

Intonational Marking of Discourse Units in Two Dena'ina Narratives

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Abstract

In this paper we investigate the phonetic realization of intonational boundary marking in two Dena'ina (Alaskan Athabascan) narratives, one recorded recently and one a generation ago. We segment this discourse into semantic units based on speaker judgments and measure non-final and final syllable rhymes for differences in pitch and duration. We find that unit-final syllables are significantly longer and lower in pitch, often preceding extended pauses that in true story performance would be filled by audience response. In the newer text we find that an intermediate-level unit seems to be marked with lengthening only, with pitch fall only occurring at the ends of more extended units.

1. General Information

Dena'ina is an Athabascan language spoken in the region surrounding the Cook Inlet. The Athabascan language family is the largest native language family in North America with about 40 different languages spoken in Canada, Alaska, California and the Southwest. The four dialects of Dena'ina are spoken by fewer than 60 speakers, all of them 60 years or older. Linguistic publications include Kari 1975, Tenenbaum 1978, and Lovick 2006.

The two texts analyzed in this study are both in the most viable dialect of Dena'ina, the Inland dialect, that spoken in Lime Village and Nondalton. Both texts are traditional stories by Nondalton speakers.

The first text, *Dlin'a Sukdu*, ('Mouse Story', hereafter 'Text 1') features one of the oldest Dena'ina speakers. It was recorded by the authors in 2006, and transcribed the following day with the help of the storyteller's eldest daughter, also a fluent speaker of the language. The transcriber also segmented the text into what we will call narrative units.

The second text, *Nutihna Deghk'isna Sukdu*, ('Story of Two Women', hereafter 'Text 2') was recorded by the storyteller himself in the 1970s. It was transcribed and translated by linguist Joan Tenenbaum with the

help of another speaker of Dena'ina. The original transcript (Tenenbaum 1973) marks both pause units and narrative units suggested by her consultant.

By "narrative unit" we mean a semantic unit (Grosz and Sidner 1986). The units differ widely with respect to length. In Text 1, there are 3 units without a verb, 53 with one verb, and 28 with more than one verb. In Text 2, there are 3 units without a verb, 60 with one verb, and 34 with more than one verb.

We had good reasons to choose these two texts among the wealth of text material in Dena'ina. Both texts were transcribed and translated, and the audio was accessible to us. Neither text contains sensitive material. Both texts are spoken by renowned storytellers, in the same dialect and in the same register; they differ in that the first text was spoken by a woman, and the second one by a man. Lastly, the texts are of similar length. These factors ensure good comparability between the texts.

2. Research Question

Dena'ina is a verb-final language, and has a large number of utterance-final particles. In Text 1, 51 out of 90 units end in a verb, 17 out of 90 units end in a particle. Thus, 22 units do not have a final segmental marker. As they have been identified by a speaker as units, we look for cues that the speaker may have used.

In Text 2, 43 out of 97 units end in a verb, 46 out of 97 units end in a particle, and 8 units do not have a final segmental marker. It seems that speakers use more than one type of criterion in identifying semantic units.

Our questions, then: What are the intonational cues that correlate with semantic unit boundaries in Dena'ina, that is, final particles, final verbs, or speaker identification? What is going on in this language where segmental markers of finality are not present, but speakers have identified a boundary? Can we identify the cues they use, and will text analysis prove a valid method for investigating intonation in Dena'ina?

3. Methods

3.1. Measurements

Based on findings in other Athabascan languages (Holton 2000, Tuttle 1998, 2005, among others) we anticipated final lengthening and final lowering as markers of intonational edges in the Dena'ina story. We therefore made three measurements for each identified syllable: rhyme length (that is, including all elements not part of the onset) and

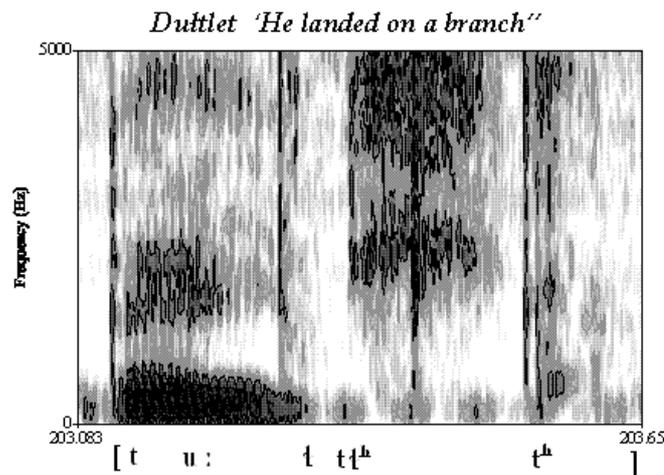
two measures of fundamental frequency, one earlier and one later in the steady state of the vowel in the nucleus.

We chose rhyme length rather than vowel length or consonant length, because final lengthening has so many possible realizations in closed syllables. The spontaneous text-based nature of our data sets makes it desirable to group the maximum number of syllables together, so we have created this general category to measure.

Rhyme length could have a confound in word category, since closed syllables may be expected to last longer than open syllables, and some word categories may be more likely to have closed final syllables—specifically, perhaps, verbs, which are often final in this SOV language. However, Dena'ina uses a number of post-verbal particles that are equally likely to have closed or open syllables, so that in fact even the word-category confound is not expected to be a problem.

In addition, many Dena'ina verbs end in open syllables, including frequent statives and verbs of motion. For this reason, we do not worry about a potential confound.

The measurement of F0 is occasionally impossible to set due to voiceless or absent vowels. F0 measurements are thus more likely to be missing than duration values. Figure 1 shows a spectrogram of a verb with obstruent initial and final stem, but no nucleus vowel. Examples of this type seem most common when both consonants have a continuant component.



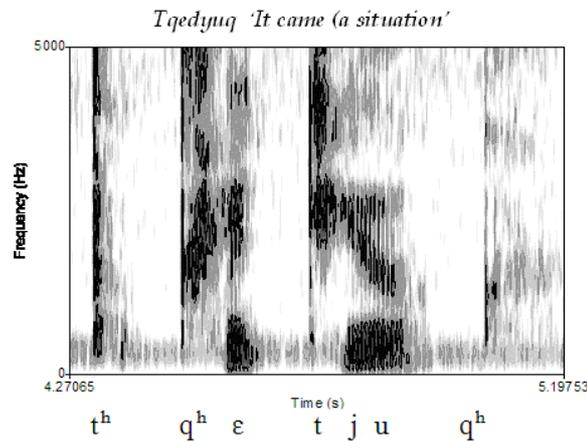
(1) Figure 1. A vowelless verb stem from Text 2 (Unit 19)

3.2 The definition of syllables

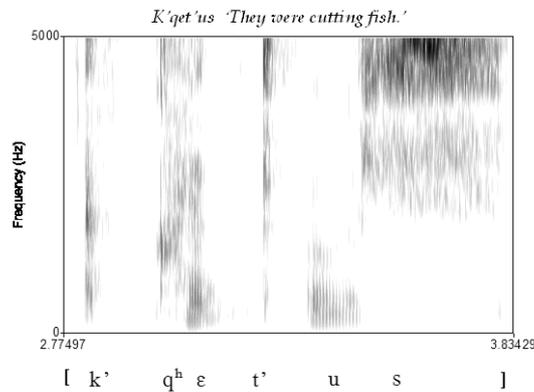
Because Dena'ina syllables have not been researched elsewhere, and the language displays some rather remarkable consonant clusters, we made the following assumptions about syllables, based on general expectations about syllables:

1. Codas are limited to one consonant.
2. Onsets may include up to three consonants.

This means that clustering stops and ejectives in verb prefixes do not lengthen syllables, because they are generally in onsets and not in rhymes. This also means that we are not counting purely consonantal prefixes (*z-*, *n-*) as syllabic. This is an arbitrary decision. Examples are shown in Figures 2-4.

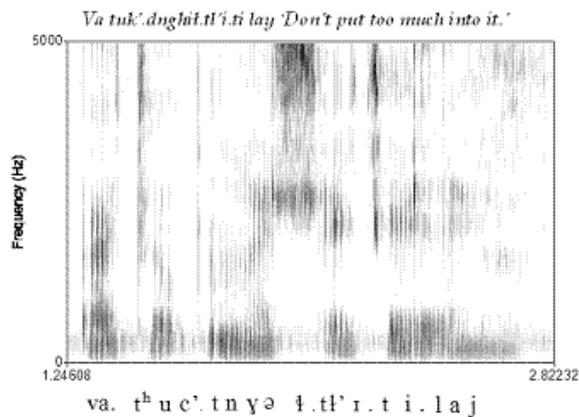


(2) Figure 2. Word-initial consonant cluster CCVC.CVC (Text 1 unit 24)



(3) Figure 3. CCV.CVC (Text 1 unit 3.)

We consider the example in Figure 3 disyllabic as well, since the initial ejective forms an onset cluster with the following stop. The single ejective in the middle of the word we assume to be an onset.



(4) Figure 4. CV.CVC.CCCVC.CV.CV.CVC (Text 1, Unit 88)

Figure 4 shows a three-consonant cluster at the beginning of the third syllable. Listening to this example and counting out beats, we get six, which is consistent with our assumptions of syllable structure.

There could be other ways to sort out the intricacies of Dena'ina syllables. However, we think the net effect of our assumptions in this paper will be neutral, since complex onsets such as those in the word in Figure 4 are rare, actually represented in only two or three words within our sample of roughly 1800 syllables from the two stories.

Syllable rhymes were measured from the beginning of the rhyme unit (usually F2 of the nucleus vowel, but in the case of a consonant-only rhyme, the burst of a stop or affricate, or the beginning of distinctive noise frequency in the case of a fricative.) The end of a rhyme when there is no pause is the onset of the next syllable (closure of a following stop or affricate, initiation of distinctive noise for a fricative, etc.) In the case of a following pause, the end of an onset is counted as the end of the speaker's oral noise. When the unit ends in a vowel, the narrator of Text 2 often closed the syllable with a glottal stop, which he then released; we measured to the end of audible aspiration of this release. Final consonants were also often aspirated, and we measured to the end of the aspiration before pause.

4. Results

4.1. Rhyme length and finality in narrative unit

4.1.1. Text 1 durations

We find that the narrative units of the Mouse story, as segmented by the native speaker, have intonational properties that are distinct from units separated by a pause. Both of our measures, rhyme duration and F0, are involved.

With 793 syllables measured from the story, we found the following mean durations in different positions within our narrative units.

	Count	Mean	SD
Initial	88	147 ms.	104
Medial	628	142 ms.	77
Final	77	166 ms.	104

(5) Table 1. Rhyme durations in Text 1 sorted by finality in narrative unit

While initial and medial position show almost identical means, final position has a much longer mean. The difference between final and medial rhyme lengths is significant at $p = .0207$ in Fisher's PSLD post-hoc test to analysis of variance. We attribute this difference to unit-final lengthening.

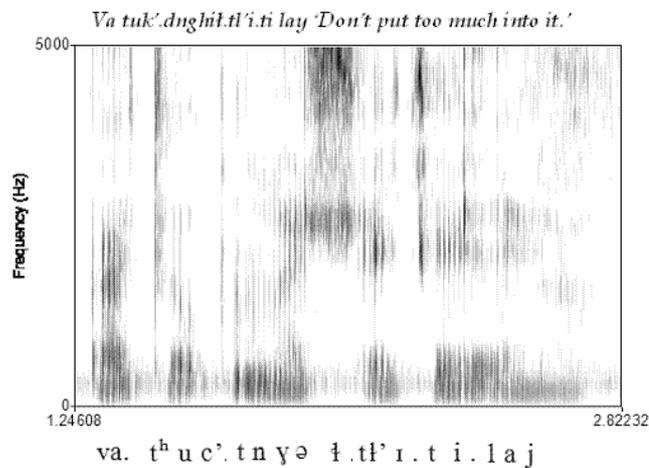
4.1.2. Text 2 durations

With 1001 syllables measured from the story, we found the following mean durations in different positions within our Story Units.

	Count	Mean	SD
Initial	92	87	54
Medial	776	110	3
Final	87	201	139

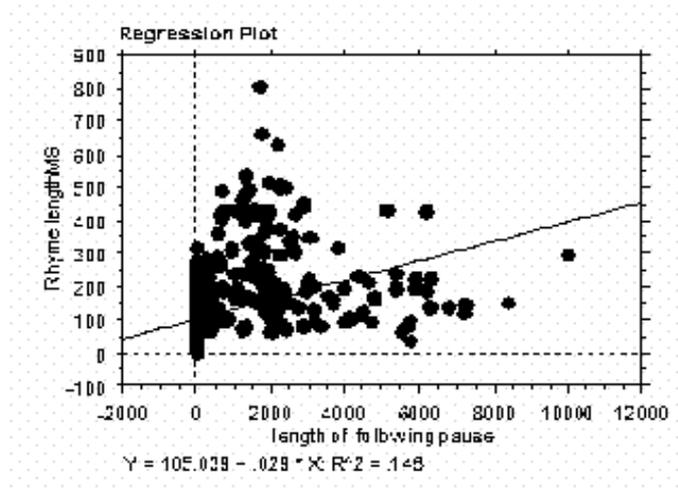
(6) Table 2. Rhyme durations in Text 2, sorted by finality in narrative unit

In post-hoc testing, the differences in duration were significant at $p < .0001$ for comparisons of final and initial position and final and medial position. In addition, initial and medial positions were different at $p = .01$. The difference in means is considerable for this narrator, as shown in Figure 5.



(7) Figure 5. Rhyme duration means in Text 2 sorted by narrative unit position

Note that the variability of rhyme lengths is much greater in final than in non-final position. However, in this narrator's work there is also a relationship between pause length and rhyme length. We measured all pauses in Text 2 and found a positive correlation between length of pause and length of pre-pause rhyme. A regression plot is shown in Figure 6.



(8) Figure 6. Regression plot for rhyme length and length of pause in Text 2.

4.2. F0 and finality in narrative unit

F0 is also different in unit-final versus other syllables, and this is consistent over both stories. Final position is associated with lower F0.

4.2.1. F0 and finality in Text 1

Results for F0 in Text 1 are shown in Table 3.

	Count	Mean	SD
Initial	83	137.1 Hz	17.6
Medial	604	137.4	89.5
Final	72	117.7	14.2

(9) Table 3. F0 measures for Text 1

Using analysis of variance, we find the difference between medial and final syllables to be significant at $p = .0488$. This is not a very striking result statistically; but the large variance in medial position may represent a factor we do not understand yet.

4.2.2. F0 and finality in Text 2

When we look at F0 in different narrative unit positions in Text 2, we see a difference between all three types of syllables. The measurements are shown in Table 4.

	Count	Mean	SD
Initial	87	99.2 Hz	7.6
Medial	731	103.2	36
Final	66	90.5	10.4

(10) Table 4. F0 measures for Text 2

Medial and final rhyme F0s are significantly different at $p = .0028$ for this story. Initial and final, and medial and initial comparisons show no significant difference.

4.3. More about pauses

We have seen that syllable rhymes are longer, and late-measured F0 is lower, in syllables final in these units, in both stories. This is independent of who did the segmentation.

The most obvious possible confound here is measurable pause. In order to find out whether our speakers are using pause as a primary cue to unit boundary, we checked on unit-internal pauses and found the following.

4.3.1. Intra-unit pauses in Text 1 and Text 2: F0

Syllables followed by pauses in Text 1 do not show lowered F0. Fisher's PLSD following ANOVA had $p = .2398$. So, in Text 1 the storyteller is not marking all syllables preceding pause as final_pause, in itself, does not define finality for this narrator. Figures are shown in Table 5.

	Count	Mean	SD
No pause	627	138.6 Hz	87.8
Pause follows rhyme	60	125.2	16.4

(11) Table 5. F0 in Text 1 sorted for following pause

In Text 2, following pauses were associated with F0 drop in general, whether the pauses occurred internal to units or at unit boundaries. Of 159 syllables that preceded pauses in this story, 73 were unit-final, and 83 were medial; only 3 were initial. Table 6 shows figures for F0 for the Text 2 data set. A t-test was significant at $p = .0023$, showing that in this narrative, all pauses were marked with an F0 drop. The total number of syllables tested here is less than the total number of syllable-preceders, because some syllables could not be measured for F0.

	Count	Mean	SD
No pause	749	103.3 Hz	35.3
Pause follows rhyme	135	93.9	10.4

(12) Table 6. F0 in Text 2 sorted for following pause

Thus, we find that two speakers have two strategies for handling intra-unit pauses. The narrator of Text 1 allows a continuation pause within a unit, which she does not mark with an F0 drop; the narrator of Text 2 marks all pause-preceding syllables with an F0 drop.

4.3.2. *Intra-unit pauses in Text 1 and Text 2: Lengthening*

In Text 1, when syllables preceding pauses are segregated, a statistical difference shows up between those syllables that are unit-final, versus those that are medial. Figures are shown in Table 7.

Unit Position	Count	Mean	SD
Medial	57	216.6	16.1
Final	75	104.4	12.1

(13) Table 7. Lengthening before pause in Text 1

Thus, it appears as if the narrator of Text 1 marks intra-unit pauses differently from unit-boundary pauses. Within a unit, pause is preceded by lengthening, but lengthening within units is greater than at unit boundaries. Since this speaker does not use F0 at intra-unit pauses, perhaps lengthening needs to be a more salient cue.

In Text 2, among syllables that precede pauses, no statistical differences show up between groups in terms of rhyme length. While this speaker does mark all pauses with F0 drop; he does not reliably distinguish intra-unit and unit-boundary pauses using rhyme length. Figures are given in Table 8.

Unit Position	Count	Mean	SD
Initial	3	190.7ms	102.0
Medial	83	242.1	130.6
Final	73	219.2	143.6

(14) Table 8. Lengthening before pause in Text 2

The narrator of Text 2 thus seems to mark no difference between intra-unit pauses and pauses at boundaries, with respect to rhyme lengthening.

5. Summary and discussion

Measurable intonational phenomena in two Dena'ina stories show that rhyme lengths are longer in unit-final position, and also when a pause follows. Both conditions are statistically significant in Text 1, but unit-internal pause precursors show a bigger effect. In Text 2, rhyme length does not differ depending on the position of the syllable within a narrative unit.

In both stories, F0 is lower at the ends of narrative units, and this is a significant finding. In Text 1, F0 is not significantly lower preceding pauses within units, but there is a slight difference in means.

Dena'ina, like other Athabascan languages, is exotic in its phonology, morphology and syntax. However, our findings regarding intonation seem reassuringly normal: intonation is used in different ways to mark different sizes of units, with the utterance most clearly marked by final lengthening and final lowering. The realization of intonational marking is similar to that seen in languages we know more about, such as English. Within the story unit, it seems that pitch is held steady until the last syllable or so, while durations are responsive to pauses, a strategy for keeping the hearer involved. Naturally we expect to find that narration has intonational patterns distinct from other speech registers, and look forward to such comparisons.

Certainly, Dena'ina intonation cannot be used to find edges of syntactic units, any more than in any other language; blind listening will yield confusion here as elsewhere. What intonation can provide is information about meaning and discourse relationships (Swertz 1997.)

In the case of highly endangered languages like Dena'ina, text techniques can often provide better information than the measurement of elicited fragments. Because older texts exist for this language that can be compared with our newer fluent recording, we were able to test our methodological assumptions. While personal style and circumstances of recording may vary, the findings in this case are congruent enough to conclude that rhyme length and F0 are valid measures of Dena'ina Athabascan intonation.

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