

VOWEL PRODUCTION VARIATION IN  
COLLEGE STUDENTS BASED ON  
SOCIAL INTEGRATION

by

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A THESIS

Submitted in partial fulfillment of the requirements  
for the degree of Master of Science  
in the Department of Communicative Disorders  
in the Graduate School of  
The University of Alabama

TUSCALOOSA, ALABAMA

2020

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## ABSTRACT

Exemplar theory represents the encoding of individual experiences as a collection of episodic memories known as exemplars, which form “exemplar clouds” (Drager & Kirtley, 2016). Originally used to model phonetic classification in perception, the exemplar theory has been extended to speech production with evidence that the perception-production loop can cause shifts over time. While exemplars are considered robust and stable categories, Clopper (2014) suggested that shifts can occur when individuals move to an environment in which they are exposed to a high quantity of exemplars from different regional or social distributions. The present study investigated the following research question: Does involvement in highly structured social groups, such as Greek life, influence the variation of vowel productions in young adults? The overarching purpose of the study was to explore how immersion in new social groups leads to exemplar shifts in college students. The data from this study was collected from 30 in-state female students at The University of Alabama (15 Greek, 15 non-Greek) from a semi-structured interview, reading passages, and word list tasks. Results indicated a statistically significant difference in degree of monophthongization of /aɪ/ based on Greek status. Specifically, participants in Greek organizations were significantly more diphthongal in reading passages and word list tasks, and the difference was trending towards significance for conversational tasks and all tasks combined. Thus, these results indicate that involvement in highly integrated groups such as Greek life may impact exemplar shifts in college students.

*Key words:* sociophonetics, exemplars, production shift, social integration, monophthongization

## DEDICATION

This thesis is dedicated to my family who have always been there with love, encouragement, and support.

## LIST OF ABBREVIATIONS AND SYMBOLS

ANOVA	Analysis of Variance
$\alpha$	alpha; the level of significance
$p$	p-value; the probability of the obtained results occurring under the assumption of the null hypothesis
F1	first formant
F2	second formant

## ACKNOWLEDGEMENTS

I am incredibly grateful to all of the professors and supervisors in our department for their guidance and mentorship. I would especially like to thank Dr. Reed, my committee chair, for his guidance and assistance on this project and for always being willing to answer endless questions. Thank you for being so willing to share your knowledge and expertise of research and linguistics to guide this project. I would also like to thank my committee members Dr. Cheimariou, Dr. Yoo, Dr. Buhr, and Dr. Picone for their insight and support. I am also grateful for the lab workers and undergraduate students who helped make this project possible. Last but not least, I am grateful for the love and support of my friends and family throughout this project.

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## 1. INTRODUCTION

Originally used as a theory to model phonetic classification in perception, exemplar theory has been extended to aspects of speech production in recent research with evidence that the perception-production loop can cause shifts in linguistic production over time. In particular, exemplar theory provides a successful model for vowel categorization (Pierrehumbert, 2000). Each experience with different phonetic tokens slightly alters the entire system of exemplars. When these changes accumulate, the distribution of different forms may shift (Gahl & Yu, 2006). Clopper (2014) proposed that robust categories are highly stable and usually do not drift; however, shifts may occur when an individual must frequently process forms that differ from previous experiences and exemplars, such as the result of moving or encountering a new social or regional distribution. Although the current literature acknowledges exemplar theory and has formed a solid basis of understanding for how initial exemplar clouds are formed, there has not been as much research on how these forms might shift later in life or what the implications of these shifts might be.

Munson (2010) described sociophonetics as containing both the “*signifiant*” and the “*signifié*.” The *signifiant* refers to the phonetic form, such as a monophthongized /aɪ/, and the *signifié* refers to the social meaning, such as the social group associated with the specific production. Munson proposed that the *signifié* can refer to social stratifications such as age, social class, ethnicity, regional origin, sexuality, and others. Research by Gahl and Yu (2006) indicated that individual representations are associated with socio-indexical information as well as with phonetic information. Foulkes and Docherty (2006) concluded that speech production

cannot convey solely linguistic information without simultaneously serving to index some degree of social information. Additionally, recent research by Drager (2015) has underscored the need to incorporate social theory into linguistic theories such as exemplar modeling. At least some variation in speech production is correlated with the speakers' social characteristics. Even when exemplars are created, the speech of the interlocutors indexes more than just linguistic information. Other factors such as the situation of the conversation and social characteristics of the speaker are also indexed alongside the phonetic details of the speech production. Not only is one's production influenced by social factors, but Drager (2005a, 2005b, 2011) and Staum Cassanto (2008) suggested that social factors of both the listener and the speaker, such as perceived gender, age, social class, and race, can also influence an individual's perception of speech. Furthermore, Drager and Kirtley (2016) reported that exemplars might predict sociolinguistic variation of which the speaker may not even be aware. According to Nycz (2016), explicit awareness is not required for an individual to acquire a certain phonetic feature. Exemplars, therefore, can be both socially and phonetically indexed, but the speaker likely will not even consciously notice the patterns. These social attributes may portray information about the speaker such as membership to a specific social group, and as such, the distinctions may even be socially learned. Cramer, Tamasi, and Bounds (2018) explain that while individuals can judge each other by a variety of more or less subtle cues such as age, clothes, education, professions, or others, nothing is as commonly or as accurately used to judge a speaker as their own speech. After just a few seconds of speech, a listener is able to make certain perceptions and categorizations of the speaker. However, speakers and listeners are usually not actively aware that they have encoded such information (Clopper & Pisoni, 2004a). Drager and Hay (2012) used case studies to explore how differences in productions based on exemplar modeling

could be used to classify different social groups. They found that groups could be indexed by social classification as observed by where and with whom they ate lunch. Therefore, exemplar theory can be extended past simply explaining the perception-production loop of phonetics to exploring socio-indexical information encoded in the exemplars. While more research still needs to be conducted, there is evidence that a speaker's exemplar clouds are heavily influenced by membership in and participation in certain social groups.

One point of interest has been the various factors that might influence exemplar shifts. Clopper (2014) found that more recently encountered exemplars will have stronger representation in the exemplar cloud, which might account for a relatively rapid adaptation. Furthermore, the authors explained that while most exemplars are robust and unlikely to shift over time, encountering a large quantity of new tokens as the result of changing one's environment could cause a shift. For example, if a speaker becomes a member of a new social or regional group, the exemplar distributions would be different than the speaker's previous environment, which would alter the tokens to which the speaker was exposed. Bybee (2001, 2002) emphasized the importance of token frequency as a factor in exemplar shifts. Similarly, Sancier and Fowler (1997) studied what factors might be responsible for changes in speech production well after the critical period for language acquisition. The researchers concluded that shifts might be the result of the speaker's attempt to imitate the speech he/she hears that is affiliated with a certain social group. In other words, the speaker's productions may shift as the speaker is adjusting to a new environment and attempts to align him- or herself with a particular social affiliation and the concomitant social meanings the particular affiliation conveys. However, the study called for more research to determine if there is a more profound reason behind shifts in production than a disposition to imitate. Pierrehumbert (2003) supported these

findings and proposed that community feedback is a powerful tool in the exemplar system, especially once the system has matured.

Based on this research, a prominent question of discussion is why certain groups adopt certain variants but avoid others. An important distinction is to note that speakers' productions do not shift simply because of membership or association with a group, but specifically because they want to be associated with that group and/or they want access to the social capital that specific group possesses. Eckert (2000) proposes that children are able to recognize that language patterns are associated with social possibilities from a rather young age. The meaning associated with particular variations is constructed based on individuals' relationship to, and opinion of, certain social groups, as well as their relative places and statuses within the social context. Drager (2015) cites Labov (1963) and his work in Martha's Vineyard to explain how speakers decided which variations to adopt. Rather than adopting variations associated with overt prestige in other areas, the speakers adopted local variations that were associated with covert prestige on the island. These speakers understood the emotions and opinions of the people on the island and actively sought to be associated with the local fishermen rather than the visitors or "outsiders." Similarly, Trudgill (1974) described male speakers acquiring variations typically oriented towards working-class that were associated with covert prestige rather than overt prestige. Furthermore, Drager explained that speakers manipulate linguistic variables in much the same way individuals choose to style their clothes or their hair, and all of these variables come together to construct their identities. In her own research, Drager (2010, 2015) investigated the degree to which phonetic variation in tokens of /a<sup>h</sup>i/ could be predicted by social stance. Her research found that the girls in her study exhibited trends in their speech that were consistent with other non-linguistic variables that formed their identities. Linguistic variables

were manipulated and adopted based on their associated social meanings, and a single linguistic variant could be used for multiple social goals. Eckert (2000) emphasizes that variations are the result of co-participation in social groups, not simply the co-presence, and speakers adopt certain variations based on a sense of belonging and entitlement to that group. Campbell-Kibler (2016) describes this phenomenon as accommodation theory. That is, the likelihood that a speaker's productions will converge with a particular group depends on the speaker's perception of and attitude towards that group. The speaker must identify with a particular social group and want to project a shared membership with the group before he/she will begin to adopt linguistic variations associated with that group.

Reed (2016) also identified speakers' rootedness as a variable that can impact their linguistic productions. Reed defined rootedness as the strength of feelings of local attachment and found that feelings of rootedness not only affect speakers' attitudes towards linguistic variables, but also their actual linguistic behavior (Reed, 2018). Speakers may acquire certain linguistic features (or not) depending on their feelings towards and perceptions of the area with which the features are associated (Reed, 2014). In studies of the Appalachian dialect, Reed found that a speaker's rootedness was a factor in the monophthongization of /aɪ/, particularly in more stigmatized contexts, and the speakers' productions could actually signal their feelings of rootedness. Additionally, Reed (2016) found that incorporating local identity provides crucial information about the individual's social capital in that specific community. Therefore, rootedness to an area could impact whether a speaker adopts linguistic variations in much the same way that a speaker may adopt certain variations to identify with a particular social group.

Another critical area of research is the time period required for an exemplar shift to take place. Pierrehumbert (2000) noted the importance of the entrenchment effect, which explains

that speakers who are immersed in a new speech environment may experience exemplar shifts over a time period of several months. Evans and Iverson (2007) studied the time frame of speech production shifts in college students in England based on vowel productions before beginning college (T1), after three months (T2), after one year (T3), and after two years (T4). Some participants were found to already demonstrate shifts in vowel productions as early as the three-month measurement. While the most drastic shifts occurred between T1 and T4, there was evidence of shifts in production between T1 and T2, suggesting that production shifts can occur over a matter of months when speakers receive frequent exposure to particular tokens in a new environment such as a college campus. Sancier and Fowler (1997) found similar results. In this study, a Brazilian speaker who was fluent in both Portuguese, her first language, and English, her second language, was studied after traveling between the United States and Brazil. Her speech was recorded after a 4.5 month stay in the United States, after returning from Brazil after 2.5 months, and after returning from the United States after four months. Not only did her speech show shifts in a measurement of voice onset timing (VOT) that differed between the United States and Brazil, but these differences were perceptible to the Brazilian listeners. That is, her speech not only demonstrated gestural shifts, but listeners of her native language were able to identify which productions occurred after she had been in the United States. This study provides evidence that exemplar shifts are flexible enough that they can occur over a period of a few months if the speaker is immersed in the new environment. For our study, all participants had been on campus for an average of four semesters, with only one student having been on campus for one semester. Therefore, it was expected that all participants should have begun to show shifts based on campus influences if such shifts were going to occur.

Perhaps an overlooked factor in the exemplar theory as far as encoding both phonetic and

socio-indexical information is the difference in how males and females utilize language and its socio-indexical information. Eckert (2000), as cited by Hay, Nolan, and Drager (2006) studied how high school students used socio-indexical information in their productions and found that females tended to exploit variations in production to demonstrate affiliation with a particular social group more so than males did. Similarly, Drager (2005b) found that females appear to utilize language as a socio-indexical tool more than males as a means to assert their identities. However, this difference could be confounded with the possibility that females are more aware of the relationship between variations in speech and social identification. Hay et al. (2012) concluded that gender could be a factor in the sensitivity to social factors in speech perception. Therefore, it is important to keep in mind that gender could play a role in how and/or how quickly an exemplar shift occurs and how linguistic variation is used to create an individual's identity.

The existing literature was quite helpful in selection of targets for the current study. Clopper and Pisoni (2004b) found that listeners were able to perceive differences in dialect from productions of speakers from New England, the South, and the North/West regions. While this study did not investigate whether the participants could distinguish between social affiliations, the participants were able to distinguish major regional differences. One of the most easily perceived differences used in this study was the monophthongized / $\widehat{a}i$ /. This characteristic has widely been associated with the southern region of the United States (Labov, Ash, and Boberg, 2006). Thomas (2001) states the monophthongization of / $\widehat{a}i$ / is part of the "Southern shift," and Thomas (2003) explains that monophthongization of / $\widehat{a}i$ / is a hallmark of vowels in most Southern dialects. Davies (2018) also describes monophthongization of / $\widehat{a}i$ / as a pronunciation that has become a stereotype of Southern speakers. Foley (1972) created a linguistic atlas of

Tuscaloosa County, Alabama and found typical Southern vowel variants, including what he described as a “slow” diphthong /aɪ̯/, which would be considered glide-weakened or monophthongized. Crane (1977) studied the social stratification of /aɪ̯/ in Tuscaloosa, Alabama and found three variations in the production: fully diphthongized, produced with a reduced shift with the second element of the diphthong approximating a high and front /ɛ̞/, and completely monophthongized, with most productions showing at least some reduction in diphthongal shift. Therefore, this dialectical marker was selected for the study. Interestingly, Davies (2018) observed a disconnect among students at The University of Alabama with some negatively judging the extreme monophthongization of /aɪ̯/ associated with northern Alabama, whereas others were fiercely proud of the Southern American English dialect spoken in Alabama, associating the dialectical variations with the region, family, heritage, and tradition. While monophthongization of /aɪ̯/ can be viewed as a stigmatized production, Labov’s work (1963) found that when participants are attempting to align themselves with a social group through shifts in speech production, the speakers may acquire aspects associated with covert prestige rather than overt prestige. That is, a speaker might acquire a particular production that might otherwise be stigmatized because that production is associated with covert prestige of a particular regional group. In addition, Hay, Drager, and Thomas (2013) studied whether real-word status affected speakers’ degree of merger for Ellen/Allan and lot/thought. The authors found that the speaker’s degree of merger depended at least partially on whether the words were real or nonce words. Furthermore, real-word status affected the mergers differently in production and perception. Since the effects of using nonce words has not been researched in depth, this study did not use nonce words to avoid potential confounding factors on speakers’ exemplar shifts.

This study sought to fill gaps in the current literature regarding the possibility of social integration as a factor underlying exemplar shifts. The current literature has not explored what factors might be causing exemplar shifts to occur more frequently or more rapidly for certain individuals but not for others. While some authors have proposed a desire to imitate others or to align oneself with a particular social affiliation as possible driving factors for exemplar shifts, this possibility has not been well researched. Furthermore, this study could provide more support for the incorporation of social theories into linguistic models proposed by Drager (2015). Overall, this study sought to contribute to the growing research on exemplar shifts in adults and the underlying mechanisms and factors that influence these shifts, such as the use of linguistic variation as a means of social expression.

The following research question was explored: Does involvement in highly structured social groups, such as Greek life groups, influence the variation of vowel production in young adults? If immersion in a new regional or social group can impact exemplar shifts, it is important to know whether the variation in production is similar for all members of that group. I hypothesized that there would be a significant difference in degree of monophthongization of /aɪ/ between Greek and non-Greek students, specifically a greater degree of monophthongization for Greek students, potentially indicating an exemplar shift has occurred. That is not to say that non-Greek students would not produce monophthongal tokens of /aɪ/, but it was hypothesized that these students would exhibit a greater degree of monophthongization than students in other groups. Due to the higher degree of social integration associated with Greek life, these students are likely to be more connected to campus and possibly more rooted to the university. Therefore, Greek students may also be more connected to the South and the southern aspects of the university, leading to more southern-sounding speech. Since relatively long-term immersion in a

new regional or social group is required for exemplar shifts, it seems logical that students who are immersed both in a new regional area and in a highly structured social group will exhibit more of an exemplar shift than others, thus leading to a significant difference in production. By including only in-state students, the researchers hoped to equalize the influence of a new region and instead focus on the influence of new social groups. The overarching purpose of this study was to explore how immersion in a new social and regional group leads to exemplar shifts in college students. This study fit under a current Institutional Review Board approval for The University of Alabama for the study of speech production in Alabama. The approval letter is included in Appendix G.

## 2. METHODS

### a. Participants

Participants for this study were recruited from an undergraduate communicative disorders class at The University of Alabama. Extra credit points were offered as an incentive for participation in the study. Fifty-four participants were recruited overall; however, only 30 participants were included. Fifteen participants were involved in Greek life, and 15 were not. All participants were female undergraduate students from the state of Alabama and lived full-time in Tuscaloosa, Alabama for the spring 2019 semester. The participants had been on campus for an average of four semesters and a range of one semester to six semesters. Twenty-four participants were excluded for the following reasons: gender (male) (three exclusions), age (two exclusions), out-of-state (17 exclusions), nationality (one exclusion), incorrectly filled out background information (two exclusions). Since only seven of the 54 participants responded as being willing to return for a second recording, only data from the first recordings were used for this study. Participants were divided into two groups (Greek and non-Greek) based on their membership in Greek organizations. These two groups were used to investigate whether students involved in certain groups, in particular those involved in Greek life, are more likely to shift their productions of /aɪ/ to align their identities with their social groups.

### b. Procedures

**i. Integration and location background.** Information on participants' integration and involvement in on-campus groups was gathered through a self-reported questionnaire included in Appendix A. The questionnaire was completed during the same session as speech collection.

Participants were instructed to fill out the questionnaire based on their commitments and involvements with on-campus groups on an average week. The questionnaire also contained questions about how long the participant had been a student on-campus and questions about location background regarding where the participants would be living full-time over the spring 2019 semester. The questionnaire also addressed the speech background of the participants with questions about their hometowns. Data collected from the questionnaire was used to select in-state participants from the state of Alabama as well as to sort participants into Greek and non-Greek groups. The researchers recognized that some students may have chosen to attend the university for the sports/football atmosphere or other reasons, and therefore it may be difficult to fully capture students' motivations for attending the university or for joining certain groups. In addition to the background questionnaire, the participants completed a Rootedness Metric adapted from Reed (2016) to determine their degree of rootedness to The University of Alabama. The Rootedness Metric was adopted for a slightly different purpose as it measured the participants' affiliation and integration with an institution as part of their identity rather than a location. Although the participants may not have been from Tuscaloosa and therefore may not be seen as "rooted" to the city, the adapted Rootedness Metric measured a slightly different form of rootedness. The adapted Rootedness Metric as well as the scoring guidelines used are included in Appendix B.

**ii. Speech data collection.** Data was collected from all participants to measure the presence of and degree of monophthongization of /aɪ/ based on their membership with Greek groups. Speech data was collected over the course of the spring 2019 semester, and therefore should exhibit some shifts in the participants' productions, if those shifts were going to occur. Data was collected from each participant in a conversational task, reading passages, and word

lists, in that order. The order of the tasks was kept uniform in order to gradually bring attention to the task of speech, so the speech task became more “formal” or less natural as the tasks progressed for all of the participants. The conversational speech was collected through a semi-structured interview using the questions listed in Appendix E. Speech data from the interview was included since reading passages and word lists could potentially bring the speakers’ attention to the task and potentially be less representative of the speakers’ more natural speech productions. The researchers noted that the dialect of an interviewer might impact speech production of the interviewee. The lab workers assisting with data collection were mindful of this possibility; however, since data was collected by different individuals with varying degrees of monophthongization themselves, the collection of speech samples may have been influenced by the speech of the interviewer. The participants were all interviewed either by their professor or by a trained lab worker. Reading passages included both *The Rainbow Passage* and the *Arthur the Rat* passage included in Appendix D. The stimuli used in the word list is included in Appendix C and included words with a variety of contexts of /aɪ/ as well as words that do not include /aɪ/ in order to avoid any bias in production. For both the reading passages and the word lists, the participants were instructed to read at a natural pace, and they were given an opportunity before each reading task to read over the passage or word list and ask about any unfamiliar words. Since the possibility of performativity was a concern, the researchers hoped to blind the participants as to what speech sound was being studied. Performativity refers to the exaggerated use of dialectical features and may occur even in more “natural” speech situations. Depending on the individual speaker, performativity may result in more vernacular speech or hyper-performed speech (Schilling-Estes, 2008). Therefore, the word lists and reading passages contained a variety of stimuli both with and without tokens of /aɪ/, making it unlikely that

participants' productions were as impacted by performativity specific to /aɪ/. The data was gathered in a sound attenuated booth using a high-quality microphone.

**iii. Speech data analysis.** After the speech data was collected, it was transcribed using Praat acoustic software. Additionally, the data was analyzed with FAVE-Extract (Rosenfelder et al., 2014) and Montreal Forced Aligner (McAuliffe, Socolof, Mihuc, Wagner, & Sonderegger, 2017) using the DARLA web interface (Reddy & Stanford, 2015) and the Vowels R package (Kendall & Thomas, 2010). The semi-automated function was used, and it did not filter out stop-words, unstressed vowels, or vowels with F1 or F2 bandwidths over 300. The degree of monophthongization was determined by measuring the Euclidean distance using the following formula:  $\sqrt{(F1_{\text{onset}} - F1_{\text{glide}})^2 + (F2_{\text{onset}} - F2_{\text{glide}})^2}$ , where the onset was measured at 20% and the glide was measured at 80% duration of the vowel in order to measure the change occurring during production of the diphthong. The Euclidean distance was calculated for each token of /aɪ/ across all three tasks for all participants. The calculation of the Euclidean distance for each participant for each speech situation was the data used for statistical analysis. The data was analyzed to determine if the participants' involvement in Greek life impacted the presence of or degree of exemplar shifts as determined by the degree of monophthongization of /aɪ/ measured by the Euclidean distance. Each participant produced an average of 256 tokens of /aɪ/, with 17 tokens possible in the Rainbow Passage, 38 tokens possible in the Arthur the Rat passage, 39 tokens possible in the word list, and an average of 158 tokens in the conversational task.

### **c. Analysis**

To perform the analysis, we used R (R Core Team, 2019) and the *lme4* package for linear mixed effects regression models (Bates, Maechler, & Bolker, & Walker, 2015) as described in the tutorial by Winter (2013). The *plyr* package was also used for data analysis (Wickham,

2011), and *ggplot2* was used to create the graphics (Wickham, 2016). We fitted linear mixed effects regression models for all three tasks as well as for overall data with all tasks combined to analyze the relationship between Euclidean distance, which measures the degree of monophthongization, and the participants' involvement in Greek life. Our fixed effects included Rootedness Metric Score, Greek status, task (for the overall model only), duration, and token environment (pre-voiced or pre-voiceless). Duration and token environment were included as fixed effects as these two variables have been shown to impact the likelihood of monophthongization. Pre-voiced tokens of / $\widehat{a}i$ / as well as tokens that are shorter in duration are more likely to be monophthongized when compared to pre-voiceless or longer tokens (Reed, 2016). As random effects, we included the subject and the item since some of the variation may be due to the individual herself or the specific word being spoken. The  $p$ -values were obtained via likelihood-ratio tests of the full model with the fixed effect in question against the model without that effect. For our study, we compared the models both with and without Greek status included as a fixed effect as well as with and without Rootedness as a fixed effect to determine whether either of these variables impacted Euclidean distance.

### 3. RESULTS

The Euclidean distances for the tokens of  $\widehat{ai}$  were analyzed for the effect of both Greek status as well as Rootedness Metric score. Data was analyzed to determine the significance of both of these variables across all three tasks as well as for combined data. The following results were found.

Table 1  
*Rootedness Metric Score Statistics by Greek Status*

Statistic	Greek	non-Greek	Overall (All Participants)
Rootedness Metric Score - Mean	8.4	7.567	7.983
Rootedness Metric Score - Median	8	8	8
Rootedness Metric Score - Mode	9.5	8	7.5
Rootedness Metric Score - Range	7 (4.5-11.5)	8 (3-11)	8.5 (3-11.5)

A summary of Rootedness Metric scores based on Greek affiliation is included in Table 1. Overall, Greek participants tended to score higher on the Rootedness Metric than non-Greek participants. These statistics were not surprising as the Greek participants' extensive social and financial investment into their sororities likely impacts the degree to which they want to be associated with their groups and with The University of Alabama. Additionally, there may be a greater degree of prestige and status tied to Greek affiliation than other on-campus groups. Students who have joined these groups might be more likely to want to affiliate themselves not only with the social group of their sorority, but also the university with which it is affiliated. While non-Greek participants were still rooted to the university overall, they tended to be less rooted, on average, than their Greek counterparts.

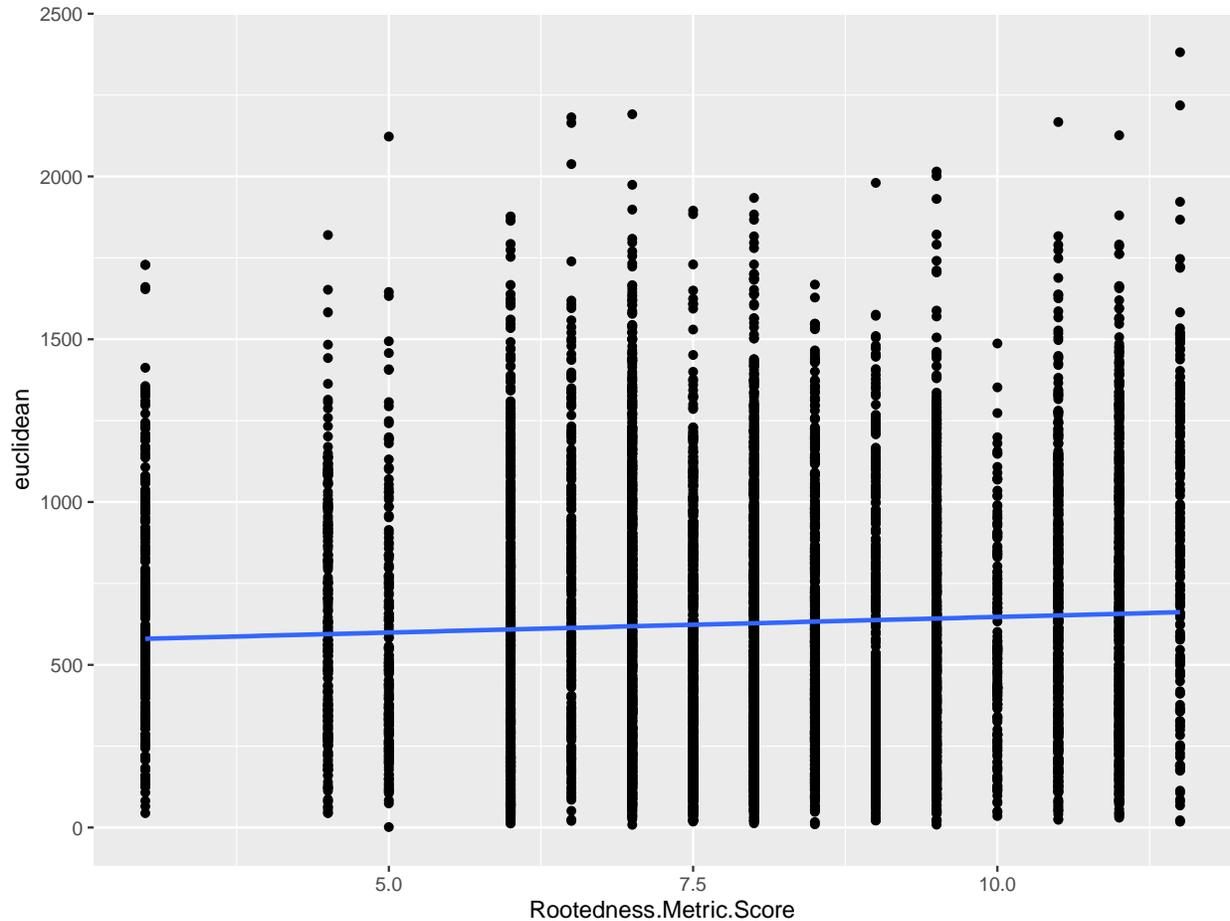


Figure 1. Euclidean Distance by Rootedness (Overall)

Figure 1 depicts changes in Euclidean distance based on Rootedness Metric score for all participants combined. Interestingly, even though The University of Alabama is located in the heart of a southern state, Euclidean distance tended to increase with participants' rootedness. That is, the more rooted the participant was to the university, the more diphthongal she tended to be. While the Rootedness Metric was meant to evaluate the participants' attachment to The University of Alabama as a southern institution representing southern heritage and traditions, this does not seem to be the case. Rather, the metric seemed to measure the participants' connection to an institution of higher learning, which may relate more to prestige and social status than southern traditions. Instead of being rooted to the location of the university, they may have actually been identifying as being rooted to the prestige and status of the campus. While the

university used to be a primarily southern campus, the nature of campus has changed over the past few decades along with the growth of the student body. As the majority of both general campus and Greek life has shifted from in-state to out-of-state students, the university has also developed into a much larger university with an increasingly growing reputation as a prestigious institution of higher learning.

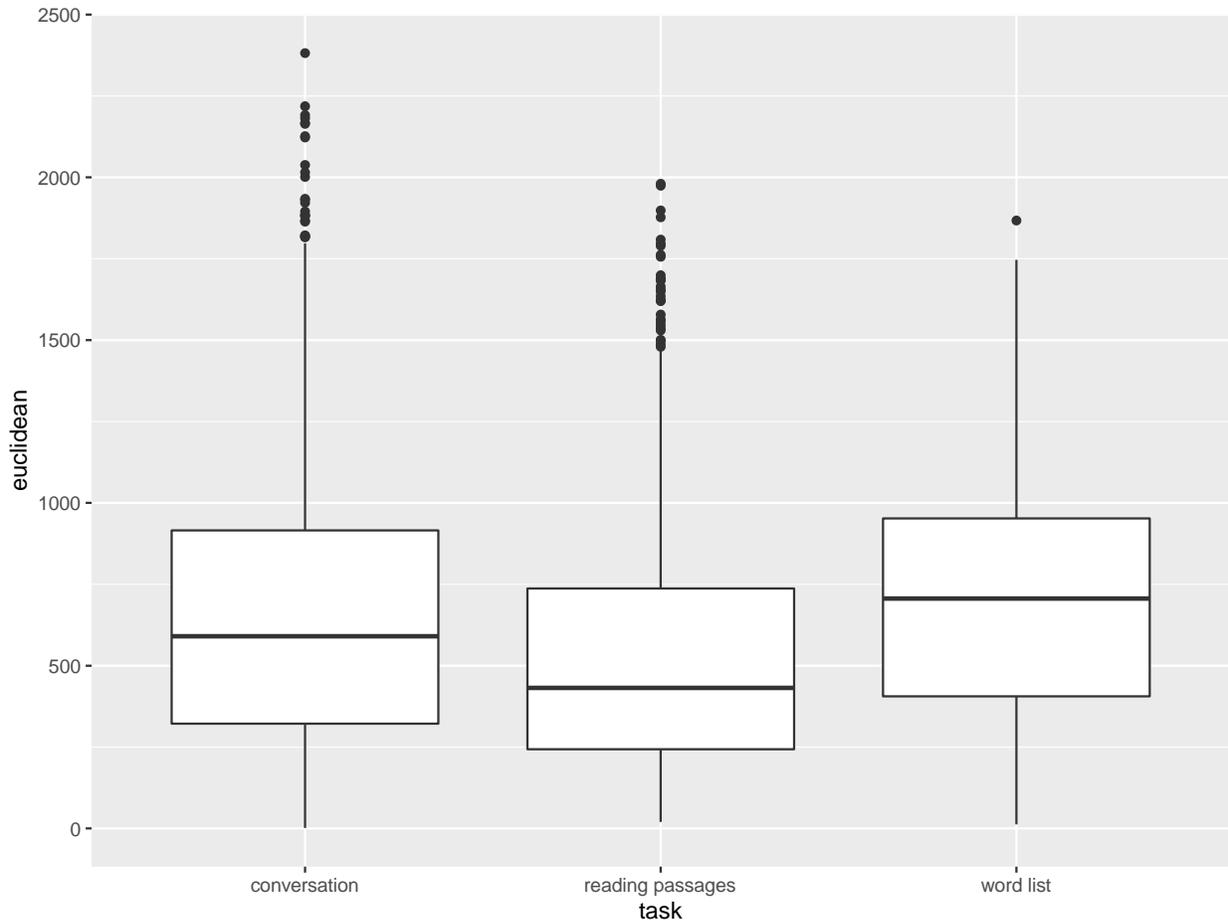


Figure 2. Boxplot of Euclidean Distance by Tasks

Figure 2 shows a boxplot illustration of the distribution of Euclidean distance based on data from the three tasks. Euclidean distance varied by task for the participants as a whole. When data for Euclidean distance for both groups was combined, the reading passage task tended to contain the tokens of /aɪ/ that were more monophthongized, followed by the conversation task and then the word list. Of all of the tasks, the reading passages tended to be

more monophthongized and therefore sound more southern. In contrast, the word list task data tended to contain tokens of /aĩ/ that were relatively more diphthongal. The difference across tasks may have been the result of performativity or increased formality during conversation.

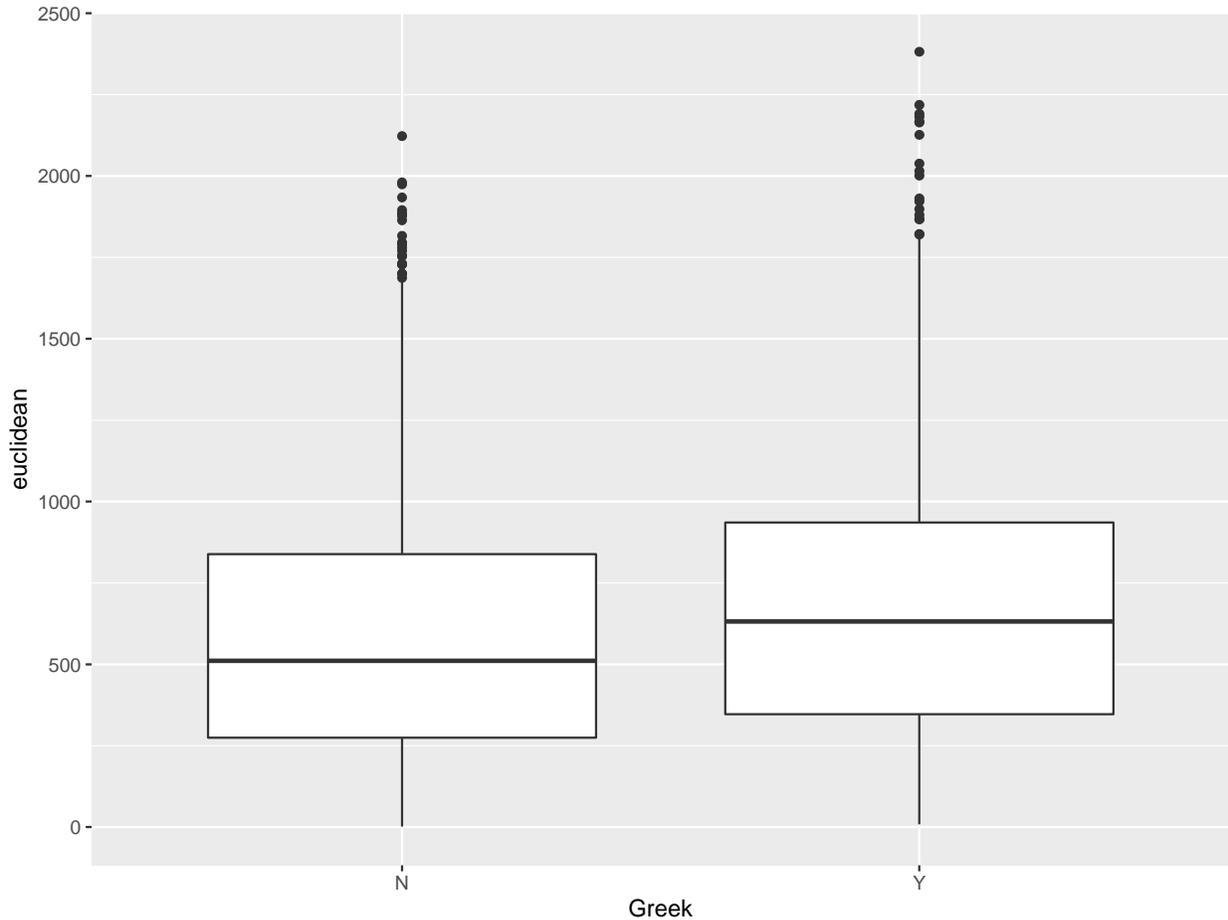


Figure 3. Boxplot of Euclidean Distance by Greek Status

Additionally, trends in Euclidean distance were noted based on the participants' Greek status. Figure 3 shows a boxplot of overall Euclidean distance for all tasks combined for Greek versus non-Greek participants and demonstrates a noticeable distinction between the two groups. Contrary to what we expected, Greek participants sounded less southern than non-Greek participants, not more, based on Euclidean distance for tokens of /aĩ/. Although our hypothesis was incorrect, there was still a difference in production of /aĩ/ between the Greek and non-Greek

groups. For all tasks, non-Greek participants were more likely to produce more monophthongized tokens of /aī/, whereas Greek participants produced more diphthongized tokens of /ai/.

Table 2  
*Mean Euclidean Distance of /ai/ by Task by Greek Status*

Task	Greek	non-Greek	Overall (All Participants)
Conversation ( $p = 0.2153$ )	680.7005	621.2608	649.7763
Reading Passages ( $p = 0.0227$ )*	575.5165	478.0373	526.5849
Word List ( $p = 0.04963$ )*	792.629	593.858	693.2435
All Tasks Combined ( $p = 0.09114$ )	673.3879	584.79	627.9424

*Note.* \* $p < 0.05$

The mean Euclidean distance for each individual task as well as for all tasks combined based on Greek status is summarized in Table 2. Greek participants not only had a greater Euclidean distance for the overall data, indicating a more diphthongal production, they were also more diphthongal across all three tasks compared to non-Greek participants. However, both Greek and non-Greek participants showed variation in mean Euclidean distance based on the task. Interestingly, the two groups did not follow the same trends among tasks as far as the order of most to least monophthongal. Non-Greek participants were most monophthongal during the reading tasks, followed by the word list and then the conversation task. Greek participants were also the most monophthongal during reading tasks, but the conversation was more monophthongal than the word list task. Formality during the conversational task as well as performativity may have impacted the trends across task by Greek status. Semi-structured interviews were conducted either by the participants' professor or by trained lab workers. While the participants were familiar with their professor, the trained lab workers may have been unfamiliar speech partners. Additionally, non-Greek participants may have been more likely to become more diphthongal during the interview as the formality of the task increased. The level

of familiarity as well as the degree of performativity across other tasks may have impacted how Euclidean distance changed across tasks for Greek and non-Greek participants. Potential explanations for these differences across tasks based on Greek status as well as possible impacts of performativity and formality are explored in more detail in the discussion section.

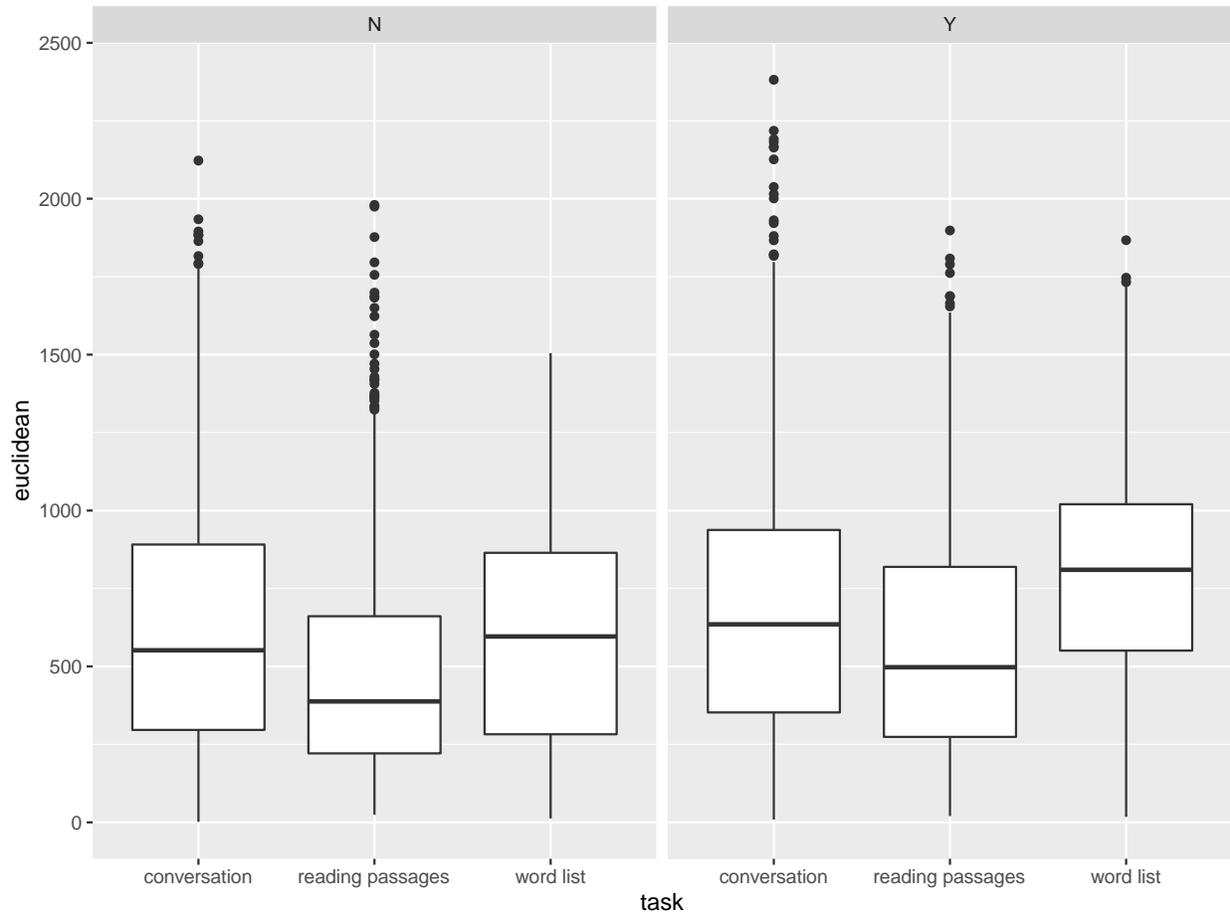


Figure 4. Boxplot of Euclidean Distance by Task by Greek Status

Figure 4 illustrates how Euclidean distance varied by task across Greek and non-Greek participants. This boxplot illustrates that across all three tasks, Greek participants tended to produce more diphthongal tokens of /aĩ/ when compared to the tokens produced by non-Greek participants. Both groups of participants had the lowest Euclidean distance for the reading passages, indicating a more monophthongal production of /aĩ/ when compared to the other two tasks. For the Greek participants, the word list tasks had the highest Euclidean distance and

therefore a more diphthongal production. However, non-Greek participants had the highest Euclidean distance for the conversational task. Based on this data, there seems to be a trend of more diphthongal (i.e., less southern) tokens of /aɪ/ for participants affiliated with Greek organizations.

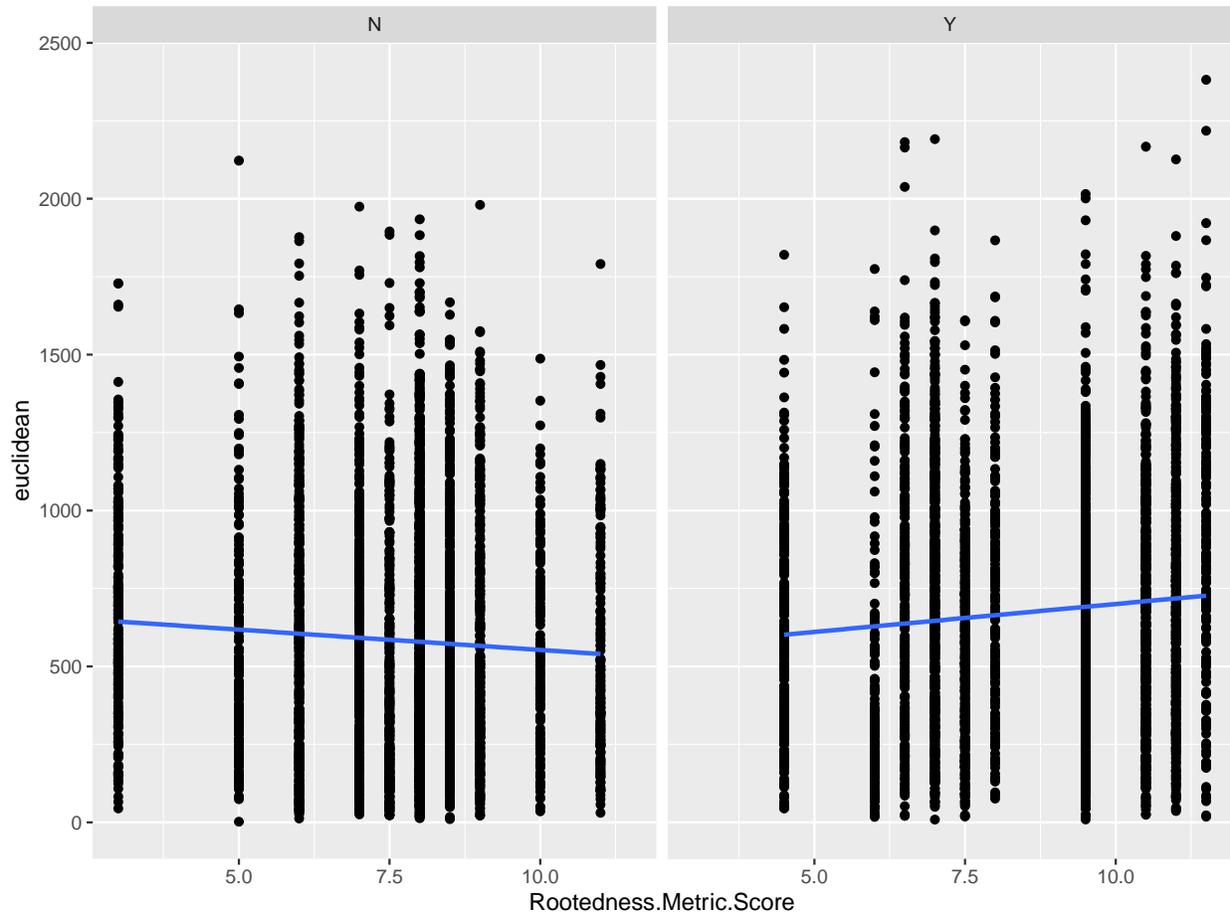


Figure 5. Euclidean Distance by Rootedness by Greek Status

Figure 5 illustrates trends in Euclidean distance based on rootedness and Greek status. When combining the effects of Greek status and rootedness, a distinct pattern emerged for the two groups. While overall statistics showed an increase in Euclidean distance as rootedness increased (Figure 1), this trend was actually different based on Greek affiliation. For non-Greek participants, Euclidean distance tended to decrease as rootedness increased. However, for Greek participants, Euclidean distance tended to increase as rootedness increased. The different trend

in Euclidean distance based on rootedness and Greek status could indicate that Greek and non-Greek participants were rooted to different aspects of the university, such as the location of a southern university versus the prestige of an institution of higher learning or of their Greek affiliation.

Table 3  
*Mean Euclidean Distance of /aɪ/ by Task by Greek Row*

Task	Old Row	New Row	Greek, not specified	Overall Greek
Conversation	667.2643	687.569	717.5166	680.7005
Reading Passages	578.8767	533.5501	602.2854	575.5165
Word List	770.6112	812.7445	893.678	792.629
All Tasks Combined	662.2908	672.1347	718.5758	673.3879

The mean Euclidean distances for each task by Greek row affiliation are summarized in Table 3. Of the 15 Greek participants, two were members of New Row sororities, 11 were members of Old Row sororities, and two did not specify their sorority. While there were some differences noted between Old Row and New Row participants, these differences were not very large. Old Row participants had a greater Euclidean distance for the reading passages task, but New Row participants had a greater Euclidean distance across the conversation and word list tasks. The group with the greatest Euclidean distance across all three tasks were the participants whose row affiliation was not specified. Since only two of the participants were members of New Row sororities and two participants did not specify their Greek row affiliation, there was not enough data to draw any significant conclusions. Depending on the affiliation of the two unspecified participants, different trends may have emerged for row affiliation. Therefore, more research with a greater variety of Greek affiliation across Old Row and New Row is necessary before any conclusions can be drawn about the impact of specific Greek affiliation. Overall, there was not a great difference in Euclidean distance based on the specific Greek affiliation of Old Row and New Row Greek participants.

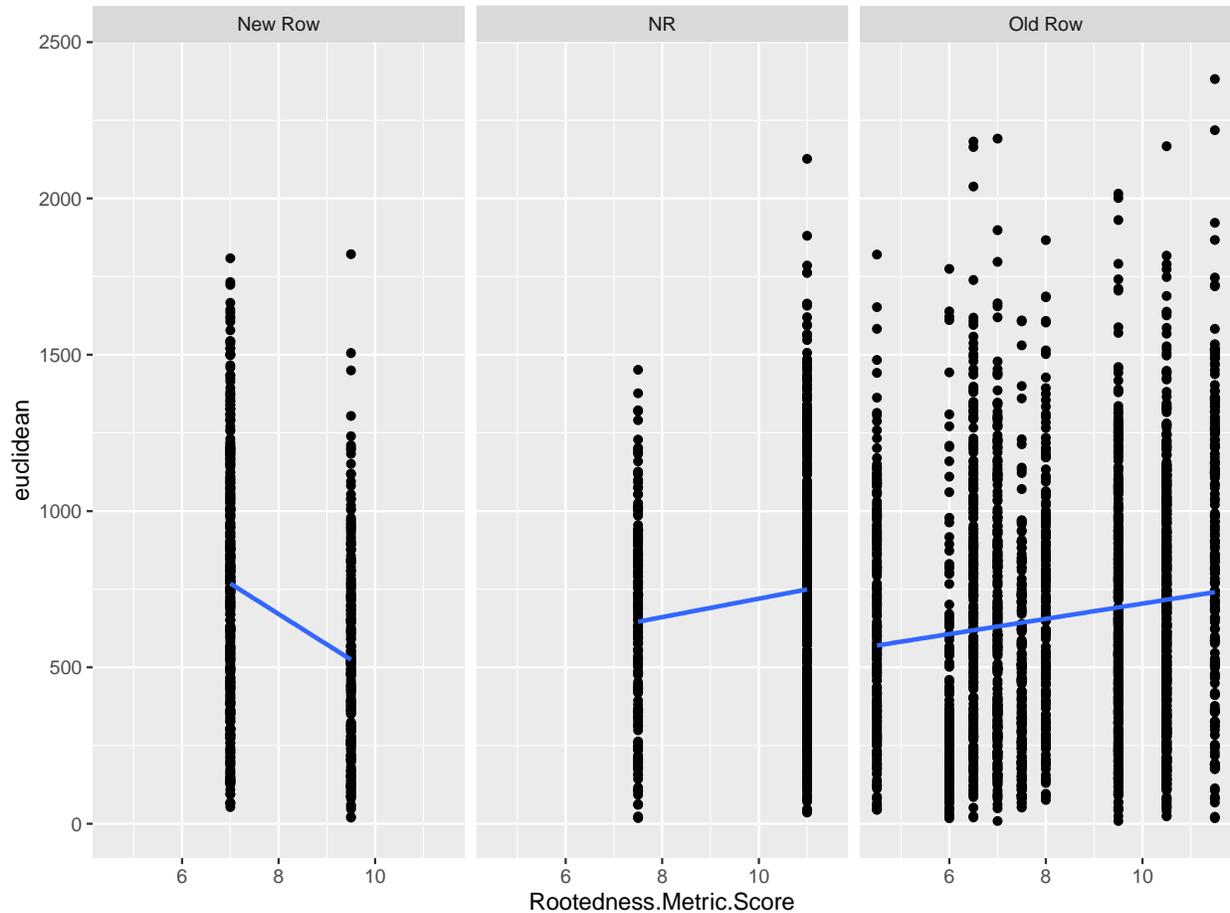


Figure 6. Euclidean Distance by Rootedness by Greek Row

Interestingly, Greek row also seemed to impact the interaction between rootedness and Euclidean distance. This information is illustrated in Figure 6. When all Greek participants were combined, Euclidean distance tended to increase as rootedness increased. Whereas Old Row Greek participants maintained the same trend for Greek participants in general, that was not the case for New Row Greek participants. For New Row participants, Euclidean distance decreased as rootedness increased, following the same trend as non-Greek participants. Potential explanations for these different trends will be explored later in the discussion section. However, since only two participants were in New Row sororities, more data is needed to further investigate the impact of New Row versus Old Row sororities.

Statistical analysis was performed for the linear mixed effects regression models for each task individually as well as for all of the tasks combined to determine the effect of both Greek status and Rootedness Metric Score on the participants' Euclidean distance. Random effects included in the models were the subject and item in order to account for individual variation. Fixed effects included Rootedness Metric Score, Greek status, task (for the overall model only), duration, and token environment. By using a likelihood-ratio test to compare the full models with the model missing the fixed effect in question, we were able to determine the significance of the fixed effect ( $\alpha = 0.05$ ). An ANOVA was performed for Rootedness Metric Score for all tasks ( $p = 0.5019$ ), conversation ( $p = 0.747$ ), reading passage ( $p = 0.7879$ ), and word list ( $p = 0.1735$ ) models. There was not a significant difference in production of /aɪ/ for any of the conditions based on the participants' rootedness. While there were some interesting trends noted in Euclidean distance based on rootedness, it was not a statistically significant variable in any of the speech conditions.

Greek status was also analyzed as a fixed effect across all speech conditions. Although Greek status was not statistically significant for the overall model with all tasks combined ( $p = 0.09114$ ), it does seem to be trending towards a significant difference in Euclidean distance based on Greek affiliation. On average, the Euclidean distance increased by 64.36 units for Greek participants compared to non-Greek participants. There was no significant difference between Greeks and non-Greeks in the conversational condition ( $p = 0.2153$ ), but Euclidean distance did increase by 36.544 units, on average, based on Greek status alone. However, there was a significant difference between Greeks and non-Greeks for both the reading passages ( $p = 0.0227$ ) and word list ( $p = 0.04963$ ) conditions. Therefore, Greek status was determined to be a significant variable in the participants' Euclidean distance for these two tasks. For the reading

passages, Euclidean distance increased by 91.336 units, on average, just for Greek status. The average increase in Euclidean distance was even greater for the word list, with an average increase of 149.94 units for Greek status alone. While these results do not support our hypothesis that Greek participants would produce more monophthongal tokens of / $\widehat{a}i$ /, we did find a significant difference in production of / $\widehat{a}i$ / based on the participants' Greek affiliation, particularly for the reading passages and word list conditions.

#### 4. DISCUSSION

Overall, the data did not support our initial hypothesis. While there was a significant impact of Greek status for Euclidean distance in multiple speech tasks, Greek participants were actually more diphthongal for all tasks. For this study, we included only in-state participants in an attempt to control for the participants' baseline production of / $\widehat{ai}$ / before attending the university as much as possible. Therefore, the increase in Euclidean distance across all tasks for Greek participants could indicate an exemplar shift for / $\widehat{ai}$ . Although monophthongization of / $\widehat{ai}$ / is associated with Alabama, this variation may not be as represented in sororities due to the influence of out-of-state members. According to Flanagan (2016), out-of-state students have held the majority in the Greek system since 2012. Furthermore, statistics for The University of Alabama's sorority recruitment applicant pool for Fall 2017 found that only 559 of the 2,340 female students who received bids were from Alabama (23.9%), while 1,781 were from out-of-state (76.1%), including 45 different states and eight different countries (The University of Alabama Panhellenic Association: Eligibility, 2019). While Old Row sororities are historically Southern and previously held more in-state members, that is no longer the case. Due to the large majority of out-of-state students, these organizations may not reflect the speech patterns of the state of Alabama. Rather, the speech of Greek participants could reflect more out-of-state patterns, even for in-state students, due to frequent exposure to the speech of out-of-state students. Additionally, sororities have a higher percentage of out-of-state students than the campus as a whole. Based on updated statistics including the Fall 2019 freshman class, 40% of

students enrolled at The University of Alabama are in-state students and 58% are out-of-state students. Approximately 3% of the student body is international students (Undergraduate Admissions: Quick Facts, 2019). Greek participants may be experiencing a shift towards less southern sounding speech as they are frequently exposed to a large number of tokens from out-of-state students in their sorority and are likely to want to associate themselves with this group. Since sororities actually have a higher percentage of out-of-state students than the general campus, Greek students are likely being exposed to a greater frequency of new exemplars than students who are just involved in general campus groups. Members of Greek life participate in activities as a group, attend more frequent meetings, and may even live in-house together. Greek houses on campus allow sorority members to be more active as a group as they serve as a center for housing, meals, and activities, which is not the case for other on-campus groups. As they are exposed to more tokens of speech that is not southern and want to sound like a member of their group, their speech may shift toward these non-southern tokens.

The data does seem to suggest that the Greek participants may have experienced exemplar shifts away from more southern speech patterns, at least for the production of /aɪ/. Not only are the Greek participants being exposed to a greater number of out-of-state students within their organization than campus in general, they may also be more likely to want to be associated with their group. Accommodation theory forms an important foundational aspect of shifts in production because speakers' productions do not shift simply because they are part of a group, but rather because they want to be associated with that group. Speakers' productions can converge or diverge to sound more or less like people with whom they do or do not want to be associated. In contrast with many other general campus groups, there is a certain level of prestige and status that accompanies Greek affiliation. In addition, members of Greek

organizations must fulfill more financial and time requirements than most other organizations require. Whereas most on-campus groups may have minimal to no cost to join and, with the exception of honor societies, usually do not require any type of application, members of Greek life have completed a more involved process and pay much larger financial dues for membership. Greek affiliation also provides a more extensive social networking system than do most on-campus groups. As such, it seems logical that Greek affiliation may be more important to the individual's identity than less involved groups since there are additional financial costs and a relatively selective "rush" process that are unique to the Greek system. If the individual wants to be identified as a member of that sorority, her speech may be shifting towards the less southern speech of the out-of-state majority of the Greek system.

Greek participants were more rooted to the university on average than non-Greek participants. However, Euclidean distance tended to increase as rootedness increased when data for all participants were combined. Interestingly, this trend changed when participants were divided into Greek and non-Greek. While rootedness was not a statistically significant variable in Euclidean distance, there were two distinct trends for non-Greek and Greek participants. The trend for non-Greek participants showed that Euclidean distance did tend to decrease as rootedness increased. For these participants, the metric may have been measuring the rootedness to the heritage and southern aspects of the university as it was intended. This trend may be the result of non-Greek students feeling more connected to the southern location and heritage of the university rather than the prestige associated with a particular group. When Greek participants were divided into Old Row and New Row, the New Row Greek participants also followed the trend of decreasing Euclidean distance with increasing rootedness. However, Old Row Greek participants maintained the trend of increasing Euclidean distance with increasing rootedness.

The distinction between Old Row and New Row participants may reflect a difference in socioeconomic status or prestige of the individual sororities. Traditionally, Old Row sororities may be considered to be more prestigious and may recruit members of a slightly higher economic status. Our adapted Rootedness Metric may not have actually measured their rootedness to the location of the campus or the southern aspects of campus, but rather their rootedness to the prestige and status of attending a large university as an institution of higher learning and being a member of an Old Row sorority. Therefore, as their rootedness to these aspects becomes stronger, they tend to sound less southern. In contrast, the Rootedness Metric may have been more accurately measuring New Row participants' attachment to the heritage and southern aspects of the university as with the non-Greek participants. As they become more rooted, they tend to sound more southern, at least as far as the degree of monophthongization of /aɪ/. However, since only two participants specified that they were in New Row sororities, more data is needed to determine if these trends are representative of Old Row and New Row members.

While rootedness did not have a statistically significant impact on Euclidean distance for any of the speech tasks, Greek status was statistically significant for reading passages and word lists and was trending towards significance for all tasks combined. The reading passages were the most monophthongal for both groups, but conversation was the most diphthongal for non-Greek participants while the word list was the most diphthongal task for Greek participants. The lack of statistical significance for Greek status in the conversational task could be the result of performativity, or it may be that the participants were more inclined to adapt their speech based on the interviewer. For example, some of the participants may have used a more formal speech pattern when conversing with their professor as an interviewer, which may have resulted in more

diphthongal productions across both groups. Additionally, the lab workers who assisted in interviewing the participants were strangers to most of the participants, which may have impacted their speech, especially during conversation. More research would be necessary to further explore the differences across tasks among Greek and non-Greek participants.

## 5. CONCLUSION

The present study examined whether Greek status impacted vowel production variation in college students as measured by the Euclidean distance of  $/\widehat{ai}/$ . Overall, the results of this study showed that involvement in Greek life impacts vowel production variation in college students. Greek affiliation was found to be a statistically significant variable in the degree of monophthongization across word list and reading passage tasks with a trend for significance for all tasks combined. However, rootedness was not a statistically significant variable for any of the tasks. The influence of Greek affiliation is likely due to the high degree of social integration and co-participation. These results support the research of Eckert (2000) and Campbell-Kibler (2016), who emphasized the importance of co-participation in social groups in order for a speakers' productions to converge with those of the group. An individual's speech will not change simply because of membership in a group, but rather due to his/her perception of and attitude towards the group and a wish to project that group as part of his/her identity. Furthermore, the results support the incorporation of social theories into linguistic models as proposed by Drager (2015). In our study, participants' speech productions were significantly impacted by their social groups, emphasizing the interconnectedness of social variables and linguistic productions.

As far as clinical implications, these results may help explain why speech therapy intervention may not always be as successful, particularly with adult clients. If the client is being exposed to a large number of tokens of a particular sound production outside of the therapy room, only being exposed to the different production within the therapy room likely will not be

sufficient to change the client's production. It is important for the clinician to take into account clients' affiliations and groups outside the therapy room and whether they are being exposed to certain productions in their home or social lives. At the very least, an awareness of the client's speech input outside of therapy may improve the success of intervention.

There are several limitations to the present study. Since we were only able to gather speech data from one point in time, we could only assume that the variation in production between groups was the result of an exemplar shift. However, we could not show evidence of an actual shift. Ideally, data could be collected at multiple points in time at the beginning of the participants' freshman year as well as throughout their college careers. Additionally, our study only included female participants; therefore, these patterns may not necessarily be present across male Greek and non-Greek students and males and females often use linguistic markers differently. Furthermore, while demographic statistics were available for in-state students and out-of-state students both for overall campus and for Greek life members, it would be helpful to specify which students were from other Southern states when considering the impact of the speech of out-of-state students. For the sake of this paper, participants from any state other than Alabama were considered out-of-state; however, it may have been more helpful to classify other members of campus and Greek life groups as Southern or non-Southern if that data were available. Information on the specific in-state and out-of-state demographics of Old Row and New Row sororities would also be beneficial in order to further explore the different trends in rootedness and Euclidean distance based on specific Greek affiliation. A relatively small number of participants limited the conclusions that could be drawn for Old Row and New Row participants. Future research should include more participants from a greater variety of sororities, if possible.

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## APPENDICES

### Appendix A

#### Background Questionnaire

##### Background Information

1. Name:
2. Age:
3. Race/Ethnicity:
4. Gender:
5. Year on campus: FRESHMAN                  SOPHOMORE                  JUNIOR                  SENIOR
6. How long have you been on campus (number of semesters)?
7. Hometown:
8. Major:
9. Level of education:
10. Will you be in Tuscaloosa full-time for the spring 2019 semester?                  YES                  NO
11. Will you be in Tuscaloosa full-time for the summer 2019 semester?                  YES                  NO
12. If answered NO to #11, where will you be living full time for the summer 2019 semester?

##### Involvement On-Campus

1. What groups are you involved in on campus? Please list ANY groups you are involved with outside of class. (Ex: Greek affiliation, clubs, church, volunteer groups, etc)

2. List how long you have been involved with each of these groups.
  
3. Is your involvement with these groups voluntary or required?
  
4. In general, do you feel favorable about your affiliation with these groups? (yes or no)
  
5. On a scale of 1 to 10 (10 being most favorable, 1 being least favorable), please rate your enjoyment of each group you are involved with.
  
6. On average, what is your total time commitment to groups listed above? Please select one of the options below.
  - Less than 5 hours per week on average
  - 5-10 hours per week on average
  - More than 10 hours per week on average

## Appendix B

### Rootedness Metric (*adapted from Reed 2016*)

1. Was The University of Alabama one of your top choices when deciding where to attend college? YES NO
2. Are there any circumstances in which you could see yourself transferring from The University of Alabama? YES NO
  - a. If yes, what kind of circumstances might lead you to that decision?  
\_\_\_\_\_
  - b. How often would you visit campus if you transferred?  
\_\_\_\_\_
3. How often do you visit other college campuses? \_\_\_\_\_
4. Do you plan to stay in Tuscaloosa after you graduate? YES NO
  - a. If no, where do you plan to move?  
\_\_\_\_\_
5. Has anyone from your immediate family (siblings, parents, etc) attended The University of Alabama? YES NO
  - a. If so, who?  
\_\_\_\_\_
  - b. If so, where they involved in Greek life on campus? YES NO
6. Do you usually attend events on campus? YES NO
  - a. If so, what type of events do you attend?  
\_\_\_\_\_
7. Are you a University of Alabama fan? YES NO

a. If no, what college/university do you support? \_\_\_\_\_

8. Rank the following (1-4) in the order that you most identify with:

The University of Alabama | Tuscaloosa, AL | Alabama (state) | The South

\_\_\_\_\_

9. Please indicate on the following scale the degree to which you would say your identity is tied to The University of Alabama.

My identity is not  
at all tied

My identity is  
somewhat tied

My identity is  
closely tied

1

2

3

4

5

### **Rootedness Metric Scoring**

1. Yes = 1 point; No = 0 points
2. No = 1 point; Yes = 0 points
3. Never = 2 points; Occasionally/Rarely = 1 point; Frequently = 0 points
4. Yes = 1 point; No = 0 points
5. A. >2 family members = 2 points; 1-2 family members = 1 point; none = 0 points  
B. Yes = 1 point; No = 0 points
6. A lot (more than one; more than sporting events) = 2 points; A few (only one type; only sporting events) = 1 point; None = 0 points
7. Yes = 1 point; No = 0 points
8. UA as #1 = 2 points; South as #1 = 1 point; Tuscaloosa as #1 = 0 points; Alabama as #1 = 0 points
9. 5 = 2 points; 4 = 1.5 points; 3 = 1 point; 2 = 0.5 points; 1 = 0 points

No response = 0 points

Total points possible: 15 points

## Appendix C

### Word List

Please read the following words. Some of the words appear more than once

tide...tight	gull...gall	card...cart	tribe...tripe
cot...caught	how...hoe	shied...shade	feel...fill
pin...pen	sided...sighted	pool...pole	how's...house
hard...heart	Abe...ape	siding...sighting	hill...heel
pool...pull	tyke...take	boat...bout	gate...gait
sighting...siding	bide...bite	five...fife	lout...loud
tour...tore	coal...cool	indoor...endure	feel...fill
hi...hay	fife...five	height...hide	endowed...in doubt
golf...gulf	doll...dull	sighted...sided	tripe...tribe
bite...bide	bake...bike	heart...hard	dawn...Don
pole...pull	tight...tide	hall...hull	sight...side
cart...card	ten...tin	dies...dice	surely...Shirley
hawk...hock	tote...toad	ate...aid	tock...talk
day...die	dice...dies	hag...Hague	heel...hill
side...sight	full...fool	taught...tot	Harper...harbor

## Appendix D

### Reading Passage – Arthur the Rat

Once upon a time there was a young rat who couldn't make up his mind. Whenever the other rats asked him if he would like to come out hunting with them, he would answer in a hoarse voice, "I don't know." And when they said, "Would you rather stay inside?" he wouldn't say yes, or no either. He'd always shirk making a choice. One fine day his aunt Josephine said to him, "Now look here! No one will ever care for you if you carry on like this. You have no more mind of your own than a greasy old blade of grass!" The young rat coughed and looked wise, as usual, but said nothing. "Don't you think so?" said his aunt, stomping with her foot, for she couldn't bear to see the young rat so cold-blooded. "I don't know" was all he ever answered, and then he'd walk off to think for an hour or more whether he would stay in his hole in the ground or go out into the loft.

One night the rats heard a loud noise in the loft. It was a very dreary old place. The roof let the rain come washing in, the beams and rafters had all rotted through, so that the whole thing was quite unsafe. At last one of the joists gave way, and the beams fell with one edge on the floor. The walls shook, the cupola fell off, and all the rats' hair stood on end with fear and horror. "This won't do," said their leader. "We can't stay cooped up here any longer." So they sent out scouts to search for a new home. A little later on that evening the scouts came back and said they had found an old-fashioned horse-barn where there would be room and board for all of them. The leader gave the order at once, "Company fall in!" and the rats crawled out of their holes right away and stood on the floor in a long line.

Just then the old rat caught sight of young Arthur—that was the name of the shirker. He wasn't in the line, and he wasn't exactly outside it—he stood just by it. "Come on, get in line!"

growled the old rat coarsely. "Of course you're coming, too?" "I don't know," said Arthur calmly. "Why, the idea of it! You don't think it's safe here anymore, do you?" "I'm not certain," said Arthur undaunted. "The roof may not fall down yet." "Well," said the old rat, "we can't wait for you to join us." Then he turned to the others and shouted, "Right about face! March!" and the long line marched out of the barn while the young rat watched them. "I think I'll go tomorrow," he said to himself, "but then again, perhaps I won't—it's so nice and snug here. I guess I'll go back to my hole under the log for a while just to make up my mind." But during the night, there was a big crash. Down came beams, rafters, joists—the whole business.

Next morning—it was a foggy day—some men came to look over the damage. It seemed odd that the old building was not haunted by rats. But at last, one of them happened to move a board, and he caught sight of a young rat, quite dead, half in and half out of his hole. Thus the shirker got his due, and there was no mourning for him.

## Reading Passage – The Rainbow Passage

When the sunlight strikes raindrops in the air, they act as a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow. Throughout the centuries people have explained the rainbow in various ways. Some have accepted it as a miracle without physical explanation. To the Hebrews it was a token that there would be no more universal floods. The Greeks used to imagine that it was a sign from the gods to foretell war or heavy rain. The Norsemen considered the rainbow as a bridge over which the gods passed from earth to their home in the sky. Others have tried to explain the phenomenon physically. Aristotle thought that the rainbow was caused by reflection of the sun's rays by the rain. Since then physicists have found that it is not reflection, but refraction by the raindrops which causes the rainbows. Many complicated ideas about the rainbow have been formed. The difference in the rainbow depends considerably upon the size of the drops, and the width of the colored band increases as the size of the drops increases. The actual primary rainbow observed is said to be the effect of super-imposition of a number of bows. If the red of the second bow falls upon the green of the first, the result is to give a bow with an abnormally wide yellow band, since red and green light when mixed form yellow. This is a very common type of bow, one showing mainly red and yellow, with little or no green or blue.

## **Appendix E**

### **Interview Module**

#### Opening Questions

1. How are you? How has the semester been going?
2. How have your classes been going?
3. What are your plans for next semester?
4. How many semesters do you have left before you graduate?

#### The University of Alabama

1. What's your day to day life like on campus?
2. What do you like about the university?
3. What is your favorite part of UA's campus or campus life?
4. Are there differences between UA's campus and other places?
5. What makes UA different from other college campuses?
6. Are there things about campus or campus life that you miss when you go home for breaks? Why?
7. Are there things about campus or campus life that you do not miss when you go home for breaks? Why?
8. How do you think new students (transfer students, freshmen) learn to "fit in" on campus?

#### Identity

1. Would you say being a student at UA forms part of your identity? Why?
2. Is there another place that you identify with? Why?
3. Do you feel that your connections with other UA students form part of your identity? Why?

4. What makes UA so special?
5. What sets people apart that feel the same way?

## Appendix F

Table 1

*Rootedness Metric Score Statistics by Greek Status*

Statistic	Greek	non-Greek	Overall (All Participants)
Rootedness Metric Score - Mean	8.4	7.567	7.983
Rootedness Metric Score - Median	8	8	8
Rootedness Metric Score - Mode	9.5	8	7.5
Rootedness Metric Score - Range	7 (4.5-11.5)	8 (3-11)	8.5 (3-11.5)

Table 2

*Mean Euclidean Distance of /aɪ/ by Task by Greek Status*

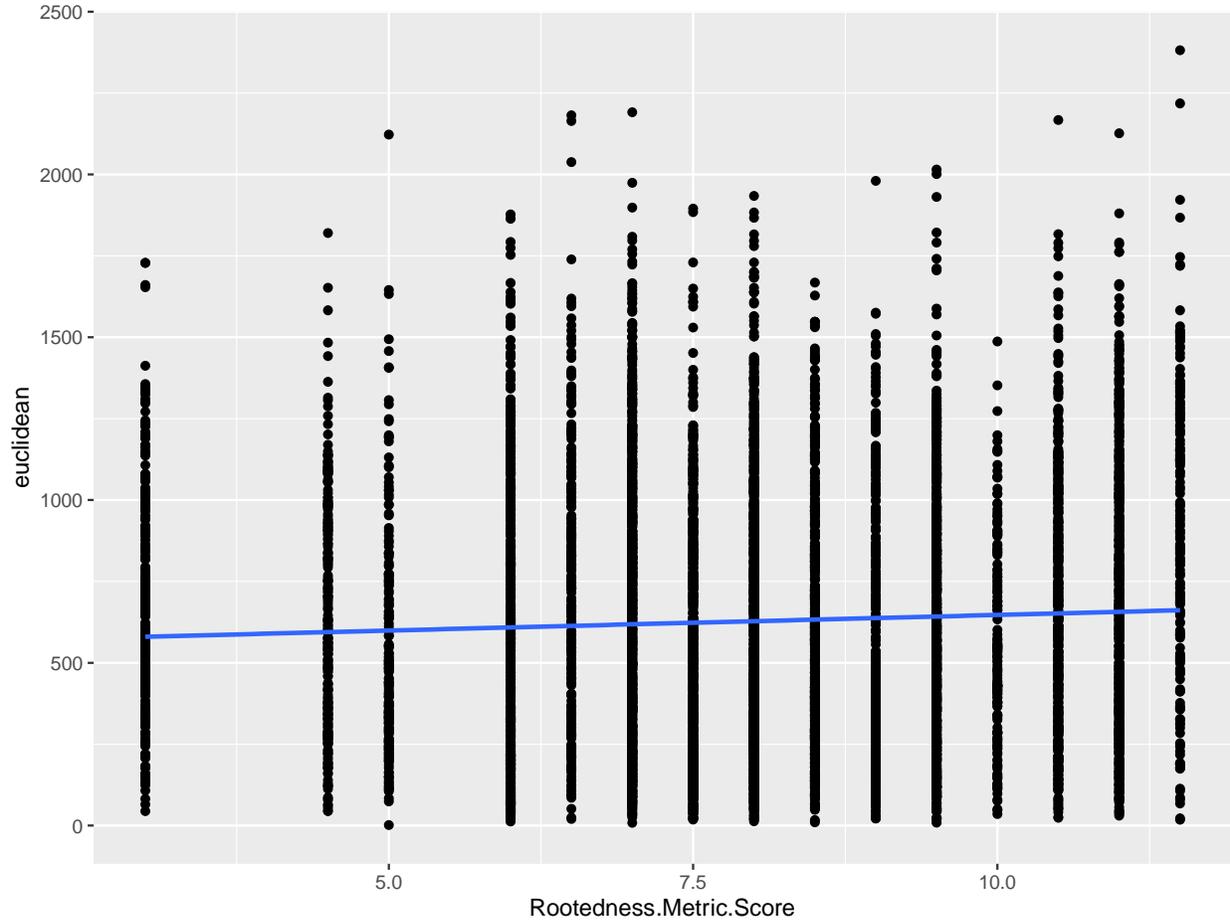
Task	Greek	non-Greek	Overall (All Participants)
Conversation ( $p = 0.2153$ )	680.7005	621.2608	649.7763
Reading Passages ( $p = 0.0227$ )*	575.5165	478.0373	526.5849
Word List ( $p = 0.04963$ )*	792.629	593.858	693.2435
All Tasks Combined ( $p = 0.09114$ )	673.3879	584.79	627.9424

*Note.* \* $p < 0.05$

Table 3

*Mean Euclidean Distance of /aɪ/ by Task by Greek Row*

Task	Old Row	New Row	Greek, not specified	Overall Greek
Conversation	667.2643	687.569	717.5166	680.7005
Reading Passages	578.8767	533.5501	602.2854	575.5165
Word List	770.6112	812.7445	893.678	792.629
All Tasks Combined	662.2908	672.1347	718.5758	673.3879



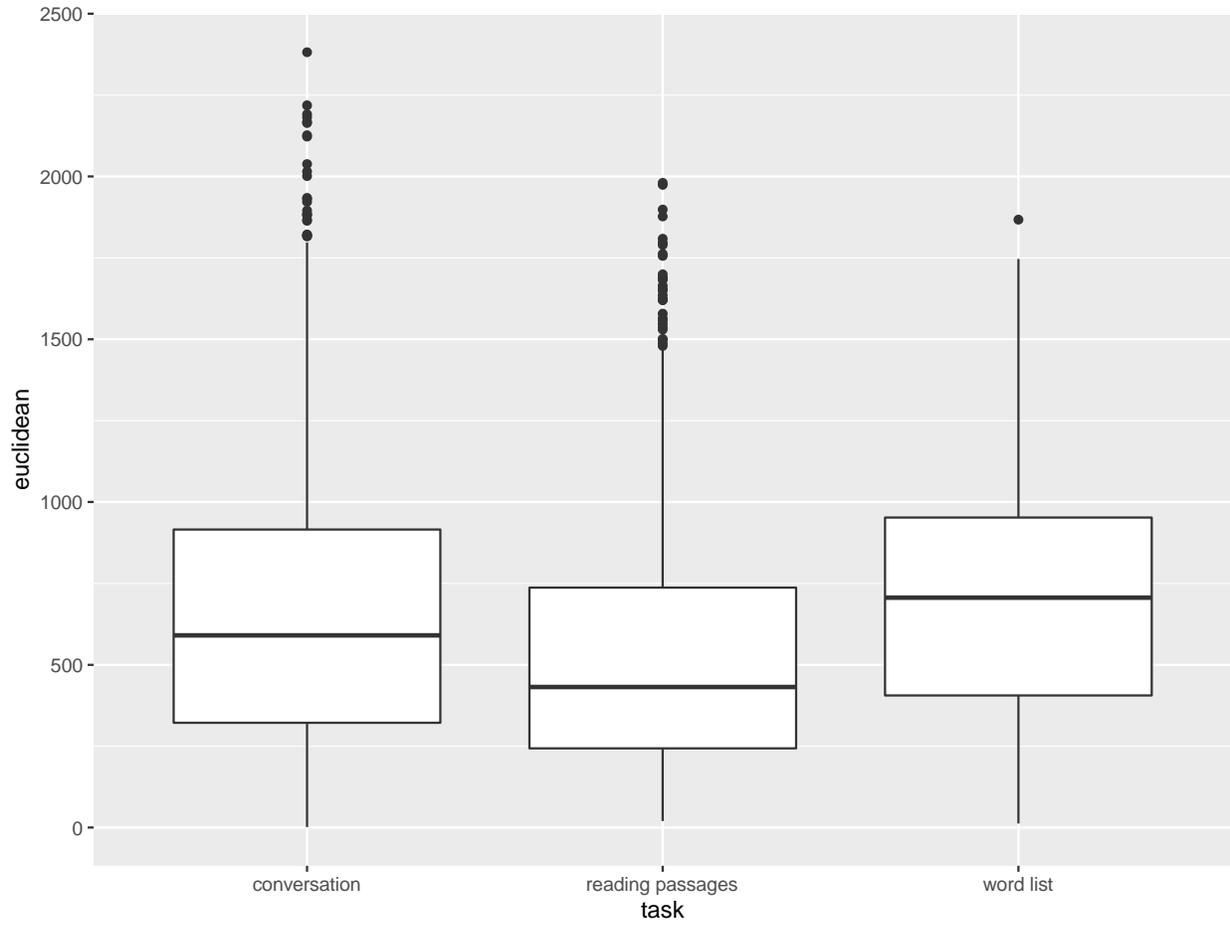


Figure 2. Boxplot of Euclidean Distance by Tasks

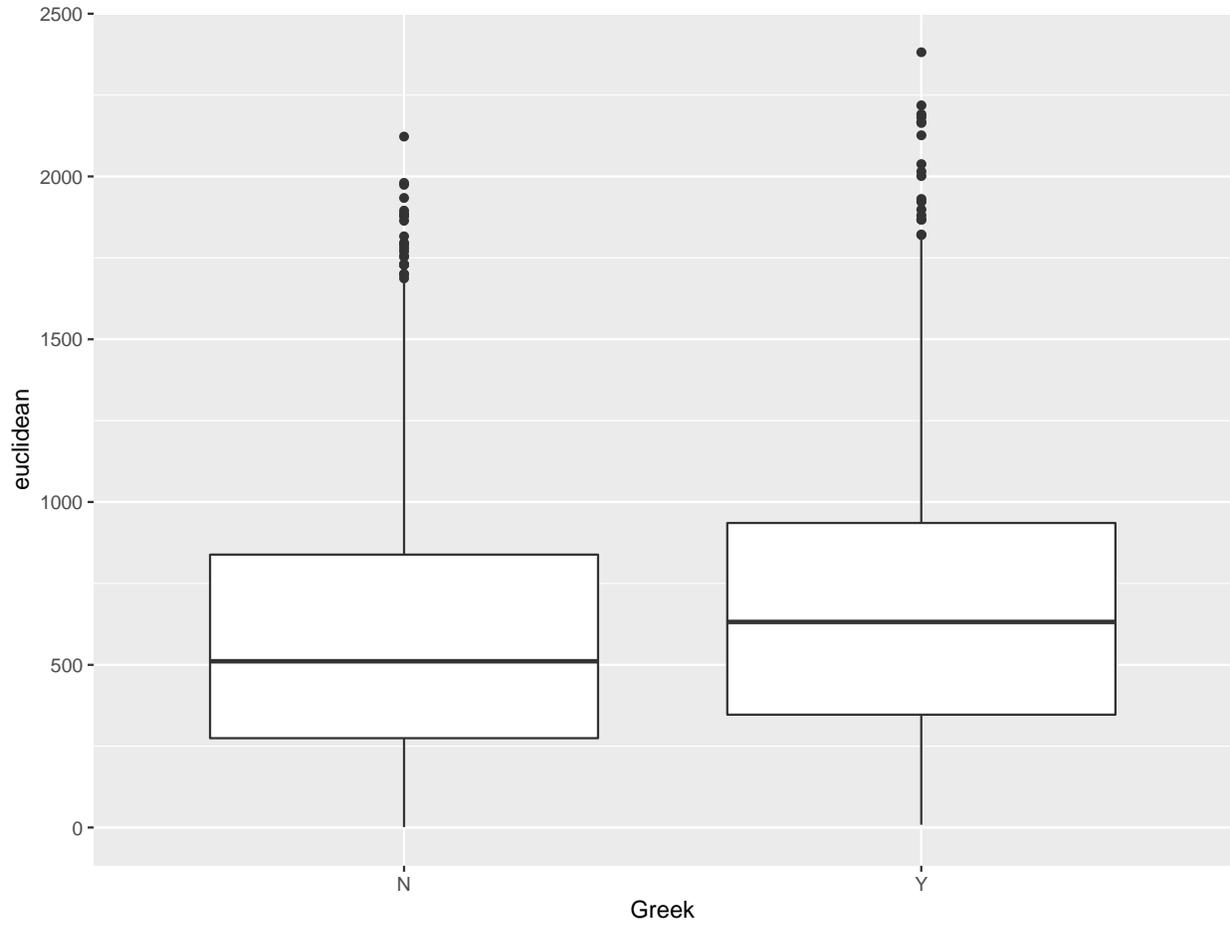


Figure 3. Boxplot of Euclidean Distance by Greek Status

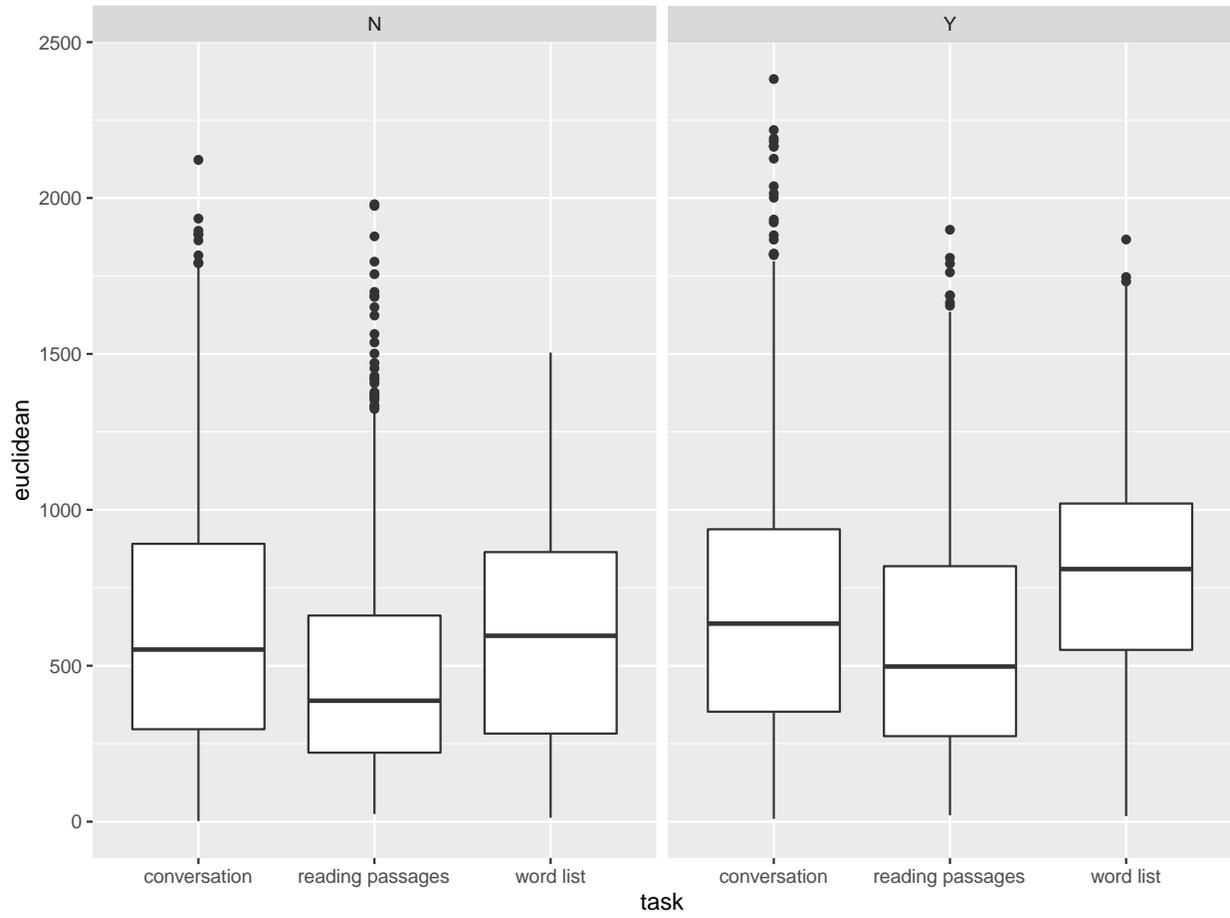


Figure 4. Boxplot of Euclidean Distance by Task by Greek Status

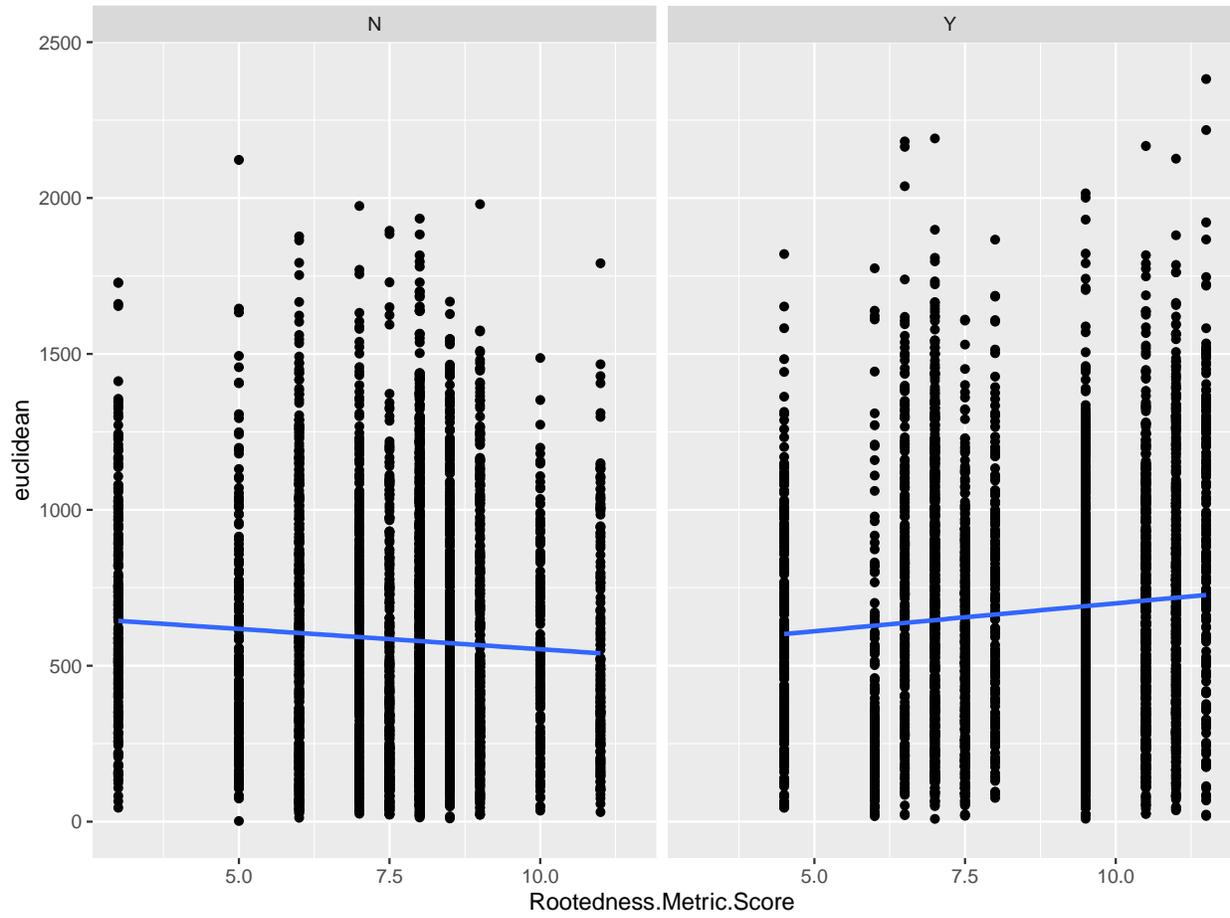


Figure 5. Euclidean Distance by Rootedness by Greek Status

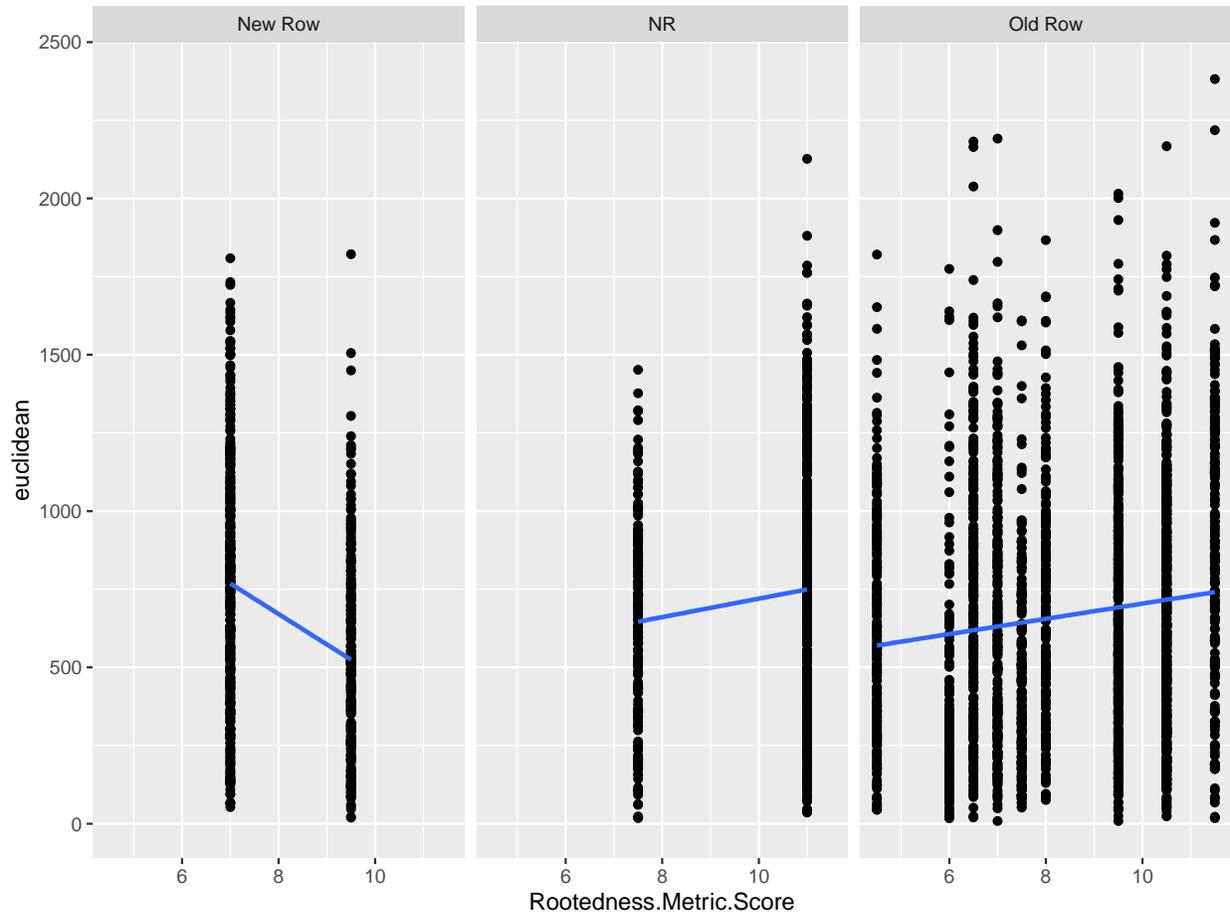


Figure 6. Euclidean Distance by Rootedness by Greek Row

## Appendix G



Office of the Vice President for  
Research & Economic Development  
Office for Research Compliance

November 15, 2019

Paul E. Reed, Ph.D.  
Assistant Professor  
Department of Communicative Disorders  
College of Arts & Sciences  
The University of Alabama  
Box 870242

Re: IRB # 18-OR-405-R1 "Linguistic Variation in Alabama"

Dear Dr. Reed:

The University of Alabama Institutional Review Board has granted approval for your renewal application. You have also been granted the requested waiver of informed consent. Your renewal application has been given expedited approval according to 45 CFR part 46. Approval has been given under expedited review category 7 as outlined below:

*(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.*

The approval for your application will lapse on November 14, 2020. If your research will continue beyond this date, please submit a continuing review to the IRB as required by University policy before the lapse. Please note, any modifications made in research design, methodology, or procedures must be submitted to and approved by the IRB before implementation. Please submit a final report form when the study is complete.

Please use reproductions of the IRB approved informed consent form to obtain consent from your participants.

Good luck with your research.

Sincerely,

A black rectangular redaction box covering the signature of the Director &amp; Research Compliance Officer.

Carpanato T. Myles, MSM, CIM, CIP  
Director & Research Compliance Officer

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