1. INTRODUCTION

Certain vowel characteristics have long been recognized as hallmarks of linguistic variation in what has been described as the Southern U.S. dialect of the United States. The study presented here utilizes the *Linguistic Atlas of the Gulf States* (*LAGS*) (Pederson et al., 1986), an extensive sociolinguistic audio corpus available through the *Linguistic Atlas Project* (Kretzschmar, 2011) at the University of Georgia, to explore whether features typically thought of as Southern are present in the speech of ten speakers from southeastern Georgia. Concomitantly, we present methods for analysis of this under attended resource, with the hope of encouraging future acoustic research on *LAGS*.

Presented here is a preliminary, non-exhaustive exploration of the data available in *LAGS*, that specifically considers productions of vowels involved in the Southern Shift (Fig. 1). The *Atlas of North American English* (*ANAE*; Labov et al., 2006), describes this shift as beginning with the monophthongization of the diphthong /aɪ/ to long /a:/ in open syllables as in *high, why,* and *my,* and before voiced consonants as in *five, ride, wide,* and *while*. Additionally, the tense /eɪ/ in *paper* and *bait* moves down in the vowel space, and the lax /ɛ/ in *guess* and *bet* moves up, effectively meaning that these two vowels begin to share vowel space, and eventually swap places. The tense /i/ in *tree* and *beat,* and the lax /ɪ/ in *kitchen* and *bit,* behave similarly, also switching places in the vowel space with the former moving downwards, and the latter moving upwards. These shifts are reported to trigger raising and fronting of the low front vowel /æ/ as in *dad* and *have*, as well as fronting of the back vowels /oʊ/ as in *road* and *know,* and /u/ in *room* and *two*.

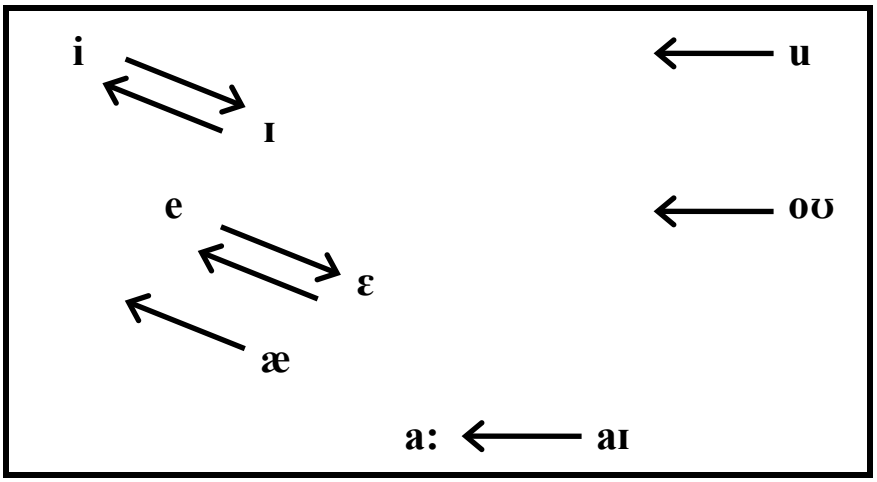

Figure 1. The Southern Shift as adapted from the Atlas of North American English (Labov, Ash, & Boberg, 2006).

Although the *ANAE* features impressionistic analysis of speech produced by speakers throughout the Southern U.S., comparatively little acoustic analysis was performed. Speech from the region of interest to our study (a collection of five counties in southeastern Georgia) was never acoustically analyzed, with the closest acoustically analyzed speech coming from only two speakers (both female and age 43) from Jacksonville, FL. We in fact expect that there is greater speaker variation in the region than that which is captured and represented in *ANAE.* Although impressionistic descriptions of Southern speech are common (Dorrill, 2003; Thomas, 2005), acoustic analyses often offer a more objective and thorough picture of speech. Few acoustic

analyses of the kind detailed here, in which spontaneous or near-spontaneous speech is examined, have been undertaken (cf. Clopper et al., 2005; Feagin, 2003; Thomas, 2001, 2003).

LAGS (Pederson et al., 1986) features sociolinguistic interviews with 1121 speakers recorded from 1968-1983 in the states of Florida, Georgia, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, and Texas. The corpus' original purpose was to gather wordforms and phonetic transcriptions of specific target lexical items, which were analyzed by *LAGS* fieldworkers and trained scribes. However, these lexical items were produced in the context of an interview, and thus all other words uttered by the participants during these sessions remain to be analyzed (Pederson, 1976). Furthermore, previous phonetic analysis of *LAGS* was impressionistic, and did not have the benefit of scriptable or automated analysis tools.

Below we analyze vowels produced by speakers in this historical corpus, in order to study Southern speech as spoken in Southeast Georgia in the early 1970s. We compare our findings to previous descriptions of the Southern Shift in particular. This was accomplished by mapping vowel productions in selected lexical items spoken in one well-sampled speaker area of *LAGS*. Our acoustic analysis reveals considerable variation within the productions of individual speakers, even at the level of individual lexical items. Variation across speakers is also present, particularly with respect to hallmark features of Southern speech, even though our sample draws from a small geographic area. A secondary goal is to demonstrate a method for working with the *LAGS* corpus to collect large data sets for acoustic analysis. Importantly, *LAGS* provides a snapshot of historical speech against which present-day speech in the region may be compared. The methods applied here thus serve as a model for exploring other speaker areas of *LAGS*.

2. METHODS

A. *LAGS* Materials

Audio recordings from *LAGS*, originally recorded on cassette or reel-to-reel tape, have been digitized and are publicly available on the website of the *Linguistic Atlas Project* at the University of Georgia, www.lap.uga.edu (Kretzschmar, 2011). Accompanying these recordings, though not available on the website, are written *Protocols* available in microform (Pederson, 1981), which contain narrow phonetic transcriptions of as many as 1031 target lexical items per speaker elicited by *LAGS* fieldworkers, although often far fewer items were successfully elicited and transcribed (Pederson et al., 1986). Interviews typically lasted for hours, involving spontaneous speech and description by the interviewee, amounting to a total of 5300 hours of audio (Montgomery and Nunnally, 1998). Only a fraction of this audio (i.e., the individual target lexical items) has been transcribed, however, meaning that there is a wealth of phonetic information yet to be analyzed.

For *LAGS*, each individual's data were processed by transcribers into a handwritten *Idiolect Synopsis*, with examples of vowel productions in different environments, as well as other morphological and lexical features. Interviews for each state are divided into *LAGS* speaker areas, which typically include a set of contiguous counties, created on the basis of social, geographic and historical factors. There is presently no precise time alignment between lexical items referenced in the *Protocols*, and their location in the audio. For this reason, and because the remaining words were never noted, the corpus effectively remains untranscribed from the perspective of modern acoustic phonetics. However, *LAGS* has the potential to offer thousands of hours of continuous dialect speech.

B. Transcription and data selection

This study is the first to present acoustic analyses of fully transcribed *LAGS* interviews. The *LAGS* speaker area *AK*, highlighted in Fig. 2, comprises the southeastern Georgia counties of Ware, Charlton, Camden, Glynn, and Brantley (however no speech from this county was collected) and is considered by *LAGS* a complete speech community. Its ten speakers (for whom audio is available; 5M, 5F; mean age = 63.7) vary widely in age, sex, race, occupation, county, and education. Table 1 provides demographic information for each speaker. Speaker numbers were assigned by *LAGS*. The aforementioned sociolinguistic factors were coded following *LAGS* conventions: Gender (male = M, female = F); age (years), Race (African American = AA, white = W); Socioeconomic status (SES: lower class = L, middle class = M, upper class = U); Hours of audio; and total number of words available per speaker (count).

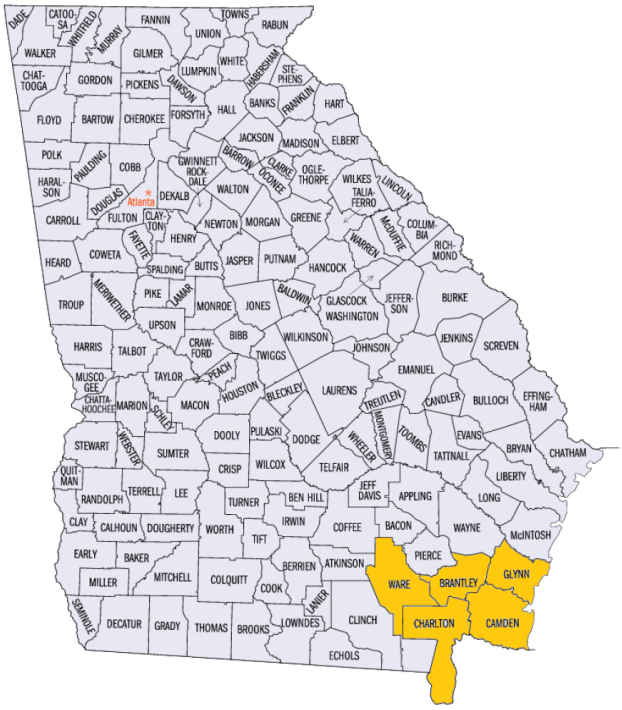

Figure 2. Map of Georgia, with counties in LAGS speaker area AK highlighted.

Table 1. Speaker information

Speaker	County	Age	Gender	SES	Race	Hours of audio	Number of words
195	Camden	80	M	M	W	9h	74,083
197	Charlton	72	F	M	W	1h 10min	4,740
197A	Charlton	71	M	L	W	2h 50min	4,812
198	Charlton	76	M	M	W	2h 10min	7,787
199	Ware	78	M	L	W	4h 20min	15,466
199A	Ware	50	M	M	W	1h 55min	2,031
200	Glynn	74	F	L	AA	4h	10,532
201	Glynn	23	F	M	AA	3h 15min	2,850
201A	Glynn	58	F	M	W	3h 10min	4,673
202	Glynn	55	F	U	W	3h 15min	5,360

Digitized linguistic interviews with these speakers were made available via *The Linguistic Atlas Project* at the University of Georgia (Kretzschmar, 2011). For manageability, the 30-minute files were divided into smaller pieces of approximately 3.5 minutes each. Transcription was carried out in SPPAS (Bigi and Hirst, 2012), at the utterance level, using the software package's tools for silence detection, TextGrid creation and manual orthographic transcription (IPU Transcribe). The resulting Praat TextGrids (Boersma and Weenink, 2015) were used to create a searchable index file of over 132,300 words linking word labels to utterance-level audio time stamps, which was used to identify candidate target words.

C. Target items

While most dialect studies focus on particular keywords that indicate regional variation, given the full transcriptions generated for this project, our goal was to identify and sample words that appeared most often across speakers. In this way it was possible to obtain a representative sample of monophthongs and diphthongs produced by each speaker, typically with multiple repetitions of each word. We selected words that were (a) spoken by as many speakers as possible, preferably with multiple repetitions, which also (b) contained a vowel targeted in our study that was (c) likely to be stressed, and thus unreduced.

We then returned to the TextGrids and audio to annotate individual target words and vowels. Vowels were coded according to canonical citation forms of the words. Any tokens that were deemed unsuitable for analysis were left unannotated. 143 unique lexical items were grouped by root (e.g. *higher, highly,* and *high* were grouped as *high),* and a total of 36 unique root words (1974 total tokens) have been analyzed. Table 2 below shows the total number of tokens per vowel, and the root words gathered for each vowel. It should be noted that this is an initial, non-exhaustive analysis, and not all productions of each target word and vowel have yet been annotated.

Table 2. Tokens and root words per target vowel

Vowel	Tokens	Root words
aɪ	582	right, white, wife, five, side, nine, high
æ	240	have, had, dad
ɑ	161	got, lot, father, hog, closet
ɛ	80	fence, guess
eɪ	64	place, paper, name
i	146	tree, three
ɪ	69	think, kitchen, mill
oʊ	222	know, home, road
ɔ	194	call
u	76	school, room
ʊ	92	put, wood, bull
ʌ	48	sun, stuff

D. Acoustic analysis

The recordings, originally made on cassette or reel-to-reel tape, contained a high-frequency buzz. All .wav files were thus subjected to a high-pass Hann band filter (with 100 Hz smoothing) above 15000 Hz to eliminate this noise. Acoustic characteristics of all target vowels were automatically extracted in Praat (Boersma and Weenink, 2015), in two different ways. In each

case, the formant extraction algorithm was manually optimized for each speaker. To plot the vowels as monophthongs in F1, F2 space, we sampled formants F1, F2 and F3 at the vowel midpoint. Because of the noisy nature of some recordings, the resulting data were hand-checked and corrected.

To examine spectral change over time, we extracted F1, F2, and F3 at 10% intervals of each target vowel's duration, using the same speaker-specific formant settings. It is not currently feasible to hand-check these data, and thus we only present the interval data as averages with confidence intervals equivalent to one standard deviation. While the time-interval data allow us to evaluate spectral change over the course of the vowel, the midpoint data are traditional in dialectal analyses and are immediately comparable to the predictions of the Southern Shift model. We present results from either the midpoint formant analysis or from the time-step analysis, depending on the characteristics of each target vowel.

3. RESULTS

A. Acoustics of /aɪ/ in coastal Georgia

Because the monophthongization of /aɪ/ has been described as the feature that triggers the movement of the other vowels, particular focus was given to analysis of this vowel. Monophthongization is expected to occur before voiced coda consonants, and word-finally, but not before voiceless consonants (in the particular region of the South examined here); however, as this description is based on limited data, lexical items with /aɪ/ followed by voiceless consonants were included to explore whether monophthongization also occurs in these words. Of particular interest for the canonically diphthongal /aɪ/ was its F1, F2, F3 trajectory across the length of the vowel, as movement in the F2 across the vowel would indicate a diphthong (predicted when the vowel is followed by a voiceless consonant, as in *white*), and a flat trajectory would indicate a monophthong (predicted when the vowel occurs word-finally as in *high,* or is followed by a voiced consonant as in *side*).

Based on the data presented in the *ANAE*, we would expect monophthongization of /aɪ/ by all speakers word-finally and before a voiced sound, but not before a voiceless sound. This element of the shift is thought to have occurred as early as the late 1800's (Thomas, 2005); thus we would expect even the oldest speakers to demonstrate such monophthongization. Figure 3 shows the mean trajectories of this vowel in the three aforementioned phonetic environments for each individual speaker. Given the aforementioned *ANAE* data, monophthongization (indicated by a flattening of the F2 of the vowel, vs. a convergence of F2 towards F3 in a diphthong) is predicted in the first two columns of the figure, but not in the third. While this pattern is observed in some speakers (200, 201, & 202), it is crucially not observed in all speakers. Speaker 195 (the oldest speaker at age 80), does not monophthongize in any phonetic environment, while speakers 197 and 201A monophthongize in every environment. Speakers 197A and 198 contradict the predictions mentioned above by monophthongizing only before a voiceless sound.

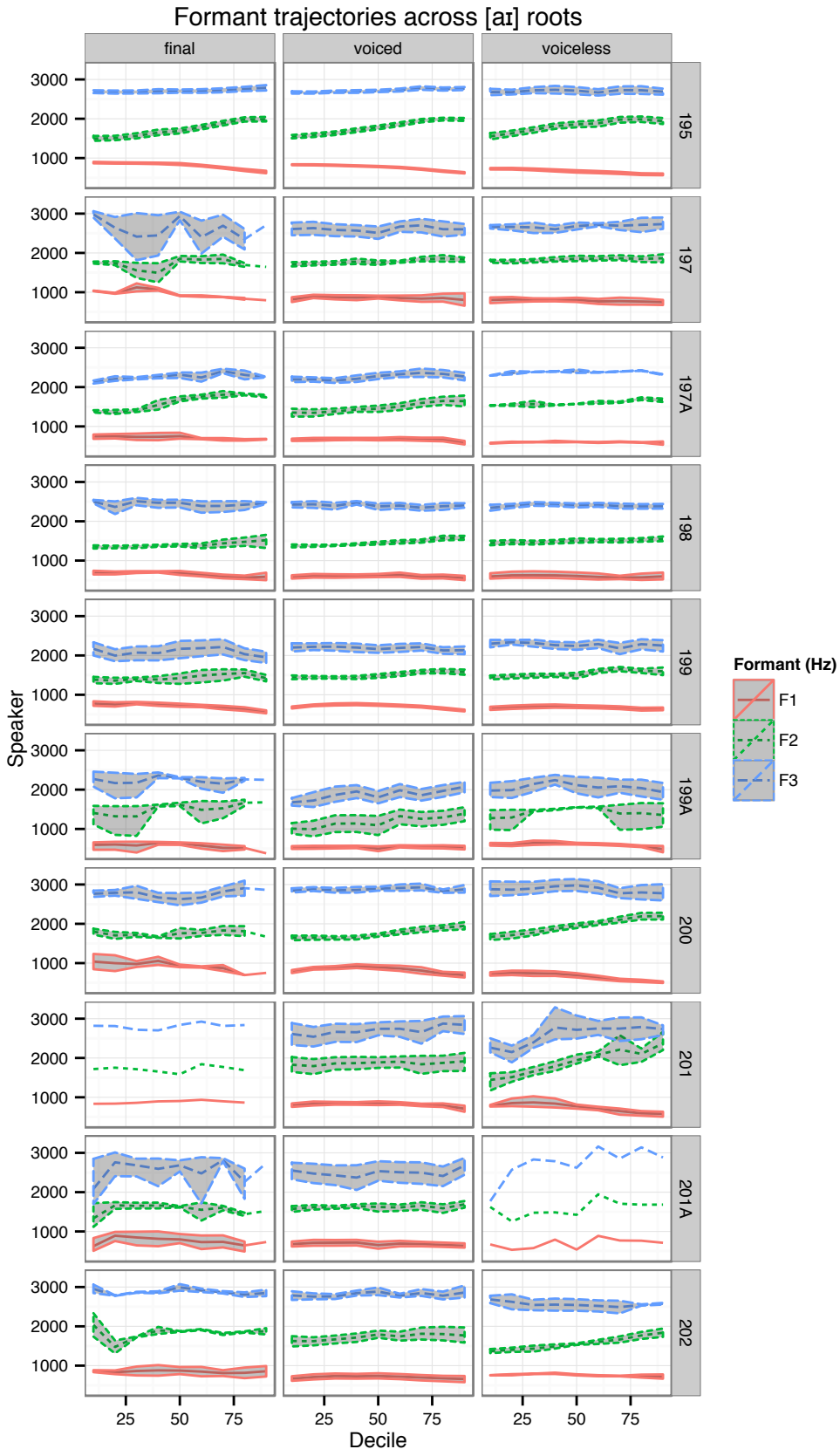

Figure 3. Mean trajectories of /aɪ/ across phonetic environments (confidence band = 1SD).

B. Acoustics of monophthongs in Coastal Georgia

The Southern Shift also predicts that /eɪ/ and /ɛ/ share, or swap, vowel spaces, as do /i/ and /ɪ/. The low front vowel /æ/ is predicted to rise, and the back vowels /oʊ/ and /u/ are predicted to front. As in the previous section, these Southern speech features are observed only in some speakers. Figures 4 and 5 illustrate how vowel productions for each speaker were examined. All productions were first plotted, as shown for Speaker 195 in Fig. 4. Average productions of words were calculated and plotted, along with ellipses calculated by vowel provided there were enough productions of the vowel to do so (as shown in Fig. 5).

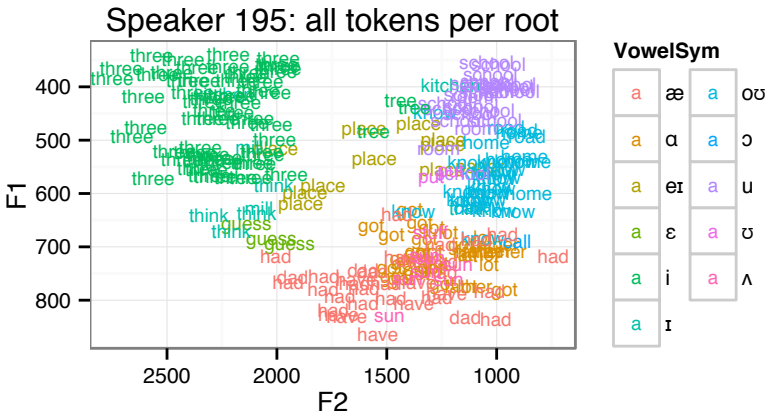

Figure 4. All productions of words by Speaker 195.

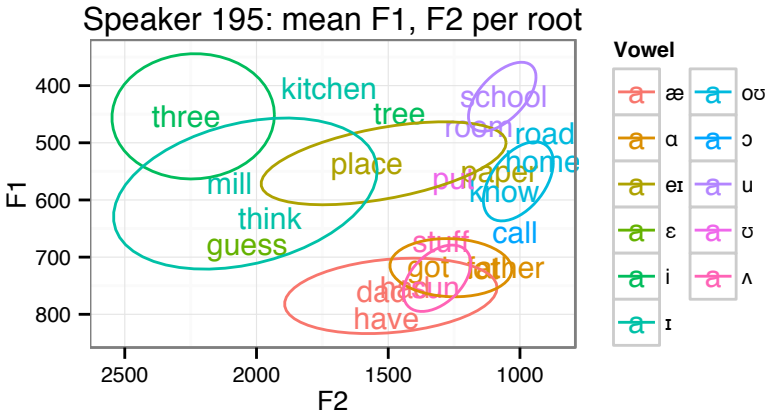

Figure 5. Average F1, F2 of each word produced by Speaker 195; ellipses (1SD) by vowel.

Speaker 195 does not seem to demonstrate any of the features predicted by the Southern Shift. While there is some overlap of the /i/ (*three, tree*) and /ɪ/ (*mill, think*) vowel spaces, it is minimal.

The minimal overlap of Speaker 195's productions may be compared to the vowel space of Speaker 197 in which vowel overlap is more pronounced (see Fig. 6). Of the ten speakers examined here, Speaker 197 demonstrates the most evidence of the Southern Shift: her data show overlap of /eɪ/ (*paper, place, name*) and /ɛ/ (*fence, guess*), raising of /æ/ (*had, have, dad*), and fronting of /oʊ/ (*know, home*) and /u/ (*school*). Nonetheless, this speaker does not show any overlap of /i/ (*tree, three*) and /ɪ/ (*mill, think*).

No speaker in this dataset demonstrates all features predicted by the Southern Shift. Additionally, there is no discernible pattern to the features that speakers do display. Speakers

197A, 198, 199 and 199A, for instance, do not display monophthongization of /aɪ/ in the predicted contexts (word-finally, and before a voiced consonant), which has been described as the triggering feature of the entire shift; however, these speakers still show some consequent features of the shift, raising of /æ/ for speakers 199 and 199A, overlap of /i/ and /ɪ/, and /eɪ/ and /ɛ/ for speakers 197A and 199A, overlap of /eɪ/ and /ɛ/ for speaker 198, and fronting of /oʊ/ and /u/ for speakers 198 and 199A. Table 3 details features of the Southern Shift produced by each speaker, while Fig. 7 provides charts all speakers' vowel spaces.

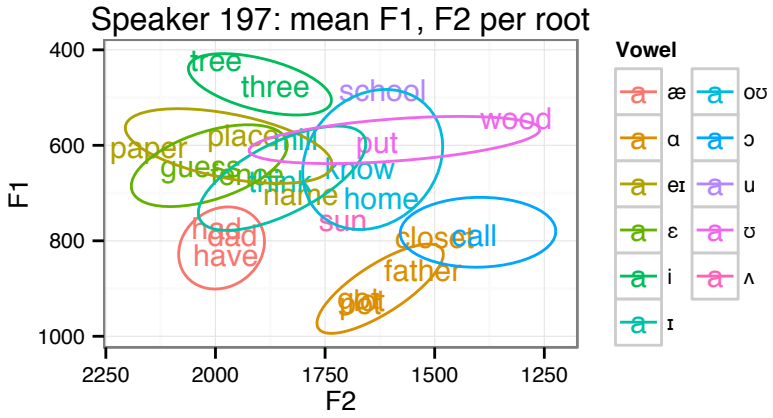

Figure 6. Average F1, F2 of each root word, with ellipses (1SD) by vowel, for Speaker 197.

Table 3. Southern Shift features displayed by each speaker. (+) indicates that the feature is displayed by the speaker. (*) indicates a feature not predicted by the Southern Shift for this region of the South; however, this feature is predicted by the Shift in other Southern regions.

Feature		195	197	197A	198	199	199A	200	201	201A	202
/aɪ/ → [a:]	/__ #		+					+	+	+	+
	/__ [C_{+voice}]		+						+	+	+
	/__ [C_{-voice}]*		+	+	+					+	
/i, ɪ/ overlap				+			+		+		
/eɪ, ɛ/ overlap			+	+	+		+		+	+	+
/oʊ/ fronting			+		+		+				
/u/ fronting			+		+		+				+
/æ/ raising			+			+	+		+		+

These results indicate that contrary to the representation of Southern speech in the *ANAE,* the Southern Shift is not prevalent in its entirety in this region of the South, and that where predicted features do occur, they do not necessarily occur in the order or manner predicted. Furthermore, features of the Southern Shift that are not predicted to be present in the particular region of interest here, but which are present elsewhere in the South (e.g. the monopthongization of /aɪ/ before voiceless consonants), are indeed present in the speech of some speakers of this region.

It must also be noted that wide variation within individual speakers is evident in the data. Figure 8 illustrates individual variation observed for three words, *call, have,* and *three.* The word *call,* for instance, ranges in pronunciation from [kɑl] to [kɔl] to [kol], particularly in Speakers 197A, 198, and 200. If the wide variability detailed above within and across individuals is indeed the case in one geographically small speaker area, we should consider whether these results are generalizable to other speaker areas and to the wider Southern dialect region.

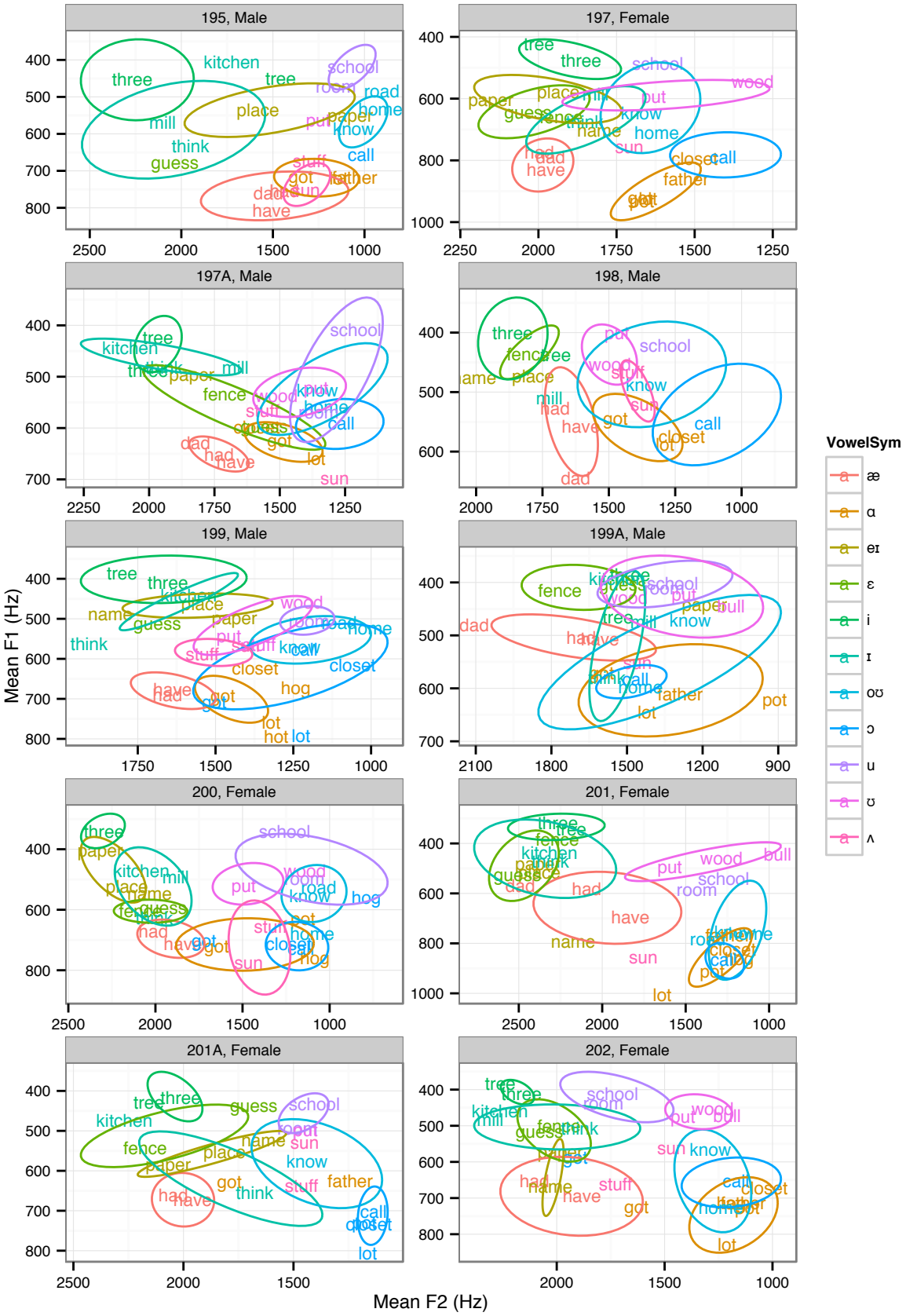

Figure 7. Average F1, F2 of root words, with confidence ellipses (1SD) by vowel, for all speakers.

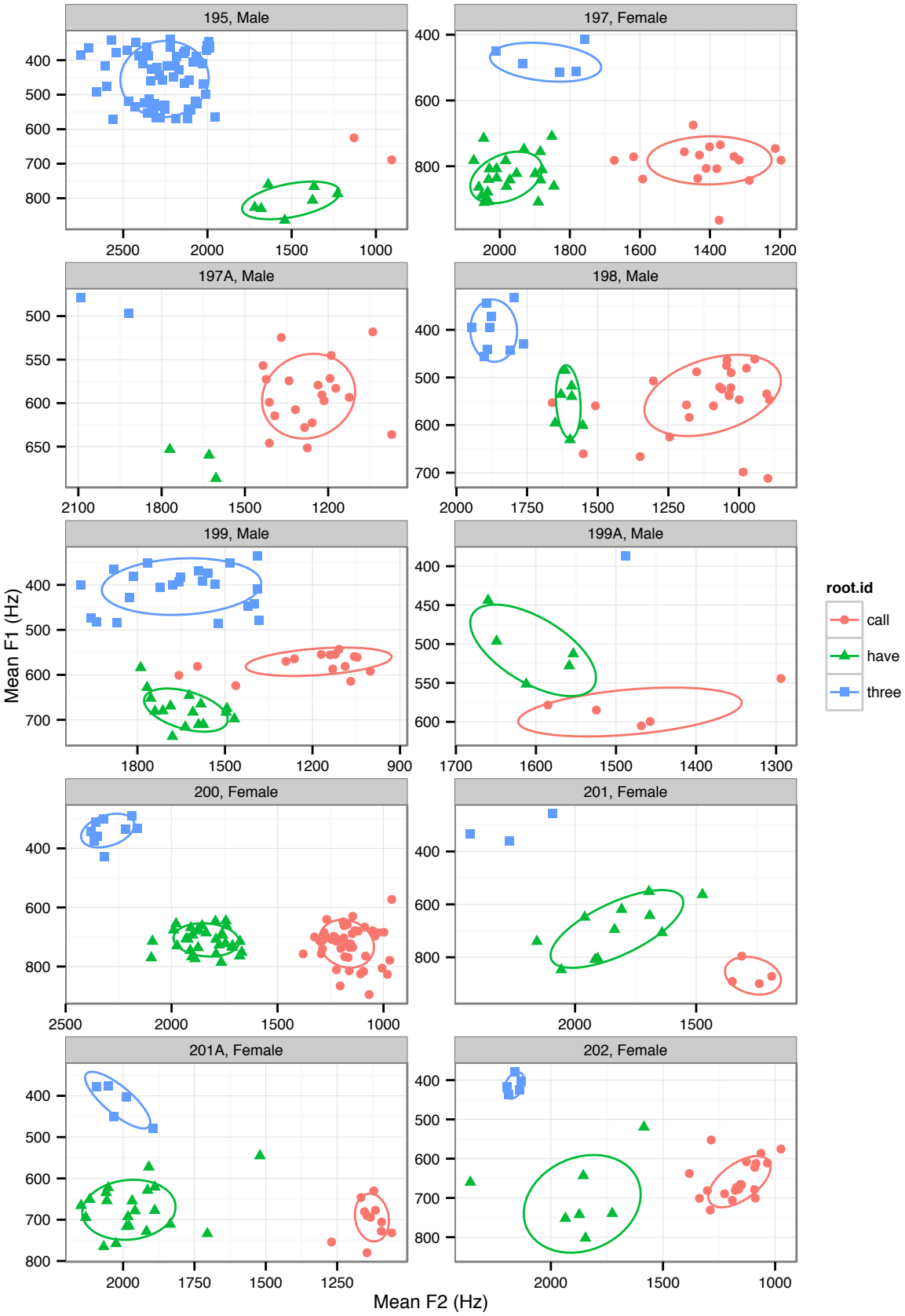

Figure 8. F1, F2 of three root words, with confidence ellipses (1SD) by vowel, for all speakers.

4. DISCUSSION

In this acoustic analysis of full *LAGS* interviews, wide variability in vowel production within individuals, and across speakers, has been demonstrated in the target lexical items examined. While some speakers used Southern speech features some of the time, these features were by no means used all of the time. Additionally, some speakers did not use certain Southern speech features at all. This is not to say, however, that these speakers do not "sound Southern". Further analysis of other typically Southern speech features (e.g. post-vocalic rhotic deletion) are planned.

Overall, gaining a comprehensive picture of vowel productions via transcription and analysis of *LAGS* constitutes an important step forward in representing dialectal speech patterns. This set of objective acoustic data additionally provides a basis for comparison of present-day speech obtained in studies of the region today and could facilitate analysis of language change over time. Findings such as ours, that features of the Southern Shift are not uniformly applied across all speakers within a small geographic area, point to the complexity of dialect description. Such outcomes should encourage not only further, and more detailed, analyses of historical corpora, but also a more fine-grained approach to the analysis of speech in present-day dialectology. Future work on this corpus will include an increased sample of lexical items, as well as quantitative measures for evaluating the presence of Southern dialect features in coastal Georgia.

ACKNOWLEDGMENTS

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