Situating Blackfoot within a typology of (mobile) boundary tone grammars

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Background: Pitch contours in Blackfoot (Algonquian; Frantz 2017) are characterized by a rise to a pitch peak (H) on a stressed syllable and a fall to a L boundary tone at the right edge of the stress domain (Miyashita & Weber 2020; Van Der Mark 2003; Weber 2016). Previous research does not address whether the domain-initial low that contributes to the rise is better characterized as a low boundary tone %L introduced by the prosodic domain, or as part of a complex L+H pitch accent. Additionally, different pitch contours have been proposed for long vowels (H vs. HL vs. LH), but there is no evidence that they support phonological contrast (Stacy 2004). Possibly, the observed variation can be derived through the interaction of word and phrasal prosody.

Aims: This study has two aims: (i) to establish the location of the L pitch minimum via quantitative analysis of pitch tracks; (ii) to situate Blackfoot within a typology of intonational grammars that vary in how tones introduced by prosodic constituents dock to segmental strings.

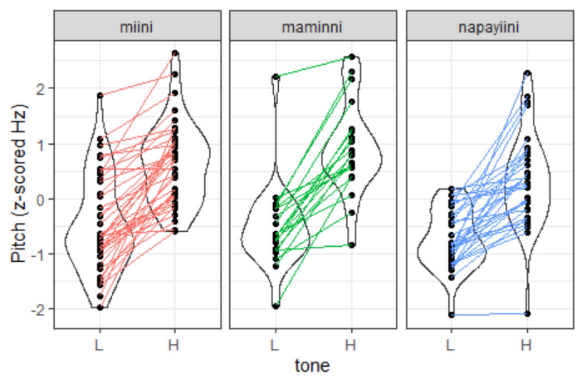
Predictions for pitch contours: If the boundary %L tone docks to an edge syllable, then the pitch slope from L to H will be greatest in words with first syllable stress, and smaller in words with stress on a later syllable (Gussenhoven 2004; Pierrehumbert & Beckman 1988). Also, the time from the beginning of the domain to the pitch minimum will be consistent across stress position. Alternatively, if the L docks to the stressed syllable, then pitch slope will remain constant across stress position, but the time to the pitch minimum will be higher in words with non-initial stress.

Methods: To evaluate our predictions, we examined pitch contours in stems that vary stress position: first syllable stress /ˈmiːn-/ 'berry', second syllable stress /maˈminː-/ 'wing'), third syllable stress /napaˈjin-/ 'bread'. We report data from 8 speakers producing 4 tokens per condition (2 reps of the singular and plural form of each target stem). For each token, we extracted the f0 minima in the first 40% of the word, to represent L, and the f0 maxima, to represent H, that followed the minima. F0 was normalized within speaker. The duration of the interval between L and H was calculated as a percentage of word duration. Pitch slope was calculated by dividing the change in f0 from L to H by the duration of the interval between L and H. To statistically assess the effect of stress position on pitch slope and the timing of the initial L tone relative to the start of the word, we fit nested linear mixed effects models to both dependent variables. To a baseline model including only a random intercept for speaker, we added the fixed effect of stress position and determined statistical significance through model comparison via a likelihood ratio test.

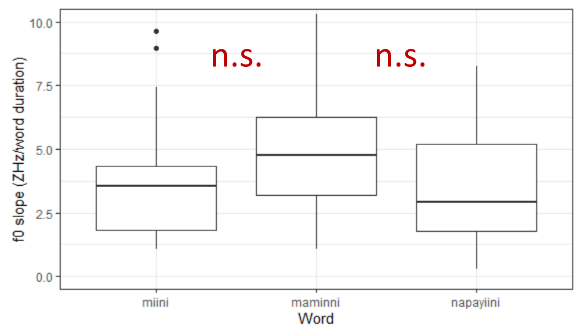
Results: In Figure 1: (a) shows that the pitch for the L and H tones has a similar range of variation across words; (b) shows that the pitch slope does not decrease in words with non-initial stress (in fact, pitch slope slightly *increased* from /ˈmiːn-/ to /maˈminː-/ but this was not statistically significant: $\chi^2 = 2.43$, $p = 0.30$); (c) shows that there is a significant delay in the timing of the L tone from the start of the word in /maˈminː-/ relative to /ˈmiːni/ ($\chi^2 = 900.7$, $p < 0.001$). Thus, if stress falls away from the left edge on the second syllable, the L tone appears to move with it. The L tone timing does not differ between words with stress on the second and third syllable.

Discussion: Although there is no contrastive evidence for a "lexicalized" L+H pitch accent in Blackfoot, the relative timing of the L and H is also not compatible with a "boundary tone" analysis. That is, the L occurs relatively close in time to the pitch maximum, leading to consistent pitch slope across all stress positions. We therefore propose that the L tone is introduced by the prosodic domain, and "jumps" to the stressed syllable, a mobile tone pattern which may function to enhance the perceptual salience of the stressed syllable H.

(a) Change in pitch consistent across stress position



(b) No decrease in pitch slope with non-initial stress



Typology: More broadly, we see potential for aspects of pitch variation to derive from the interaction between word and phrasal prosody. Figure 2 presents a typology of surface outcomes, G_1-G_4, resulting from the introduction of an L tone by a prosodic domain. In G_1 the %L tone docks to an edge syllable; these are true boundary tones. In G_2 the %L docks to an edge syllable and spreads to the stressed syllable, creating an L plateau. In G_3 (Blackfoot), the %L associates to a stressed syllable; the L plateau results from a Blackfoot-specific %L boundary tone at the right edge of the previous domain. In G_4 the L+H sequence has been grammaticalized as a rising pitch accent, potentially contrasting with other accents. Notably, different grammars may condition similar pitch contours, e.g, G_2-G_4; this surface ambiguity may seed grammatical variation and change.

(c) Timing of L increases with stress position

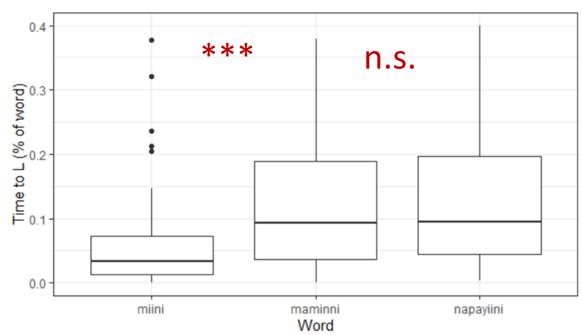
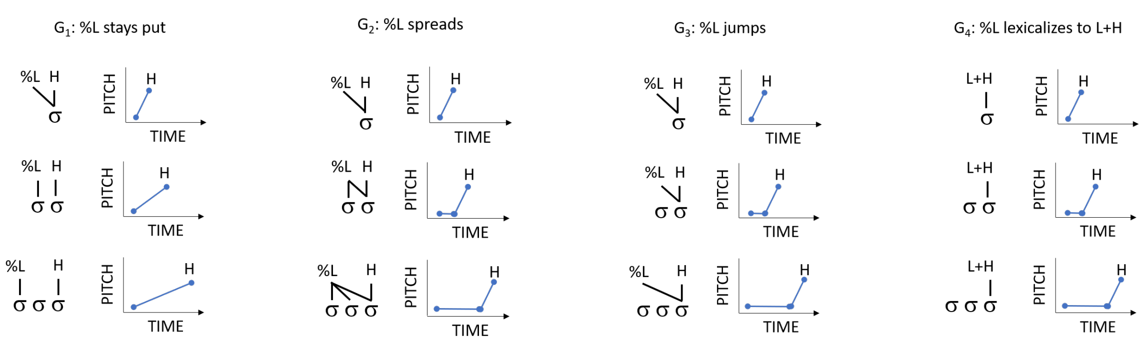


Fig 1. Blackfoot pitch results

Fig 2. Typology of four grammars; G1 makes distinct phonetic predictions from G2-G4



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