



# Intonation and Voice Quality of Northern Appalachian English: A First Look

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## Abstract

This study presents preliminary results on intonation and voice phonation in northern Appalachian English (NAE). Participants were 10 native, monolingual speakers of American English who were born and raised in small towns in central and northern Pennsylvania. They worked in pairs to provide interactive dialogues. The final boundary tone, along with vowels in sentence-final-word and their H1\*-H2\* values were examined. Two features stand out in this dialect. First, in addition to the default falling intonation, participants also make frequent use of a level intonation in declaratives, which is likely a feature of this dialect. Second, creaky voice predominates in this dialect. Overall, in longer sentences, younger participants and females had lower H1\*-H2\* values (i.e., creakier vowels) in sentence/IP-final position. The occurrence of creak has even spread to sentence-medial positions, which is not explainable through prosodic properties alone. Taken together, level intonation and creaky phonation might be seen as key features separating NAE from other Appalachian dialects, which in turn suggests micro-prosodic variation in Appalachian speech. The two features also effectively distinguish NAE from other American English dialects where level pitch contour is uncommon and creaky voice, should it appear, is even creakier than that produced by NAE speakers.

**Index Terms:** intonation, creaky voice, Appalachian English, prosodic variation, American English dialects

## 1. Introduction

Despite a growing body of research on regional prosodic variation of American English [1, 2, 3, 4], the prosodic characteristics of Appalachian English, one of the archaic dialects that often gets stigmatized in mainstream American culture [5, 6, 7, 8, 9], has remained largely under-documented. To date, only sporadic inquiry has been made into eastern Kentucky (i.e., the central Appalachian) [6] and eastern Tennessee (i.e., the south-central Appalachian) English [9, 10]. To further our understanding of Appalachian English prosody, this paper investigates the dialect spoken in small towns in central and northern Pennsylvania, the northern Appalachian as defined by the Appalachian Regional Commission.

### 1.1. Appalachian English prosody

Using reading passage and interview data, previous studies show that Appalachian English displays a regional pattern in the realization of pitch accent, viz., in addition to the default high tone (H\*), speakers from eastern Kentucky [6] and eastern Tennessee [9, 10] use the rising pitch accent (L+H\*) in neutral declarative sentences at more frequent rates than other varieties. The unique intonational contour then serves as a

socio-indexical marker that sets Appalachian speakers apart from General and Southern American English speakers [9].

Despite these interesting findings, one should avoid assuming an overarching linguistic homogeneity within the vast Appalachian dialect/cultural zone [9]. Our preliminary observations on northern Appalachian English (henceforth, NAE) for instance, suggest that NAE speakers make frequent use of non-falling intonation and creaky voice in neutral declaratives. The non-falling pattern is uncommon in either Appalachian [6, 9, 10] or other American dialects. A detailed phonetic-acoustic analysis would help provide support for our observations.

### 1.2. Creaky voice in English

Creaky voice, also termed vocal fry, is produced with compressed and thick vocal folds, hence resulting in a series of irregularly spaced vocal pulses and very low fundamental frequency [11, 12]. In some languages, creaky phonation contrasts with modal voice (regular voicing). In English, however, creaky voice does not have a phonemic status. It may occur at the end of an intonation phrase (IP) with a falling intonation [13, 14, 15] or may relate to declination, whereby fundamental frequency gradually diminishes over the course of an utterance due to physiological constraints [13].

The use of creaky voice also varies according to dialect and gender. Sociolinguistic studies have reported the prevalence of vocal fry in young women's voices in Virginia [16], the Pacific Northwest [15, 17, 18], the Washington D.C. Metropolitan Area [19], and California [20, 21, 22]. Potential socio-discourse functions of creaky voice are discussed as well. For instance, [22] holds that creaky voice is seemingly in the process of being reinterpreted as a new type of American women's voice quality that is perceived as more "educated", "upwardly mobile," and "urban" than non-creaky modal voice. Using interview data, [21] suggests that females prefer creak as a means of enacting negative, disengaged affect in interactions. Since creaky voice also predominates in NAE, a systematic analysis of creaky voice would help unpack whether NAE speakers use creak to enact any of the socio-discourse functions as noted in other studies.

### 1.3. Aims of the study

This paper has two specific goals. First, we describe declarative intonation in NAE to identify potential micro-prosodic variation within the Appalachian dialect zone. Second, we investigate how the occurrence of creaky voice is influenced by prosodic and social factors and discuss whether NAE speakers use creaky voice to perform certain discourse function(s) in interaction.

## 2. Methods

The present study is based on data collected for a larger project on prosodic variation in Appalachian English. We currently focus on the speech of northern Appalachians.

### 2.1. Participants and their Appalachian identity

10 participants (8 females + 2 males) were recruited for this study. This included 8 college students (ages 18-22) and two university staff members (ages 54-61). These participants are monolingual native speakers of American English with little exposure to other foreign languages. They were born and raised in small towns in central and northern Pennsylvania, and their parents/primary caregivers were also raised in the same region. The participants worked in pairs to complete dialogue tasks. Each pair of participants had known each other prior to the experiment.

After the speech production tasks, a questionnaire was administered to gather demographic information and residence and travel history from each participant. Questionnaire responses show that all participants identified Pennsylvania as part of the Appalachian mountain chain and 7 out of the 10 participants claimed an Appalachian identity. Hence, it should be safe to treat their speech as representative of NAE.

### 2.2. Elicitation

Each pair of participants was instructed to complete interactive card games [23] and a modified monopoly game. **Interactive card game 1-1:** the participants took turns to name an object on the card using the carrier sentence [I see \_\_\_\_ on the card.] **Interactive card game 1-2:** the participants took turns to request a target card from their partner for card matching using the carrier sentence [I need \_\_\_\_.] **The monopoly game:** each participant was given a to-do list that specified the six target cards they needed to collect during the game. When playing the game, the participants took turns to throw the dice and move the game piece along the game board. Each time they moved the game piece, they needed to draw a card from the pile placed in the middle of the game board and read the text printed on the card out loud to see whether that card was the target item as specified on their own to-do list. The game ended when one of them returned to the starting point, and the one who collected more target cards won the game. The pile placed in the middle contained 40 cards: 12 target cards (6 for each participant) plus 28 irregular items. The text printed on the cards included trying local restaurants, visiting local tourist attractions, and attending local social/sports events. For each card, a relevant picture is offered to help contextualized the text.

### 2.3. Analysis

#### 2.3.1. Auditory analyses

- **Intonation:** for each sentence, the final boundary tone was labeled based on the first author’s auditory impression and visual inspection of the pitch contour on Praat [24]. We followed the ToBI annotation convention [25, 26] with minor modifications to better capture the phonetic realization of the sentences. For instance, in addition to the canonical falling (L%) and rising (H%) edge tones, !H-L% was used to depict the flat pitch contour throughout the whole sentence (Figure 1). In rare cases, !H-!H% was adopted to portray a small terminal

rise in the sentence [27]. The percentage of each final boundary tone was calculated.

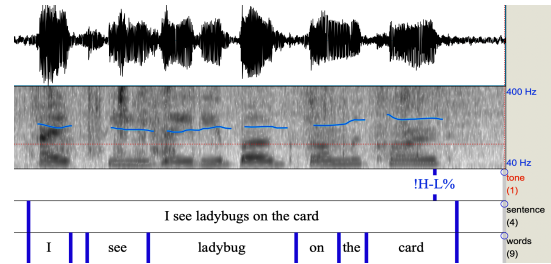


Figure 1: Example of flat pitch contour (!H-L%).

- **Creaky voice:** here we focused on sentence/IP-final words because creak is most likely to occur in sentence-final position [13, 14, 15]. For each final word, we segmented and labeled the vowels (see the “vowels” tier in Figure 2), and calculated the percentage of creaked vowels. Following [28], the decision between creaky and non-creaky voice was based on the first author’s auditory impression of “crackling” voice quality, along with visual inspection of the spectrograms and pitch tracks (irregular pitch contour for creaky voice) on Praat (Figure 2).

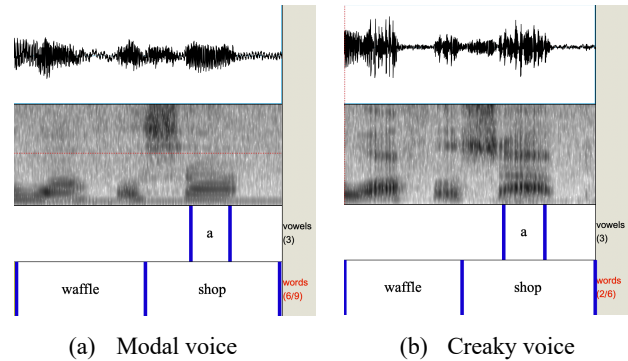


Figure 2: Illustration of modal (a) and creaky (b) voice.

#### 2.3.2. Acoustic analyses

- **Sentence-final-word creak:** the most common measure of creaky voice is the amplitude difference between the first and second harmonics (i.e.,  $H1^*-H2^*$ ) [11, 29, 30, 31, 32]. Low  $H1^*-H2^*$  has been shown to be a correlate of creaky voice in many languages, including English [20, 21, 33]. Here we investigated the  $H1^*-H2^*$  measure using the VoiceSauce program [34, 35], and the  $H1^*-H2^*$  values were normalized to facilitate interspeaker comparison. We then performed a mixed effects linear regression with  $H1^*-H2^*$  as the dependent variable. Three factors – Age (older vs. younger), Gender (male vs. female), and Task (card games vs. monopoly) – were included as fixed factors to see how they affect the  $H1^*-H2^*$  values, and Speaker was included as random effect. The statistical analyses were performed in RStudio [36]; the *lme4* package [37] was used for the linear mixed-model analysis and the *lmerTest* package [38] was used to estimate p-values; the *car* package [39] was used to identify and remove outliers and influential data points. The formula of the final model in *lme4* was:  $H1^*-H2^* \sim \text{Age} + \text{Gender} + \text{Task} + (1 | \text{Speaker})$ .
- **Sentence length and creakiness:** since creak may relate to declination [13], and declination slope strongly

correlates with sentence length (i.e., longer sentences have more frequent declination, thereby steeper slope) [40], it seems plausible to expect that longer sentences might be produced with more creak. To test this hypothesis, we examined the correlation between sentence length (syllables per sentence) and degree of creakiness (i.e., the  $H1^*-H2^*$  values) and investigated whether this relationship varies according to Age, Gender, and Task. The statistical analyses were performed in RStudio using the *lsr* [41] package.

### 3. Results

In total, 413 neutral declaratives were elicited (230 from interactive card games + 183 from the monopoly game). 10 sentences were eliminated due to background noise or breathy phonation. This yielded a dataset of 403 sentences for analysis.

#### 3.1. Intonation

In the interactive card games, both flat pitch contour (51%) and falling intonation (48%) predominate in participants' speech. This is different from the monopoly dialogue where participants produced a default falling intonation in most instances (64%), followed by a fair amount of flat pitch contour (33%). The small final rise pattern (!H-!H%) constitutes an insignificant portion of our data (1% for the card games and 3% for the monopoly game).

A closer investigation indicates that the occurrence of creaky voice seems to be conditioned by intonation – of the 260 creaked sentences, a falling intonation context (74%) is far more preferable for creaky voice than a level intonation (26%).

#### 3.2. Sentence-final-word creak

**Auditory analysis:** for the card games, 425 final-word vowels were analyzed and 171 (40%) of them were identified as creak. For the monopoly dialogue, 141 (48%) out of the 293 final-word vowels were identified as creak. **Acoustic analysis:** the results returned two significant main effects. First, participants had lower  $H1^*-H2^*$  values (i.e., creakier vowels) in the monopoly dialogue than in the card games ( $\beta = -0.03$ ,  $t = -24.86$ ,  $p < 0.001$ ). Second, males produced lower  $H1^*-H2^*$  values than females ( $\beta = -0.08$ ,  $t = -2.9$ ,  $p = 0.013$ ). Younger participants showed slightly lower  $H1^*-H2^*$  values than older speakers, but the difference did not reach statistical significance ( $p = 0.796$ ).

#### 3.3. Sentence length and creakiness

Even though we did not find a significant relationship between sentence length and degree of creakiness from the current dataset ( $r = -0.09$ ), some trends are worth noting. First, when sentence length increases, younger participants produced lower  $H1^*-H2^*$  values (Figure 3a). Second, when sentence length increases, the  $H1^*-H2^*$  values decrease, with female speakers exhibiting a sharper slope than males (Figure 3b). Last, for both game tasks, when sentence length increases, the  $H1^*-H2^*$  values slightly decrease (Figure 3c).

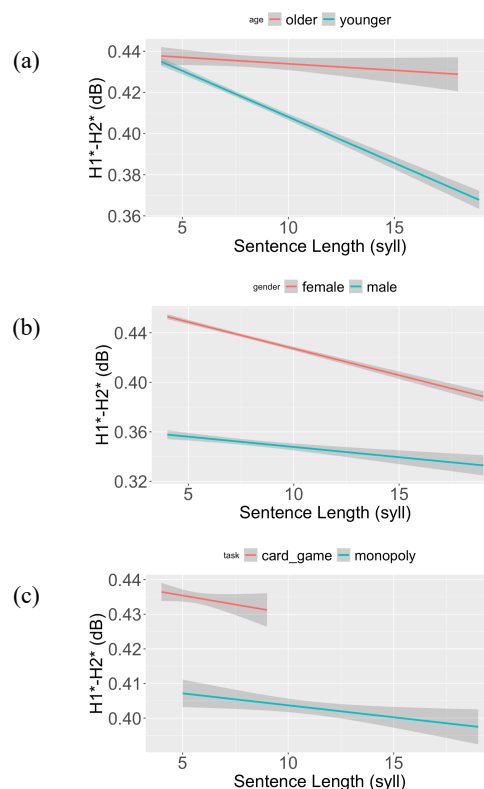


Figure 3: The relationship between sentence length and  $H1^*-H2^*$  by different factors.

### 4. Discussion

Despite growing scholarly interest in regional prosodic variation in American English, our knowledge of Appalachian English prosody is still largely limited. A detailed phonetic-acoustic analysis of NAE would help remedy the gaps in the existing literature.

In the present study, the NAE speakers exhibited two salient features: level intonation and high rates of creaky voice. Potential explanations are offered below.

#### 4.1. Level declarative intonation

Two types of dialogue games were conducted to collect semi-spontaneous speech. The participants behaved differently in the two tasks. In the card games, both level (!H-L%, 51%) and falling intonations (L%, 48%) prevail, whereas in the monopoly dialogue, participants preferred a falling intonation (64%) over a flat pitch contour (33%).

The frequent occurrence of level intonation in the card games may be explained through sentence length and game design. For the former, the sentences are usually shorter in the card games (4 to 9 syllables) than those in monopoly dialogue (5 to 22 syllables), participants may thus have shallower and less frequent declination [40] in their card game speech, leading to a flat pitch contour. As for game design, the use of flat contour may be interpreted as a kind of repetitive prosody as the participants were requested to use specific sentence structures throughout the card game session (section 2.2). The upcoming utterances were highly predictable, which may have made the game less interesting to the participants. The participants may therefore make less pitch movements in their

speech, an indicator of lower degree of speaker's involvement [42, 43].

The monopoly game, conversely, is pretty luck-based and each card contained different text, accompanied by a relevant picture, to serve as primes to elicit more "authentic" local speech from the participants. The participants found the game entertaining and were highly engaged in this session, which makes us believe that the monopoly dialogue would better resemble northern Appalachian speech. Even though participants used a default falling intonation in most cases, the flat contour still constitutes a non-trivial portion of the data. Since all participants are monolinguals, the level intonation is not explainable through a foreign linguistic input. Cross-dialect transfer does not provide a satisfactory explanation for the non-canonical pattern either because level intonation is not commonly seen in other American dialects. Given the high rate of level intonation in monopoly speech, it seems plausible to treat level declarative intonation as a potential NAE feature.

#### 4.2. The (socio-)distribution of creaky voice

Another pronounced feature is the prevalence of creaky voice. Overall, creaky voice is more likely to occur in a falling intonation context than in a level intonation contour.

For final-word vowels, the auditory analysis suggests that participants produced more creaked vowels in monopoly dialogue (48%) than in card game speech (40%). Our auditory impression is supported by the acoustic analysis as the H1\*-H2\* measurements suggest creakier vowels (lower H1\*-H2\* values) in monopoly dialogue than in the card games. This finding is surprising because creaky voice has been associated with "low-activation", "boredom" [44] and "negative, disengaged affect" [21]. Considering that the participants were friends and were highly involved in the monopoly game, it seems less likely that our participants used creaky voice to convey negative feelings or stances. We therefore interpret creaky voice as another feature of NAE.

We are also interested in learning the relationship between sentence length and degree of creakiness. As Figure 3c illustrates, in both game tasks, participants produced creakier vowels as the sentence progresses. The correlation, however, is rather weak based on the current data. More speech data will be needed to help clarify the relationship.

Some other interesting trends are worth mentioning. First, younger speakers showed a higher degree of creakiness in longer sentences (Figure 3a). Second, females used creakier vowels in longer sentences than their male counterparts (Figure 3b). This mimics the general trend that creaky voice is an emerging feature led by younger females in American English. One caveat should be given here, however. Given the small dataset and the imbalanced sample in Age and Gender (section 2.1), the results should be considered suggestive rather than conclusive. More males and older participants are needed in the future to revisit our argument.

Last but not least, we found that the use of creaky voice has gone beyond sentence/IP-final domain and spread to *sentence-medial* positions. In total, 73 sentence-medial creaked syllables were attested in both dialogue tasks. A closer examination of these medial creaked syllables shows that, even though they mostly (67%) align with the boundary of some inner prosodic domain such as an intermediate phrases (ip), a fair amount of medial creaked syllables (33%) in fact occur in non-edge positions. In this regard, a prosodic constraint is inadequate to account for the occurrence of non-

edge creak. Rather, the non-edge creak seems to lend support for the argument that creaky voice is likely a dialect feature of NAE.

## 5. Summary

This study presents preliminary results on the intonation and voice phonation in NAE. Two features stand out in this dialect: level intonation and the prevalence of creaky voice in neutral declarative sentences. In addition to the default falling intonation, participants also employed a level intonation in their monopoly dialogue (more similar to real conversation), which may exhibit a unique feature of this dialect. The rate of using a level intonation is even higher in the card games, which in addition to showcasing a dialect feature, may in part arise from the repetitive nature of the game design.

Creaky voice is also pervasive in the data. Overall, creaky voice is more likely to concur with a falling intonation. Additionally, in longer sentences, younger participants and females produced creakier vowels in sentence/IP-final position than their counterparts. The facts that participants produced creakier vowels in monopoly dialogue (more casual) than in the card games (relatively formal) and that the occurrence of creak has spread to sentence-medial positions lead us to believe that creaky voice is more than the product of a prosodic/discourse/physiological constraint, but may be a feature specific to the northern Appalachian dialect area.

A brief comparison shows that level intonation and creaky voice are unobserved in other Appalachian dialects [6, 9, 10]. Conversely, the high rates of L+H\* commonly used in the eastern part of both Kentucky [6] and Tennessee [9, 10] are rare in NAE based on our auditory impression. Future analysis would help depict a clearer picture of the micro-prosodic variation in Appalachian English. Cross-dialectally, level intonation is also uncommon in other American English dialects. Although creaky voice has been reported in various regions [15, 16, 17, 18, 19, 20, 21, 22], there is dialect effect on the degree of creakiness, with Californian speakers being creakier (even lower H1\*-H2\*s) [20, 21] than NAE speakers.

## 6. Acknowledgements

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