Real-Time Trends in the Texas English Vowel System: F2 Trajectory in GOOSE as an Index of a Variety's Ongoing Delocalization

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Abstract

A complex process of change is underway in the Central Texas English GOOSE vowel. Koops (2010) describes it as the simultaneous operation of two qualitatively different fronting processes. One is a feature of traditional Southern American English (SAE) while the other results from a recent innovation in mainstream American English (MAE). In this paper, we examine a corpus of digital and digitized recordings of Central Texas English (TxE) speech, spanning 30 years in real and 100 in apparent time, to determine the distribution of these two variants of GOOSE throughout the social spectrum. We test two methods for modeling sub-phonemic variation in our dependent variable and perform regression analysis of both linguistic and social factors conditioning this variation. We find, in particular, that women favor the more prestigious MAE variant, suggesting a sound change in progress that aligns TxE more closely with MAE.

Keywords: sociophonetics, sound change, dialect leveling, Texas English

1 Introduction

Central Texas, at the junction of the traditional Southern and Southwestern cultural and dialect regions, is undergoing urbanization and ethnic diversification at a faster pace than most other Southern states (Tillery, Bailey, & Wikle 2004). As a result, the reindexicalization and commodification of vernacular speech forms observed throughout North America (Johnstone 2004, 2010) are particularly advanced in Texas, while at the same time, a process of dialect leveling can be observed. Many features of the traditional Texas dialect of English (TxE) have been replaced by their Mainstream American English (MAE) counterparts (Bailey, Wikle, & Sand 1991), a trend that began around the end of World War II and which has accelerated since the 1980s.

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In a study that extends over the entire territory of Texas, Bailey *et al.* (1991) find that linguistic innovation in TxE from the latter half of the twentieth century onward is, for the most part, a diffusion of MAE features which displaces traditional features of TxE. In addition to the geographic trajectory of these changes, they examine stratification across class, gender, and ethnicity (207).[1] Innovative forms diffuse into the rest of Texas via the Dallas-Forth Worth area, with a secondary point of diffusion being the Central Texas region, i.e. Austin to San Antonio.[2] Before reaching Dallas, however, linguistic innovations diffusing from the north may first take hold in smaller towns such as Lubbock and Wichita Falls, situated closer to the inland states of New Mexico and Oklahoma, respectively (207).

The GOOSE vowel is one feature participating in the broad reorientation of TxE phonology towards MAE.[3] Fronting of this vowel affects nearly all varieties of North American English (Labov, Ash, & Boberg 2006; Thomas 2001), but fronted GOOSE is also an established feature of white Southern English, and thus TxE. Therefore, the way in which the de-traditionalizing trend of TxE manifests itself in the GOOSE vowel has been partly obscured in previous research: both the traditional Southern and the MAE form of the vowel are fronting in apparent time.[4] Because research on vocalic variation often captures monophthongs through single-point formant measurements in order to plot them at a single point in two-dimensional space (Labov, Yaeger, & Steiner 1972), subtler qualitative changes in vowel trajectory remained unknown until recently. Koops (2010), however, finds that measurements at multiple points throughout the vowel reveal systematic qualitative differences between Southern American English (SAE) and MAE variants of the GOOSE vowel. Koops classifies twenty speakers of Houston English as using either a dominantly SAE or an MAE phonological system, based on a compound vowel index ("Southern Vowel Shift index", Koops 2010: 116) which does not include GOOSE. In his study, speakers who are classified as SAE speakers according to his index produce GOOSE as a stable, fronted monophthong. Meanwhile, MAE speakers realize the vowel with a diphthongal trajectory, with a first auditory target near the front of the articulatory vowel space and an offglide toward the back. Koops argues that the auditory contrast between the typical realization of the SAE group and that of the MAE group is due primarily to the difference in second formant trajectories. Trajectories of the first formant also show systematic, but less pronounced, differences between the two groups (116).

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[1] Bailey *et al.* (1991)'s study focuses on regional variation by sampling each county in Texas, but does not exhaustively consider interactions between geography and ethnicity, gender, or class. Their sampling method is only sensitive to class and ethnicity insofar as socioeconomic status and ethnic makeup varies by county. Counties with low Anglo populations are less innovative because the index for linguistic innovativeness focuses on features that are innovative *in Anglo-TxE*. The role of gender is not addressed at all.

[2] High scores for innovativeness in counties closer to the Mexican border may be due to a methodological flaw, the authors concede (Bailey *et al.* 1991: 209): the Spanish substrate may produce accent features very similar to some of those features that the index rates as "innovative" in Anglo-TxE, notably the lax-tense transposition that is indicative of Southern Vowel Shift progress in words containing FLEECE/KIT, FACE/DRESS, or GOOSE/FOOT before /l/ (Labov, Ash, & Boberg 2006). A string of counties along the Mexican border showing high innovation scores, from El Paso to Webb, is therefore dismissed entirely as a source of linguistic innovation.

[3] We adopt the Wells (1982) lexical sets for discussing systematic changes in English varieties.

[4] Fronting of the GOOSE vowel in American English has typically been discussed as a unitary phenomenon under the theory that GOOSE-fronting "spilled out of the South" in the 20th century and spread to the north and west (Thomas 2001: 33). However, Koops (2010) argues—convincingly, we believe—that the Southern and Mainstream American fronting trends of GOOSE reflect distinct and differentiable diachronic processes.

Whereas Koops (2010) is primarily concerned with the etiology of these two ways of implementing GOOSE-fronting, we approach this topic from a variationist angle, with a primary interest in the social stratification of GOOSE-fronting. Using a corpus of digital and digitized recordings of TxE speech spanning approximately thirty years in real time and roughly a century in apparent time, we investigate the distribution of the different trajectories for the GOOSE vowel among speakers of TxE. We hope to shed light on the changing norms of spoken English in Texas and thus on the mechanics of the devernacularization of TxE.

While previous work on the issue has utilized laboratory data, our approach combines elicited heritage data, which allows us to look at change in real time, with detailed phonetic analysis. We heuristically develop our analytic approach first by demonstrating a manual coding approach, and then by detailing a fully automated approach on which we base our conclusions.

1.1 The linguistic variable

The description of the non-Southern and the Southern types of GOOSE vowels by Koops (2010) is based on 10 speakers of Houston English classified as "non-Southern" based on an index of their realizations of FACE, FLEECE, TRAP, DRESS, and KIT, all vowels that are affected by the Southern Vowel Shift, and 10 speakers who were classified as "Southern" according to the same index. Out of a larger sample of 42 speakers of Houston English, these were the 20 speakers who were at the non-Southern and Southern extreme based on this index. Aggregate formant contours were obtained using smoothing spline ANOVA (Nycz & De Decker 2006) and normalized formant and duration measurements. Figures 1 and 2, taken from Koops (2010) and reproduced with the author's permission, show tokens from two representative speakers: the first illustrates the trajectory of a non-Southern GOOSE vowel, and the latter the Southern GOOSE trajectory.

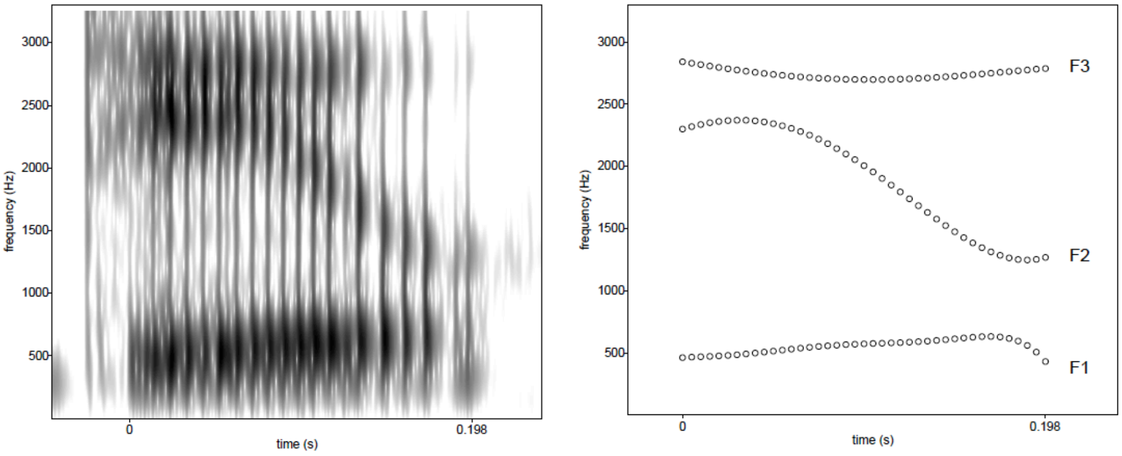

Figure 1: Utterance-final *do*, 19-year-old female Houston Anglo speaker (from Koops 2010: 115).

There are differences between the two types in F1, F2, and F3, but Koops (2010) argues that "the F2 trajectory seems to contribute most to the auditory contrast" between the two types (116). Within the diagnostic dimension of F2, we find an early articulatory peak and a strong backing towards the offset in the non-Southern type (Figure 1) and a relative plateau for the

Southern type (Figure 2), in which the F2 at onset and offset is approximately the same.

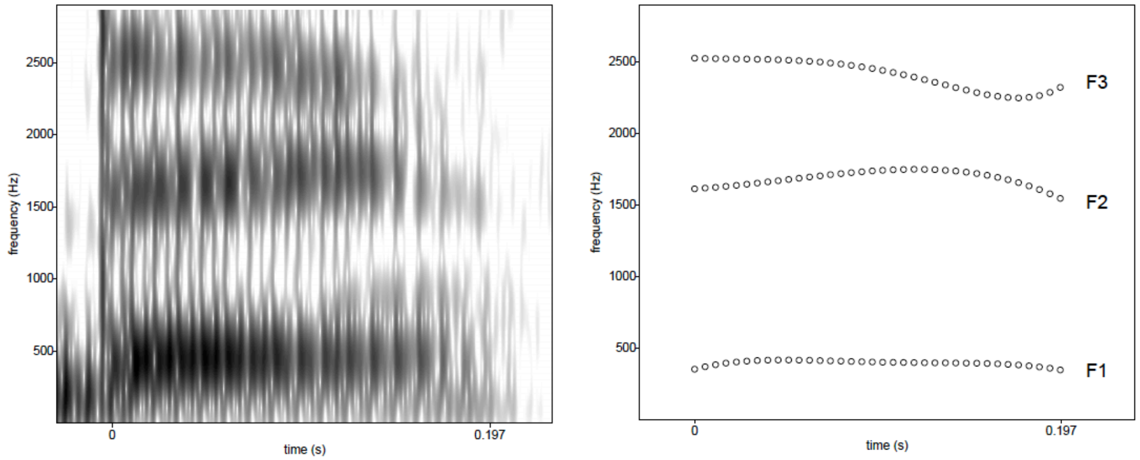

Figure 2: Utterance-final *do*, 45-year-old male Houston Anglo speaker (Koops 2010: 116).

It is known that in many varieties of American English, GOOSE-fronting is inhibited when the vowel is followed by /l/ as in words like *school.* The constraint is frequently disregarded in SAE (Baranowski 2008; Fridland & Bartlett 2006), however; for example, in Koops' (2010) study fronting is “variably present in older Anglos but absent in all others” (115) even before /l/. In order to avoid any of the variation induced by this phonetic context, no cases of the GOOSE vowel before /l/ are considered in this study.

1.2 Data

For the analysis we use legacy data collected at the University of Texas at Austin between 1980 and 1985. The 1980s dataset is fairly large and diverse, though not extensively documented, including recordings of over 350 speakers from all over Texas, particularly those from around Austin and Houston. The survey, directed by Gary Underwood, was originally designed to study synchronic variation in the PRICE vowel and its correlation with ideas of Texan identity in speakers' self-images (Underwood 1988). The speaker metadata includes age at the time of recording, gender, place of residence both at the time of recording and during their youth, as well as occupation and level of education. The heritage data encompasses many interview styles, and very few interviews include word lists targeting the GOOSE vowel. Short of word list data, perhaps the most ideal for the present study, we settled for another relatively controlled elicitation technique, a reading passage entitled “Growing up in Texas” that was read by many of the Austin speakers. While this text was designed to elicit as many realizations of the PRICE vowel as possible[5], it does contain eight tokens of GOOSE as well.

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[5] In reference to the University of Texas’s alma mater, “The Eyes of Texas are upon You,” and to the phonetic variable under study, the title of the 1980s project was “The /ai/s of Texas.”

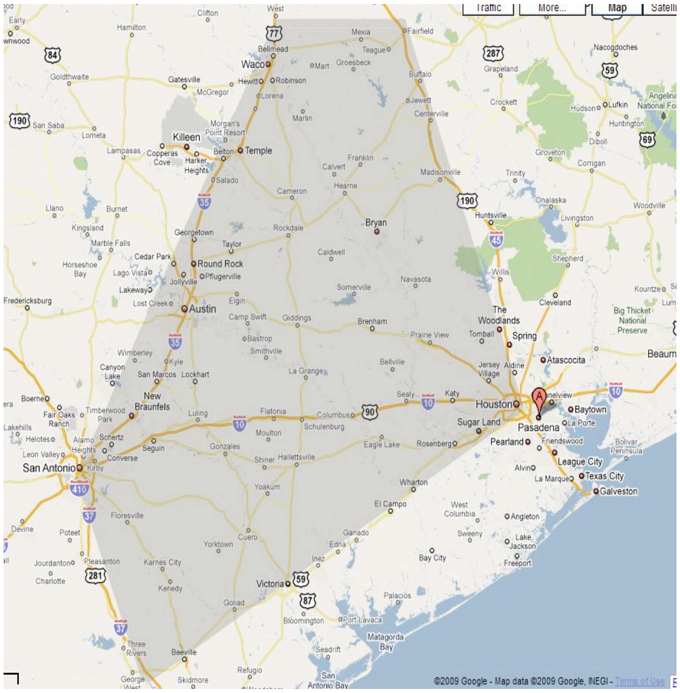

Figure 3: Map of Central Texas. Interviewees all grew up and live in the shaded area (Google Maps 2013).

In selecting speakers for this study, we focused on recordings judged impressionistically to be of the highest sound quality. We chose only speakers who grew up in and lived in Central Texas, a region defined as shown in Figure 3, at the time of the recording. In the absence of systematic metadata on participant ethnicity, we also decided to focus on speakers from the largest ethnic group in the area, Anglo-Americans, and therefore excluded all speakers who either self-identified as non-Anglo in the recorded interview or, when ethnicity was not a topic of the conversation, whose speech impressionistically suggested a non-white ethnic affiliation. Following these criteria, we ended up with a set of 35 recordings in total. The dataset includes 15 female and 20 male speakers. The age range is between 12 and 76, although there are no speakers between 37 and 57 years of age. Unfortunately, we were unable to obtain any information about the recording equipment used for these interviews.

A matching comparative dataset was collected for the present day in 2010 and 2011.[6] It comprises recordings of 28 female and 32 male speakers, who also grew up and now live in Central Texas, as defined in Figure 3. The participants we recorded were asked to read a standardized wordlist and the same readng passage as Underwood's speakers, and to participate in an informal sociolinguistic interview.

Recordings were analyzed in Praat (Boersma & Weenink 2012). The spectrogram frequency range was set from 0 to 5000 Hz for male speakers and to 6500 Hz for female speakers. Formant frequencies for the eight tokens of the GOOSE vowel as well as eleven other vowels (for normalization purposes) were extracted by script. Measurements were taken for F1, F2, and F3 at nine different points in each token of the GOOSE vowel, located across the vowel's duration. Cut-off points were generally those where F2 became clearly discernible, although in individual

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[6] Both datasets were collected by students in the class "E 321L - American English" at the University of Texas at Austin, taught by Underwood in the 1980s and by Hinrichs in 2010-11.

cases other factors (such as F1, F3, or the existence of periodic noise in the sound wave) were also taken into account.

Preceding coronal segments are known to have a strong influence on the realization of GOOSE. In MAE, a preceding coronal results in a higher F2 onset for the GOOSE vowel. In speakers showing the complete form of the Southern Vowel Shift, however, this effect is not noticeable (Baranowski 2008). In order to trace the variation induced by preceding coronals, each token in the dataset was coded for the place of a preceding consonant (labial, coronal, dorsal, or glottal); liquids were considered a separate group. This coding was also applied to the following segment, with an additional level for tokens in open syllables, i.e. with no consonant in coda position. In all, 349 tokens of GOOSE not preceding /l/ were gathered.

2 First approach: coding visualized formant trajectories

In a first attempt to capture sub-phonemic variation in the data, we created a separate graph for each token of GOOSE on which we plotted the nine values taken for F2, thus representing the horizontal trajectory of tongue movement throughout vowel production in each individual case. The *y*-axes of the graphs encompass the range of raw formant values in Hz for any given instance of GOOSE. On this dimension, the scale does not remain constant, but varies from token to token. It intersects the origin at 800 to 1500 Hz and extends upwards to values between 2200 and 3500 Hz. Since the focus here is not on absolute measures of frontness sensitive to interspeaker physiological differences, but rather on formant trajectory, no speaker normalization was performed. The *x*-axis represents duration, so that not all graphs extend all the way to the end of the two-dimensional space.

2.1 Manual coding

Each plot of GOOSE F2 was coded impressionistically using a scheme derived from examples given by Koops (2010). Duration was disregarded in this process as was all other information such as phonetic environment, lexical environment or any background on the speaker or time of recording. The coding scheme included three levels: “MAE” for plots approaching the diphthongal, backing trajectory described by Koops for non-Southern speakers, “SAE” for the relatively flat (or even slightly fronting) Southern trajectory, and “X” for cases where no clear assignment to either of the above categories could be made. Figure 4 shows three examples of vowel tokens plotted in this way.[7] Two of the authors independently coded all 408 tokens. For 139 tokens, no agreement on either “SAE” or “MAE” could be reached. Of the tokens with coder agreement, 95 were coded as MAE, 104 as SAE, and 209 as X. In other words, 52.2% of all cases (213 out of 408) were assigned a clear label as either MAE or SAE.

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[7] The appearance of a “worm” is an artifact of automated smoothing of the acoustic measurements.

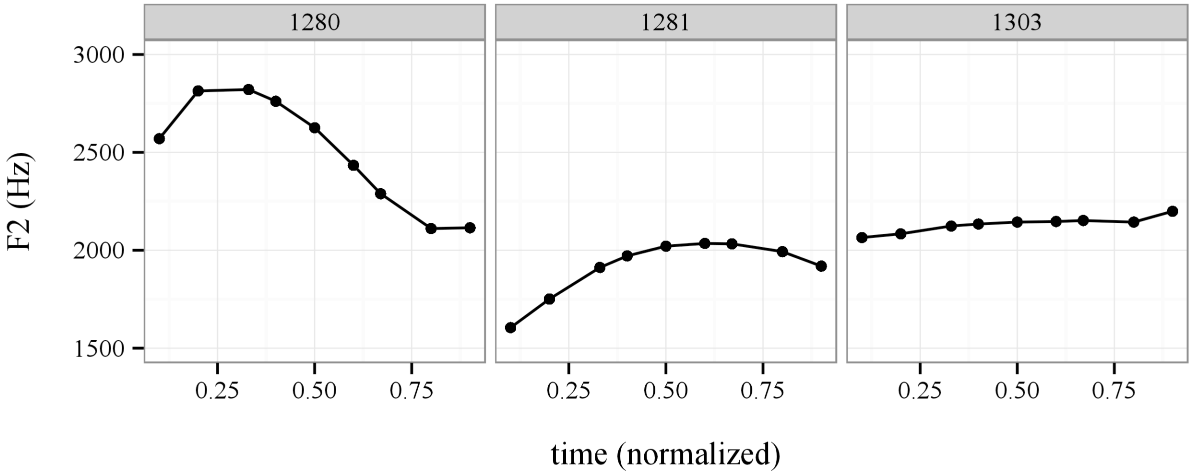

Figure 4: Three examples of GOOSE tokens from the dataset (*x*-axis: normalized time, *y*-axis: F2 in Hz.).

Figure 4 shows a clear case of a token with MAE F2 trajectory on the left (cf. Koops (2010)'s visualization in Figure 1), which both coders classified as "MAE". The plot on the right-hand side shows a relatively flat trajectory, which both coders classified as "SAE" (cf. Koops's visualization of a Southern-type token in Figure 2). The center plot, however, causes problems for manual coding. The procedure shows F2 trajectory without any context. The fact that the token's onset is low relative to the glide may be due to any number of reasons, including a preceding phonetic segment favoring lower F2 in the onset, or a following segment that favors higher F2 in the offset. Cases such as this caused problems for impressionistic coding and prevented inter-coder agreement rates from reaching an acceptable level of reliability, remaining as low as 60% in the present study.

Given the problems arising in impressionistic coding, we pursued a different method of coding variation in F2 trajectory. The next section describes this approach, in which the dependent variable was the difference between F2 at onset and at offset.

3 Second approach: F2(20%) - F2(80%)

3.1 Method

3.1.1 Dependent variable

The first analysis did not produce acceptable inter-coder agreement to justify quantitative analysis. What is needed is a measure of vowel trajectory that is less susceptible to individual coder errors and, we hope, more sensitive to social variation in the data. To achieve this, we measured the degree of backing in a given instance of GOOSE as the difference in Hz between F2 at the 20% and 80% points in each vowel's duration. The MAE GOOSE-fronting variant, as seen in Figure 1, will tend towards a positive value according to this metric, whereas the SAE variant as in Figure 2 will usually show a value near zero. Negative values are not represented in either Figure 1 or 2, but they do occur—usually as a consequence of co-articulation effects from adjacent segments—and can be included in the statistical analysis without a problem.

For this method, tokens of the vowel following /j/ (as in *infuse*) or preceding /l/ (as in *cool*) were excluded from the analysis, leaving a total dataset of $N = 349$. Raw formant values were not used, under the hypothesis that interspeaker physiological differences might distort this measure. Consequently, each speaker's vowel space was normalized according to a technique proposed by Watt & Fabricius (2002) and implemented by Kendall & Thomas (2010). For every vowel class except GOOSE, measures at the midpoint were taken, but for GOOSE we measured values at 20, 50, and 80% of duration. To calculate the outcome variable for the present analysis we subtracted the normalized F2 at 80% from that at 20% for each token of GOOSE. Visual inspection of the resulting measure, henceforth F2(20%) − F2(80%), suggested that this measure was approximately normally distributed in our sample: it has minimal skewness ($g_1 = 0.634$), consistent with apparent symmetry about the mean.

3.1.2 *Fixed effects*

Using this continuous outcome variable, we constructed a linear mixed-effects regression model (Pinheiro & Bates 2000). The following fixed effects were included:

- preceding phonetic environment: labial, coronal, dorsal, glottal, or liquid;
- following phonetic environment: the levels of the preceding environment factor, with GOOSE in syllable-final position coded separately, as "coda";
- speaking style, according to the type of elicitation used: interview, reading passage, or wordlist;
- speaker gender;
- speaker age at time of recording; and
- speaker year of birth.

3.1.3 *Centering and residualization of variables*

So as to satisfy the assumptions of linear modeling, and to achieve numerical stability and efficient convergence with the mixed-effects model estimation procedure, all predictors must be orthogonal (that is, uncorrelated). This is particularly important for speaker year of birth, a measure representing real time, and speaker age at time of interview, a measure representing age-grading). In a longitudinal study of sufficient length, year of birth will be inversely correlated with age because the youngest speakers will not even have been born at the start of the study. In our sample, for instance, the youngest speaker interviewed in the second half was born in 1993, years after the original recordings were made. In our sample, age and year of birth were very strongly correlated ($r = -0.86$); consequently, both measures cannot be included in the same regression model as is. Including both age and year of birth in addition to all the predictors described so far results in a condition number (κ) of 400 and a variance inflation factor (VIF) of 8.3; $\kappa > 30$ and VIF > 5 are thought to indicate problematic degrees of multicollinearity (Belsey, Kuh, & Welsch 1980). To eliminate this multicollinearity, we use a technique known as *residualization* (Gorman 2010). For two partially correlated predictors, residualization consists of simply replacing one predictor with the component of it which is uncorrelated with the first predictor. (Correlation among predictors is computed by simple linear regression.) Here, speaker year of birth is entered first, and speaker age is residualized against it. Both of these are then *centered*; that is, they are scaled by subtracting out the mean value for each.

3.1.4 Random effects

In addition to the fixed effects described above, we use a “maximal” (as large as possible) random effects structure. This includes per-speaker and per-word random intercepts (e.g., Johnson 2009), as well as per-speaker random slopes for speaking style. Additional random slopes resulted in non-convergence. This model allows speaker and word to vary in their degree of F2 change, and also allows speakers to vary in degree of style shifting, but holds grammatical conditioning constant across the sample, corresponding to standard definitions of the speech community (e.g., Guy 1980).

3.2 Findings

3.2.1 Linear regression modeling: significance of factors

To compute p-values for individual predictors, we use the log-likelihood ratio test to compare the full model to a model with the same random effects structure but with the corresponding fixed effects removed, following Barr *et al.* (in press). One effect is significant: women have a significantly larger F2(20%) − F2(80%) than men ($p = 0.0064$), consistent with the hypothesis that the MAE fronting variant is in the process of replacing the SAE variant and the well-known tendency of women to lead sound changes in progress (Labov 1990); however, neither year of birth nor speaker age approaches significance.

3.2.2 Relative importance of factors

It is premature to conclude that there is no apparent time trend in F2(20%) − F2(80%); our failure to find significant trends in real or apparent time may simply reflect the low statistical power of our small sample. Rather than focusing on p-values, we now consider relative effect size, which is insensitive to sample size. To compute this, we use a method independently proposed by Kruskal (1987) and Lindeman et al. (1980: 119f.), among others. We first compute the residual R^2 for all possible orders in which the fixed effects may be entered into the model, then average across the different orderings, then finally, scale these averaged residual R^2 values so that they sum to 1; this represents the relative variance accounted for by different predictors. The resulting values are shown in Table 1 below.

We see that preceding and following phonetic context are the most important predictors of F2(20%) − F2(80%); the gender effect, while more reliable in our sample, has a much smaller effect on the dependent variable. Elicitation style falls between the phonetic factors and gender. Here, the word list data provide the most favorable condition for a high F2(20%) − F2(80%), i.e. the MAE variant of GOOSE.

Predictor	Relative effect size
style	0.13
preceding environment	0.36
following environment	0.36
gender	0.03
year of birth	0.03
age at time of interview	0.09

Table 1: Relative effect size of factors in the analysis.

4 Discussion and conclusions

Following Koops (2010)'s description of the two variants of GOOSE present in TxE, in this paper we developed a method for studying their sociolinguistic distribution and its development in real and apparent time. We tested two ways of modeling variation on the sub-phonemic level and found a scalar measure of the difference between normalized F2 at 20% and at 80% of vowel duration to be best suited for our analysis. Compared to impressionistic coding, this approach leaves less room for annotator errors and is better able to capture subtle variation in the data. Linear regression modeling was performed with the F2(20%) – F2(80%) measure as the dependent variable and a number of linguistic and sociolinguistic predictors, including a maximal random effects structure. To avoid issues of collinearity, speaker age was residualized against speaker year of birth and both predictors were centered.

The statistical analysis of factor significance indicates that only speaker gender exerts a significant influence on the dependent variable, the difference in Hz between F2 at the 20% and 80% points in each GOOSE vowel's duration. An ordering of the relative effect sizes of our predictors, which is less sensitive to our comparatively small sample size, suggests the additional importance of preceding and following phonetic segments as well as interview style. While the size of our sample prevents us from making any firm conclusions, then, we do find socially ordered variation in TxE GOOSE. Both the effect of gender and that of interview style follow the predicted direction of an on-going change from above, with women favoring the innovative MAE variant and the entire sample favoring it in formal, word list elicitation style. With respect to the general development of TxE, the picture that emerges from the present study falls in line with the trend toward dialect leveling observed by Bailey *et al.* (1991). Speakers, especially women, orient towards an innovative prestige variant associated with mainstream US speech in the most formal contexts, rather than maintaining the traditional Southern pronunciation.

To enable a more comprehensive view of the sociolinguistic development GOOSE is undergoing in TxE and to corroborate our findings with a more solid quantitative basis, the collection and/or transcription of more data is required. This will not only increase the statistical power of our models, but allow us to include necessary additional factors in the analysis. Most noteworthy, our discussion in the present paper has been restricted to Anglos. In future research we intend to examine the dynamics of the change described here across ethnic groups, including at least the two major groups in the region besides Anglos: Hispanics and African Americans. Additionally, a series of matched-guise perception experiments is planned in order to assess whether hearers distinguish between and/or ascribe social meaning to the variation we observe at the sub-phonemic level in GOOSE.

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