Quantifiable Acoustic and Phonetic Differences between Primary and Secondary Stress in American English Words

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Submitted to the faculty of the Department of Linguistics in
partial fulfillment of the requirements for the degree of
Bachelor of Arts

April 20, 2016

ABSTRACT

A difference between primary and secondary stress in American English words is seen in syllables like /hɑs/ where it is primarily stressed in the word *hospital* /ˈhɑspɪtɫ̩/ and secondarily stressed in the word *hospitality* /ˌhɑspɪˈtælɪti/ (here ˈ denotes primary stress and ˌ denotes secondary stress). The existence of such a distinction has been disputed in theories that suggest that secondarily stressed syllables and syllables with no stress are one and the same (Cutler 1986), or that while a contrast may be present, it is not necessarily recognizable by native speakers (Mattys 2000).

In my experiment, I aimed to find quantifiable distinctions between phonetic and acoustic cues or exponents to primary and secondary stress in English words, in an effort to show that acoustic contrasts do exist, and that they have useful real-world applications like speech recognition. To do this, I found a native speaker of American English and presented him with 153 elicitation phrases consisting of a two-sentence structure. The first sentence gave the speaker semantic context in order to avoid incorrect pronunciations (for example the verb *to abstract* instead of the noun *abstract* when the latter is intended)[1]. The second sentence, containing my target word, was read allowed and recorded. Here is a sample sentence for *abstract*:

> "A summary of an experiment or paper. I can use the word *abstract* sensibly in this context."

Here, in order to test the phonetic and acoustic differences between primary and secondary stress, the syllable /æb/ appeared as primarily stressed in the word *abstract*, but as secondarily stressed in the word *abduct*. For each syllable I examined, the speaker was given two contexts (primary and secondary) to speak. I was then able to make acoustic measurements comparing these two.

Using Praat Scripts and Praat TextGrids (Boersma and Weenink), I was able to measure duration, vowel quality, fundamental frequency, intensity, and spectral tilt of the vowels in my target syllables. I then compared the values of the measurements of the minimal pairs by making a vowel plot of the F1 and F2 measurements, and making boxplots of the secondarily stressed

[1] This did not work as well as I would have hoped and I did occasionally get some incorrect pronunciations despite the phonetic context.

measurement value subtracted from the primarily stressed measurement value. Running t-tests on these boxplots, I was able to test if the non-zero means were statistically significant.

I found duration, intensity, and spectral tilt to be cues to the contrast between primary and secondary stress for my speaker.

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1. INTRODUCTION

In this project, I am investigating phonetic exponents of stress in English in order to find measurable differences between primary and secondary stress. Stress vs. no stress in English words is demonstrated to be distinguished chiefly through vowel quality (Mattys), which can be easily observed in examples like *export* (v) /əksˈpɔɹt/ vs *export* (n) [ˈɛkspɔɹt] and *protest* (v) [prəˈtɛst] vs *protest* (n) /ˈproʊˌtɛst/ where the contrasts in the first syllables are phonetically realized as full vowels vs shwa. However, in minimal pairs whose contrast is that of primary and secondary stress, rather than stress vs no stress, the vowel quality does not necessarily change. Cutler (1986) examined this phenomenon in which she described minimal pairs like *forbear* (v) /ˌfɔɹˈbɛ˞/ and *forebear* (n) /ˈfɔːɹˌbɛ˞/, whose vowel qualities are the same and whose meanings are instead recognized through some other acoustic cue, in this case syllable duration, fundamental-frequency movements, and intensity. Beckman (1986) discusses several phonetic exponents to stress, including pitch, volume, vowel quality, and duration. Lieberman (1960 453) finds fundamental frequency and amplitude differences to be significant in stress contrasts in general. And more specifically Plag, Kunter, and Schramm (2011) find spectral balance to have a strong correlation with contrasts between primary and secondary stress. Through acoustic measurements, I hope to (1) determine which, if any, of these cues English speakers use to differentiate between primary and secondary stress, and (2) if such a distinction is quantifiable.

1.1 Building the experiment and outcomes

I found a native speaker to pronounce 75 minimal pairs of syllables in primary and secondary stressed environments. After segmenting and analyzing the speaker's vowels for vowel quality, duration, fundamental frequency, intensity, and spectral tilt, I was able to compare acoustic information of these syllables to see if any trends exist in comparing primary and secondary stress. I found that vowel intensity (volume), duration, and spectral tilt (defined below) are statistically significant cues to an acoustic difference between primary and secondary stress syllables produced by this speaker.

2. PRIMARY AND SECONDARY STRESS IN PREVIOUS RESEARCH

2.1 Definition of stress

Mary Beckman (1986) presented what she called the *Stress Accent Hypothesis* with two proposals: 1. "...there is such a thing as accent that can be identified and separated from other phonological phenomena in a language." (ix) and 2. "...phonological categories are not necessarily phonetically uniform across languages or within a language." (ix) While the first few chapters of her text focus on defining "accent" and in what contexts it refers to "stress", it is the latter half in which she discusses the effect on accent of various phonological cues. These are fundamental frequency, duration, amplitude, and spectral coefficient (vowel quality).

Beckman was particularly interested in examining these cues in the context of Japanese and English, and was surprised to find that fundamental frequency showed a much greater mean effect on accent than did any of the other cues in Japanese. But with English, fundamental frequency only showed slightly more mean effect than duration and spectral coefficient, and amplitude was yet still not far behind those two cues.

Beckman's work shows us acoustic ways we can account for stress in English, and these cues have been well attested in other work for quite some time (Schane 1979, Fry 1955).

2.2 Definition of primary and secondary stress

Acoustic contrasts between primary and secondary stress are not so clearly defined in the literature. A few minimal pairs whose phonetic properties are almost exactly the same except for in vowel duration, intensity, and perhaps fundamental frequency exist in English. Some of these pairs, like *forebear* /ˈfɔɹˌbɛɚ/ and *forbear* /ˌfɔɹˈbɛɚ/, seem to be made up entire of heavy syllables (Cutler 1986), that contrast only in stress pattern. These are different from minimal pairs like *cannery* (ˈkæ.nɚ.ɹi) and *canary* (kəˈnɝ.ɹi) that do show differences in vowel quality. We might say that a contrast between *forebear* and *forbear* may be one of primary and secondary stress, because vowel quality does not change between their pronunciations.

Plag, Kunter, and Schramm (2011) investigated F0, intensity, duration, pitch slope, and what they called spectral balance, otherwise known as spectral tilt, in order find acoustic cues to this contrast. Unlike authors of other papers that have discussed the distinction, they examined these stress patterns in both pitch accented and non-pitch accented contexts, because utterance pitch accent has a such a great effect on fundamental frequency, one of the major attested exponents to stress. They found F0, intensity, and spectral balance, but not duration nor pitch slope, to be significant correlates to primary and secondary stress when the word was in a pitch accented environment[2] (371). They considered pitch slope because they found contours within the target syllables, and thus wanted to examine a change in F0 instead of average pitch. Though my own experiment does not include a specific measurement of pitch slope, I do measure pitch excursion (the max pitch minus the min pitch), which is related.

2.2.1 Spectral Tilt

Spectral tilt is a measurement of the slope of a spectral slice at a given time point (see figure 2.1). The measurement can be made in a variety of ways, though it usually includes comparing the intensity of the first harmonic H1, to the intensities of other harmonics and formants. Non-zero slopes can indicate creaky voice and breathy voice in speech production.

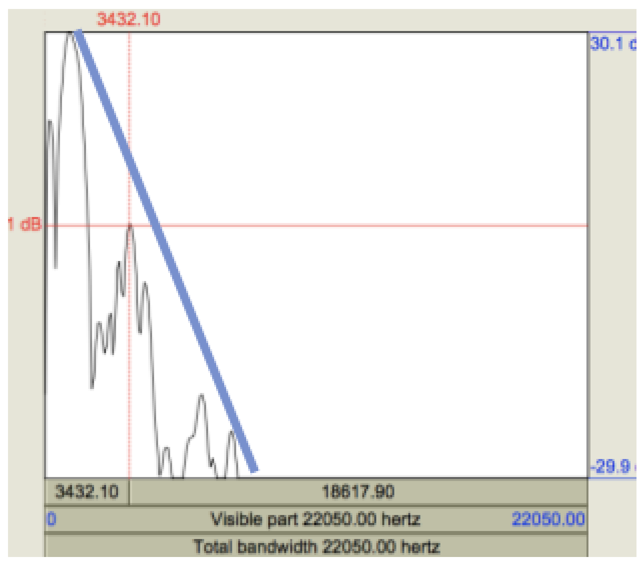

Figure 2.1: spectral tilt

Plag, Kunter, and Schramm (2011) found that spectral balance, their measure of spectral tilt, can be an indicator of stress by demonstrating that it is higher in primarily stressed syllables of right-prominent words and in secondarily stressed syllables of left-prominent words. Here a *left-prominent word* has primary stress at its beginning (e.g. ˈ*vio late*) and secondary stress at its end. A *right-prominent word* has primary stress at its end (e.g. ˌvioˈlation) and secondary stress at its beginning.

[2] Their word environment was "She said [x] again", which [x] is the target word.

Sluijtera and van Heuven (1996) also found spectral balance to be a cue to stress in general (not necessarily primary and secondary stress) in Dutch words, showing that "stressed vowels hav[e] more high-frequency emphasis than unstressed vowels." (2483) Though doing so in a different language, they showed that stressed vowels in Dutch have a greater amplitude in their higher-order harmonics than unstressed vowels.

2.2.2 Primary and secondary stress as word pitch accent

de Jong (2004) considered stress itself to be a binary feature, "whereby syllables which are heads of prosodic constituents are systematically hyperarticulated" (494). In order to realize phenomena like primary and secondary stress, he asserts that stressed syllables can be marked or unmarked with a pitch accent feature. Therefore a primary stress syllable has the features [+stress +accent] while a secondary stress syllable is marked as [+stress -accent] (494). In essence, de Jong claims that the primary/secondary stress contrast is solely represented in pitch differences.

2.3 How can primary and secondary stress be used?

2.3.1 Primary and secondary stress for lexical access

Research on minimal pairs whose phonemes are equivalent (recall the *forebear / forbear* example) has examined whether these pairs are homophonous in terms of our lexical entries of the words, or instead are somehow part of the lexical access code, meaning that English speakers can hear acoustic differences between them and use those differences when looking up these words in mental lexicons. Cutler (1986) examined such pairs as primers for word recognition of semantically related and unrelated words, to test if she would find faster recognition time if the presented word was similar or related in meaning. For example, a computer screen would display the word *forebear*, and subjects would have to recognize if the terms *ancestor* (clearly related to the noun *forebear*) and *tolerate* (clearly related to verb *forbear*) were words. Cutler hypothesized that response times for *ancestor* would be faster than those for *tolerate*. This would have shown that "prosodic information is sufficient to constrain lexical access" (210) and, in the case of *forebear*/*forbear*, that a primary/secondary stress contrast specifically is prevalent enough to affect the word retrieval process. However, this is not what she found. Instead, differences between word recognition speeds were not statistically significant enough to suggest such an effect, and therefore she claimed that stress pairs like *forebear/forbear* are "functionally homophones" because speakers do not seem to hear a difference between them (215).

Though these results show that stress differences do not necessarily impact semantic understanding in terms of access, acoustic differences may still exist between such primarily and secondarily stressed pairs. Even if these distinctions are not perceptible (see discussion below), they may still be relevant to technological speech recognition.

2.3.2 Native speaker conscious distinction

Sven Mattys (2000) examined whether native American English speakers are capable of distinguishing between primary and secondary stress within words without accompanying lexical information. He isolated word fragments such as /pɹɔsɪ/ from the words *prosecutor* (in which it is primarily stressed /ˈpɹɔsɪ/) and *prosecution* (in which it is secondarily stressed / pɹɔsɪ/) and asked the native speakers to match the word fragments to the original word given only the auditory data of the fragments in isolation. He found that the speakers were more likely to correctly match the fragments than statistical chance of correct matching, which he believes is evidence that speakers do have the capability to distinguish between primary and secondary stress in isolation.

3. EXPERIMENT TO FIND CUES TO PRIMARY AND SECONDARY STRESS

Considering this previous research, I built an experiment to compare the difference in duration, midpoint pitch, pitch excursion, midpoint intensity, mean intensity, F1, F2, and spectral tilt of minimal primary/secondary stress pairs.

3.1 Description of data collection

Recordings were made in an Industrial Acoustics Company soundproof room using a Zoom H5 Handy Recorder, which can be set up to automatically start and stop recording when it senses sound from the speaker's input mic above a certain level. With this functionality, each of my elicitation sentences were nicely recorded into separate .wav files, making my labeling process more efficient. The auto start and stop made some errors such that only 137 of my 153 target words were able to be labeled.

My speaker wore an SM10A dynamic headworn microphone, which prevented noticeable effects of the speaker moving while reading the sentences as the mic was always a constant distance and angle away from his mouth.

3.1.1 Speaker

My speaker is a 20 year old male and a native speaker of American English. His voice in general had a very low pitch in my recordings, ranging from 65Hz to 100Hz; sometimes there were only three or four wave periods over the entire duration of a vowel. This did not prevent Praat from taking acoustic measurements, as one might expect it would, because though they were at a low frequency, his vocal fold vibrations were indeed regular.

3.1.2 Praat and text grids

See Appendix B for my Praat scripts. These scripts collected and arranged my acoustic data into a .csv file.

3.2 Cues

3.2.1 Duration

Easily the simplest measurement, duration was the length of the vowel in seconds determined with Praat TextGrids (Boersma & Weenink), where boundaries were placed at spectral time points where the onsets and codas clearly ended and began respectively. (Figure 3.1)

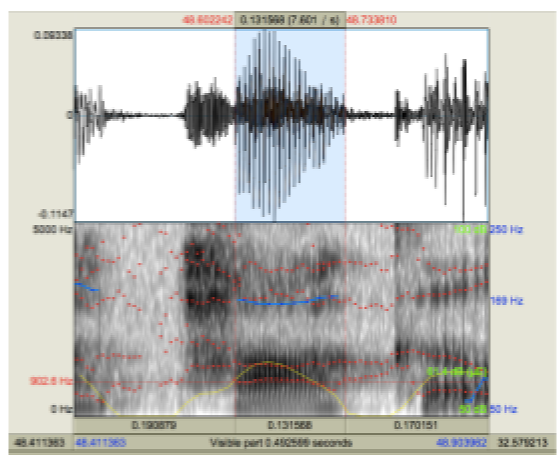

Figure 3.1: the vowel /ɑ/ in /əˈpɑ.kəˌlɪps/. The boundary between the aspiration of /p/ and the coda /k/ is clear. This vowel has a duration of 0.013 seconds.

3.2.2 Midpoint pitch

Taken at the middle point of the vowel, midpoint pitch was the F0 at this timepoint. This was computed using the a time step of 0.01 with a minimum pitch of 50Hz and a maximum pitch of 250Hz. In five instances Praat failed to calculate this cue, and the syllables were labeled as "undefined". They were not included in the midpoint pitch comparisons analysis.

3.2.3 Pitch excursion

Pitch excursion is defined as the maximum pitch minus the minimum pitch in Hz, as a way to measure change in pitch over the duration of the vowel. This measurement is particularly useful for diphthongs, of which I included none, but is nonetheless a worthy measurement to take to look for any correlation. Praat failed to retrieve the max and min F0 of two elicitations, and these syllables were not included in the pitch excursion comparisons analysis.

3.2.4 Midpoint intensity

Like midpoint pitch, midpoint intensity is simply the intensity (amplitude) taken at the middle point in the vowel in dB.

3.2.5 Mean intensity

Mean intensity was calculated using Praat's Get mean… function. Again the value is in decibels and was calculated over the full length of the vowel.

3.2.6 F1 and F2

F1 and F2, like F0, were calculated in Hz, and sampled from the middle of the vowel. I used these values to examine vowel quality differences in the target vowels.

3.2.7 Spectral tilt

Spectral tilt was calculated in dB, as a measurement of the difference between the intensity of the first harmonic F0, and the intensity of the second formant F2. As discussed in the results section, I also took H1 - H2 (where H2 is the second harmonic) and H1 - F1 differences (all measured in dB) in an attempt to get multiple measurements for spectral tilt. But these latter two were deemed not statistically significant.

Praat failed to take spectral tilt measurements on two of the target words so they were included in the spectral tilt comparison analysis.

3.3 Acquisition of minimal pairs

The CMU Pronouncing Dictionary (Weide 1994) provides a corpus of over 134,000 English words divided into ARPAbet phonemes, with all vowels labeled as primarily, secondarily, or zero stressed. Using this data set I was able to identify over 70 syllables that appear in both primary and secondary stress environments. For example the syllable /kɑt/ shows secondary stress in *apricot* /ˈæp.ɹɪˌkɑt/ and primary stress in the word *dichotomy* /daɪˈkɑt.ə.mi/. Though a useful resource, I was not the first to find there are some issues with their labelings. Hayes and White (2013:51) found several vowels labeled incorrectly, and I in particular noticed that, for example *baptize* was labeled as ['B', 'AE2', 'P', 'T', 'AY1', 'Z'] /ˌbæpˈtaɪz/ rather than the correct ['B', 'AE1', 'P', 'T', 'AY2', 'Z'] /ˈbæpˌtaɪz/. For the words I selected as targets, I made sure that they were indeed transcribed correctly so that I was testing for the proper stress environment.

In choosing my syllables, it was important to provide visually contrastive (in terms of spectra) vowel environments. To do so, all of my onsets and codas were either stops, affricates, or fricatives, allowing for easier vowel boundary labeling. Additionally, I avoided diphthongs, as such a drastic change in vowel quality would influence my acoustic measurements.

3.4 Creation of elicitation sentences

For my full list of utterances with target syllables see Appendix A. After identifying 153 words that contained these syllables in their primary and secondary stressed environments, I organized them into elicitation sentences that provided both a semantic context and universal phonetic context for each word. For example, the utterance for *assassination* was:

"Murder a politician. I can use the word *assassination* sensibly in this context."

The phonetic context /d [word] s/ from the phrase "use the wor**d [x] s**ensibly in this context" placed a plosive before the word and the sibilant fricative after, providing again visually discernable spectra environments when the target syllables had no onset (ex. /æb/ in *abduct*) or no coda (ex. /ti/ in *trustee*). This also ensured that the target words would be pronounced in the same syntactic area of the sentence, eliminating influence of utterance inflection on the data, which Plag, Kunter, and Schramm (2011) found to affect the realization of primary and secondary stress.

The first part of each utterance ("Murder a politician" in the example above), gave semantic contexts for the words, in order to compensate for homographs (two separate pronunciations and meanings but same spelling). *abstract* was a prime example of this, because I wanted my speaker to pronounce the noun form /ˈæbˌstɹækt/ not the verb *to abstract* /ˌæbˈstɹækt/. Unfortunately, providing semantic context did not always help in coaxing proper stress assignment, and in several cases (including *abstract*), my speaker mispronounced the intended syllables. These errors were not included in the final computations.

The sentences were randomized using Python before being presented to the speaker. The appendix shows their random order.

3.5 Data analysis

The .csv files were parsed using Python and R, in order to observe, if any, quantifiable trends between vowels in the same syllable context in primary and secondary stress environments. Difference scores for these minimal pairs were calculated for duration, midpoint pitch, pitch excursion, midpoint intensity, mean intensity, and spectral tilt. Boxplots for some of these measurements, as displayed below, show a non-zero mean difference. A vowel space scatter plot was also created to compare F1 and F2 values for primarily and secondarily stressed vowels.

4. RESULTS

Some of these cues did yield statistically significant results when subtracting the value of a cue of a secondarily stressed syllable from the value of the cue of the primary stressed syllable. We might have expected the secondary stressed syllables to have shorter durations, quieter intensities, lower pitches, more centralized vowels, and more creaky voice. For this speaker, we do see these trends in intensity and spectral tilt after running t-tests for significant data on each acoustic measurement. In this section, I will present the raw data and t-test results of my acoustic measurements, and in the following section (Discussion), I discuss in detail the relevancy of these results. In order to deem data statistically significant, it needed to have a p-value of 0.05 or below.

4.1 Duration

The boxplot to the right (figure 4.1) shows clearly that the difference in duration between primary stress vowels and secondary stress vowels is roughly zero. On average, my speaker's primary stress vowels were 8 milliseconds longer than their counterparts with a p-value of .025, meaning ~97.5% confidence.

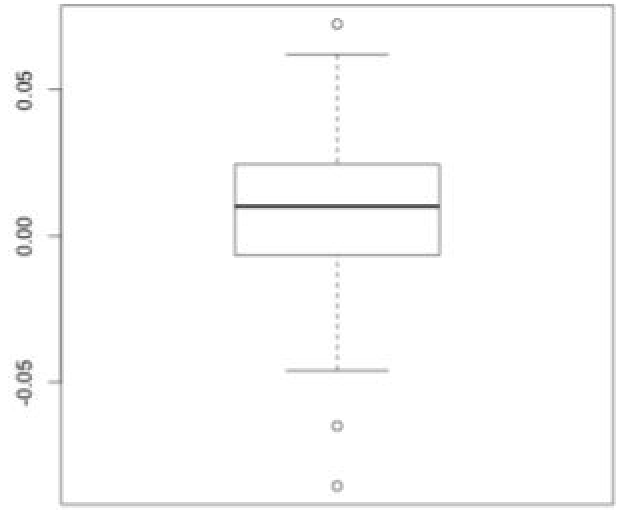

Figure 4.1: duration

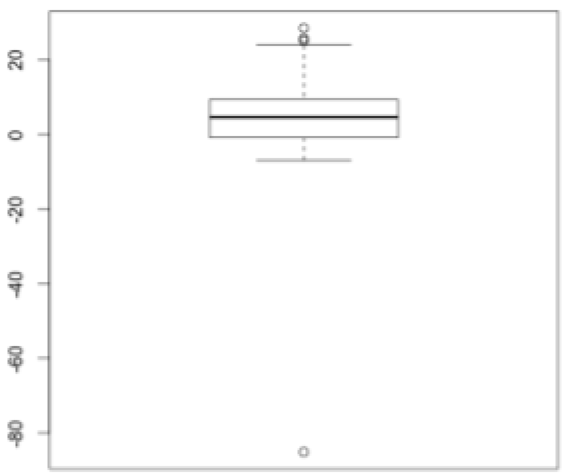

Figure 4.2: midpoint pitch

4.2 Midpoint Pitch

Similar to duration, our boxplot for midpoint pitch (figure 4.2) also centers around zero. A t-test against 'the true mean is not equal 0' hypothesis shows not quite enough confidence (~94%) for statistical significance. The mean of midpoint pitch is 3.821, meaning on average, primary stressed syllables were ~3.8Hz greater than their secondary stress counterparts.

4.3 Pitch Excursion

A t-test on the data for pitch excursion yields a mean of .321, meaning that the average difference between the max pitch and the min pitch in the primary stress vowel was approximately .32Hz greater than that of the secondary stressed vowel. But a t-test on this data yields a p-value of .801,

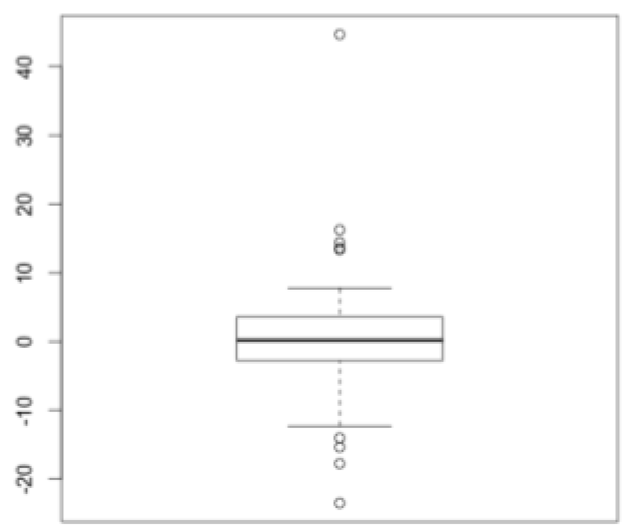

Figure 4.3: pitch excursion

which is not at all statistically significant. (See figure 4.3)

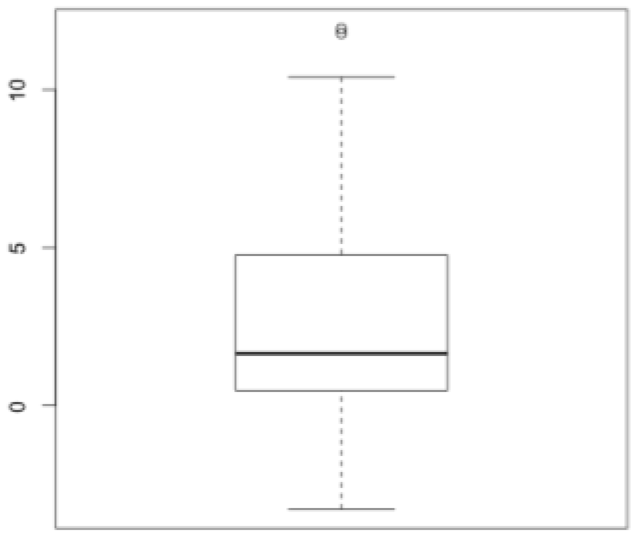

Figure 4.4: midpoint intensity

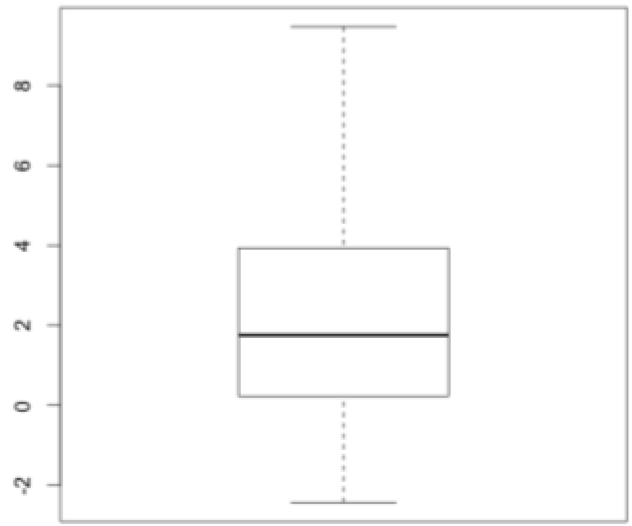

Figure 4.5: mean intensity

4.4 Midpoint and Mean Intensity

The data for midpoint intensity (figure 4.4) show that on average, the primary stress vowels were 2.690 dB louder than the secondarily stressed vowels. Similarly with mean intensity (figure 4.5), the primary stress vowels were on average 2.379 dB louder than the secondarily stressed vowels. These data are statistically significant with p-values of 1.818×10^{-7} and 3.857×10^{-8} respectively.

4.5 Vowel Space

The plot of my speakers vowels is shown at the right (figure 4.6). I did not run any statistical significance tests on these clusters, but they do not appear to show many patterns anyway.

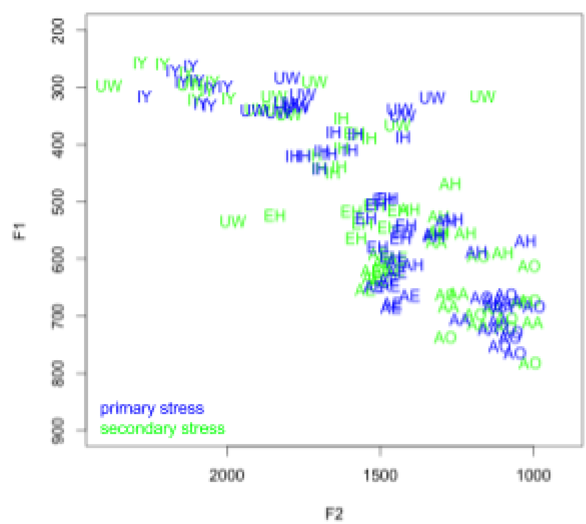

Figure 4.6: vowel space

4.6 Spectral Tilt

Figure 4.7 shows an average spectral tilt of -2.100, meaning on average, the difference between the intensity of H1 and the intensity of F2 of secondarily stressed vowels (H1 - A2) was ~2.1dB greater than that of the primarily stressed

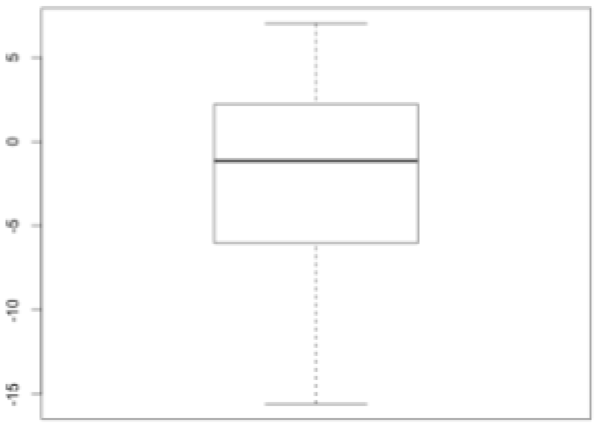

Figure 4.7: spectral tilt

vowels, meaning that the spectral tilt of the vowels of secondary stress syllables was, on average, greater. These results are statistically significant, with a p-value of 0.008.

4.6.1 Other Spectral Tilt Measurements

Intensity measurements of harmonic one minus harmonic two (H1 - H2) and harmonic one minus formant 1 (H1 - A1) were taken, but did not yield statistically significant results.

5. DISCUSSION AND APPLICATIONS TO SPEECH RECOGNITION

5.1 Discussion

As stated above, acoustic measurements for duration, intensity, and spectral tilt yielded statistically significant results, while measurements for F0, F1, and F2 did not. Interpretation and applications of these results are discussed below.

5.1.1 Duration

Though statistically significant, the average difference in duration between primary and secondary stressed vowels in the target syllables is so small (8ms) that it is not discernable by the human ear. So for my speaker, duration is certainly not an exponent he uses to produce a distinction. Despite this, the difference does have applications in speech recognition; computers, as demonstrated here, can hear a contrast in duration.

Plag et al. (2011) did not find duration to be a correlate to the primary and secondary stress distinction, though Beckman did find it to be a cue to stress in general.

5.1.2 Intensity

Both midpoint and mean intensity measurements showed primarily stressed syllable vowels to be on average between two and three decibels louder than their secondarily stressed counterparts. Based upon the p-values in the statistical significance test for this measurement, intensity for this speaker is his primary cue for distinguishing between primary and secondary stress. This supports Plag et al. (2011) in finding intensity to be an exponent to this contrast, but contrasts with Beckman's findings that showed that while it is relevant, intensity is low in the hierarchy of acoustic cues to word internal stress. Perhaps this is further justification for showing that there is indeed three-way difference between no stress, primary stress, and secondary stress, as in one comparison, stress vs no stress, intensity does not demonstrate a strong correlation, but in another, primary vs secondary, it does.

5.1.3 Spectral Tilt

Like Plag et al. this experiment showed slope of spectral slices to be a strong correlate to the distinction between primary and secondary stress syllable vowels. Though spectral balance and spectral tilt are mathematically different measurements, they do allow for demonstrating the same phenomena, namely breathy voice and creaky voice. As explained above, greater slopes (farther away from zero) correspond to creaky voice, and my speaker tended to have creakier secondarily stressed vowels.

It is important to note that Plag, Kunter, and Schramm distinguished between right-prominent and left-prominent words with taking their acoustic measurements. Left-prominent words have primary stress towards the beginning of the word, while in right-prominent words primary stress is found towards the end. Their spectral balance measurements actually yielded different results for the two word types: for right-prominent words, the right (primarily stressed) syllable had greater (farther away from zero) slope, meaning that for right-prominent words, the primarily stressed syllable was pronounced with creakier voice. Whereas with left-prominent words, the secondarily stressed syllable (right syllable) showed a greater slope and therefore creakier voice. My data, though not as specific, can still support Plag et al., because 75% (114 out of 153) of my target words were left-prominent.

5.1.4 Pitch and Formants

In contrast to Beckman's findings, my speaker does not seem to use pitch or vowel quality to distinguish between primary and secondary stress. Again this is more evidence for the three-way zero, primary, and secondary stress distinction, in which pitch and vowel quality are used to differentiate only between stress vs no stress. But these results also differ from Plag et al. (2011), who found F0 to be a correlate to the distinction, and de Jong (2004), who defined primary and secondary stress in terms of pitch. Perhaps across speakers pitch is more of a cue, and my particular speaker is an outlier in terms of not using it to hear or pronounce the acoustic distinction.

5.2 Applications

One could say this is important to linguistics and human knowledge because I am attempting to model what the human brain does into order to understand stress. This not only has phonetic implications, but semantic ones as well because, as shown with examples like *forebear*/*forbear*, stress can be contrastive in English. Being able to demonstrate such a process can only further advance our understanding of human cognition and interpretation of acoustic data in speech.

But greater implications include those in speech recognition, where it seems contrasts between primary and secondary stress are hardly taken into account, if at all. Normally this is not an issue because syntactic context helps distinguish the intended meaning. However, if a speaker were to ask their phone, for example, "what is the definition of forebear" and "what is the definition of forbear", the software would most likely not hear the difference. Including an algorithm that recognizes the differences between primary and secondary stress in speech recognition programs could increase their accuracy.

APPENDIX

A Full List of Elicitations

The sentences are shown followed by the ARPAbet syllable.

1. Recover. I can use the word recuperate sensibly in this context. ['K', 'UW1', 'P']
2. Make the same quantity or size. I can use the word equalization sensibly in this context. ['IY2', 'K']
3. Not a llama. I can use the word alpaca sensibly in this context. ['P', 'AE1', 'K']
4. Approve. I can use the word authorization sensibly in this context. ['AO2', 'TH']
5. Procreate. I can use the word reproduce sensibly in this context. ['D', 'UW1', 'S']
6. Not increase. I can use the word decrease sensibly in this context. ['D', 'IY1', 'K']
7. Unconditional and absolute. I can use the word categorical sensibly in this context. ['K', 'AE2', 'T']
8. Genocide in World War II. I can use the word holocaust sensibly in this context. ['K', 'AO2', 'S', 'T']
9. Pause. I can use the word hesitate sensibly in this context. ['HH', 'EH1', 'Z']
10. Procreation. I can use the word reproduction sensibly in this context. ['D', 'AH1', 'K']
11. Science of the universe. I can use the word cosmology sensibly in this context. ['K', 'AO2', 'Z']
12. Factories. I can use the word industrialize sensibly in this context. ['D', 'AH1', 'S']
13. Exclude and shun. I can use the word ostracize sensibly in this context. ['AO1', 'S']
14. Britannica. I can use the word encyclopedia sensibly in this context. ['P', 'IY1', 'D']
15. Imagination. I can use the word creativity sensibly in this context. ['T', 'IH1', 'V']
16. East-African. I can use the word Ethiopian sensibly in this context. ['IY2', 'TH']
17. Assertive and opinionated. I can use the word dogmatic sensibly in this context. ['D', 'AO2', 'G']
18. Not on the path. I can use the word deviation sensibly in this context. ['D', 'IY2', 'V']
19. Donator. I can use the word benefactor sensibly in this context. ['F', 'AE2', 'K']
20. Principles are incontrovertibly true. I can use the word dogmatism sensibly in this context. ['D', 'AO1', 'G']
21. “He lives!” I can use the word resuscitate sensibly in this context. ['S', 'AH1', 'S']
22. Recover. I can use the word recuperation sensibly in this context. ['K', 'UW2', 'P']
23. Excited. I can use the word enthusiastic sensibly in this context. ['TH', 'UW2', 'Z']
24. A political concept. I can use the word federalism sensibly in this context. ['F', 'EH1', 'D']
25. From a Mediterranean island. I can use the word Maltese sensibly in this context. ['T', 'IY1', 'Z']
26. Excessively obedient with a motive. I can use the word sycophantic sensibly in this context. ['S', 'IH2', 'K']
27. A review or re-examination. I can use the word reconsideration sensibly in this context. 'S', 'IH2', 'D']
28. A regular back and forth movement. I can use the word oscillation sensibly in this context. ['AA2', 'S']
29. Newspaper. I can use the word publication sensibly in this context. ['P', 'AH2', 'B']

30. Emergency room. I can use the word hospital sensibly in this context. ['HH', 'AA1', 'S']
31. Increase rapidly. I can use the word escalate sensibly in this context. ['EH1', 'S']
32. A social and mental condition. I can use the word autism sensibly in this context. ['AO1', 'T']
33. Concentrate in and become an expert. I can use the word specialize sensibly in this context. ['S', 'P', 'EH1', 'SH']
34. Christen a baby. I can use the word baptize sensibly in this context. ['B', 'AE1', 'P', 'T']
35. Instinctive and involuntary. I can use the word automatic sensibly in this context. ['AO2', 'T']
36. Part of the immune system. I can use the word antibody sensibly in this context. ['B', 'AA2', 'D']
37. Mollify. I can use the word pacify sensibly in this context. ['P', 'AE1', 'S']
38. Self-centered. I can use the word egotism sensibly in this context. ['IY1', 'G']
39. Revitalize. I can use the word rejuvenate sensibly in this context. ['JH', 'UW1', 'V']
40. Cash register. I can use the word cashier sensibly in this context. ['K', 'AE2', 'SH']
41. Another word for 'item'. I can use the word object sensibly in this context. ['AA1', 'B'], ['JH', 'EH2', 'K']
42. Descent of the Holy Spirit. I can use the word Pentecost sensibly in this context. ['K', 'AO2', 'S', 'T']
43. Murder a politician. I can use the word assassinate sensibly in this context. ['S', 'AEA', 'S']
44. Revolutionary. I can use the word visionary sensibly in this context. ['V', 'IH1', 'ZH']
45. Teacher of Plato. I can use the word Socrates sensibly in this context. ['T', 'IY2', 'Z']
46. Seed for an anise. I can use the word aniseed sensibly in this context. ['S', 'IY2', 'D']
47. Reindeer. I can use the word caribou sensibly in this context. ['B', 'UW2']
48. Frustratingly stubborn. I can use the word obtuse sensibly in this context. ['AA2', 'B']
49. Zero percent chance. I can use the word impossibility sensibly in this context. ['P', 'AO2', 'S']
50. Hearable. I can use the word auditory sensibly in this context. ['AO1', 'D']
51. Self-centered. I can use the word egotistical sensibly in this context. ['IY2', 'G']
52. Angsty teen. I can use the word attitude sensibly in this context. ['T', 'UW2', 'D']
53. Vengeful. I can use the word vindictive sensibly in this context. ['D', 'IH1', 'K']
54. Eight singers. I can use the word octet sensibly in this context. ['AA2', 'K']
55. Revitalize. I can use the word rejuvenation sensibly in this context. ['JH', 'UW2', 'V']
56. An elongated shape. I can use the word oblong sensibly in this context. ['AA1', 'B']
57. A type of antibody. I can use the word antitoxin sensibly in this context. ['T', 'AA1', 'K', 'S']
58. Suppose. I can use the word supposition sensibly in this context. ['S', 'AH2', 'P']
59. An addition or addendum. I can use the word supplement sensibly in this context. ['S', 'AH1', 'P']
60. Administrator. I can use the word trustee sensibly in this context. ['T', 'IY1']
61. Not regular. I can use the word inconsistency sensibly in this context. ['S', 'IH1', 'S']
62. Giant woody grass that grows in the tropics. I can use the word bamboo sensibly in this context. ['B', 'UW1']

63. Launch. I can use the word catapult sensibly in this context. ['K', 'AE1', 'T']
64. Compost. I can use the word decompose sensibly in this context. ['D', 'IY2', 'K']
65. A way to describe a christening ceremony. I can use the word baptismal sensibly in this context. ['B', 'AE2', 'P', 'T'], ['T', 'IH1', 'Z']
66. Reason or support. I can use the word justification sensibly in this context. ['JH', 'AH2', 'S']
67. Friendly reception of guests. I can use the word hospitality sensibly in this context. ['HH', 'AA2', 'S']
68. Religion. I can use the word Judaism sensibly in this context. ['JH', 'UW1', 'D']
69. Mammal in Florida. I can use the word manatee sensibly in this context. ['T', 'IY2']
70. Conquer. I can use the word subjugate sensibly in this context. ['S', 'AH1', 'B']
71. Electricity. I can use the word conductivity sensibly in this context. ['D', 'AH2', 'K']
72. Not a millipede. I can use the word centipede sensibly in this context. ['P', 'IY2', 'D']
73. Murder a politician. I can use the word assassination sensibly in this context. ['S', 'AE2', 'S']
74. Conservatives. I can use the word republicanism sensibly in this context. ['P', 'AH1', 'B']
75. A nut. I can use the word cashew sensibly in this context. ['K', 'AE1', 'SH']
76. Type of bacteria. I can use the word streptococcus sensibly in this context. ['K', 'AO1', 'K']
77. Inebriated. I can use the word intoxication sensibly in this context. ['T', 'AA2', 'K', 'S']]
78. Being sophisticated. I can use the word sophistication sensibly in this context. ['F', 'IH2', 'S']
79. Make a copy. I can use the word duplication sensibly in this context. ['D', 'UW2', 'P']
80. Quiz Bowl. I can use the word competition sensibly in this context. ['T', 'IH1', 'SH']
81. Revival, resurrection. I can use the word resuscitation sensibly in this context. ['S', 'AH2', 'S']
82. Formal male suit. I can use the word tuxedo sensibly in this context. ['S', 'IY1', 'D']
83. Aliens. I can use the word abduct sensibly in this context. ['AE2', 'B']
84. To make sophisticated. I can use the word sophisticate sensibly in this context. ['F', 'IH1', 'S']
85. Thinking deeply. I can use the word cogitation sensibly in this context. ['K', 'AA2', 'JH']
86. Division and contrast between two. I can use the word dichotomy sensibly in this context. ['K', 'AA1', 'T']
87. Astronaut from Russia. I can use the word cosmonaut sensibly in this context. ['K', 'AO1', 'Z']
88. Family history. I can use the word ancestry sensibly in this context. ['S', 'EH2', 'S']
89. Ethnically European. I can use the word caucasian sensibly in this context. ['K', 'AO2', 'K']
90. Soak. I can use the word saturate sensibly in this context. ['S', 'AE1', 'CH']
91. Dystopia. I can use the word apocalypse sensibly in this context. ['P', 'AA1', 'K']
92. Thinking deeply. I can use the word cogitate sensibly in this context. ['K', 'AA1', 'JH']
93. Confirm or give support. I can use the word corroborative sensibly in this context. ['T', 'IH2', 'V']
94. Mesmerize. I can use the word transfix sensibly in this context. ['F', 'IH1', 'K', 'S']
95. North and south. I can use the word magnetism sensibly in this context. ['T', 'IH2', 'Z']
96. A tangible or visible manifestation. I can use the word embodiment sensibly in this context. ['B', 'AA1', 'D']

97. Zombies. I can use the word apocalyptic sensibly in this context. ['P', 'AA2', 'K']
98. Reason or support. I can use the word justify sensibly in this context. ['JH', 'AH1', 'S']
99. Disgustingly indecent. I can use the word obscene sensibly in this context. ['AA2', 'B']
100. Showing poor judgment. I can use the word injudicious sensibly in this context. ['JH', 'UW2', 'D']
101. Affected by autism. I can use the word autistic sensibly in this context. ['AO2', 'T']
102. Renouncer or abandoner. I can use the word apostate sensibly in this context. ['P', 'AO1', 'S']
103. High pitch male voice. I can use the word falsetto sensibly in this context. ['S', 'EH1', 'T']
104. Descent of the Holy Spirit. I can use the word Pentecostal sensibly in this context. ['K', 'AO1', 'S', 'T']
105. Acceptance of new ideas. I can use the word receptivity sensibly in this context. ['S', 'EH2', 'P']
106. Harry Potter and the Chamber of Secrets. I can use the word petrify sensibly in this context. ['P', 'EH1', 'T']
107. Robotic. I can use the word automate sensibly in this context. ['AO1', 'T']
108. A summary of an experiment or paper. I can use the word abstract sensibly in this context. ['AE1', 'B']
109. Ears under a change of pressure. I can use the word equalize sensibly in this context. ['IY1', 'K']
110. Make a formal judgment. I can use the word adjudication sensibly in this context. ['JH', 'UW2', 'D']
111. A rapid increase. I can use the word escalation sensibly in this context. ['EH2', 'S']
112. Not neon. I can use the word pastel sensibly in this context. ['P', 'AE2', 'S']
113. Ordered. I can use the word systematic sensibly in this context. ['S', 'IH2', 'S']
114. Make a copy. I can use the word duplicate sensibly in this context. ['D', 'UW1', 'P']
115. League or alliance. I can use the word federation sensibly in this context. ['F', 'EH2', 'D']
116. Pediatrician. I can use the word specialization sensibly in this context. ['S', 'P', 'EH2', 'SH']
117. Asian Country. I can use the word Bhutan sensibly in this context. ['B', 'UW2', 'T']
118. Pretentious display of luxury. I can use the word ostentation sensibly in this context. ['AO2', 'S']
119. Running lengthwise rather than across. I can use the the word longitudinal in this context. ['T', 'UW1', 'D']
120. A type of tree. I can use the word sycamore sensibly in this context. ['S', 'IH1', 'K']
121. We all live in a yellow ______. I can use the word submarine sensibly in this context. ['S', 'AH2', 'B']
122. At least one oxygen and another element. I can use the word oxide sensibly in this context. ['AA1', 'K']

123. Factories. I can use the word industrialization sensibly in this context. ['D', 'AH2', 'S']
124. African country. I can use the word Djibouti sensibly in this context. ['B', 'UW1', 'T']
125. An inserted object. I can use the word inset sensibly in this context. ['S', 'EH2', 'T']
126. Not a peach. I can use the word apricot sensibly in this context. ['K', 'AA2', 'T']
127. Not pathos or logos. I can use the word ethos sensibly in this context. ['IY1', 'TH']
128. Require or demand. I can use the word necessitate sensibly in this context. ['S', 'EH1', 'S']
129. Fighting between armed persons. I can use the word combat sensibly in this context. ['B', 'AE2', 'T']
130. Handicapped. I can use the word accessibility sensibly in this context. ['S', 'EH2', 'S']
131. Prone to fighting. I can use the word combative sensibly in this context. ['B', 'AE1', 'T']
132. Chemicals from petroleum. I can use the word petrochemical sensibly in this context. ['P', 'EH2', 'T']
133. Back and forth rhythmically. I can use the word oscillate sensibly in this context. ['AA1', 'S']
134. Approve. I can use the word authorize sensibly in this context. ['AO1', 'TH']
135. Reachable. I can use the word accessible sensibly in this context. ['S', 'EH1', 'S']
136. Self-indulgence. I can use the word hedonistic sensibly in this context. ['HH', 'IY2', 'D']
137. Wooden cross. I can use the word crucifix sensibly in this context. ['F', 'IH2', 'K', 'S']
138. Excited hobbyist. I can use the word enthusiast sensibly in this context. ['TH', 'UW1', 'Z']
139. Self-indulgence. I can use the word hedonism sensibly in this context. ['HH', 'IY1', 'D']
140. Make a formal judgment. I can use the word adjudicate sensibly in this context. ['JH', 'UW1', 'D']
141. A theater in a middle school. I can use the word auditorium sensibly in this context. ['AO2', 'D']
142. Visual representation. I can use the word visualization sensibly in this context. ['V', 'IH2', 'ZH']
143. Birth control. I can use the word contraceptive sensibly in this context. ['S', 'EH1', 'P']
144. To interrupt. I can use the word interject sensibly in this context. ['JH', 'EH1', 'K']
145. Collision or crash. I can use the word impact sensibly in this context. ['P', 'AE2', 'K']
146. Mass produce. I can use the word manufacture sensibly in this context. ['F', 'AE1', 'K']
147. Subordinate. I can use the word subsidiary sensibly in this context. 'S', 'IH1', 'D']
148. A pause. I can use the word hesitation sensibly in this context. ['HH', 'EH2', 'Z']
149. Hair and makeup. I can use the word beautician sensibly in this context. ['T', 'IH2', 'SH'][3]
150. Maximum absorption. I can use the word saturation sensibly in this context. ['S', 'AE2', 'CH']
151. Not on the path. I can use the word deviate sensibly in this context. ['D', 'IY1', 'V']
152. Fruits and veggies. I can use the word produce sensibly in this context. ['D', 'UW2', 'S']

[3] This is a falsely labeled word that I did not catch when creating my elicitation sentences.

153. Fidel Castro. I can use the word dictatorial sensibly in this context. ['D', 'IH2', 'K']

B Praat Scripts

Duration, pitch, vowel quality, intensity

```
# This script is adapted from one distributed under the GNU General Public Licence.
# Copyright 19.3.2002 Mietta Lennes

## It is also adapted from a script that was written by Claire M-C in December 2012 for use with the Engish
## stress study stimuli. Which was frankensteined from the labeler.praat script and the annotate WOI script
## from Michael Wagner's suite of stuff for doing prosody experiments

form Calculate the total duration of intervals
comment Make acoustic measurments for intervals in tier:
integer Duration_tier 1
comment that are labeled as:
sentence Label duration
comment (intervals with no label will not be included)
sentence Filename output.csv
positive Time_step 0.01
positive Minimum_pitch_(Hz) 50
positive Maximum_pitch_(Hz) 250
endform

###### prep the info window and output file
clearinfo

printline Label	Duration	Median Pitch	Min Pitch	Max Pitch	F1	F2	Median Intensity	Mean
Intensity
writeFileLine: "/Users/alexandra/Desktop/output.csv", ""

appendFileLine: "/Users/alexandra/Desktop/output.csv", "Label,Duration,Median Pitch,Min Pitch,Max Pitch,F1,F2,Median Intensity,Mean
Instensity"


###### identify where the files are located

recordings_folder$ = "/Users/alexandra/Desktop/Alexandra/School/Senior_Year/Senior_Thesis/files/final/Recording/recordings/"

Create Strings as file list... list 'recordings_folder$'*.wav
sound_file_count = Get number of strings


# "/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final/Recording/recordings/", "",
"/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final/Recording/recordings/"
# "/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final/Recording/recordings/", "",
"/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final/Recording/recordings/"
#Create Strings as file list: "fileList", "/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final*.wav"

# Loop through files and make grids (this section partly inspired by code by Katherine Crosswhite). The script goes through
# list it made. This little chunk gets a single sound file and makes a variable object_name$ that is the name of the sound
# file but with the file extension stripped off.
```

```
for k from 1 to sound_file_count
    select Strings list
    current$ = Get string... k
    Read from file... 'recordings_folder$''current$'
    object_name$ = selected$ ("Sound")

# Below: look for a textgrid in the textgrid folder. If found, open it, otherwise make new one. An existing textgrid will
# not be changed by the script at all. A new textgrid will have the tiers you listed in the tiers field. The tier names that
# were also in the point_tiers field will be point tiers; the others will be interval tiers.
# This section inspired by code by Jen Hay.
# *** Edited by CMC so that if there's no textgrid it just prints an error

        grid_name$ = "'recordings_folder$''object_name$'.TextGrid"
        if fileReadable (grid_name$)
        Read from file... 'grid_name$'
        Rename... 'object_name$'

# End Jen Hay inspired block

########################### create pitch, formants, and intensity objects from sound file
        select Sound 'object_name$'
        To Pitch... time_step minimum_pitch maximum_pitch

        select Sound 'object_name$'
        To Formant (burg)... 0.01 5 5500 0.025 50

        select Sound 'object_name$'
        To Intensity... 100 0


########################### get duration from textgrid
        select TextGrid 'object_name$'

        numberOfIntervals = Get number of intervals... duration_tier

        ########################### Loop through all intervals in the selected tier:
        for i from 1 to numberOfIntervals

                select TextGrid 'object_name$'
                label1$ = Get label of interval... duration_tier i

                # The next line will make sure that intervals with empty or "forbidden" labels are not included:
                if label1$ <> ""


                        # duration
                        start = Get starting point... duration_tier i
                        end = Get end point... duration_tier i
                        duration = end - start
                        middle1 = (start + end) / 2

                        # pitch
                        select Pitch 'object_name$'
                        medianpitch = Get value at time... middle1 Hertz Linear
                        minpitch = Get minimum: start, end, "Hertz", "Parabolic"
                        maxpitch = Get maximum: start, end, "Hertz", "Parabolic"
```

```
#formants
select Formant 'object_name$'
fone = Get value at time... 1 'middle1' Hertz Linear
ftwo = Get value at time... 2 'middle1' Hertz Linear

#intensity
select Intensity 'object_name$'
medianintensity = Get value at time... middle1 Cubic
meanintensity = Get mean... start end dB

printline 'label1$', 'duration', 'medianpitch', 'minpitch', 'maxpitch', 'fone', 'ftwo', 'medianintensity', 'meanintensity'

appendFileLine: "/Users/alexandra/Desktop/output.csv", label1$, ",", 'duration', ",", "'medianpitch'", ",", "'minpitch'", ",", "'maxpitch'", ",", 'fone', ",", 'ftwo', ",", 'medianintensity', ",", 'meanintensity'

endif

endfor
endfor

select all
Remove
```

Spectral tilt

```
# This script is adapted from one distributed under the GNU General Public Licence.

# Copyright 19.3.2002 Mietta Lennes


## It is also adapted from a script that was written by Claire M-C in December 2012 for use with the Engish

## stress study stimuli. Which was frankensteined from the labeler.praat script and the annotate WOI script

## from Michael Wagner's suite of stuff for doing prosody experiments


form Calculate the total duration of intervals

comment Make acoustic measurments for intervals in tier:

integer Duration_tier 1

comment that are labeled as:

sentence Label duration

comment (intervals with no label will not be included)

sentence Filename spectraltiltoutput.csv

positive Time_step 0.01

positive Minimum_pitch_(Hz) 50

positive Maximum_pitch_(Hz) 250
```

```
endform

###### prep the info window and output file
clearinfo

printline Label	H1_H2	H1DB	H2DB	H1_A1		A1DB		H1_A2		A2DB

writeFileLine: "/Users/alexandra/Desktop/output.csv", ""
appendFileLine: "/Users/alexandra/Desktop/output.csv", "Label,H1_H2,H1DB,H2DB,H1_A1,A1DB,H1_A2,A2DB"

###### identify where the files are located

recordings_folder$ = "/Users/alexandra/Desktop/Alexandra/School/Senior_Year/Senior_Thesis/files/final/Recording/recordings/"

Create Strings as file list... list 'recordings_folder$'*.wav
sound_file_count = Get number of strings

# "/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final/Recording/recordings/", "",
"/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final/Recording/recordings/"
# "/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final/Recording/recordings/", "",
"/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final/Recording/recordings/"
#Create Strings as file list: "fileList", "/Users/alexandra/Desktop/Alexandra/School/Senior_Thesis/files/final*.wav"

# Loop through files and make grids (this section partly inspired by code by Katherine Crosswhite). The script goes through
# list it made. This little chunk gets a single sound file and makes a variable object_name$ that is the name of the sound
# file but with the file extension stripped off.

for k from 1 to sound_file_count
    select Strings list
    current$ = Get string... k
    Read from file... 'recordings_folder$''current$'
    object_name$ = selected$ ("Sound")
```

```
# Below: look for a textgrid in the textgrid folder. If found, open it, otherwise make new one. An existing textgrid will
# not be changed by the script at all. A new textgrid will have the tiers you listed in the tiers field. The tier names that
# were also in the point_tiers field will be point tiers; the others will be interval tiers.
# This section inspired by code by Jen Hay.
# *** Edited by CMC so that if there's no textgrid it just prints an error

	grid_name$ = "'recordings_folder$''object_name$'.TextGrid"
	if fileReadable (grid_name$)
	Read from file... 'grid_name$'
	Rename... 'object_name$'

# End Jen Hay inspired block
########################### create pitch, formants, and intensity objects from sound file
	select Sound 'object_name$'
	To Pitch... time_step minimum_pitch maximum_pitch

	select Sound 'object_name$'
	To Formant (burg)... 0.01 5 5500 0.025 50

	select Sound 'object_name$'
	To Intensity... 100 0
########################### get duration from textgrid
	select TextGrid 'object_name$'
	numberOfIntervals = Get number of intervals... duration_tier

	########################### Loop through all intervals in the selected tier:
	for i from 1 to numberOfIntervals

		select TextGrid 'object_name$'
		label1$ = Get label of interval... duration_tier i

		# The next line will make sure that intervals with empty or "forbidden" labels are not included:
		if label1$ <> ""
```

```
# duration
start = Get starting point... duration_tier i
end = Get end point... duration_tier i
duration = end - start
middle1 = (start + end) / 2

# pitch
select Pitch 'object_name$'
medianpitch = Get value at time... middle1 Hertz Linear
minpitch = Get minimum: start, end, "Hertz", "Parabolic"
maxpitch = Get maximum: start, end, "Hertz", "Parabolic"
h1hz = Get mean... start end Hertz
h1hz_a = h1hz-(h1hz/10)
h1hz_b = h1hz+(h1hz/10)
h2hz = h1hz*2
h2hz_a = h2hz-(h2hz/10)
h2hz_b = h2hz+(h2hz/10)

#formants
select Formant 'object_name$'
fone = Get value at time... 1 'middle1' Hertz Linear
ftwo = Get value at time... 2 'middle1' Hertz Linear
f1_a = fone-(fone/10)
f1_b = fone+(fone/10)
f2_a = ftwo-(ftwo/10)
f2_b = ftwo+(ftwo/10)

#intensity
select Intensity 'object_name$'
medianintensity = Get value at time... middle1 Cubic
meanintensity = Get mean... start end dB
```

```
########This is code that allows for intensities of harmonics to be calculated.
########Adapted from a script by Christian DiCanio
select Sound 'object_name$'
chunkLENGTH  = (end-start)
Extract part... start end Rectangular 1 no
chunk_part = selected("Sound")
To Ltas... 50
ltasID = selected("Ltas")
h1db = Get maximum... h1hz_a h1hz_b None
h2db = Get maximum... h2hz_a h2hz_b None
a1db = Get maximum... f1_a f1_b None
a2db = Get maximum... f2_a f2_b None
h1_h2 = h1db - h2db
h1_a1 = h1db - a1db
h1_a2 = h1db - a2db

select 'ltasID'
Remove
printline 'label1$', 'h1_h2', 'h1db', 'h2db', 'h1_a1', 'a1db', 'h1_a2', 'a2db'
appendFileLine: "/Users/alexandra/Desktop/output.csv", label1$, ",", 'h1_h2', ",", 'h1db', ",", 'h2db', ",", 'h1_a1', ",", 'a1db', ",", 'h1_a2', ",", 'a2db'

endif

endfor
endfor

select all
Remove
```

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