Prosodic differences among dialects of American English

Senior Thesis

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by:

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Table of Contents

Abstract

Linguistic stress or emphasis can be conveyed by at least four different acoustic cues: change in fundamental frequency (f0), increased duration, greater intensity, and spectral expansion (e.g., Fry, 1955). However, relatively little is known about the prosodic differences among American English dialects, for example, whether and how speakers of different dialects use variation in linguistic stress and how they express emphasis or emotions. The current study is a parametric examination of the extent, range and rate of change of fundamental frequency (f0) along with duration and intensity in English vowels produced in the Midland (central Ohio), the Inland South (western North Carolina), and in the North (southeastern Wisconsin). We will analyze recordings taken from controlled, read sentences from 24 women aged 50-64 years who have spent the majority of their lives in one of the three regions in the United States (Ohio, North Carolina, and Wisconsin). Five vowels were produced in sentences in two consonantal contexts (before a voiced coda and before a voiceless coda) in both stressed and unstressed syllables controlling for syntactic, lexical, and phonetic context. To examine the differences between the dialects, several programs were used to complete the analysis of f0, duration, and intensity. Analysis included tracking f0 over the course of the vowel (using a specially written Matlab program). Following extraction of these f0 tracks, another Matlab program aided the user in correcting f0 tracking errors. Changes in f0 will be displayed in terms of both raw Hz values and semitone excursions from onset values. This study supports the claim that dialects can differ systematically in their use of prosodic cues.

List of Tables

List of Figures

1. Introduction

Abundant research has demonstrated significant differences among languages in the use of prosodic cues to signal stress, lexical accent, lexical tone, etc. (see, for example, Jun, 2006). The proposed research examines whether there is significant variation among different American English dialects in the use of such prosodic cues. To date, there is an extensive body of research showing that differences among dialects are typically manifested at several levels of linguistic structure, including lexicon, grammar, semantics, pragmatics, and phonological processes pertaining to consonants and vowels (Wolfram & Schilling-Estes, 2006; Labov et al., 2006). Recent work has also explored the differences in speech tempo among the dialects (Jacewicz et al., 2009; 2010). However, little is known about the prosodic differences, for example, whether and how speakers of different dialects use variation in linguistic stress and how do they express emphasis or emotions. There is some data which suggest that such prosodic differences can be found in English are that they are perceptually salient (van Leyden & van Heuven, 2006).

Linguistic stress or emphasis can be conveyed by at least four different acoustic cues: change in fundamental frequency (f0), longer duration, greater intensity and spectral expansion (e.g., Fry, 1955), in descending order of importance. The role of f0 is most important. When there is an appropriate f0 change on a syllable, this syllable will always be perceived as stressed. Syllable duration is another influential cue and stressed syllables are always longer than unstressed syllables. Overall intensity is considered a weaker cue to stress although numerous studies found that loudness increases as syllable takes a more important position in a sentence (Sluijter & van Heuven, 1996).

2. Methodology

2.1 Speakers

24 women, ages 50-64 years old, produced speech samples. 8 were from central Ohio (OH, Columbus area), 8 were from western North Carolina (NC, Cullowhee area), and 8 were from southeastern Wisconsin (WI, Madison area). These speakers were born, raised, or spent majority of their lives within the selected dialect variety. None of the speakers reported any speech disorders (Fox, Jacewicz & Hart, in review).

2.2 Speech material and procedure

Five vowels (/ɪ, ɛ, e, æ, aɪ/) were selected and produced in sentences in 2 consonantal contexts: before a voiced coda (b_dz) and before a voiceless coda (b_ts). The sentences elicited 2 levels of stress for each target word in b_dz context (bids, beds, bades, bads, bides) and in b_ts context (bits, bets, baits, bats, bites). The sentences were constructed to elicit: 1) the nuclear accent on the most prominent syllable corresponding to the main sentence stress, and 2) a low prosodic prominence corresponding to unstressed position in a sentence (Fox, Jacewicz & Hart, in review).

Examples of sentence sets (nuclear accent in bold):

1) Ted says the dull **FORKS** are cheap.

   No! Ted says the dull **BADES** are cheap.

2) Rob said the tall **CHAIRS** are warm.

   No! Rob said the tall **BEDS** are warm.

3) Jane thinks the small **CATS** are cute.

   No! Jane thinks the small **BIDES** are cute.

Examples of sentence sets (unstressed position in bold):

1) Ted says the dull **bades** are WEAK.

   No! Ted says the dull **bades** are CHEAP.

2) Rob said the tall **beds** are COLD.

   No! Rob said the tall **beds** are WARM.

3) Jane thinks the small **bides** are GROSS.

   No! Jane thinks the small **bides** are CUTE.

The audio recordings were previously collected. Full details regarding the recording procedures can be found in Fox and Jacewicz (2009). Briefly, recordings were controlled by a custom program in Matlab which displayed a sentence set to be read by the speaker on the computer monitor. The first sentence in the sentence set was used to elicit the stressed word in the second sentence. For example, "Rob said the tall CHAIRS are warm. No! Rob said the tall BEDS are warm." The words "chairs" in the first sentence was used so that the speaker would produce stress on the word "beds" in the second sentence. The sentence sets were presented in random order. A head-mounted Shure SM10A dynamic microphone was used positioned about 1.5 in. from the speaker's mouth. The samples were recorded and digitized at a 44.1-kHz sampling rate with 16-bit quantization. The speaker read the sentence placing the main sentence stress on the word in all caps. Only fluent productions (without pauses) were accepted. For that reason, multiple repetitions of each sentence were obtained (as many as needed) to select the three most fluent repetitions for subsequent acoustic analysis. A total of 1408 sentences were analyzed, 60 sentences from each speaker (except for one speaker who produced 30 sentences) (Fox, Jacewicz & Hart, in review).

2.3 Duration and intensity measurements

Linguistic accent can be significantly influenced by syllable duration. The duration of each vowel was measured for Ohio, North Carolina, and Wisconsin speakers. Adobe Audition, a waveform editing program, was used to identify vowel onsets and offsets for all target vowels which were then marked by hand. Using a custom Matlab program, two different researchers then checked these vowel onsets and offsets; this custom Matlab program displayed the target word, target vowel and then marked both the word and vowel onsets and offsets. The duration was then computed for all of the target vowels. As expected, stressed vowels were longer in duration (before voiced and voiceless codas) than unstressed vowels for Ohio, North Carolina, and Wisconsin.

Although it is considered a weaker cue than change in fundamental frequency and duration, intensity is important to stress. Two intensity measures were computed: root-mean-square (rms) amplitude peak and overall rms amplitude. Rms amplitude peak estimates the peak energy of the vowel and was based off a series of 16 ms windows with 50% overlap over the entire duration of the vowel. Overall rms amplitude is the root- mean- square from the vowel onset to the vowel offset. Stressed vowel variants of Ohio, North Carolina, and Wisconsin speakers had a greater intensity than unstressed vowel variants.

2.4 f0 measurements

The full details regarding the procedure for measuring and calculating f0 can be found in Fox, Jacewicz & Hart (in review). Vowel onsets and offsets for all target vowels identified using Audobe Audition, a waveform editing program. Two different researchers checked these landmarks using a custom Matlab program that displayed the target word, target vowel and marked word and vowel onsets and offsets. After these landmark locations had been identified, f0 measurements were made using a different group of custom Matlab programs. Overall f0 was computed using autocorrelation analysis over the entire duration of the vowel. Next, f0 autocorrelation measurements were made in a series of 16 ms windows (with 50% overlap) over the course of the vowel. Following these measurements, another program displayed both the overall and individual segment f0 values and, using TF32 (Milenkovic, 2003), allowed hand correction of mistracked f0 values. These hand-corrections were then checked and modified where deemed necessary by Robert A. Fox. All measurements were then time-normalized to a 0-100 point scale (based on the time proportions for each separate vowel) with f0 values between actual measurement points based on linear interpolation. Given differences in basic speaking f0s among speakers (related to a number of physiological features including size of the vocal folds), examination of the prosodic "melody" of the vowel (which may be linked to linguistic properties according to Ladd, 2008) on the basis of the original Hz measurements would be hampered by such variation. Therefore, in this study we examine the changes in f0 relative to the onset frequency using the semitone scale (in terms of cents, which is 1/100 of a semitone). This scale also more appropriately reflects speakers' (and listeners') intuition regarding intonational spans across speakers (Nolan, 2003). The time-normalized f0 change values (at normalized time points from n=0 to 100) were converted to cents using the following formula: $f0\_change_n = 1200 * \log_2 (f0_n \ / f0_0)$, where $f0_0$ represents the frequency of f0 at vowel onset (Fox, Jacewicz & Hart, in review).

Figure 1 shows a schematic of the four f0 measurements used in this study. The first measurement used was max value of f0 change, or the highest peak f0 reached. The second measurement used was the time when the max f0 value occurs (when in duration the max f0 occurred). The third measurement used was the f0 change value at offset (the value of f0 when the vowel ended). And lastly, the fourth measurement used was the f0 change from max to offset (the amount of f0 decrease).

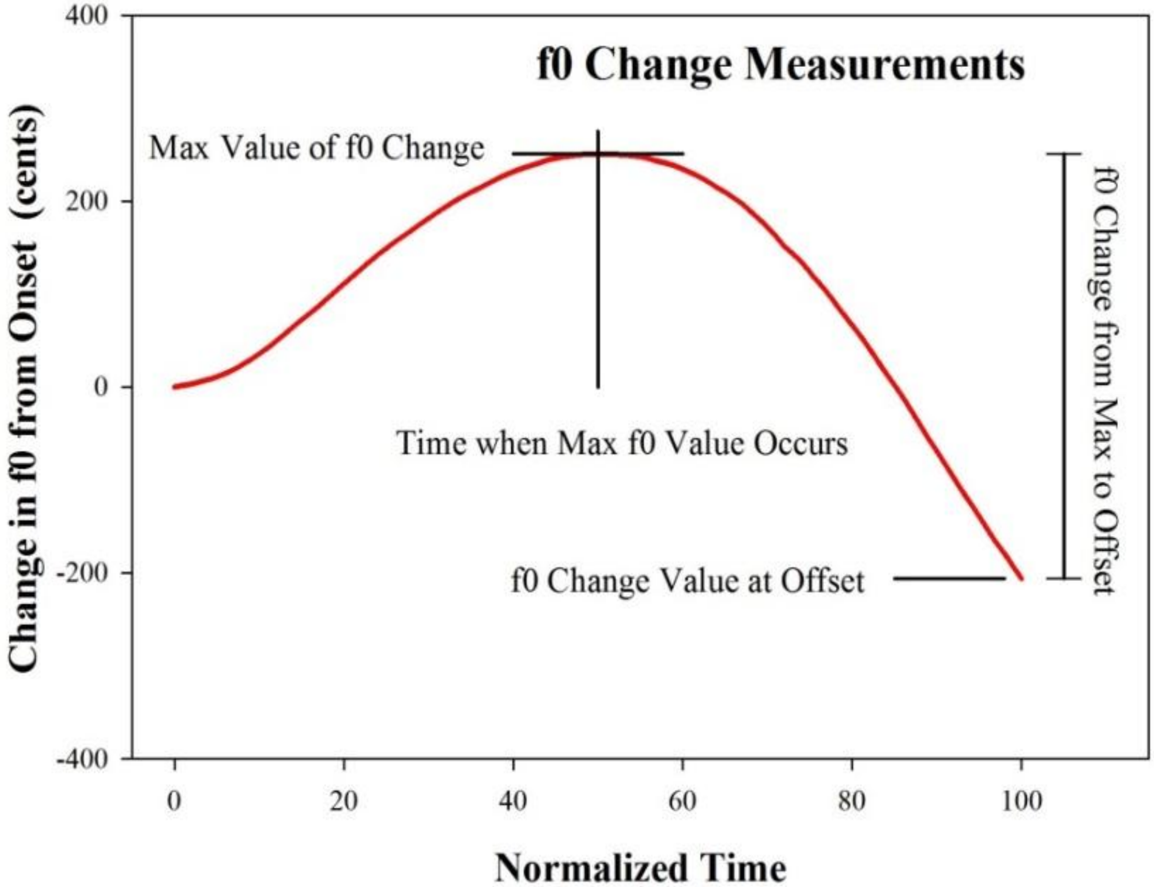


Figure 1: Schematic of four f0 measurements from Fox, Jacewicz & Hart (in review).

3 Results

3.1 Duration measurements

Table 1 summarizes the vowel duration means (in ms) for vowels in stressed and unstressed positions, both before a voiceless coda and a voiced coda. When looking at the overall vowel duration means, North Carolina speakers had the longest vowel duration (220.78 ms), followed by Wisconsin speakers (183.94 ms), and Ohio speakers (174.52 ms).

State	Stressed	Unstressed	Total
OH			
Voiceless	160.9	126.0	149.3
Voiced	223.0	153.3	199.8
Total	192.0	139.6	174.52
WI			
Voiceless	166.2	140.8	157.5
Voiced	229.3	172.4	210.5
Total	197.8	156.1	183.94
NC			
Voiceless	219.6	162.0	200.2
Voiced	271.18	182.0	241.4
Total	245.2	172.0	220.78

Table 1: Vowel duration means (in ms)

3.1.1 Stressed vowels

Figures 2 and 3 show the duration (measured in milliseconds) for stressed vowels before a voiced and voiceless coda, respectively, for Ohio, North Carolina, and Wisconsin speakers. North Carolina speakers have significantly longer durations, than Ohio and Wisconsin speakers, when producing stressed vowels before a voiced and voiceless coda. In both stressed b_dz and b_ts contexts, Ohio and Wisconsin speakers had a shorter duration than North Carolina and did not differ significantly when compared to each other. When comparing the vowel durations for each state measured in Figure 3 to the vowels measured in Figure 2, results are nearly statistically identical. The difference is that, for each state, the duration is longer for stressed vowels before a voiced coda than a voiceless coda. On average for stressed vowels before a voiced coda: OH= 223 ms, NC= 271 ms, and WI= 229 ms. Standard error for each state (b_dz stressed): OH= 7.43, NC= 11.12, WI= 8.04 .For stressed vowels before a voiceless coda: OH= 161 ms, NC= 219 ms, WI= 166 ms. Standard error for each state was low (b_ts stressed): OH= 9.33, NC= 3.82, WI= 4.80.

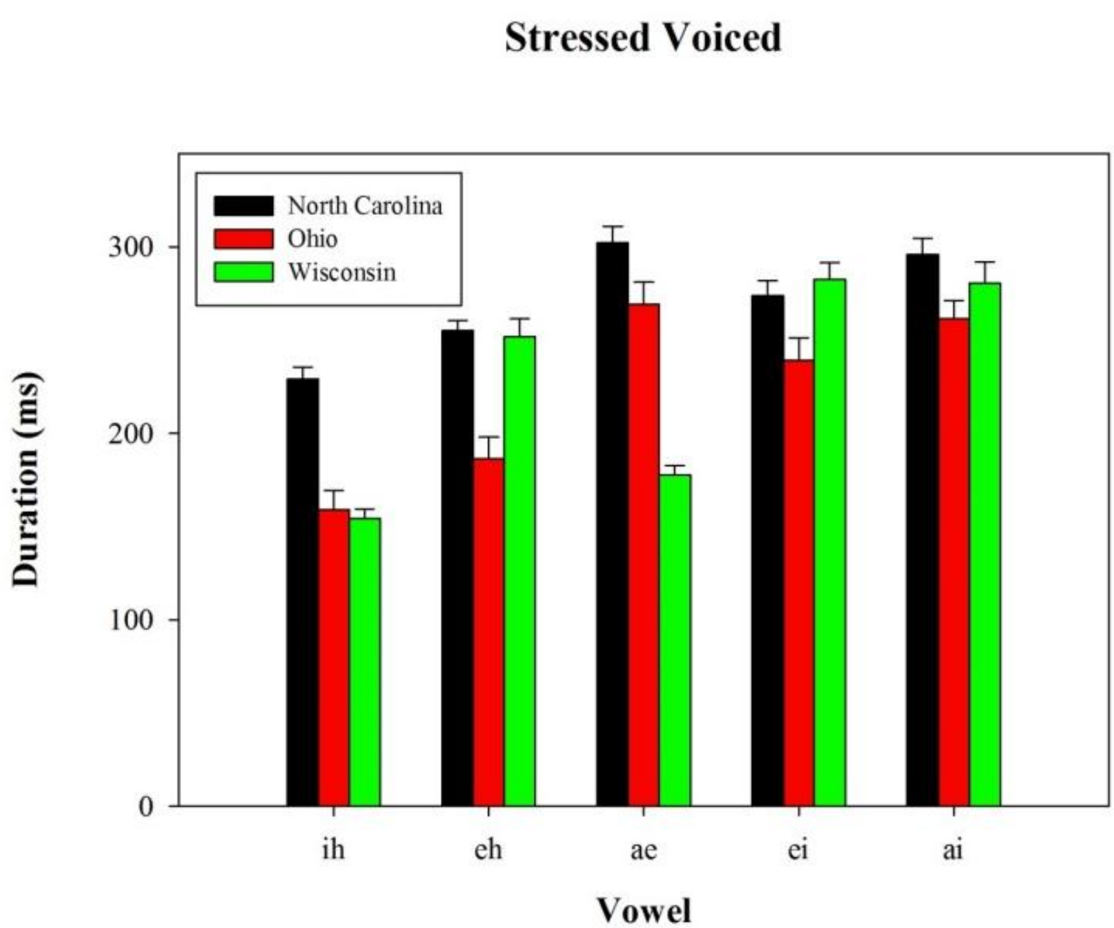


Figure 2: Vowel duration (measured in ms) for stressed vowels in /b_dz/.

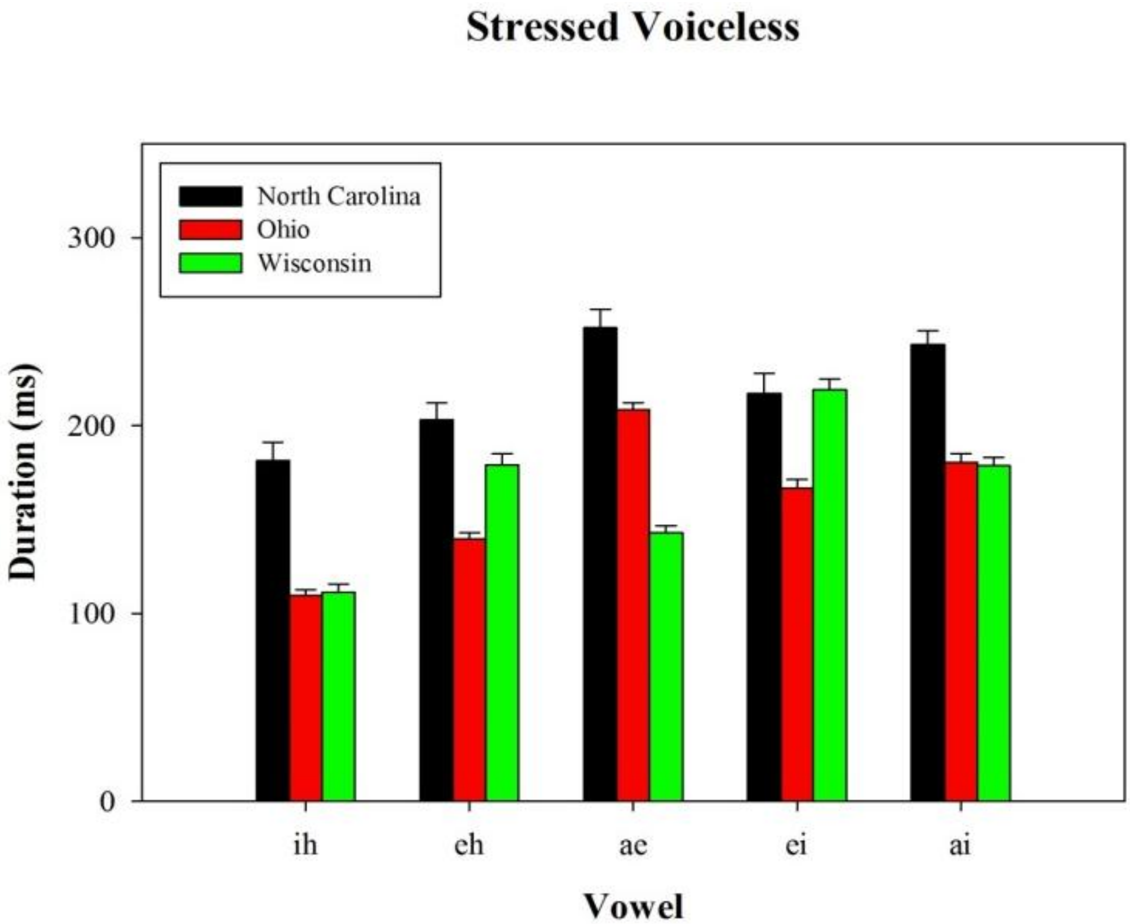


Figure 3: Vowel duration (measured in ms) for stressed vowels in /b_ts/.

3.1.2 Unstressed vowels

Figures 4 and 5 show the duration for each unstressed vowel before a voiced and voiceless coda, respectively, for Ohio, North Carolina, and Wisconsin speakers. Even in unstressed vowels, North Carolina still has the longest vowel duration when compared to Ohio and Wisconsin speakers. Ohio speakers had the shortest vowel duration when compared to the other two states. As with the stressed vowels, the duration is longer for unstressed vowels before a voiced coda than for unstressed vowels before a voiceless coda. Overall, unstressed vowels are shorter in duration then stressed vowels. On average for unstressed vowels before a voiced coda: OH= 153 ms, NC= 182 ms, WI= 172 ms. Standard error for each state (b_dz unstressed): OH= 9.16, NC= 11.76, WI= 10.35. For unstressed vowels before a voiceless coda: OH= 126 ms, NC= 162 ms, WI= 140 ms. Standard error for each state (b_ts unstressed): OH= 6.80, NC= 8.99, WI= 6.95.

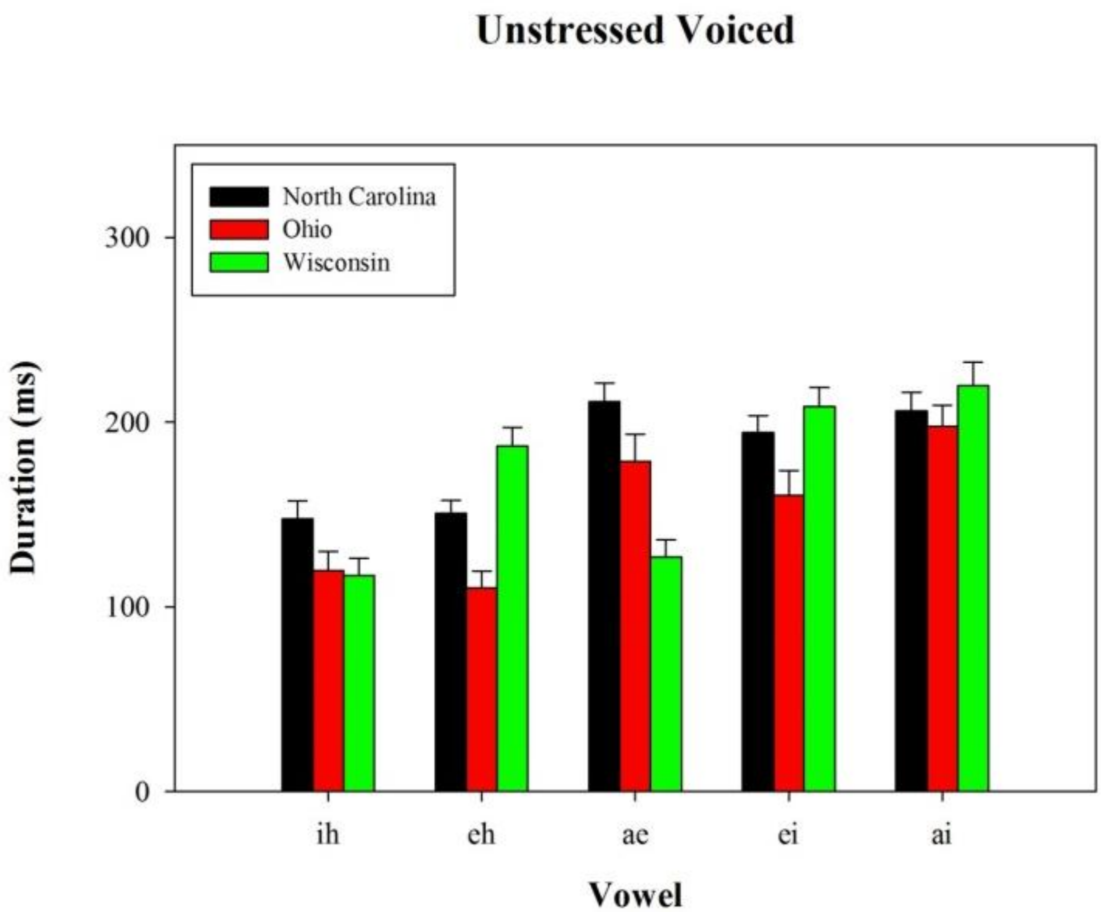


Figure 4: Vowel duration (measured in ms) for unstressed vowels in /b_dz/.

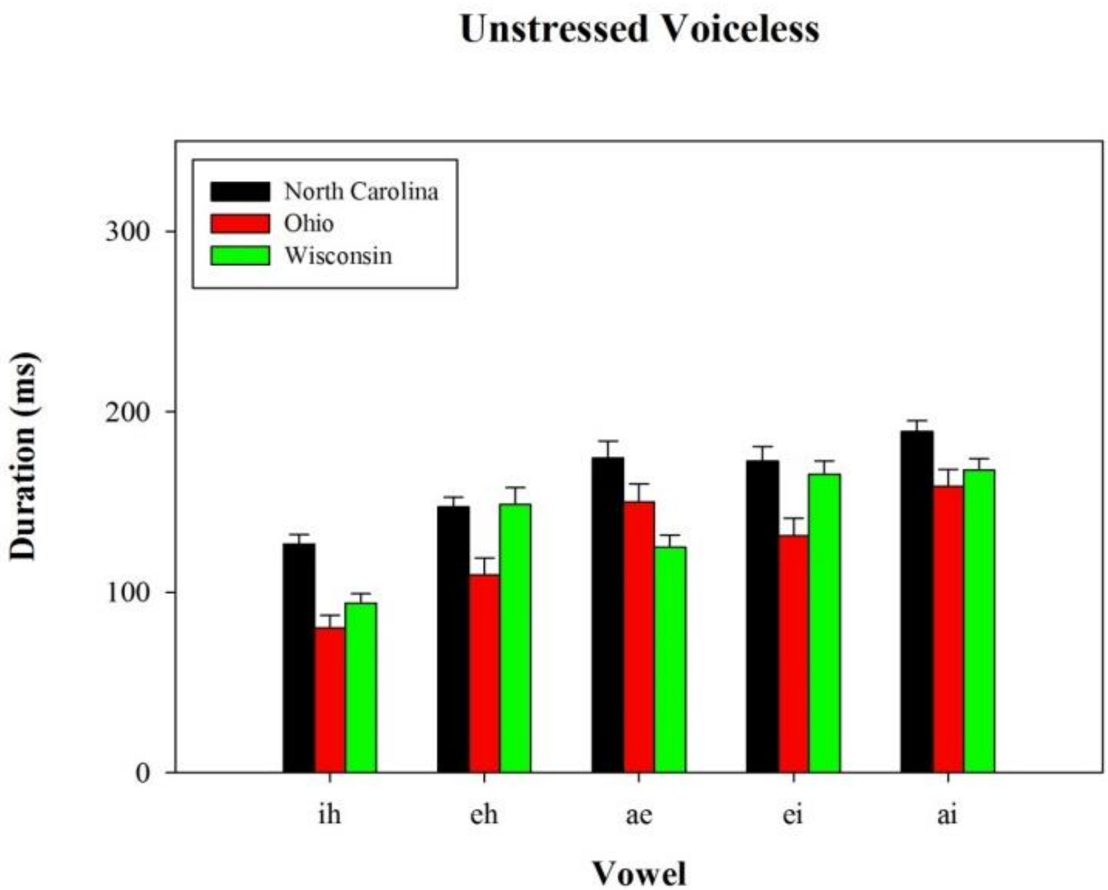


Figure 5: Vowel duration (measured in ms) for unstressed vowels in /b_ts/.

3.2 Intensity measurements

Table 2 summarizes the root- mean- square peak means (in dB) for stressed and unstressed vowels before both voiced and voiceless coda. The rms peak means for OH= -17.89 dB, NC= -16.06 dB, WI= -15.33 dB. Ohio speakers spoke with the least amount of intensity. Ultimately, Wisconsin speakers spoke with the highest intensity.

State	Stressed	Unstressed	Total
OH			
Voiceless	-16.28	-21.34	-17.97
Voiced	-15.80	-21.86	-17.82
Total	-16.04	-21.60	-17.89
WI			
Voiceless	-14.04	-18.03	-15.37
Voiced	-14.01	-17.91	-15.30
Total	-14.03	-17.97	-15.33
NC			
Voiceless	-14.13	-19.99	-16.09
Voiced	-13.98	-20.17	-16.04
Total	-14.06	-20.08	-16.06

Table 2: Root- mean- square (rms) peak means (in dB)

Root-mean- square peak estimates the maximum point of energy in the vowel. Figure 6 shows the root- mean- square (rms) amplitude peak for stressed vowels before both a voiced and voiceless coda. Figure 7 shows the root- mean- square (rms) amplitude peak for unstressed vowels before both a voiced and voiceless coda. The rms peak was lower for unstressed vowels than stressed vowels. Specifically, Wisconsin had the highest rms peak means followed by North Carolina and Ohio speakers, respectively.

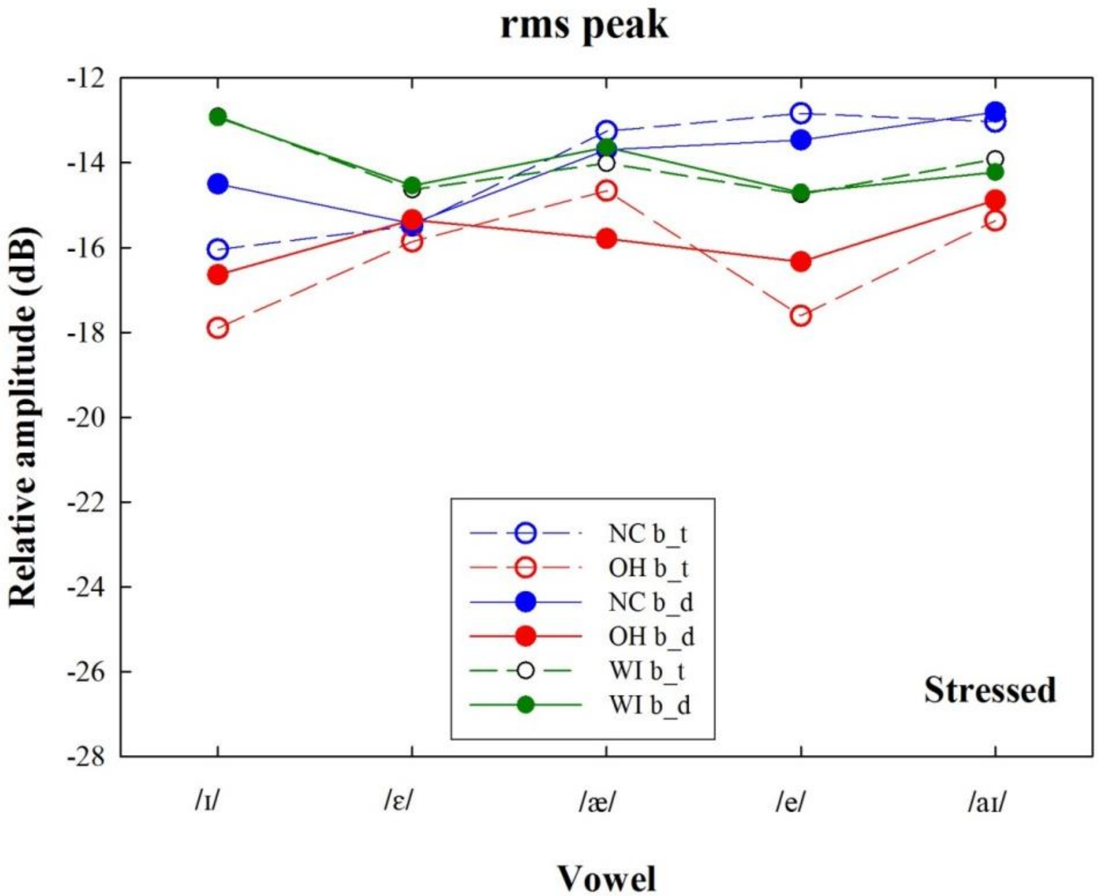


Figure 6: Root-mean-square (rms) peak (measured in dB) for stressed vowels before both a voiced and voiceless coda.

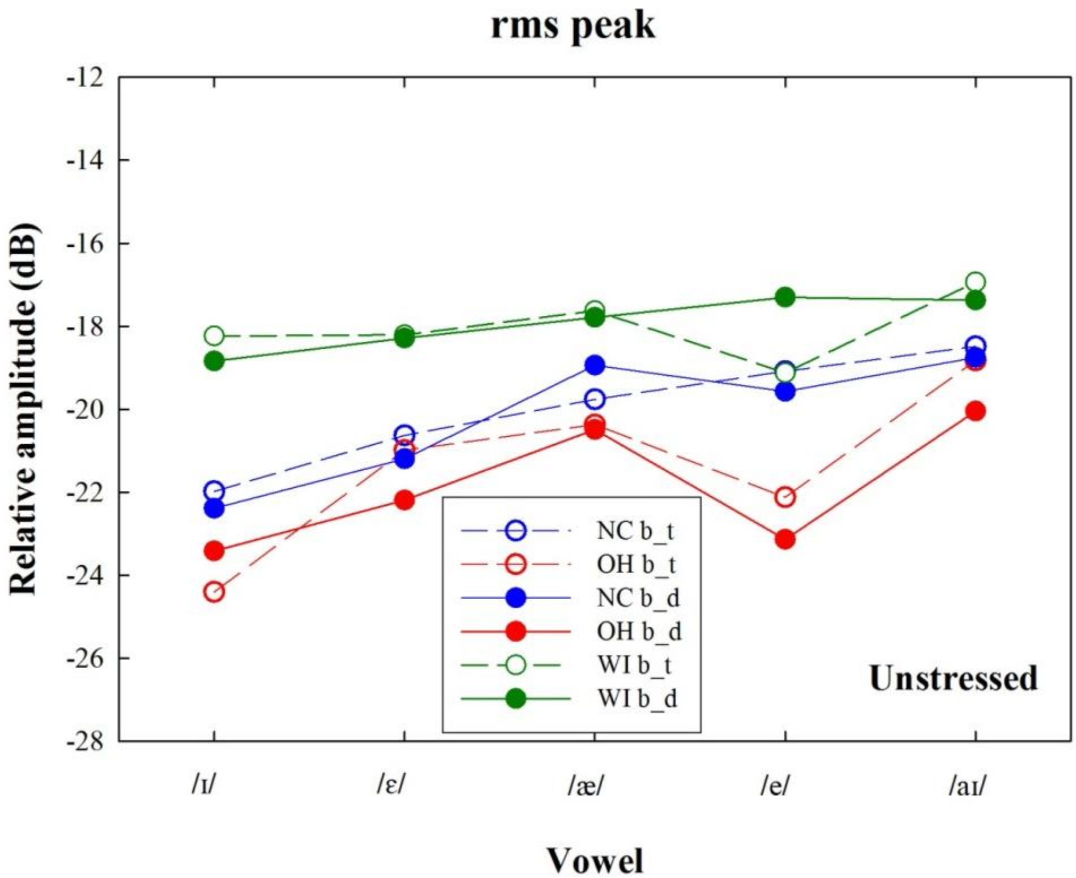


Figure 7: Root-mean-square (rms) peak (measured in dB) for unstressed vowels before both a voiced and voiceless coda.

Table 3 summarizes overall root- mean- square means (in dB) for stressed and unstressed vowels before both voiced and voiceless coda. Just like with rms peak, Ohio speakers spoke with the least amount of intensity whereas Wisconsin speakers seemed to use the most. The overall rms means: OH= -20.46 dB, WI= -17.90 dB, NC= -18.95 dB.

State	Stressed	Unstressed	Total
OH			
Voiceless	-18.99	-23.57	-20.51
Voiced	-18.66	-23.90	-20.41
Total	-18.82	-23.73	-20.46
WI			
Voiceless	-16.70	-20.54	-17.98
Voiced	-16.61	-20.27	-17.82
Total	-16.65	-20.41	-17.90
NC			
Voiceless	-17.34	-22.48	-19.05
Voiced	-17.05	-22.42	-18.84
Total	-17.20	-22.45	-18.95

Table 3: Overall root- mean- square (rms) means (dB)

The overall rms amplitude is the quadratic mean calculated from vowel onset to offset. Figure 8 shows the overall root- mean- square for stressed vowels before both a voiced and voiceless coda. Figure 9 shows the overall root- mean- square for unstressed vowels before both a voiced and voiceless coda. The overall rms was higher for stressed vowels than for unstressed vowels. Wisconsin speakers had the highest overall root- mean- square for stressed and unstressed vowels in both consonantal contexts, followed by North Carolina speakers, then Ohio speakers.

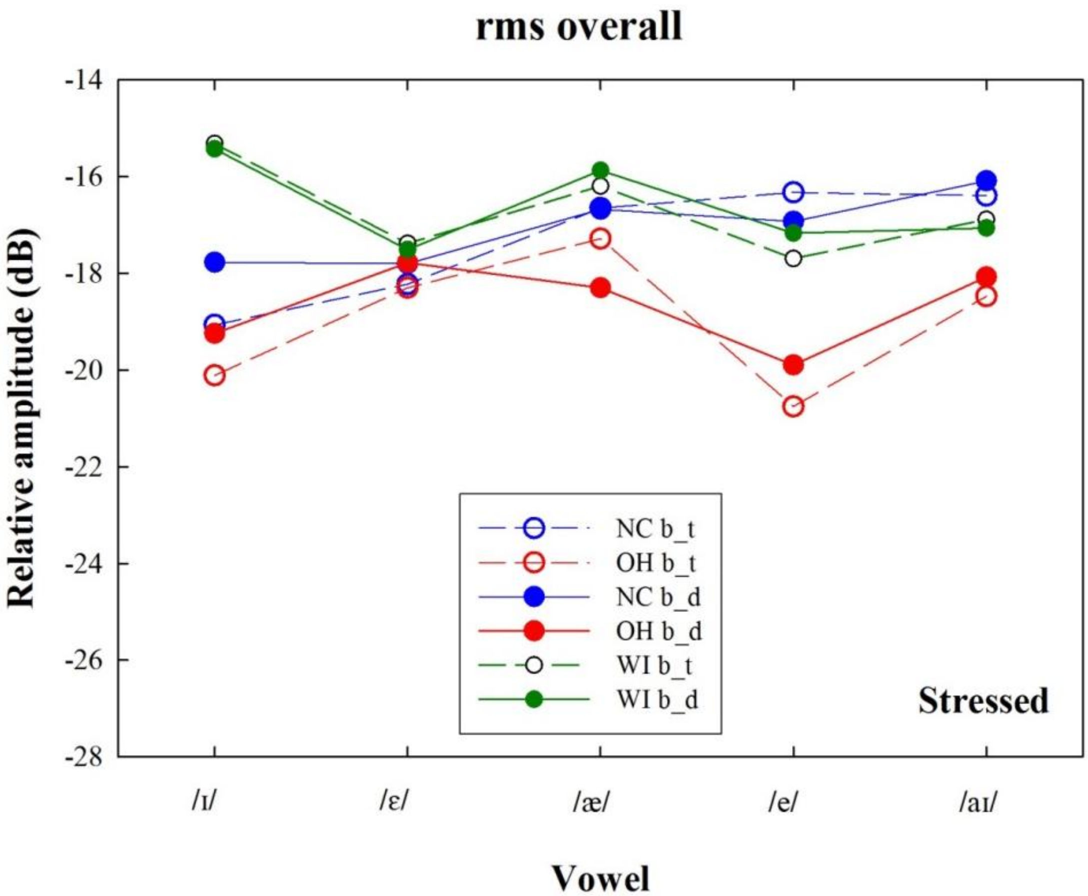


Figure 8: Overall root- mean- square (rms) (measured in dB) for stressed vowels before both a voiced and voiceless coda.

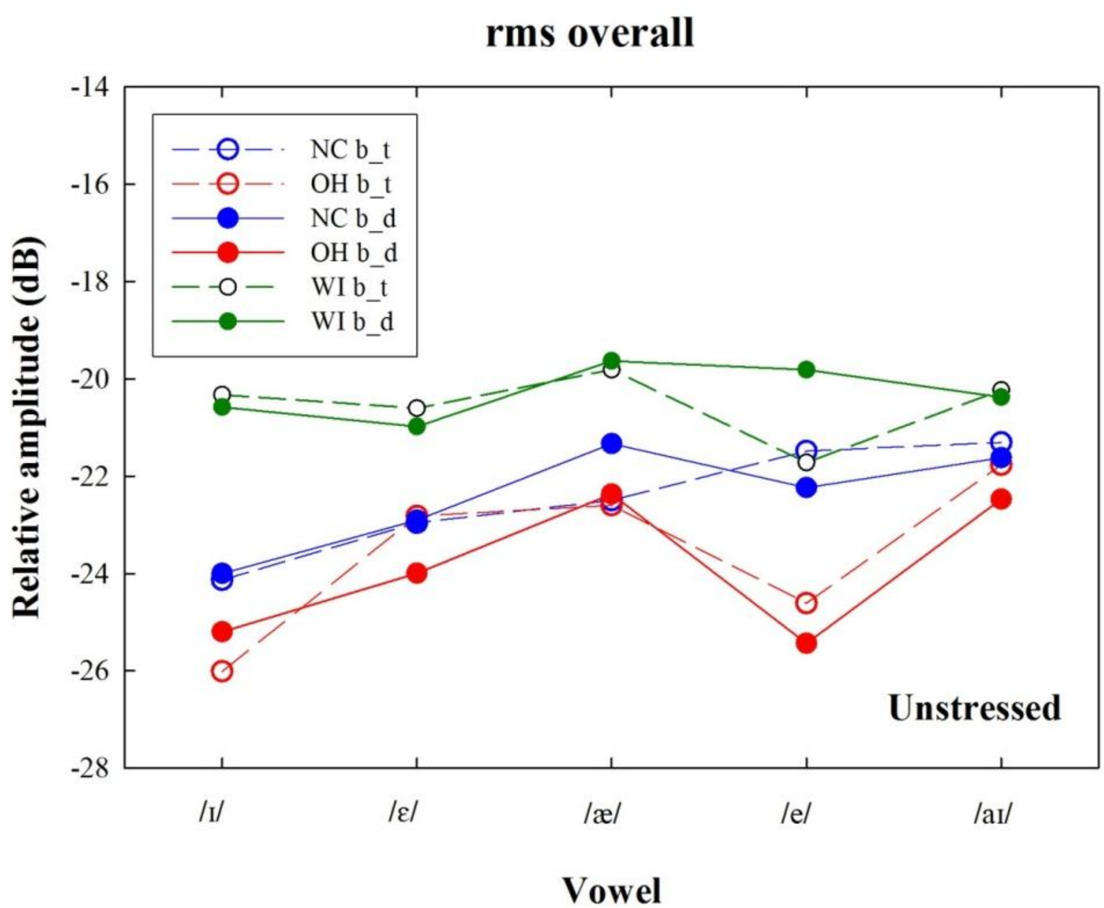


Figure 9: Overall root- mean- square (rms) (measured in dB) for unstressed vowels before both a voiced and voiceless coda.

3.3 Mean overall f0 values (in Hz)

Before examining the f0 change patterns, we took into account variation in f0 amongst speakers of different dialects. Table 4 summarizes the mean overall f0 values (in Hz) for vowels before a voiceless coda, before a voiced coda, and in both stressed and unstressed positions. A repeated measures ANOVA with the within- subject factors stress level and coda type and dialect was used to determine any significant differences (Fox, Jacewicz & Hart, in review). Stress level proved a significant effect. The total stressed vowels had a higher overall f0 mean (241.9 Hz) than unstressed vowels (170.3 Hz). No other main effects or relations were significant which indicates that speaker dialect and voicing status of the syllable coda did not affect the overall speaking/ reading f0 (Fox, Jacewicz & Hart, in review).

Coda	OH	WI	NC	Total
Voiceless				
Stressed	253.6 (13.8)	235.8 (9.2)	235.3 (13.7)	242.5 (7.1)
Unstressed	187.4 (10.3)	159.2 (5.8)	164.2 (7.1)	170.3 (5.1)
Voiced				
Stressed	252.9 (15.1)	235.8 (9.6)	235.1 (13.7)	241.2 (7.4)
Unstressed	184.9 (10.6)	161.1 (6.0)	164.8 (6.1)	170.3 (4.9)
Totals				
Stressed	253.2 (9.9)	237.3 (6.5)	235.2 (9.4)	241.9 (5.1)
Unstressed	186.2 (7.2)	160.1 (4.0)	164.5 (4.5)	170.3 (3.5)

Table 4: Mean overall f0 values (in Hz) from Fox, Jacewicz, & Hart (in review).

The changes in f0 contour collapsed around vowels /ɪ, ɛ, e, æ, aɪ/ were then examined and evaluated by separate repeated- measures ANOVAs for each coda type and stress level along the four f0 measurements: max value of f0 change, time when max f0 value occurs, f0 change value at offset, and f0 change from max value to offset (Fox, Jacewicz & Hart, in review).

3.1 Mean f0 contours

3.4.1 Stressed vowels before a voiceless coda

Figure 10 shows the mean f0 contour for stressed vowels before a voiceless coda for Ohio, Wisconsin, and North Carolina speakers. It is shown that the max value of f0 change did not vary significantly between the three states. The relative location of f0 max was ($F(2,21)=8.83$, $p=.002$, $\eta^2=.457$)**.** The time when max f0 value occurred, arose earlier in time in North Carolina speakers than in Ohio and Wisconsin speakers. The time when max f0 value occurred did not differ significantly between Ohio and Wisconsin speakers. Relative location of f0 offset was ($F\ (2,21)=6.27$, $p=.001$, $\eta^2=.374$). The f0 change value at offset was significantly lower for North Carolina speakers than for Ohio and Wisconsin speakers. The f0 change value at offset did not differ significantly between Ohio and Wisconsin speakers. The f0 change from max to offset was ($F(2,21)=16.9$, $p<.001$, $\eta^2=.617$). North Carolina speakers had a significantly greater drop, from max value of f0 change to the f0 change value at offset, than Ohio and Wisconsin speakers. Looking at the stressed vowels before a voiceless coda, it is apparent that the North Carolina speakers differed greatly from Ohio and Wisconsin speakers in three of the four f0 measurements: time when max f0 value occurs, f0 change value at offset, and f0 change from max value to offset. North Carolina speakers' f0 max occurred earlier in time, had a lower f0 offset, and a greater f0 change than both Ohio and Wisconsin speakers. (Fox, Jacewicz & Hart, in review).

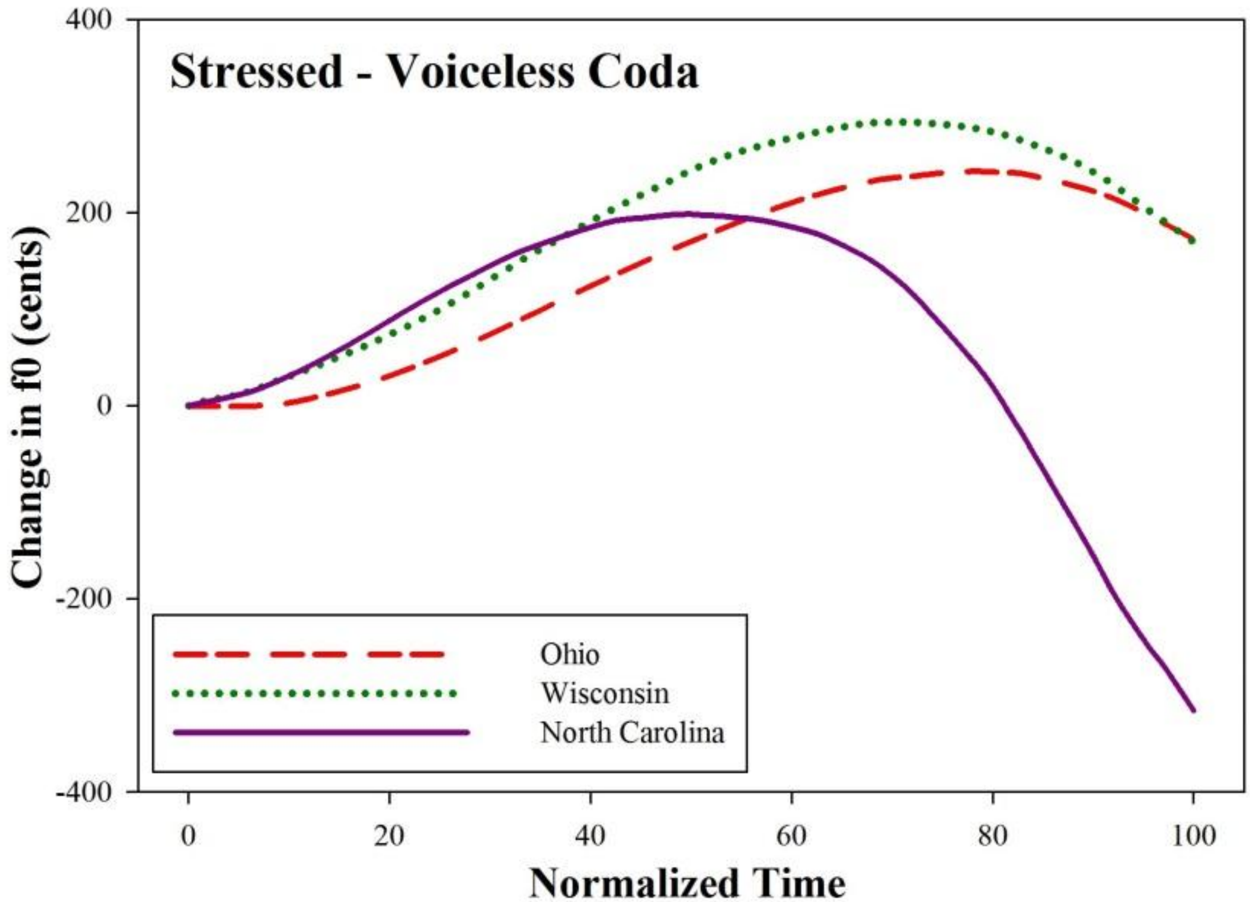


Figure 10: Mean f0 contour for stressed vowels in /b_ts/.

3.4.2 Stressed vowels before a voiced coda

Figure 11 shows the mean f0 contour for stressed vowels before a voiced coda for Ohio, Wisconsin, and North Carolina speakers. It is apparent that, when compared to the mean f0 contour for stressed vowels before a voiceless coda, the results are less dramatic. However, statistically speaking, the results are identical. Relative location of f0 max was ($F(2,21)=7.46$, $p=.004$, $\eta^2=.415$). Like the stressed vowels before a voiceless coda, the time when max f0 value occurred, arose earlier in time in North Carolina speakers than in Ohio and Wisconsin speakers. The time when max f0 value occurred did not differ significantly between Ohio and Wisconsin speakers. Relative location of f0 offset was (F(2,21)=5.22, p=.014, η^2=.332). The f0 change value at offset was, again, lower for North Carolina speakers than from Ohio and Wisconsin speakers. The f0 change value at offset did not differ significantly between Ohio and Wisconsin speakers. The f0 change from max to offset was (F(2,21)=6.97, p=.005, η^2=.399). North Carolina speakers had a greater drop, from max value of f0 change to the f0 change value at offset than Ohio and Wisconsin speakers. When comparing the mean f0 contour for stressed vowels before a voiceless coda and the f0 contour for stressed vowels before a voiced coda, the amount of f0 decrease from max to offset was smaller as well as the value of the f0 offset. (Fox, Jacewicz & Hart, in review).

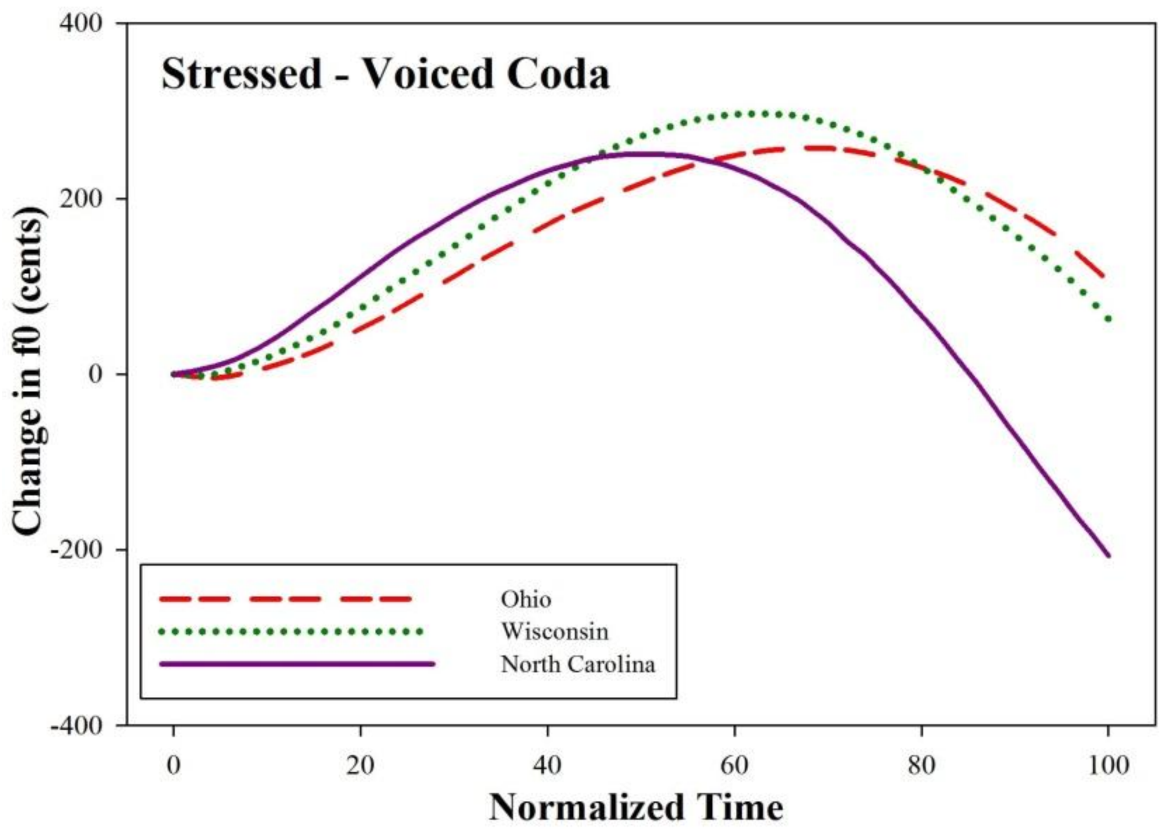


Figure 11: Mean f0 contour for stressed vowels in /b_dz/.

3.4.3 Unstressed Vowels

Figures 12 and 13 show the mean f0 contour for unstressed vowels before a voiceless and voiced coda. It is obvious that both of the contours are flat. Besides a small f0 drop in North Carolina vowels before a voiceless coda, there are no other dialect differences that can be seen. According to Fox, Jacewicz & Hart (in review), results for the unstressed vowels indicate that significant dialectal differences in pitch movement may occur when the vowels convey nuclear accents but not when the associated pitch movement is absent.

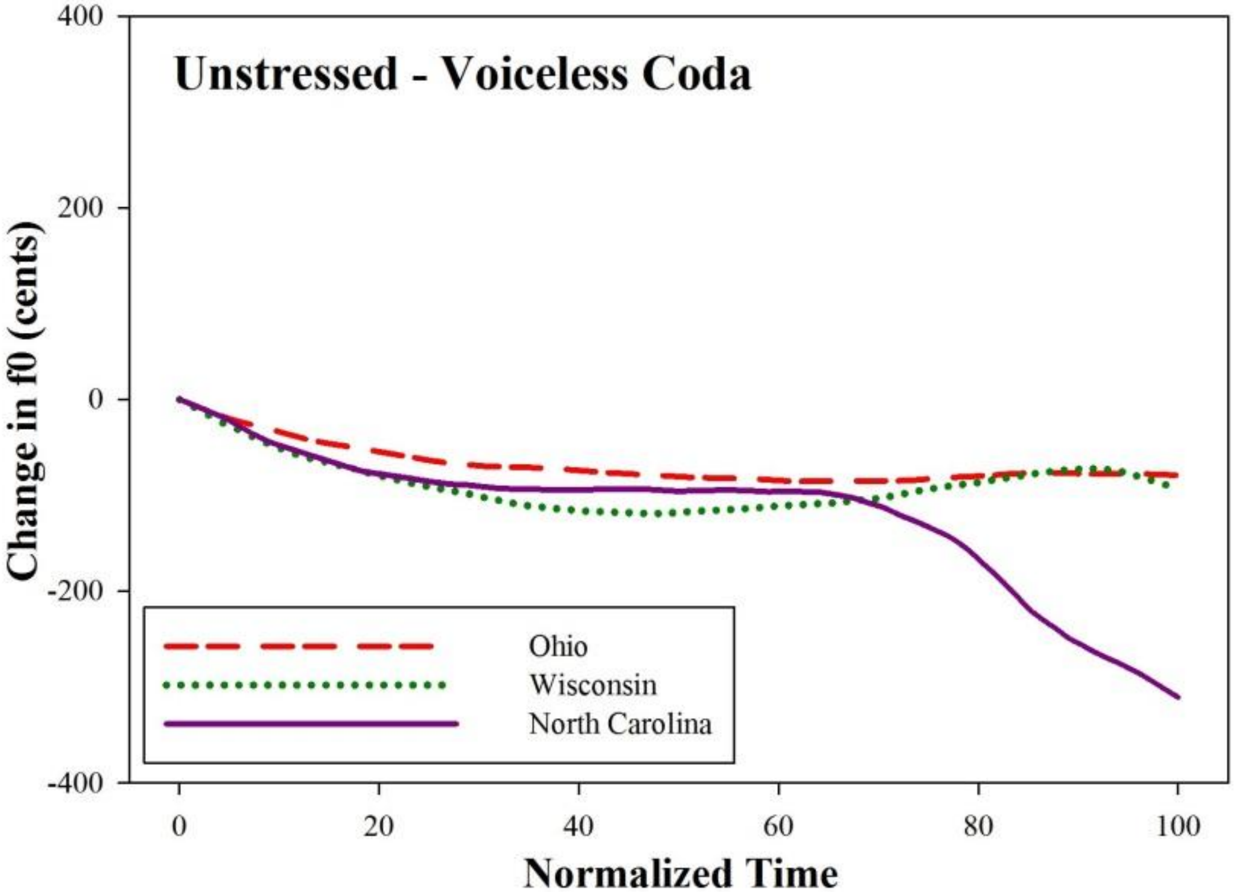


Figure 12: Mean f0 contour for unstressed vowels in /b_ts/.

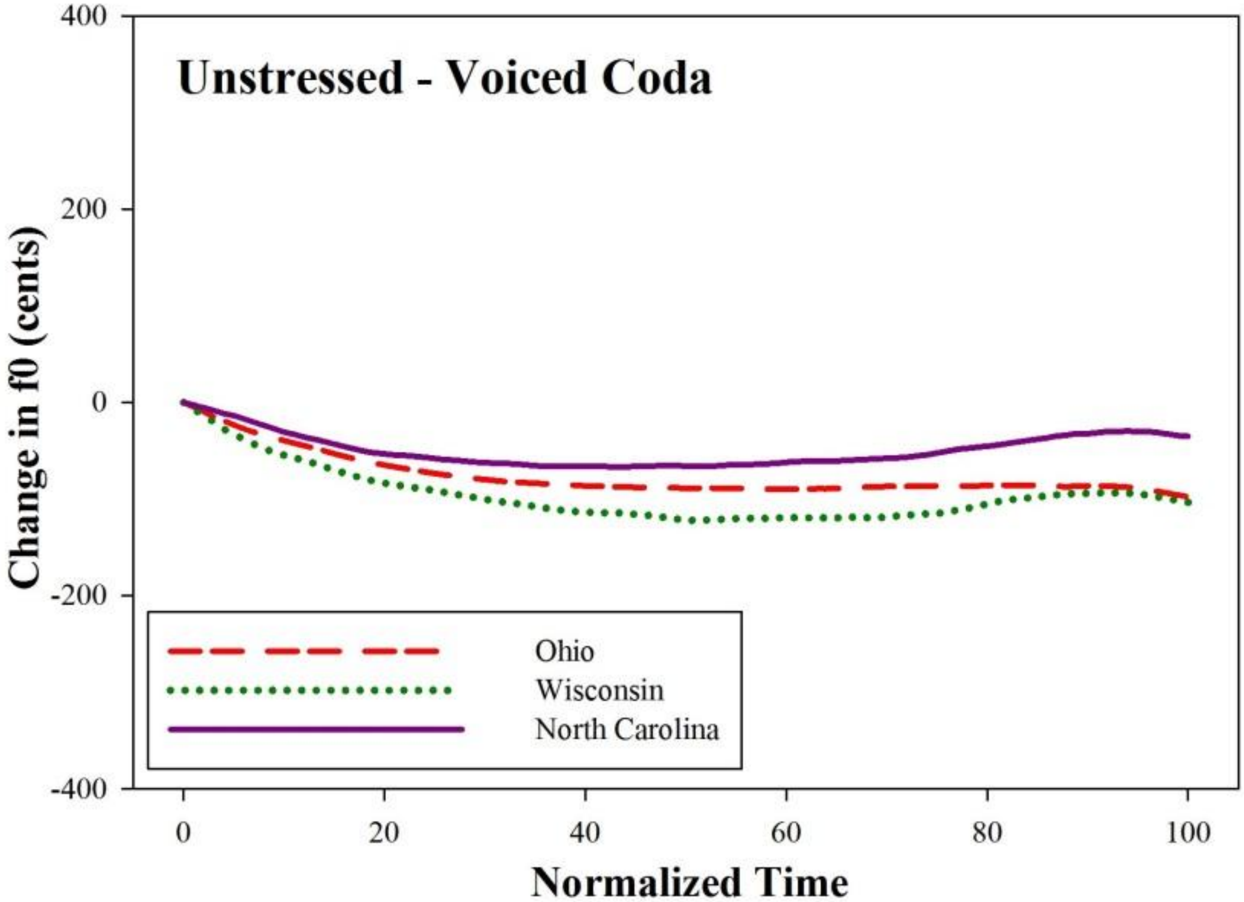


Figure 13: Mean f0 contour for unstressed vowels in /b_dz/.

4. Discussion and Conclusion

This study explored how nuclear pitch affects the dialects of three different regions of American English: Ohio, Wisconsin, and North Carolina. Also, we examined if the dialects were affected by the production of unstressed vowels. Stressed vowels were shown to have a longer duration than unstressed vowels in both voiced and voiceless contexts. Stressed voiced vowels had longer durations than stressed voiceless vowels, and unstressed voiced vowels had longer durations than unstressed voiceless vowels. The overall vowel duration means verify that North Carolina speakers had the longest vowel duration followed by Wisconsin and Ohio speakers, respectively. Stressed vowels were also shown to have a greater intensity than unstressed vowels, meaning that Ohio, North Carolina, and Wisconsin speakers all spoke louder when stressing the target vowels. Overall rms peak and overall rms means prove Wisconsin speakers to use the greatest amount of intensity, closely followed by North Carolina speakers. Ohio speakers spoke with the least amount of intensity.

The main focus of this study, the f0 variation, was observed and measured in more global terms as opposed to each of the five vowels individually. A strong finding was that the f0 contours of North Carolina speakers appeared very different than the f0 contours of both Ohio and North Carolina. For both stressed vowels before a voiceless coda and stressed vowels before a voiced coda, North Carolina vowels had an earlier f0 max, a lower f0 offset, and a greater f0 change from max to offset then both Ohio and Wisconsin vowels. Since there was a sharper f0 drop for North Carolina stressed vowels preceding a voiceless coda, the f0 contour was more exaggerated. This can be due to a more rapid change in sound energy as a function of vowel shortening (Fox & Jacewicz 2009). There were no significant differences regarding the max value of f0 change between Ohio, Wisconsin, and North Carolina speakers therefore suggesting that the speakers produced max f0 in a similar manner. Differences in dialect were only apparent when examining the remaining three f0 measurements: time when max f0 occurred, f0 change at offset, and f0 change from max to offset. Unstressed vowels revealed flat f0 contours indicating no dialectual differences. This implies that any dialect effects on the shape of the f0 contour are only apparent when the f0 contour shows pitch accent. (Fox, Jacewicz & Hart, in review).

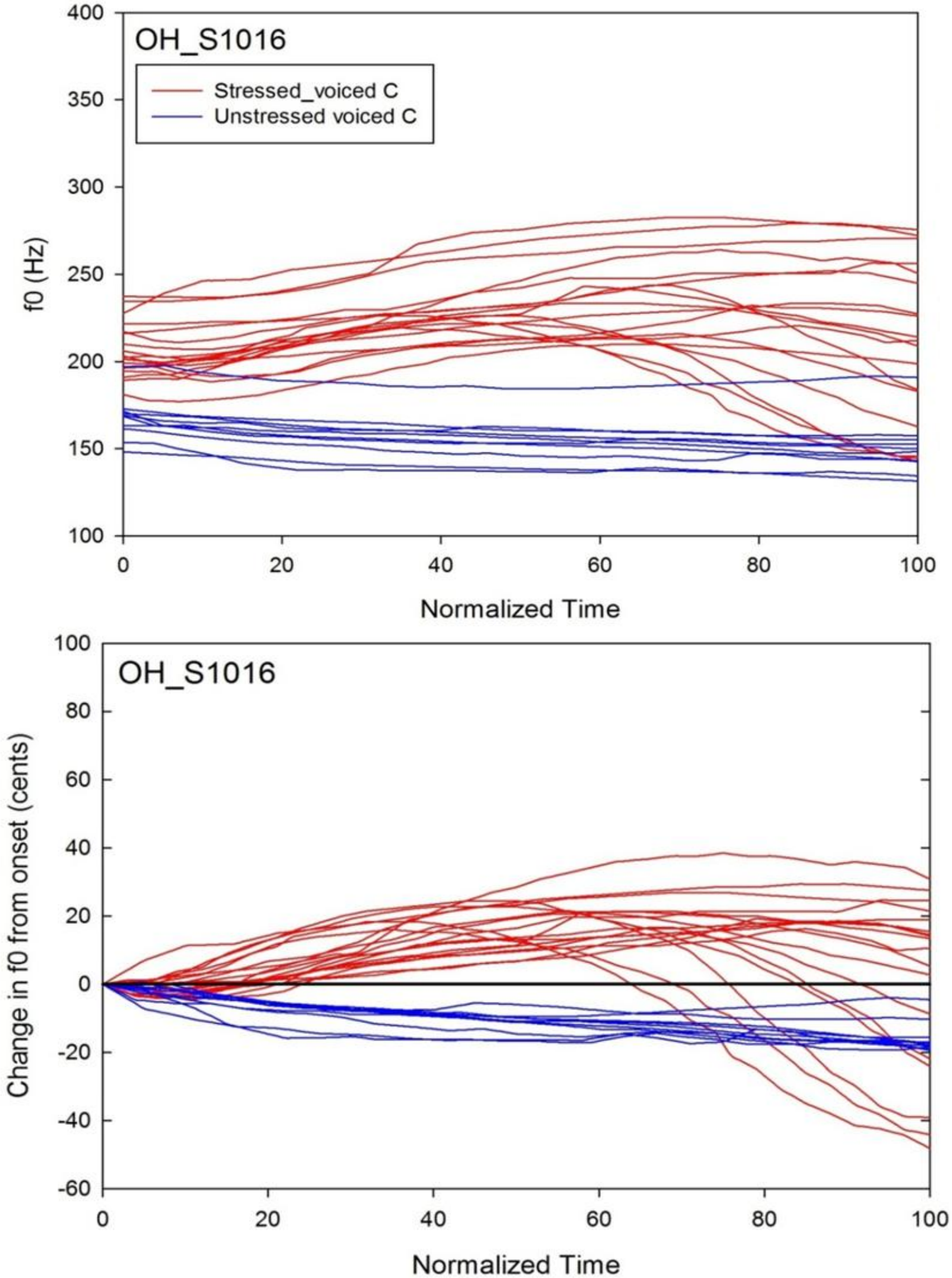
This study was undertaken as a first step towards testing the hypothesis that there is a meaningful interaction of dynamic cues in vowels related to both spectral changes and pitch variation (Fox, Jacewicz & Hart, in review). We assume that a combination of spectral changes and pitch variation contributes to the melodic features of each regional dialect. The results gathered from North Carolina vowels indicate that a more exaggerated f0 contour interrelate with a greater dynamic formant movement. The contribution of this study is that Southern North Carolina vowels have a more exaggerated f0 contour, therefore telling us that the dialect is more melodic in nature than pitch patterns of both Ohio and Wisconsin speakers. (Fox, Jacewicz & Hart, in review).

This study contributes the finding that dialects may differ in their f0 profile as they differ in other phonetic characteristics. This study provides acoustic evidence that f0 contour shape may vary to convey nuclear accent in vowels depending on the regional dialect of American English. Generally, f0 contours of North Carolina vowels exhibited greater dynamic changes than vowels of both Ohio and Wisconsin. It appears that there is a connection between greater spectral change and greater pitch contour. When working together, spectral change and pitch contour could produce the melodic variation that we use to discriminate dialects. (Fox, Jacewicz & Hart, in review).

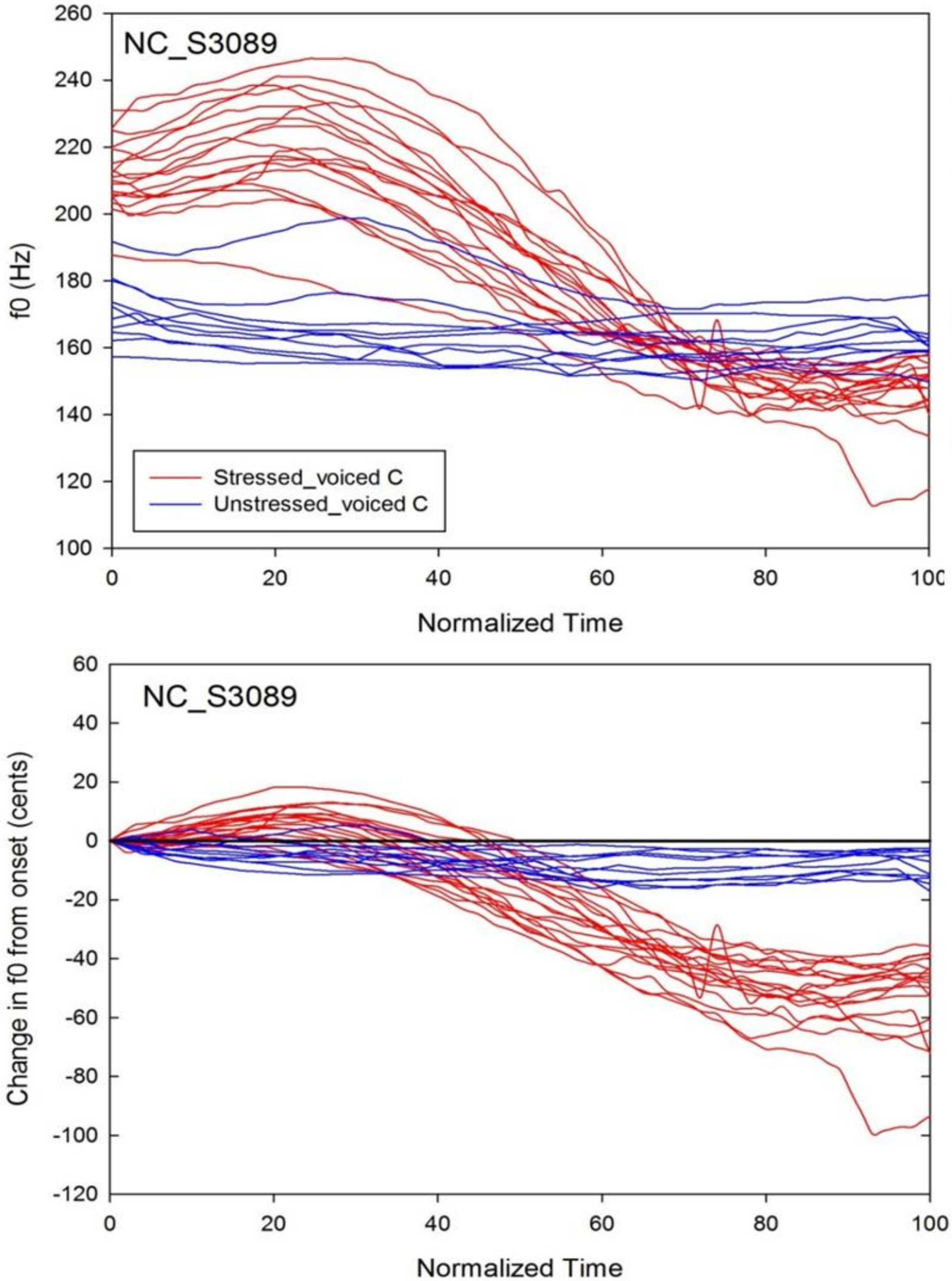
APPENDIX A

Example of an Ohio Speaker and North Carolina speaker's f0 contour shown in Hz (original Hz measurements) and shown in cents (semitone scale).

Ohio Speaker #1016



North Carolina Speaker #3089



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