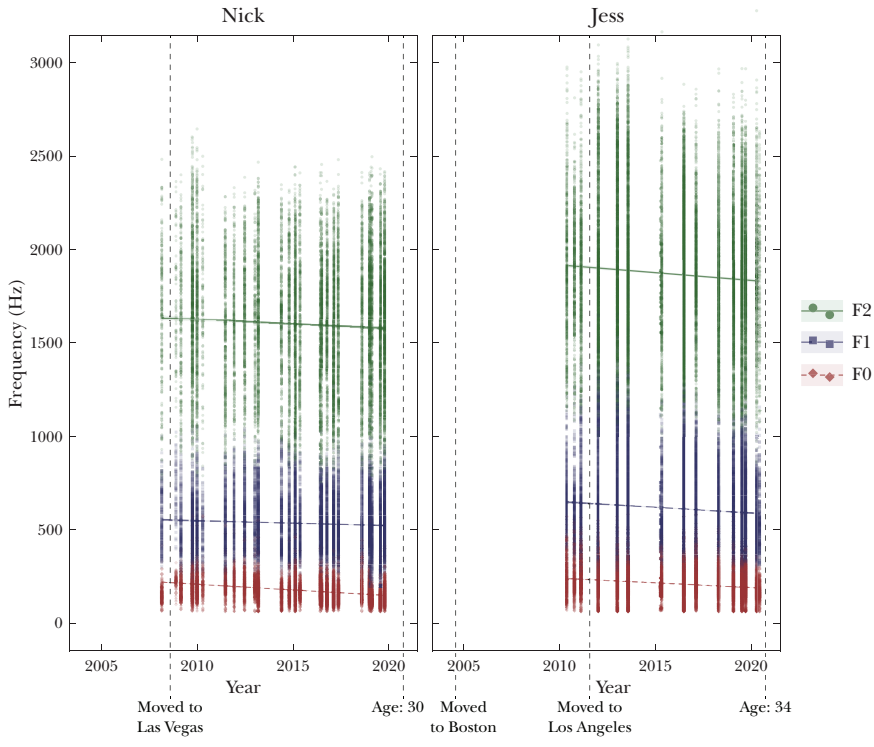
A linear mixed-effects regression model was fit to the F0 data, with fixed effects of time (i.e., day, month, and year of the video's posting) and vowel identity (due to the effect of vowel height on fundamental frequency; Whalen and Levitt 1995) and a random effect of video (as a categorical variable). Similar mixed models were fit to the global F1 and F2 across all vowels, with F1 and F2 as dependent variables and fixed effects of time and vowel duration, as shorter vowels tend to be reduced and thus centralized (Fourakis 1991).

In addition to the models for global F0, F1, and F2, separate simple linear regression models were fit to the mean F1 and F2 of each vowel per video. To examine vowel mergers, Pillai scores were calculated (Nycz and Hall-Lew 2013). More detail about these models and analyses are provided in the relevant sections below.

RESULTS

FUNDAMENTAL FREQUENCY (F0). First, there was a significant[1] decrease in vocalic fundamental frequency over time for both speakers. A linear mixed-effects regression model fit to the F0 data showed a significant effect of time, as represented by date of video publication for both Nick ($\beta = -0.0155$, $SE = 0.0031$, $p < .001$) and Jess ($\beta = -0.0148$, $SE = 0.0039$, $p = .0023$). This

FIGURE 2
F0, F1, and F2 over Time



trend is illustrated in figure 2. Decreases in F1 and F2 were strongly correlated with the decrease in F0. Notable events in the lives of each speaker are also noted as well as their current age.

A similar linear mixed-effects regression model was also fit to the F1 and F2 data. The effect of time on the decrease of F1 and F2 was also significant, but it is important to consider the possibility of covariance in formant and F0 measurements. In particular, Reubold, Harrington, and Kleber (2010) found that increasing age does result in a similar rate of change in F0 and F1 in speakers but also that F1 does undergo age-dependent change independent of changes in F0 (in accordance with the source-and-filter principle of formant frequencies). Thus, a new model that included F0 as an additional fixed effect was fit to the F1 and F2 data. Consequently, the speakers' F1 and F2 were not shown to be affected by time after F0 was accounted for (table 2). However, this result pertains to global change in F1 and F2; in the following section, individual vowel changes are explored.

TABLE 2
Model Results for the Effect of Time on Speaker F0, F1, and F2

	Nick	*Jess*
F0	$\beta = -0.0155$, $SE = 0.0031$, $p < .001$	$\beta = -0.0147$, $SE = 0.0039$, $p = .002$
F1	$\beta = -0.008$, $SE = 0.0057$, $p = .17$	$\beta = -0.011$, $SE = 0.0057$, $p < .076$
F2	$\beta = -0.0157$, $SE = 0.0066$, $p = .024$	$\beta = -0.0144$, $SE = 0.0058$, $p < .025$

VOWELS. *Short Front Vowels.* There was a general decrease in F1 and F2 over time for BIT, BAIT, BET, and BAT. In figure 3, the F1 and F2 of these four vowels from the two speakers are illustrated, and the falling pattern is clear, with the regression lines for each vowel essentially parallel.

Linear regression models were fit to the mean F1 and F2 measurements per vowel, with fixed effects of year and mean F0 (to account for correlation). Most of these models returned insignificant results for both F1 and F2, with a few notable exceptions. For Nick, F2 of BIT, BET, and BAT showed a significant decrease; for Jess, F1 of BIT and F2 of BAT showed a significant decrease. This indicates some backing of specific short front vowels over time for both speakers, but not, as discussed above, any global backing or lowering in the vowel space. The full model results are listed in table 3.

Of particular interest due to nature of the Western Shift is BAN, or the prenasal consonant allophone of BAT (not included in figure 3). In the shift,

FIGURE 3
Short Front Vowel F1 and F2 over Time

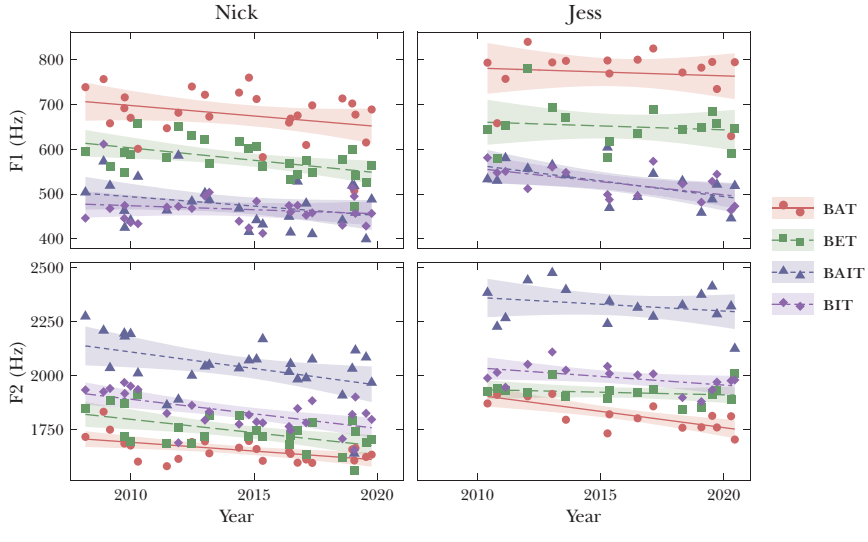


TABLE 3
Linear Model Results for F1 and F2 Change over Time in Front Vowels

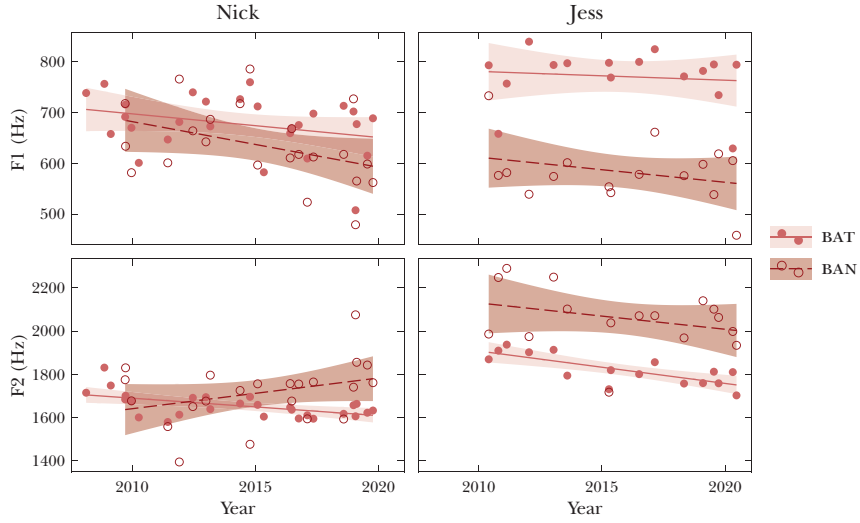
Speaker		*Vowel*	*Model Result*	
Nick	F1	BIT	$F(1,23) = 0.943$, $p = .341$	n.s.
		BAIT	$F(1,23) = 3.822$, $p = .063$	n.s.
		BET	$F(1,22) = 12.101$, $p = .002$	**
		BAT	$F(1,23) = 2.542$, $p = .125$	n.s.
		BAN	$F(1,18) = 5.399$, $p = .032$	n.s.
	F2	BIT	$F(1,23) = 16.688$, $p < .001$	***
		BAIT	$F(1,23) = 6.158$, $p = .021$	n.s.
		BET	$F(1,22) = 11.975$, $p = .002$	**
		BAT	$F(1,23) = 10.819$, $p = .003$	**
		BAN	$F(1,18) = 2.588$, $p = .125$	n.s.
Jess	F1	BIT	$F(1,12) = 8.842$, $p = .012$	n.s.
		BAIT	$F(1,12) = 6.594$, $p = .025$	n.s.
		BET	$F(1,12) = 0.28$, $p = .607$	n.s.
		BAT	$F(1,12) = 0.157$, $p = .699$	n.s.
		BAN	$F(1,12) = 1.6$, $p = .23$	n.s.
	F2	BIT	$F(1,12) = 4.147$, $p = .064$	n.s.
		BAIT	$F(1,12) = 0.947$, $p = .35$	n.s.
		BET	$F(1,12) = 0.603$, $p = .452$	n.s.
		BAT	$F(1,12) = 21.018$, $p < .001$	***
		BAN	$F(1,12) = 3.109$, $p = .103$	n.s.

$^{**}p < .01$, $^{***}p < .001$

BAN is raised and fronted, while BAT is backed, producing an allophonic split. Jess demonstrated a strong split from early on: BAN had consistently smaller F1 measurements (indicating raising) and greater F2 measurements (indicating fronting) compared to BAT, and the difference between the two allophones did not change over time. In contrast, Nick's productions were more variable overall, and there appeared to be a slight trend over time in the direction of the split. Nick's BAN increased in its F1 distance from BAT over time, while his BAN F2 started less than BAT but eventually surpassed it (figure 4). However, these changes over time were not shown to be significant in the models; only the BAT allophone showed a consistent F2 decrease for both speakers, not BAN. Although BAN was not shown to be significantly fronting, it was not following the backing trend of its nonnasal allophone.

As an interim conclusion: some short front vowels were shown to be backing over time for both Nick and Jess, though not lowering. The main exception was the BAN vowel for Nick, which showed no significant decrease in F2 over time and even a slight increasing trend.

FIGURE 4
TRAP versus HAND Allophones over Time



High Back Vowels. Neither speaker's high back vowels (BOAT and BOOT) appeared to change over time (figure 5). Linear models were fit to the mean F1 and F2 of each vowels for each speaker, with a fixed effect of mean F0. The results showed that time was not a significant predictor of formant value for any vowel for any speaker (table 4).

FIGURE 5
Back Vowel F1 and F2 over Time

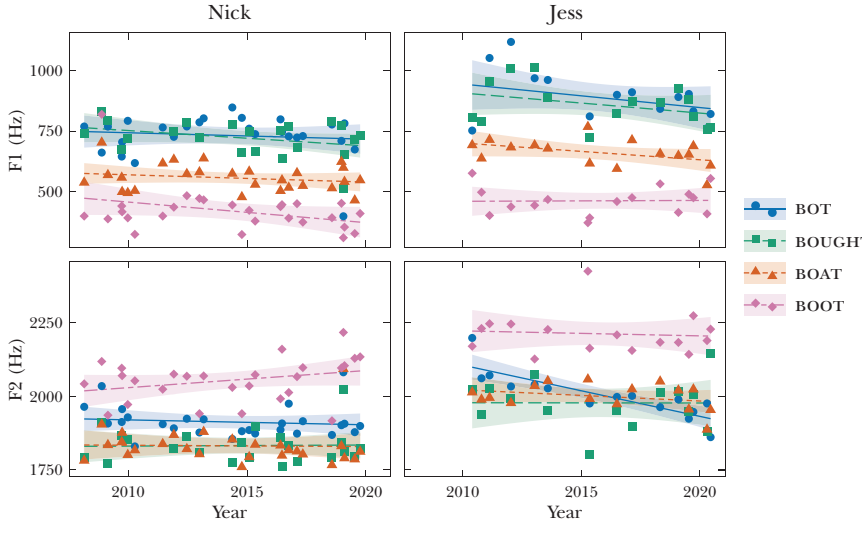


TABLE 4
Linear Model Results for F1 and F2 Change over Time in Back Vowels

Speaker		*Vowel*	*Model Result*		
Nick	F1	BOAT	$F(1,23) = 1.239$,	$p = .277$	n.s.
		BOOT	$F(1,23) = 3.659$,	$p = .068$	n.s.
		BOT	$F(1,23) = 0.39$,	$p = .539$	n.s.
		BOUGHT	$F(1,18) = 2.615$,	$p = .123$	n.s.
	F2	BOAT	$F(1,23) = 0.024$,	$p = .878$	n.s.
		BOOT	$F(1,23) = 2.747$,	$p = .111$	n.s.
		BOT	$F(1,23) = 0.33$,	$p = .571$	n.s.
		BOUGHT	$F(1,18) = 0.012$,	$p = .914$	n.s.
Jess	F1	BOAT	$F(1,12) = 3.981$,	$p = .069$	n.s.
		BOOT	$F(1,12) = 0.01$,	$p = .921$	n.s.
		BOT	$F(1,11) = 2.134$,	$p = .172$	n.s.
		BOUGHT	$F(1,11) = 1.587$,	$p = .234$	n.s.
	F2	BOAT	$F(1,12) = 1.563$,	$p = .235$	n.s.
		BOOT	$F(1,12) = 0.164$,	$p = .693$	n.s.
		BOT	$F(1,11) = 50.735$,	$p < .001$	***
		BOUGHT	$F(1,11) = 0$,	$p = .988$	n.s.

*$p < .01$, **$p < .001$

Low Back Vowels. A comparison of the low back vowels implicated in the BOT-BOUGHT merger required the removal of stopwords *was*, *wanna*, *because*, and *gonna*, which had been automatically aligned with the BOUGHT vowel but were clearly pronounced with the BUT vowel by both speakers. From here, two types of analyses were performed: linear models on the mean F1 and F2 measurements over time, and the calculation of Pillai score, which is a simple method of analyzing vowel merger (Hay, Warren, and Drager 2006; Nycz and Hall-Lew 2013; D'Onofrio, Pratt, and Van Hofwegen 2019; Kelley and Tucker 2020) from unaveraged token measurements.

First, linear models were fit to the mean F1 and F2 measurements for each vowel for each speaker. All results were insignificant, with the exception of F2 of BOT for Jess, which demonstrated a significant decrease of F2 over time ($F(1,12) = 29.08$, $p < .001$). In figure 5, the regression lines indicating F2 change over time for BOT and BOUGHT cross for Jess, while they remain parallel for Nick. This demonstrates a backing of BOT for Jess, which is a reversal of the Northern Cities Shift pattern for that vowel. Because her BOUGHT was not changing over time, it was suspected that the two vowels were merging, so an analysis of vowel overlap was conducted.

Following a modified version of the guidelines in Stanley (2019), the Pillai score for vowel category overlap was calculated for each speaker. First, the videos were separated into three time-based groupings to allow for a

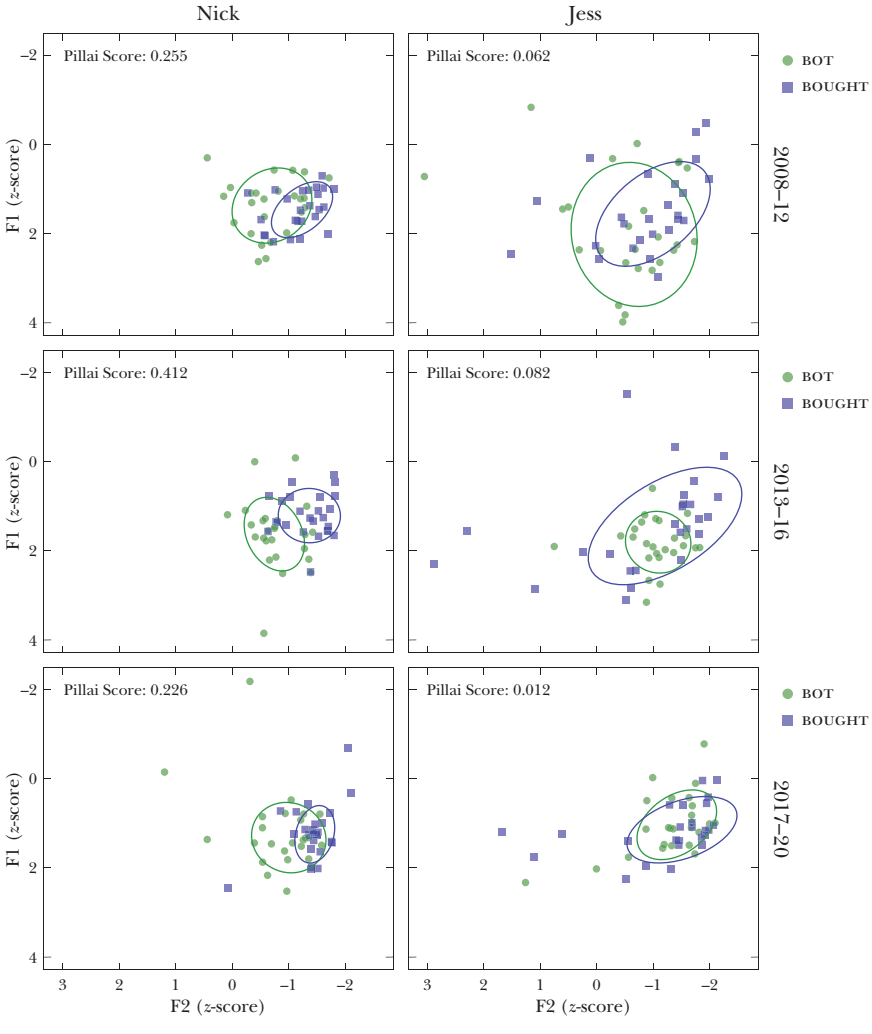
comparison of each speaker's earlier and more recent speech: videos created between 2008 and 2012, between 2013 and 2016, and between 2017 and 2020. Of all the tokens contained in each group, 25 tokens of BOT and 25 tokens of BOUGHT were sampled in order to ensure balanced comparison. The Pillai score could thus be tracked for each speaker over three discrete year groupings. Greater Pillai scores (approaching 1) indicate more distinction between vowel categories, while lower scores (approaching 0) indicate potential vowel merger.

The Pillai score was taken from a MANOVA test of combined F1 and F2, with a dependent variable of vowel (BOT or BOUGHT). Each vowel pair was plotted for each year grouping for each speaker, and the results are shown in figure 6. For both speakers across time periods, the Pillai scores are fairly to extremely low, and there is no clear pattern in the change over time.

OVERALL CHANGE IN VOWEL SPACE. Finally, change in vowel space over time was measured to gauge participation in the Western Vowel Shift. Overall vowel space area is influenced by gender identity (Diehl et al. 1996; Simpson 2002) and regional dialect: female speakers from the Inland North were shown to have larger vowel space area than speakers from the Midwest and the South (Fox and Jacewicz 2017). Although there have been no group-level comparisons of vowel space area involving Californian speakers, D'Onofrio, Pratt, and Van Hofwegen (2019) argue that the California (or Western) Vowel Shift is a consequence of ongoing vowel space compression. Their apparent-time study showed that Californians of younger generations, such as Millennials, had smaller vowel spaces areas and less dispersed vowels compared to older generations, such as Baby Boomers. To that end, the area of each speaker's vowel space was expected to decrease over time as a consequence of adapting to the Western Vowel Shift.

To visualize this change, predict.lm, an R function that generates predictions based on the outputs of the linear regression models previously fit to each vowel, was used to predict the F1 and F2 values for each speaker's vowels at the beginning and ends of their YouTube careers. Figure 7 illustrates the results of the model prediction; here, "t1" indicates the first video in their career used in this analysis, and "t2" indicates the most recent video. (These arbitrary labels were used instead of "past" or "present" because they are based on predictions, not raw data.) It can be observed in figure 7 that Nick's vowel space does indeed appear to have compressed between t1 and t2, in particular with front vowels moving backward, while Jess's vowel space instead appears to have moved upward and backward as a whole, without compression.

FIGURE 6
BOT and BOUGHT for Both Speakers with Pillai Scores, Calculated in Three Time Periods across Each Speaker's YouTube Career



To calculate vowel space, the convexHullArea function of the phonR package (McCloy 2016) was used to calculate the area of the polygon created by the mean normalized F1 and F2 values of the outermost vowels for each video. The normalized area values are plotted in figure 8. Here, it can be seen that, despite the appearance of vowel compression over time from the model prediction vowel plots, in reality, there was little change over time. A

FIGURE 7
Predicted Vowel Space Change in Time, from First Video to Last Video

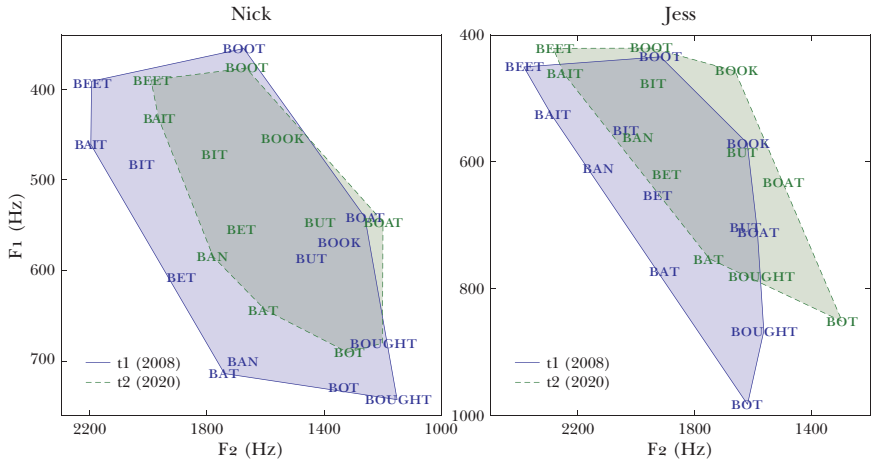
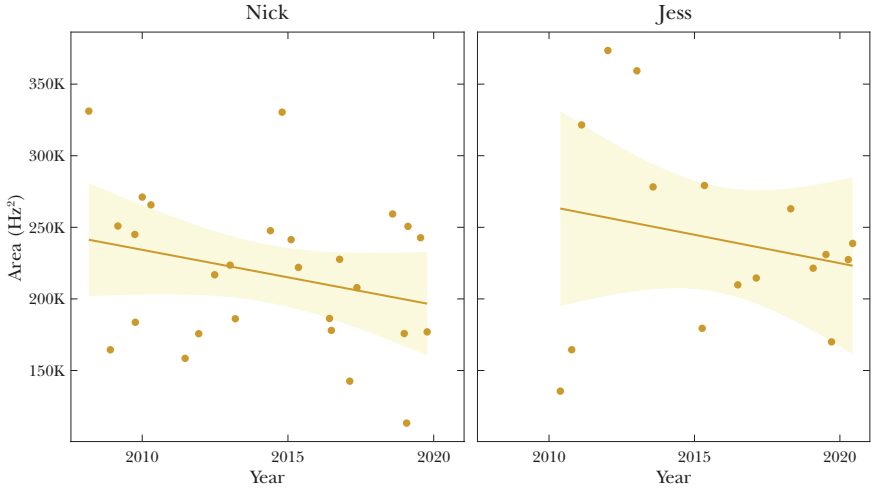


FIGURE 8
Vowel Space Area over Time



linear model was fit to this data for each speaker, with area as a dependent variable and fixed effects of year and mean vowel duration. The result did not show any significant effect of time for either Nick ($\beta = -4.37$, $SE = 8.09$, $p = .59$) or Jess ($\beta = -11.29$, $SE = 15.1$, $p = .47$). Thus, there was no significant compression in overall vowel space for these two speakers over time that could be separated from correlated factors such as a decrease in speech rate.

DISCUSSION

Overall, there was some evidence of vocalic change over time in the speakers, including decreases in F0 and changes in a few individual vowels' F1 and F2. There were no changes in global F1 or F2 that could be disassociated from the significant decrease in F0 over time. However, some of the hypotheses regarding participation in specific vowel changes associated with the speakers' second dialects were supported, and others were not.

The first hypothesis was that both speakers would demonstrate evidence of shifted short front vowels (BIT, BAIT, BET, and BAT) in both the past and present, with no significant change over time. These vowels remained, relative to each other, constant in the F1 dimension for both speakers. However, for Nick, BIT, BET, and BAT had significant decreases in F2, indicating a shift backward over time. The notable exception to this pattern for Nick was the BAN vowel, in which F2 did not undergo backing, unlike the rest of his short front vowels. This may be a consequence of his assimilation to the Western Shift pattern, in which BAT is backed and lowered, but BAN is raised and fronted. In this case, Nick appears to have acquired a phonological split that he previously did not have. This confirms the initial hypothesis.

Jess, on the other hand, was hypothesized to change in the same way, but she did not. The only significant vowel formant changes over time for her was backing of BAT through a decrease in F2. It is implausible to conclude that Jess's short front vowels were changing overall in a way that represents assimilation to the dialect of the region she relocated to.

However, the third prediction for Jess was that she would acquire the BOT-BOUGHT merger over time. This was partially supported by the data. Of all the changes in back vowels, the only significant change was Jess's BOT F2, which decreased substantially over time. This indicates backing of the vowel, which is normally fronted in Inland Northern American English. On the other hand, the Pillai score calculation for each speaker over time presented an opposing view: there was no linear relationship between time and Pillai score, meaning that overall, no merger or split occurred over time. It is possible that the low token count for each vowel implicated in the shift affected these results. Nevertheless, there is conclusive evidence that one of the vowels implicated in the BOT-BOUGHT merger changed radically in her speech over the course of 10 years. Taken together with the backing of BAT, another vowel implicated in the Northern Cities Shift, it appears that there was partial reversal of this shift in Jess's speech over time.

Finally, there was a prediction that the high back vowels BOOT and BOAT would increase in F2 over time for both speakers, as a consequence of the Western Vowel Shift's pattern of fronting. This prediction was not born out

at all in the data; both speakers maintained their original dialectal pronunciations of both vowels over time. (It is worth pointing out that both speakers started out with relatively fronted, or centralized, BOOT vowels, which is increasingly typical of the majority of American English dialects.)

The two speakers, who migrated from different dialect areas in the United States (the Northeast and Hawai'i) to the West Coast, demonstrated one major shift each in their vowel production over time, rather than wholesale assimilation to the vowel pattern of the Western Shift. Nick, who started making his YouTube videos in Hawai'i and then moved to Nevada, acquired the allophonic split between BAT and BAN. Jess, who spoke with Northern Cities Shifted vowels at the beginning of her YouTube career, reversed the fronting of BAT and BOT, the latter of which eventually became more posterior than BOUGHT. In these ways, the speakers ended up with a few Western Shifted vowels. But as for the high back round vowels, despite being among the most salient aspects of Western English, in particular as part of the Valley Girl stereotype (Hinton et al. 1987; Villarreal 2018) and a sound change that may be nearing completion (Hall-Lew 2011), neither speaker changed their production over time to have more fronted BOOT or BOAT.

As a final test of accommodation to Western English, overall vowel space was calculated for each speaker. Figure 8, which shows linear regression models for both speakers, shows a compression-like pattern for both, but neither trend was statistically significant. Compressed vowel space is one purported attribute of Western (specifically Californian) English (D'Onofrio, Pratt, and Van Hofwegen 2019), but the speakers were also up against the age-graded shift of vowels to the periphery of their vowel space (Gahl and Baayen 2019). In this study, it is likely that the perceived decrease in vowel space area over time can be attributed mainly to a decrease in vowel duration over time.

Both speakers demonstrated a pattern of piecemeal adoption of a second dialect,[2] a pattern that has some precedent. The features that are accommodated to and those that are not may differ on a social level, or the social networks that a speaker maintains from either region may influence the amount to which they assimilate to a new regional dialect (Nycz 2015). In this case, the sound change that neither speaker adopted (high back vowel fronting) was actually a fairly socially salient feature of Western English, but the change that Jess retreated from (fronting of BOT and BAT) is a salient feature of the Northern Cities Shift (e.g., "Wis-cahn-sin"). In this sense, it is plausible that Jess changed, consciously or not, only the aspects of her speech that were most identifiable as being "accented" by those in her new home.

In addition, while splits and mergers are often learned or accommodated to by adults, speech style continues to play a role in their manifestation: Johnson and Nycz (2015) demonstrated that SDA was strongest in conver-

sational speech but radically reduced in the same speakers when they read minimal pairs (returning to the norms of their original dialect). Thus, the style, context, and audience design (Bell 1984) of YouTube speech and these specific YouTubers is important to consider.

As a YouTuber whose career is built on her public-facing persona and whose voice is heard by many millions of listeners around the world, it is likely that as Jess's fan base grew, the pressure to speak using less-marked variants (e.g., less-fronted low vowels) also grew. Sociocultural analysis of the virtual space in which Jess operates has revealed a particularly hostile, misogynistic environment in the form of video comments and social media responses to her content, in comparison to the audience feedback that Nick has experienced (Wotanis and McMillan 2014). In response, Jess's performances on her vlogs both highlight and parody the gendered expectations for her behavior that her viewers may have.

With respect to her speech, which has also generated its fair share of negative feedback, one can imagine Jess either doubling down on her native dialect and brash "Bostonian" persona or changing for the sake of engaging more viewers or generating less pushback. Indeed, in a recent vlog that Jess posted in which she rewatches her own videos from very early on in her career, she makes several comments playfully criticizing the "Boston accent" that she had regularly used only seven or eight years prior. Jess's speech changes, minor as they were, may have been socially influenced by the desire to diverge from her original dialect, rather than converge to Western English. That said, it would be difficult to differentiate the influence of accommodation to California English from the influence of divergence, since Jess's migration and career expansion occurred simultaneously.

Nick had a similar career trajectory to Jess but demonstrated much less accommodation to Western English than Jess, with the main exception being the acquisition of the BAT-BAN split. The social pressure (from fans and otherwise) for Nick to converge to Western English or diverge from Hawai'i English will have been just as strong as the equivalent pressures for Jess. But Nick has built his career on a different facet of uniqueness in the YouTube world: that of a quirky Asian American. As a pioneer among a cohort of Asian American men who catapulted into YouTube stardom in the early 2010s while capitalizing on transnational appeal between the United States and Asia (Chun 2013), Nick's maintenance of a legible Asian American persona will have competed with the pressure to appeal to a broad (mostly non-Asian) American YouTube audience.

As far as his speech is concerned, this means that the phonetic features that Nick used that might index Hawaiian identity, such as a backed and monophthongized BOAT, would compete against variants that indexed a

more mainstream or unmarked American identity. It would appear that Nick, in the end, did not diverge from his original dialect and continues to speak in a way that is markedly Hawaiian after a decade of living in the West.

What then to make of the obvious exception for Nick's BAN vowel? The presence of this allophonic split has been cited in the literature as indexing Whiteness, femininity, and privilege—at least in the specific context of a schoolyard community of practice (Eckert 2008b). It also indexes young, urban identity (Podesva et al. 2015) in California, although its occurrence is still variable among different regions of California or the West (Fridland and Kendall 2017; Brotherton et al. 2019). On the other hand, phonological changes such as splits and mergers are, according to Eckert and Labov (2017), much less likely to be noticed by the casual observer and thus do not often become objects of social perception (in contrast to the accrual of meaning to concrete phonetic elements). Thus, splits and mergers are usually discussed in the context of community-wide sound change. However, for an individual acquiring a second dialect (or abandoning a first dialect), what this may mean is that Nick began converging to the split BAT-BAN system of Western English precisely because it was not noticed and thus not commented on, either by his peers in Nevada or by any of his millions of viewers.

It falls to future research, perhaps of a more qualitative or discourse analytic nature, to determine the extent to which both Jess and Nick changed aspects of their speech as a conscious, socially motivated or career-motivated shift, as opposed to automatic long-term accommodation and the natural consequence of aging. What the results from this limited study provide, though, is evidence that some amount of change did occur and reasonable speculation as to why.

CONCLUSION

This study has offered further evidence that a speaker's internal grammar, as far as phonological organization is concerned, is still subject to change in adulthood, and it has demonstrated how age and relocation to a new dialect region corresponded to dialect-specific changes in vowel formants, independent of age-graded change. The changes observed in the two speakers were not exactly equivalent, as one speaker was seen to diverge away from one aspect of her native Northern Cities dialect, while the other converged to one specific part of the Western Shift. Thus, this study also demonstrates the utility of using panel data such as YouTube to identify individual differences in longitudinal change. Finally, second dialect acquisition does not necessarily mean the wholesale adoption of a completely new phonological

system but can be broken down into component parts: one shifted vowel here, perhaps a change in consonant production there, and each operating under unique social, phonetic, and phonological constraints.

NOTES

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1. A conservative alpha criterion of 0.99 ($p < .01$) was used in this study in order to avoid Type I errors (false positives).
2. Thanks to Abby Walker (pers. comm., Mar. 2021) for noting that many of the features of Western English are also present in what is considered General American English (e.g., the BOT-BOUGHT merger and the allophonic BAT-BAN split are not restricted to the Western region); thus, shifts in the direction of these documented sound changes could also signal an orientation toward a perceived "standard" form of English, rather than Western English specifically. Importantly, the changes observed in the two speakers were shifts away from patterns of their original dialect and toward something different, whether the second dialect was Western or "General American."

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