Tone-prominence interaction in Hän Athabaskan

Abstract
Interaction between the realization of lexical tone and the placement of stress is a well-documented phenomenon in a wide variety of languages (de Lacy 1999, 2002b). In such interactions, it has been claimed that higher degrees of stress are always attracted to higher tones, and vice versa (Goldsmith 1987). This paper provides an analysis of the interaction between tone and stress in Hän, a tonal Athabaskan language spoken in Alaska and Yukon, Canada. The interaction occurs at the level of the Intonational Phrase (IP), which has not been proposed for any other language. This interaction is of interest for two reasons: it extends the typology of tone-stress interaction to the largest domain in the prosodic hierarchy, as well as suggesting that even in a tone system considered to be privative (Manker 2014), the unmarked tone is not completely inert, and can exert an influence on the phonology.

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1 Introduction

Interaction between lexical tone and stress placement is a well-documented phenomenon in a wide array of languages (Inkelas & Zec 1988; Meredith 1990; Payne 1990; Zec 1999; de Lacy 1999, 2002, and many others). In the Athabaskan family in particular, Slave (Rice 1987), Tanana (Tuttle 1998), Sekani (Hargus 2005) have proposed analyses in which stress is attracted to lexical tone, or vice-versa. Hän, like these three languages, is a Northern Athabaskan language with lexical tone. However, its tonal system, and particularly the interaction between its tonal system and stress in the language, has not been studied as thoroughly. Hän presents an interesting case in contrast to the languages mentioned above in that it is a language in which only low tone is specified underlyingly. However, this tone *repels* stress, and stress repels low tone. The dispreference for stress and lexical low tone to co-occur, manifests itself in two ways:

(1) a. Lexical low tone is prevented from spreading to a stressed syllable
b. If a stressed syllable is underlyingly low-toned, stress shifts to the left

This means that on the surface, Hän appears to provide an example of language where both stress-to-tone type and tone-to-stress type interactions exist. Examples of the phenomena in (1) will be presented in below, after the tone and stress systems in Hän in general have been discussed.

The organization of the paper is as follows: In §2, a brief overview of Hän and general Athabaskan phonology and morphology will be presented. The descriptive facts concerning tone-prominence interaction will be introduced in §3. I will develop an analysis for these interactions in §4, making use of the tonal prominence scale and constraints governing tone-prominence association introduced by de Lacy (1999, 2002). In §5 and §6, I will show that the typological predictions made by the analysis in §4 are borne out in the interactions between tone and stress in the Athabaskan languages mentioned above, as well as in two unrelated languages (Uspanteko; Bennett & Henderson 2013, Serbo-Croatian; Inkelas & Zec 1988).

2 Background

2.1 Hän and general Athabaskan

Hän is a Northern Athabaskan language, spoken in Eagle, Alaska and Dawson City, Yukon, Canada. There are two dialects of the language, one spoken in Eagle Village, Alaska and the other in Dawson City, Yukon by the Tr'ondëk Hwëch'in community. The behavior of lexical tone is among the features that differ between the two dialects, but this paper will focus solely on the Eagle dialect, with the hope that further work will be able to provide a full analysis for both dialects of Hän.

2.1.1 Athabaskan morphology

Hän, like all Athabaskan languages, has complex verbal morphology. Since the analysis of stress and tone will refer to specific morphological categories, an overview of the general Athabaskan morphological system, specifically verbal morphology, will be given here.

Athabaskan verbs are generally analyzed as a case of position class morphology. They consist of a stem preceded by a number of prefixes. A simplified template of the structure of Athabaskan verbs, adapted from Rice (2000), is shown in (2):

(2) *Basic structure of Athabaskan verbs*

preverb – quantificational – incorporate # object – subject – qualifier – tense – valence – **stem**[1]
(QF) (QL) ("classifier")

It should be noted here that, following Rice, # denotes the boundary between "disjunct" and "conjunct" prefixes. This boundary is important in Athabaskan morphology, but will not play a role in the analysis of tone-prominence interactions developed here. In most languages in the family, the qualifier, tense, and valence morphemes are fused into a single, monosyllabic portmanteau morpheme, called the *pre-stem syllable*. Of the possible verbal elements in (2), only the stem and the pre-stem syllable are obligatory. Since all verb stems in Hän are monosyllabic, this means the minimal verb in Hän is disyllabic. To give an example of how the template in (2) is manifested in Hän, a typical verb is shown in (3). The data used for this and all other sections come primarily from two speakers of the Eagle (Alaskan) dialect of Hän (RR, EB), and were collected at CoLang 2016 by myself and others. The remaining data come from a Hän narrative by another speaker (LP, 1977) of the same dialect, at the Alaska Native Language Archive.

(3) (*Ruth) wëdàtr'ëdą̀h**ch'ee***[2] "We will depend on (Ruth)"
[wədàt̪ɻ̂ədą̀htʃ̂eː]

(Ruth) wë - dä - tr'ë - däh - **ch'ee**
3SGOBJ QF PL.SUBJ 1SG. BE/NEED.IMPFV
CAUS

[1] This is the general order of the prefixes, but various morphological, phonological, syntactic, and semantic processes can alter the order

[2] In this paper, I use the practical orthography developed for the Eagle dialect of Hän. This orthography is largely phonemic, with most consonant symbols based on English consonants. The following chart shows the orthographic consonants of Hän. For each stop/affricate, the three symbols correspond to voiceless aspirated, plain voiceless, and glottalized versions. Glottal stop is represented as <'>, and <h> is as in English.

	Bilabial	Dental	Alveolar	Lateral	Palato-Alveolar	Palatal	Velar
Stop	b		t, d, t'				k, g, k'
Affricate		tth,ddh,tth'	ts. dz, ts'		ch, j, ch'		k, g
Fricative		th, dh	s, z, sr, zr	ł, l (onset)			kh, gh
Sonorant	m w		n r	l (coda)		y	

Hän vowels are represented as follows. Back non-low vowels are rounded. All vowels except <ë, ö> can be written as long by doubling them. The same vowels all also have nasal counterparts, written with an ogonek accent. Low tone is represented by the grave accent over the vowel, while high tone is not written. <ë, ö> represent schwa (or a similar default vowel): <ë> in open prefix syllables, <ö> in stems.

	Front	Central	Back
High	i		u
Mid	e	ë, ö	o
Low	a		ä

For more detail concerning Hän orthography, see Krauss's introduction to Ridley (1983).

Unlike other related languages, Hän has lost all productive suffixes on both verbs and nouns. Considering the template in (2), in which the stem is the rightmost element, this means that the verb stem is invariably the final syllable of the verb word for every Hän verb.

Morphological analysis of Hän nouns is slightly more complicated, due to the fact that historically morphologically complex nouns have become largely unanalyzable in the synchronic grammar of the language. For example, the noun *jëjuu* [d͡ʒəd͡ʒuː] 'moose' is derived from the morphologically complex Northern Proto-Athabaskan **de-ni·g^{y}-i*, which had a literal meaning like 'that which moves (or lives)' (Leer 1996, Leer 2005). Speakers of modern Hän do not analyze *jëjuu* as consisting of two morphemes like *jë-juu*, but rather as a single, bisyllabic stem. This will be important for the following discussion of stress assignment in Hän

2.1.2 Stress and prominence in Hän

In Hän, as in many other Athabaskan languages, stem syllables are phonetically prominent (Kari 1990, Bird 2004, Tuttle 2005, Rice 2005, Leer 2005, Manker 2012). The primary correlate of stem prominence varies from language to language, however. Manker (2012) finds that the primary correlate of stem-prominence in Hän is duration, particularly of stem-initial consonants. This means that the final syllable of every Hän verb is expected to be prominent in relation to the prefix syllables (this generalization holds, except for cases in which the stem is also underlyingly associated with a low tone – this will be discussed further below). It would also be expected that the first onset/syllable of disyllabic noun stems like *jëjuu* 'moose' is either as prominent or more prominent than the second onset/syllable. However, Manker (2013) finds that this is not the case. Both verbs and nouns show prominence on final syllables (which are always stems for verbs), regardless of the fact that disyllabic nouns like *jëjuu* are not synchronically analyzable as prefix + stem sequences.

Manker argues that this is evidence that stress in Hän nouns has shifted from being assigned to the morphological stem, which was usually, but not always, final, to being assigned by default to the final syllable regardless of morphological category. This would mean that the assignment of stress in nouns has developed to be purely phonological. For verbs, it is more difficult to determine whether stress is assigned to the morphological stem or to the final syllable, since, as discussed above, verb stems in Hän are invariably monosyllabic and invariably the final syllable of the verb word. I will argue in §4 that treating stress assignment in Hän verbs as purely phonological for both nouns and verbs allows for an analysis of the interaction between stress and low tone that is consistent with the typology of such interactions both within and outside the Athabaskan family.

2.1.3 Tone

Hän is among those Athabaskan languages that developed and retained contrastive tone. Due to the nature of Hän morphology, minimal pairs for tone are relatively infrequent, but are well attested. Several examples of minimal tone pairs are given below.

		LOW TONE	HIGH TONE
(4)	a.	*shə̀r* 'knot'	*shär* 'bear'
	b.	*khə̀w* 'stick/club'	*khäw* 'sled'
	c.	*jìi* 'what/which'	*jii* 'this'

In addition to low and high tone, Hän also has two surface contour tones, rising and falling, giving the surface tonal inventory in (5).

(5)

Surface tone	**Example**
Low	*shàr* 'knot'
High	*shär* 'bear'
Rising	*jëjŭu* 'moose'
Falling	*łâä* 'very much'

Despite this inventory of tones on the surface, Hän is best analyzed as having a privative tone system with marked low tone, and default high tone assigned to underlyingly unmarked syllables, as it displays the following characteristics of privative tone systems (Hyman 2001).

(6) a. Contour tones cannot be attached to a single tone-bearing unit
  i. Rising tones only occur on bimoraic syllables[3] (as in the long vowel in the final syllable of *jëjuu* 'moose').
b. Tone spread only occurs with marked tone
  i. Only low tone is able to spread in Hän (discussed further in §3)

c. OCP violations only sensitive to marked tone
  i. There is no restriction on the placement of high tone; two adjacent syllables cannot be linked to separate low tones (again, discussed further in §3)

On this analysis, the words in (5) (excluding *łää*, as the productive status of falling tone is unclear) would be represented underlyingly and on the surface roughly as follows.

(7)

Underlying	**Surface**	**Gloss**
L | µ shär	L | µ shär	knot
   shär	H | µ shär	bear
L | µµ jëjuu	L H | / µµ jëjuu	moose

[3] Though a complete analysis of the Hän syllable has not yet been done, it appears that bimoraic syllables in the Eagle dialect are those with long vowels, diphthongs, or sonorant codas

Any Hän vowel can have any of the three productive tones (low, high, rising), the only restriction being that in (6a) – rising tone can only occur on bimoraic syllables[4].

2.1.4 Note on Athabaskan tonogenesis

The privative analysis of the Hän tone system is supported by characteristics of its synchronic grammar, as discussed above, but also makes sense in terms of the diachronic development of tone in Athabaskan languages. Tonal contrasts in Athabaskan developed from an earlier phonation contrast referred to as "constriction" (Krauss 1979 [2005], Kingston 1985, Leer 1999). Constriction was derived from glottalization, so that vowels preceding either glottal stops or ejectives became "constricted". Depending on the phonetic realization of constriction, languages could develop either high-marked or low-marked (like Hän) systems (Kingston 2005). A representation of this development is shown in (8), where constriction is marked with a superscript +[5].

(8) a. High-marked: CVC'/CVʔ → CV^{+}C'/CV^{+}ʔ → CV́C'/CV́ʔ (Tanacross)

b. **Low-marked: CVC'/CVʔ → CV^{+}C'/CV^{+}ʔ → CV̀C'/CV̀ʔ (Hän, Gwich'in)**

As this process is so well documented for the Athabaskan family, the location of underlying low tone in Hän is almost entirely predictable on the basis of the historical status of vowels as either constricted or non-constricted.

3 Interaction of stress and tone in Hän

As mentioned in (1), there are two primary ways in which stress and tone interact in Hän: low tone is prevented from spreading to stressed syllables, and stress shifts leftward to avoid coinciding with low tone. In this section, I will first discuss the process of tone spread in Hän generally and show specific cases where low tone is prevented from spreading to a stressed syllable. Then, I will discuss cases where stress shifts to avoid coinciding with low tone, specifically in cases in which a verb stem is underlyingly associated with low tone.

3.1 Tone spread

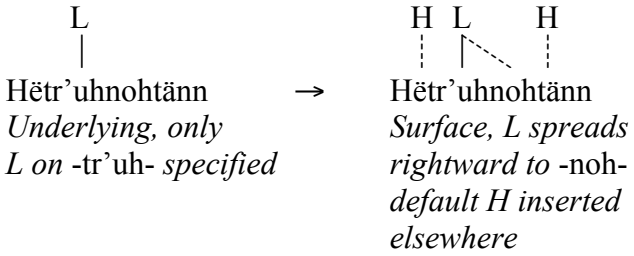
Spreading of the marked tone is a common process in Athabaskan languages, but the exact way in which tone spreads is not uniform across the family. In Hän, tone spread is always rightward. This means that any syllable to the right of a marked syllable should surface with low tone. This process is bounded to the syllable immediately adjacent to the underlying low tone (Manker 2014). A typical example of the spread of low tone is shown in (9). The prefix *-noh-*, which marks a first person subject is produced with high tone in the isolation form of the verb *noh'įį* 'I see', as well as when this verb is preceded by another high-toned syllable. However, in

[4] Under this analysis, the tone-bearing unit in Hän is the mora. This has been argued to be the case (Manker 2014), but only at some level of analysis. However, tone spread appears to be a syllable-based process, and therefore I will refer to marked vs. unmarked syllables when discussing tone spread and stress shift throughout the rest of this paper.

[5] This is a simplified depiction of the environments in which marked tone developed in Athabaskan, but suffices to show the effect of glottalization on tonogenesis in this languages. See Krauss (1979[2005]), Leer (1999), and Kingston (2005) for more detail.

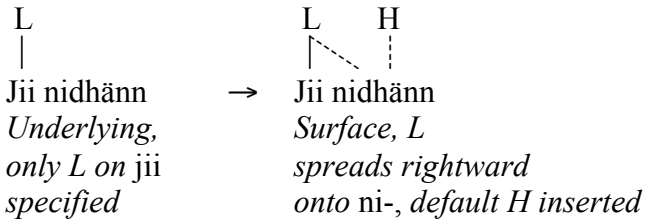
the verb *hëtr'ùhnòhtänn* 'we teach', this same prefix surfaces with low tone, due to spreading from an underlying low tone on the preceding prefix syllable *-tr'uh-* 'plural subject'.

(9) *Hëtr'ùhnòhtänn (hëdätr'ënidhänn)* '(We like) to teach'
1PL.teach.IMPFV 1PL.like.IMPFV



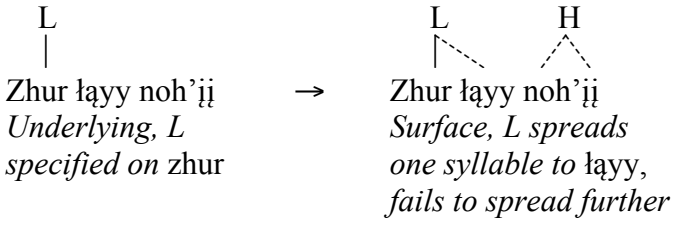
This process occurs not only within words, but also across word boundaries. An example of low tone spreading across a word boundary is seen in (10). The verb *nidhänn* 'you want' is pronounced in isolation and after a high-toned noun with high tone on both syllables. However, when preceded by the underlyingly low-toned wh-word *jìi* 'what', as shown below, the pre-stem syllable *ni-* surfaces with low tone.

(10) *Jìi nìdhänn?* 'What do you want?'
what 2SG.want



Another characteristic of low tone spread in Hän mentioned above is that it is bounded to a single syllable. Since low tone spread is blocked on unmarked (high-toned) verb stems (see (12) below and examples in (14)), the examples in (9) and (10) cannot be taken as evidence of bounded tone spread. However, in (11) we see that low tone spread is bounded even in cases where it would be possible to spread over multiple syllables. The underlying low tone on *zhùr* 'wolf' spreads to the following syllable (on the object, *łąyy* 'dog'), but fails to spread to the initial syllable of the following verb.

(11) *Zhùr łàyy noh'įį* 'The wolf sees the dog' (Manker 2014)
wolf dog see.3SG



Broadly, the above examples show that the process of tone spread in Hän has two main characteristics. First, only low tone participates in spreading. Second, the process is bounded to a single syllable to the right of the underlying low tone. In fact, both of these properties are typologically unusual. Hyman (2007) notes that there are very few clear cases of languages with low tone spread, but not high tone spread. Additionally, low tone spread in Hän is an apparent case of noniterativity, as the process is limited to single syllable. Cases of bounded tone spread such as this are problematic for non-derivational theories of phonology (Hyman 2005, Kisseberth 2007, Kaplan 2008). However, I will show in §4 that this case can be captured relatively straightforwardly by a grammar that incorporates constraints on the domain for the realization of marked low tone.

3.1.1 Blocking of low tone spread

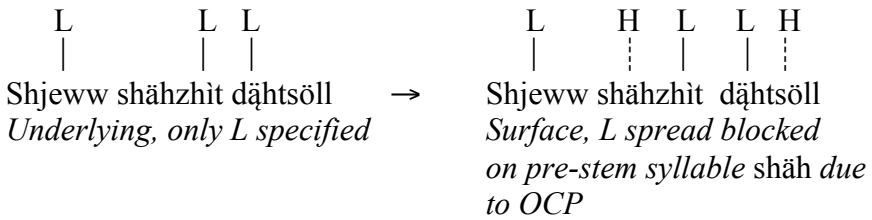
As seen in examples (9-11) low tone spreads from its underlying position one syllable rightward. However, there are two environments in which this process can be blocked.

(12) *Constraints on tone spread*

a. Adjacent syllables cannot be linked to two separate low tones (OCP; Leben 1973, Goldsmith 1976)
b. Low tone cannot spread to an unmarked (high tone) verb stem

An example of the OCP blocking tone spread is given in (13) for the sentence *Shjèww shähzhìt dą̀htsöll* 'My sister is smaller than me'. Low tone fails to spread from the first underlyingly low-marked syllable, as it would spread onto a syllable adjacent to a syllable associated with a separate low tone.

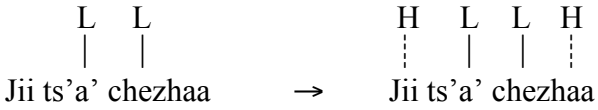
(13) *Shjèww* *shähzhìt* *dą̀htsöll* 'My sister is smaller than me'
my-sister 1SG.OBJ-be.more.than d.3SG-be.small



This type of OCP effect only manifests itself in Hän in the domain of tone spread – when two adjacent syllables are underlyingly specified for low tone, both low tones appear on the surface.

The second constraint on tone spread is that it is prohibited from spreading to an unmarked verb stem (unmarked here referring to its lack of underlying specification). This constraint is demonstrated in the utterance *Jii ts'à' chèzhaa* 'This beaver went away'. There is an underlying low tone on the prefix syllable *che-*, but it fails to spread to the verb stem *–zhaa*, even though it would be expected to, given the pattern of rightward spread observed elsewhere.

(14) *Jii ts'à' chèzhaa* 'This beaver went away'
this beaver go.away.3SG.PFV



Low tone fails to spread to stem -zhaa

I propose that the failure of low tone to spread in cases like (14) can be attributed to a dispreference for stressed syllables to associate with low tone. Recall from 2.1.2 that verb stems receive default stress in Hän, as they are always in word-final position. In §4 I will argue that it is this fact that prevents low tone from spreading onto verb stems as in (14) and propose an analysis to capture the interaction.

3.2 Stress shift

There is an additional process that is related to the dispreference for low tone and stress to co-occur. Many Hän verb stems contain vowels that were historically "constricted", and thus developed low tone. In verbs with low-tone stems, stress falls not on the final syllable (the stem), but shifts left to the penultimate syllable. Manker (2012) notes that in verbs with low-toned stems, stress was penultimate. Two examples are shown in (15) – (15a) shows stress shift in a two-syllable verb, while (15b) shows a three-syllable verb, confirming that stress shift is indeed to the penultimate syllable. Manker specifically notes verbs in which the penultimate syllable contains the reduced vowel /ə/ <ë>, and finds that the average duration of this vowel in penultimate syllables preceding low-toned stems was over double the duration of the same vowel in prefixes in other contexts (Manker 2012: 79)

(15) *Examples of penultimate stress in verbs with low tone stems*

a. ˈ*ë'ə̀ww* 's/he is eating' (stress on prefix *ë-,* rather than stem *-ə̀ww*)
3SG-eat.IMPERFECTIVE

b. *näˈch'ë'ə̀ww* 's/he is eating something' (stress on prefix *-ch'ë-*)
PV-IND.OBJ-3SG-eat.IMPERFECTIVE

This pattern is consistent with the data used in this study as well. A typical example can be found in the sentence in (16). Figure 1 shows that the duration of the prefix syllable *-dą̈h-* in two verbs, both produced in isolation. These verbs form a perfective/imperfective pair, differeing only in their stem syllable. The first verb, *wëdädą̈hch'è'* 'S/he depended on him/her' has the perfective stem *-ch'è'*, which has an underlying low tone. The second verb, *wëdädą̈hch'ee* 'S/he depends on him/her', has the imperfective stem *-ch'ee*, which is unmarked and surfaces with high tone. It can be seen that the duration of the entire pre-stem syllable, and of the onset [d], when followed by low-toned *ch'è'* is greater than the duration of the same syllable when followed by the high-toned *ch'ee*.

(16) *Penultimate stress with low-tone stem*

a. *wëdädą̈hch'è* 'S/he depended on him/her'
3SG.OBJ-QF-1SG.SUBJ.GH.be.PFV

b. *wëdädą̈hch'ee* 'S/he depends on him/her'
3SG.OBJ-QF-1SG.SUBJ.GH.be.IMPFV

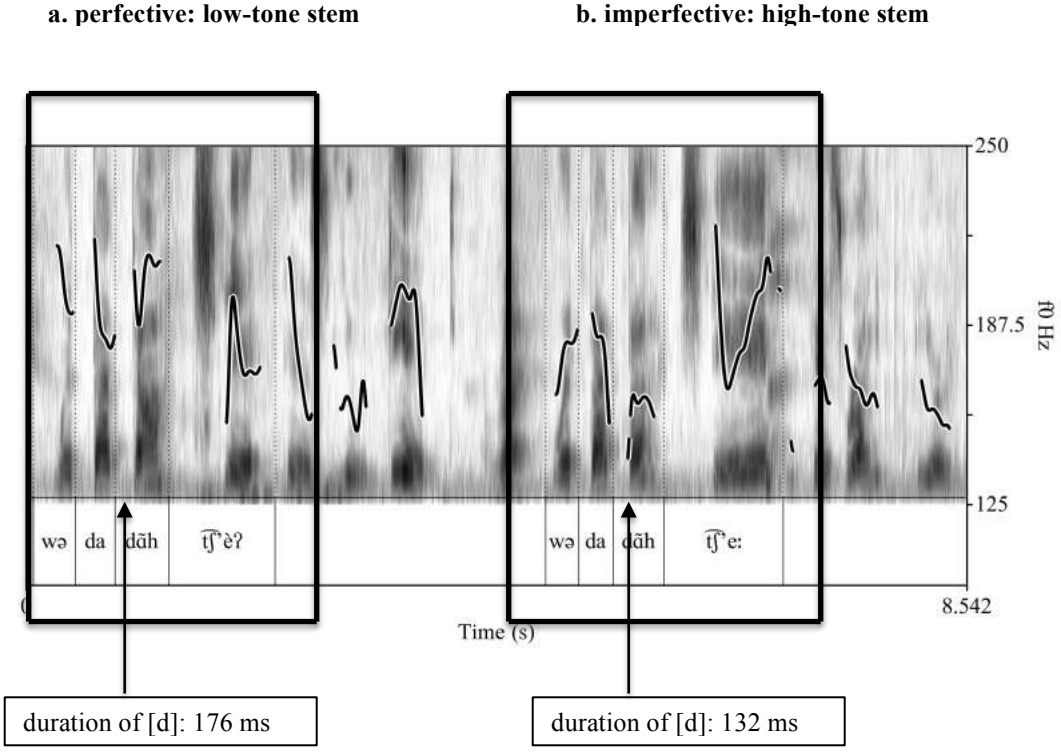


Figure 1: stress shifts from low-tone stem -ch'è' *to penultimate syllable* -däh-, *but no shift from high-tone stem* -ch'ee

One potential problem with this example is the difference in vowel length in the perfective versus the imperfective stem. The vowel is considerably shorter in the perfective stem than in the perfective stem. Due to the nature of the data, it was difficult to find verbs with identical pre-stem syllables, identical syllable counts, identical position within the sentence, as well as identical stem vowel length in order to make controlled comparisons.[6]

[6] There is one potential example contrasting verbs with high- and low-toned stems with identical length, but they occur in utterances of different lengths and rates of speech. The verb *tähaww* 'S/he will arrive' has a high-toned stem, and *tähdàww* 'You pl. will arrive' has a low-toned stem of identical length. While a direct comparison of these verbs is not possible due to their context, the range of VOTs of the [t] in the prefix syllable of *tähdàww* is slightly longer (107-152 ms) than the range of VOTs of the [t] in *tähaww* (90-136 ms).

In the following section, I will argue that the blocking of low tone spread to unmarked verbs stems and the leftward shift of stress in verbs with low tone stems (seen in (14) and (15), respectively) are in fact two effects of a single underlying constraint on the realization of tone and stress in Hän. Concretely, I will show that both of these phenomena can be accounted for by an interaction between metrical and tonal structures.

4 Analysis

4.1 Overview of constraints on tone-prominence interactions (from de Lacy 2002b)

The analysis in this section builds off of the theory of tone-prominence interactions first proposed by de Lacy (2002b). Therefore, a brief overview of that theory will be presented here before the details of the specific analysis for Hän are discussed.

Based on the observation that, when there is an interaction between lexical tone and stress, it is always high tone that attracts or is attracted to stress[7] (Goldsmith 1987, de Lacy 1999), de Lacy proposes a tonal prominence scale, modeled on Prince & Smolensky's (1993) formulation of prominence scales for representing markedness hierarchies like the sonority hierarchy. The tonal prominence scale has the following form:

(17) *Tonal prominence scale* (de Lacy 2002b: 2)
H > M > L

This scale formalizes the notion that higher tones are more prominent than lower tones, and could in principle be extended to account for any number of tonal levels. Again following Prince & Smolensky (1993), this prominence scale combines with structural positions to form a set of constraints in a universally fixed ranking. In this case, the structural positions are foot heads and foot non-heads, giving the constraints the following form:

(18) *Tone-prominence constraints* (de Lacy 2002b: 3-4)

a. *HD/L >> *HD/M
Low-toned heads are most marked, followed by mid-toned heads; no constraint on high-toned heads means this type is least marked

b. *NON-HD/H >> *NON-HD/M
High-toned non-heads are most marked, followed again by mid-toned non-heads; no constraint against low-toned non-heads means this type is least marked

The basic empirical patterns that the constraints in (18) account for are the tendency for higher tone and higher degrees of stress to co-occur, and the tendency for lower tone and lower degrees of stress to co-occur. Below, I will develop an analysis showing how these constraints, specifically *HD/L, can account for both the blocking of low tone spread and leftward stress shift in Hän. However, it will be seen in §4.4.1 that a slightly different version of this constraint is necessary to account for the pattern of tone-prominence interaction observed in Hän. This constraint is *HD(IP)/L(, which is identical to *HD/L, except that it is restricted to the most prominent of element of the Intonational Phrase (IP), rather than the foot. The necessity of this

[7] Although see Tuttle (1998) for a potential case of attraction between stress and low tone

version of the constraint, as well as the failure of plain *HD/L to capture all of the Hän data, will be discussed further below.

4.2 Motivating tone spread

Before showing how the blocking of low tone spread can be accounted for in Hän, the process of tone spread must first be motivated. In 3.1, it was shown that Hän tone spread exhibits two typologically rare properties – spreading of low tone without spreading of high tone, and noniterative tone spread. It is the latter property that has proven difficult to capture in parallel phonology. One group of proposals for dealing with noniterative tone spread appeal to the concept of peak delay (DeJong & McDonough 1993, Myers 1999, Li 2003, Hyman 2005, Kaplan 2008). These analyses rely on the fact that, whether for articulatory or perceptual reasons, tones frequently reach their targets on elements following their host TBU. While peak delay is phonetic in nature, Kaplan (2008) provides arguments, based on Chichewa (Myers 1999) that it can be phonologically controlled in some languages. We will see in the sections that follow that this is true for Hän as well. Here, I will treat noniterative tone spread in Hän as a form of "trough delay"[8].

There have been several proposals for formal implementation of peak delay in constraint-based grammars. Here, I use Kaplan's (2008) constraint PEAKDELAY (restricted to L), with the caveat that this is primarily for clarity, as the main purpose of my analysis in this paper is to show the interaction between stress and tone in Hän.

(19) TROUGHDELAY The F0 fall for a low tone must be allotted an adequate duration (two syllables)

In its original formulation, this constraint defined "adequate duration" based on linear regression models related to syllable duration for a given speaker (Myers 1999). However, lacking such phonetic detail here, adequate duration will be defined as two syllables. Violations will be assessed categorically – a candidate in which a low tone fails to be allotted *at least* two syllables will be assessed one violation. This constraint is in competition with a dispreference for multiply-linked tones, captured in (20) as *SPREAD:

(20) *SPREAD: Assess a violation for each tone associated to more than one syllable (violations assessed on number of association lines >1) (adapted form of NOLONGT (Yip 2002))

The interaction of the two constraints above captures the basic pattern of low tone spread in Hän – "spread enough to satisfy peak delay requirements, but don't spread any further". In order to account for the presence of default high tone on all other syllables, we will also need a constraint that requires TBUs (syllables in this analysis) to be associated with some tone:

(21) SPECIFY T: A TBU must be associated with a tone (Yip 2002:83)

[8] Although Kaplan (2008) notes that there are not any known cases of this phenomenon, it is not ruled out, as low tone is likely to be subject to similar articulatory or perceptual constraints as high tone in terms of duration needed for realization (Kaplan 2008: 229)

To see how these constraints interact to produce forms in which an underlying low tone spreads one syllable rightward, and all other syllables receive default high tone, it will be useful to look first at a schematic example. In the tableau in (22), we see the interaction of constraints (19-21) in a string of five syllables, with low tone specified on the first. The one crucial ranking that emerges from this case is TROUGHDELAY over *SPREAD. This prefers a candidate (22a) in which the underlying L spreads on syllable to associate with the following syllable over a candidate with no spread at all (22b). However, *SPREAD still has a role to play in preventing excessive spreading. Any candidate in which an underlying L spreads more than one syllable to the right (22c) will be harmonically bounded by a candidate in which it spreads only a single syllable, as such a candidate will incur a greater number of violations of *SPREAD. Candidates in which some syllables are left toneless (for example by failure to assign default high tone; 22d) are trivially ruled out by high-ranked SPECIFY T.

(22) *Basic ranking for low tone spreading:* SPECIFY T ; TROUGHDELAY >> *SPREAD

L | σ σ σ σ σ	SPECIFY T	TROUGHDELAY	*SPREAD
L H H H ☞ a. σ σ σ σ σ			*
L H H H H b. σ σ σ σ σ		*!	
L c. σ σ σ σ σ			**!**
L d. σ σ σ σ σ	*!**		

4.2.1 A note on underlying forms

A question that is not resolved from (22) is that of the underlying form. While there are good reasons to analyze Hän as a privative system (§2.1.3), in which only low tones are specified underlyingly, an analysis in a non-derivational framework, and in this case OT in particular, should also acknowledge the possibility of candidates in which high tone is underlying in addition to low tone (richness of the base: Prince & Smolenksy 1993[2004]). In order to account for such cases, we would need an additional constraint that disprefers associations between high tones and syllables, *PATH(H)[9]. Ranking this below *SPREAD above the basic faithfulness constraint MAX(T), we obtain the same output as in (22) (and for the rest of the forms considered

[9] This constraint is similar to *H (Bickmore 2000, Yip 2002), but penalizes association of H tones to TBUs, rather than penalizing the H tones themselves. Another option here that would allow candidate (23e) to be correctly ruled out would be *RISE (Bickmore 2000, Yip 2002) – however, this would have implications for the treatment of rising tones elsewhere in the grammar

later in the analysis), even in high tone is specified on the final four syllables. This ranking also rules out a candidate in which an underlying high tone remains on the syllable that is the target of L spreading to form a contour.

(23) *Accounting for low tone spread with underlying H:* *PATH(H) >> MAX(T)

L H H H H | | | | | σ σ σ σ σ	SPECIFY T	TROUGHDELAY	*SPREAD	*PATH(H)	MAX(T)
L H H H |⟍ | | | ☞ a. σ σ σ σ σ			*	***	*
L H H H H | | | ⟋⟋ b. σ σ σ σ σ		*!		****	
L ⟋|⟍ c. σ σ σ σ σ			**!**		
L |⟍ d. σ σ σ σ σ	*!**				****
L H H H H |⟍| | | | e. σ σ σ σ σ			*	****!	

For clarity, I will only be presenting underlying forms with L specified for the remainder of the analysis, with the assumption that analysis is also compatible with underlyingly specified high tone, with only the slight change outlined in the above tableau.

4.2.2 Accounting for directionality of spread

There is one additional aspect of low tone spread in Hän specifically that is not accounted for by the ranking in (22), namely the directionality of spreading. Low tone spreads only progressively. Here, I assume that leftward low tone spread is blocked by a highly ranked constraint L-ANCHOR(L) (Bickmore 1999), which penalizes surface low tone spans whose left edge does not correspond to the left edge of the underlying low tone span.

(24) L-ANCHOR(L): Assess a violation to an output low tone span whose leftmost TBU does not correspond to the leftmost TBU of the low tone span in the input

In the schematic example in (25), we see that this constraint rules out a candidate in which low tone spreads on syllable to the left, and so is evaluated equally to a candidate with rightward spreading by both *SPREAD and TROUGHDELAY.

(25) *Rightward low tone spread*: Leftward spreading blocked by high-ranked L-ANCHOR(L)

L | σ σ σ σ σ	L-ANCHOR(L)	SPECIFY T	TROUGHDELAY	*SPREAD
H L H H ☞ a. σ σ σ σ σ				*
L H H H b. σ σ σ σ σ	*!			*
H L H H H c. σ σ σ σ σ			*!	

4.3 Blocking of tone spread: OCP

The ranking in (22) establishes the basic pattern of low tone spread in Hän, but does not account for environments in which spreading is blocked. The first case, which is unrelated to stress, shows the effect of the OCP. This effect can be formalized as follows:

(26) OCP(L): Assess a violation for each instance of consecutive syllables associated with *distinct* low tones

If the preference to avoid adjacent syllables linked to separate low tones is stronger than the preference to allot two syllables for the realization of low tone, we see blocking of low tone spread in cases such as (27). The ranking of OCP(L) over TROUGHDELAY ensures that low tone cannot spread to syllables immediately preceding other marked syllables. In (27), we see the effect of this ranking in the sentence *Shjèww shähzhìt dạ̀htsöll* 'My sister is smaller than me.' In this case, we see that there must also be a highly-ranked separate Faithfulness constraint disfavoring the deletion specifically of low tones, preventing one low tone merging with the other and spanning four syllables (this could also be accomplished with UNIFORMITY (McCarthy & Prince 1995) or NOFUSION (Yip 2002) if the lows do in fact merge; either way, it will be assumed that candidates such as (c) are ruled out for the remainder of the analysis).

(27) *Blocking of spread on pre-low tone syllables*: OCP(L) >> *TROUGHDELAY

L L Shjeww shähzhìt dą̈htsöll	MAX(L)	SPECIFY T	OCP(L)	TROUGH DELAY	*SPREAD
L H L H ☞ a. Shjeww shähzhìt dą̈htsöll				*	*
L L H b. Shjeww shähzhìt dą̈htsöll			*!		**
L H c. Shjeww shähzhìt dą̈htsöll	*!				

4.4 Blocking of tone spread: unmarked verb stems

While it is an important piece of the description of the behavior of tone in Hän, the effects of the OCP are unrelated to the interaction between stress and tone. Of more interest in this area is the blocking of low tone spread to unmarked verb stems. As discussed previously, unmarked verb stems are stressed. If this syllable is treated as the head of a foot, it becomes possible to account for the blocking of low tone spread with the tone-prominence constraint *HD/L, described in (18). If this constraint, like OCP(L), is ranked above TROUGHDELAY, we see that low tone will not spread to an unmarked verb stem, as this would cause the head of a foot to be associated with low tone. This is demonstrated in (28), using the sentence *Jii ts'à' chèzhaa* 'This beaver went away', in which low tone fails to spread one rightward from *che-*, satisfying *HD/L, as opposed to a candidate in which low tone spreads onto the verb stem.

(28) *Blocking of low tone spread to stressed stem:* *HD(IP)/L >> TROUGHDELAY

L L [Jii ts'a' chezhaa]$_{IP}$	SPECIFY T	OCP(L)	*HD(IP)/L	TROUGH DELAY	*SPREAD
H L L H ☞ a. [Jii ts'a' cheˈzhaa]$_{IP}$		*		**	
H L L b. [Jii ts'a' cheˈzhaa]$_{IP}$		*	*!	*	*

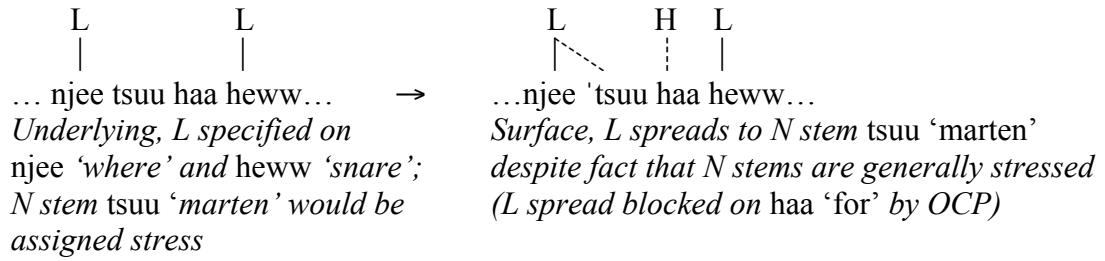
The prefix *che-* also appears with low tone when it is preceded by an unmarked (high tone) syllable such as *-jee* in *jëjee* 'man', in a sentence such as *Jii jëjee chèzhaa*. This eliminates the possibility that the low tone fails to spread onto the stem *–zhaa* due to the fact that it has already spread on syllable from *ts'à'* to *chè-*.

Since there are no mid tones in Hän, the other constraint in the tone-prominence hierarchy for foot heads, *HD/M (or *HD(IP)/M), will have no influence on any of the surface

forms in Hän, and can thus be ranked anywhere below *HD(IP)/L (since these constraints are in a universally fixed ranking).

The problem with using *HD/L in its original formulation (from de Lacy 2002b) becomes clear when considering cases in which low tone does spread onto a stressed final syllable of a noun. Despite the fact that Manker reports final stress in nouns as well as in verbs, low tone spread is not blocked on stressed syllables in nouns. In the example below, the underlying low tone is on the wh-word word '*njèe'* 'where', but it freely spreads to the following noun stem *tsuu* 'marten'. However, with the constraint ranking determined in (28), this will be ruled out in favor of a form in which low tone spread is blocked.

(29) *Shëchà' njèe tsùu haa hèww nèlèe hèdèyy* 'My father knows where to trap marten'
my-father where marten for snare set 3SG-know.IMPF



The challenge presented by this data, then, is how to differentiate between stress on noun stems and stress on verb stems in terms of its interaction with lexical low tone. There are a number of possible approaches to this problem. One approach would argue that, since verbs are still analyzable as sequences of prefixes + stem, stress on verb stems is determined by morphological category, and therefore has a different status to stress on nouns stems, which, as discussed above, appears to be determined purely phonologically in the synchronic grammar of Hän.

4.4.1 Prosodic level of tone-prominence interaction

A second option to account for the contrast in behavior between stressed noun stems and stressed verb stems would be to expand the inventory of tone-prominence constraints. In this case, the inventory would be expanded by generalizing beyond heads of feet to heads of larger prosodic constituents. In this case, a good candidate for a new constraint would be a constraint on the association of tone to the head of the Intonational Phrase (IP), which was identified in §3.1 as the likely domain of tone spread in Hän. Such a constraint would have the same general form as *HD/L, but the head would be the head of the IP rather than of the foot.

(30) *HD(IP)/L Assess a violation for every association of low tone to the head of an Intonational Phrase (IP)

In an earlier version of the theory of tone-prominence interaction (de Lacy 1999), constraints on the association of tone and stress were not limited to the heads of feet, but rather the association of tone to Designated Terminal Elements (Liberman 1975, Liberman & Prince 1977). Under this version of the theory, there are constraints on the association of tone to any terminal prosodic

node in a prosodic category α that is connected to α by an unbroken path of prosodic heads (de Lacy 1999: 2). This version of the theory includes constraints for every possible α, from the syllable to the entire utterance.

Several cases of tone-prominence interactions at prosodic levels above the prosodic word have been reported, which support this extended set of constraints. De Lacy cites Digo (head of Phonological Phrase attracts H; Kisseberth 1984, Goldsmith 1988:85), as well as Vedic Sanskrit and Korean (interaction at level of Major Phrase; Kim 1997) as examples of languages with this type of interaction. Although a further study will be necessary to fully determine the domain of tone-prominence interaction in Hän, if it is indeed the case that the interaction is sensitive to the Intonational Phrase, this would fill in a gap in the typology predicted by the earlier version of the theory developed by de Lacy[10].

The case in (29) provides a straightforward example of a form in which *HD(IP)/L makes the correct prediction, and basic *HD/L the wrong prediction. Since *tsuu* 'marten' is not the head of the intonational phrase (as there are no long breaks or significant lengthening in this utterance, it appears to be a single IP), spreading low tone to it does not violate *HD(IP)/L, even though it is a stressed noun stem. Since the attested form does not violate this updated constraint, it emerges as the surface form due by minimized the number of syllables associated to the default H tone that is inserted (further spread is blocked by the OCP).

(31) *Change in domain of tone-prominence interaction permits L spread to stress N stem*

L L | | [...njee tsuu haa heww…]$_{IP}$	SPECIFY T	OCP (L)	*HD (IP)/L	TROUGH DELAY	*SPREAD
L H L | ⟋ | a . […njee ˈtsuu haa heww…]$_{IP}$				*!	*
L H L ⟋ | | ☞ b. […njee ˈtsuu haa heww…]$_{IP}$					*

If *tsuu* 'marten' is normally stressed in the same way as other noun stems, In (32) we see that the pattern in (29) is not captured by an analysis with only the ranking *HD/L >> TROUGHDELAY. This ranking prefers an output in which the underlying low tone on the question word *njèe* 'where' is blocked entirely from spreading.

[10]There may be a case of an interaction in this domain diachronically, however. Köhnlein (2013) argues that a shift in the alignment of nuclear accents in some Franconian dialects was due to a preference for the high portion of the accent to align with a nuclear stressed syllable. He claims that an earlier L*HL accent shifted leftward in phrase-final position to become LH*L. If this is the case, it could represent, like Hän, an interaction between nuclear stress and high tone, albeit in a diachronic context.

(32)

L L | | njee tsuu haa heww	SPECIFY T	OCP(L)	*HD/L	TROUGHDELAY	*SPREAD
L H L | ⋮ | a. njee ˈtsuu haa heww				*	*
L H L | ⋮ | b. njee ˈtsuu haa heww			*!		*

4.4.2 Diagnosing IP boundaries

In order to argue that tone-prominence interactions in Hän are sensitive to the boundaries of intonational phrases, some diagnostics other than the behavior of low tone will be necessary. To this point, the intonational system of Hän has not been subject to systematic study. To the extent that it has been studied impressionistically, it has been claimed that in Hän, lexical tone always takes precedence over intonation (Krauss 2005, as cited in Holton 2005). This would mean that is unlikely that boundary tones could be used as a diagnostic for IP boundaries in Hän. However, there are a number of other potential diagnostics[11]. Among these are boundary tones (Pierrehumbert 1980), blocking of segmental processes (Jun 1996; Hayes and Lahiri 1991), lengthening (Klatt 1975, Lehiste et al. 1976, Wightman et al. 1992, and many others), and pause (O'Malley et al. 1973; Lea 1980; MacDonald 1976).

In order to determine whether IP boundaries are cued by boundary tones (which in Hän would be more likely to manifest themselves as an effect on pitch range), a much larger set of data would be necessary, so for now this will be ignored as a possible cue. There are some segmental processes that occur across word boundaries in Hän. For example, there is a process by which the schwa in the first syllable of the verb *wënohkhäww* is deleted, and the glide [w] is syllabified as the coda of the preceding postposition *-hèe* (as in 33b). However, this process is variable. It could be the fact that this variation is related to prosodic structure and could be used as a diagnostic for phrase boundaries. However, there is not enough data of this kind to determine whether this is actually the case.

(33) a. *Nihèe wënohkhäww* [[nihè:] [wənohxaw]]

b. *Nihèwnohkhäww* [nihè:wnohkhaw]

More promising as diagnostics for the present study are phrase-final lengthening and pause. There are a number of cases in which the same sentence is produced with different degrees of lengthening and pause between the words. This is often confounded with changes in speech rate, but there were several cases, one of which will be discussed in detail below, in which overall speech rate was not changed, but lengthening of word-final syllables within the utterance varied. For this reason, I will use lengthening as the primary cue for IP boundaries

[11] Further study will of course be necessary to determine the exact cues for prosodic boundaries in Hän

here, with the caveat that a systematic study of the prosodic system of Hän is necessary to build on this analysis.

4.4.3 Interactions at the IP level

If it is indeed the case that nuclear stress is the real locus of tone-prominence interaction in Hän, then we would expect to see two more patterns: blocking of low tone spread on an IP-final noun stem, and failure to block low-tone spread on an IP-medial verb stem. A potential example of blocking of low tone spread on an IP-final noun stem is found in the noun *Nàghayy* 'frog'. The data used for this study included four tokens of this word that could be analyzed as IP-final position – one isolation form, and three forms in a larger utterance, but with significant lengthening of the final syllable. It also included three tokens of the same word in a larger utterance with no lengthening in the final syllable. When pronounced in isolation (34a), or when produced IP-finally within a larger utterance (34b), this word has low tone on the first syllable and high tone on the second syllable. When produced at the left edge of a larger IP, low tone spread occurs from the first syllable *Nà-* to the second syllable *-ghayy*, and the word surfaces with low tone on both syllables (34c). Both in isolation and in IP-final (but utterance-initial) position, the duration of *-ghayy* is significantly longer than the duration of the same syllable in non-IP-final position (811 ms vs. 572 ms) [12]. See Appendix for spectrograms of the crucial utterances (34b,c) below.

(34)

a. [Näˈghayy]$_{IP}$ — *Produced in isolation, no low tone spread*
frog

b. [[Näˈghayy]$_{IP}$ [tthee kąyy däˈtlaa]$_{IP}$] — *IP-final position, no low tone spread*
frog rock on jump.3SG.PFV
'The frog jumped on the rock'

c. [[Näghayy tthee kąyy däˈtlaa]$_{IP}$] — *IP-medial position, low tone spread*

The contrast between (34a,b) and (34c) suggests that even noun stems with nuclear stress resist low tone spread, due to the preference for the head of the IP to be associated with high, rather than low, tone (*HD(IP)/L). A possible cause for the infrequency of low tone spread blocking on noun stems is the fact that Hän (like other Athabaskan languages) has default SOV word order. Verbs are found in IP-final position much more frequently than nouns, so it is much more common to observe blocking of low tone spread on verb stems than on noun stems.

The forms in (34) provide the clearest example (in the data used for this paper) of the contrast between IP-final and IP-medial nouns with respect to low tone spreading. However,

[12] The duration of *Nä-* is not longer for the forms with lengthening of *-ghayy*, so the difference in duration in the second syllable is unlikely to be due to a slower speech rate

another frequent word, *ch'ìtseyy* 'car (lit. metal)', appears to display the same behavior. In isolation, this word surfaces with low tone on the first syllable (*ch'i*), and high tone on the second, final syllable (*tseyy*). However, when it occurs in the utterance *Ch'ìtsèyy nätökłök eyy tł'aa jighörr t'ädökch'ee* 'I need tires (lit. I need what is round under metal that I drive)', low tone does spread from the first to the second syllable, paralleling the behavior of *näghayy* in (34c) above.

As mentioned above, verbs are much less common in IP-medial position than nouns. However, in such cases, we would expect low tone to be able to spread from a pre-stem syllable to a stem syllable. Due to the nature of the primary data used for this study, there are only several examples of verbs that both have a low-toned pre-stem syllable and appear in both final and non-final position. However, the examples that do exist are quite clear. In (35a), two tokens of the sentence *John Mary lëjii nè'ąyy haa wëk'eww hònlįį*, which contrast in prosodic phrasing are shown. The token in (35a.i) is a more careful production, with a greater number of IP boundaries. In this example, the verb *nè'ąyy* '3SG stole' occurs at the right edge of an IP, and low tone spread from the prefix to the stem is predictably blocked. However, in (35b.i), a more natural production of the same sentence, *nè'ąyy* occurs in IP-medial position in an IP headed by *haa* 'for'. In this case, low tone is able to spread from the prefix *nè- to the stem -ąyy*. Despite the relative scarcity of data bearing on this issue, there is more support from at least one example of such a verb in a narrative recorded by another native speaker, archived at the Alaska Native Language Archive. The verb *hiyèhnöö* 'they said (to 3SG)' appears frequently in narratives, and is generally in final position, immediately following quoted speech. In this context, it always appears with high tone on the stem, *-nöö*, as would be expected in IP-final position. However, in at least one case, this verb appears in a non-canonical word order. In this case, shown in (35b), low tone does spread from its underlying position on the prefix *-yeh-* to the stem *-nöö*. This would appear to support the claim that it is actually nuclear stress that disprefers co-occurring with low tone.

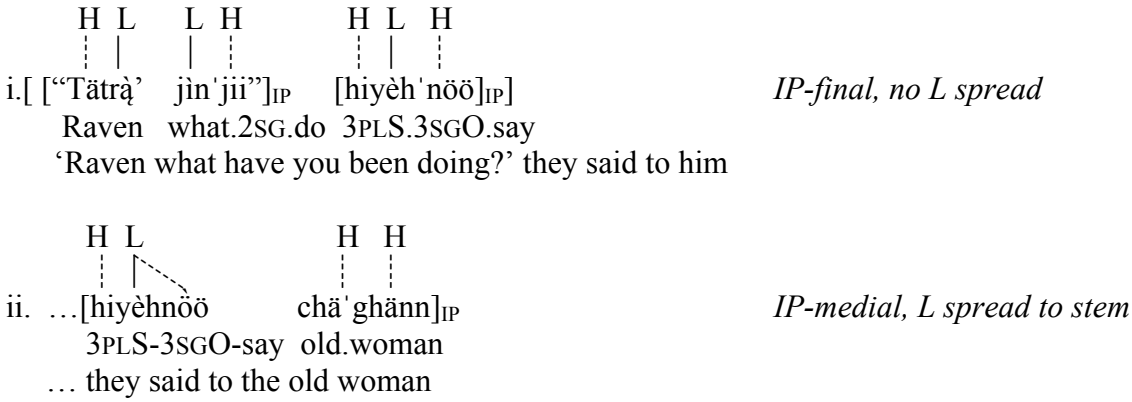
(35a)

		L		L	H		H		H	H		L	H
i.	[[John]	[Mary	ling	**ne**ˈ**'ąyy**]$_{IP}$		[ˈhaa]$_{IP}$		[wëk'eww		˛honˈlįį]$_{IP}$]	
	John	Mary	dog.POS	steal.3SG.PFV		for		angry		be.3SG.IMPFV	

'John is angry because Mary stole his dog'

		L		L		H		H	H	L	H
ii.	[John	Mary	ling	**ne'ąyy**		ˈhaa]$_{IP}$		[wëk'eww		˛honˈlįį]$_{IP}$]	
	John	Mary	dog.POS	steal.3SG.PFV		for		angry		be.3SG.IMPFV	

(35b)



4.5 Stress shift

As discussed above, the second effect of the interaction between stress and tone in Hän is leftward stress shift from underlyingly low-toned stems. This was shown for the example *Willem ëjënëtl’ät yàa wëneydèyy* ‘I remember Willem writing’. In this example, the verb stem *-dèyy* ‘remember’ was not stressed, with stress instead falling on the penultimate syllable *-ney-*. This basic interaction can be described as competition between a preference for right-aligned stress (as discussed in 2.1.2) and a dispreference for low tone to occur on the head of the IP. Since the preference for right-aligned stress applies across categories (Manker 2013), it can be captured by a constraint that aligns the head syllable of a foot with the right edge of the foot, enforcing iambic feet.

(36) ALIGN(σ_{Hd}, R, Ft, R) Align the right edge of the head syllable with the right edge of the foot (referred to as IAMB below)

In the basic case, this derives default final stress in every prosodic word in Hän. This is shown below for both a bisyllabic verb and noun.

(37) IAMB *derives default final stress in bisyllabic forms*

a. *dähtsoll* ‘3SG is small’

dähtsoll	IAMB
☞ a. dähˈtsoll	
b.ˈdähtsoll	*!

b. *jëjuu* ‘moose’

jëjuu	IAMB
☞ a. jëˈjuu	
b.ˈjëjuu	*!

The tableaux in (37) both show bisyllabic forms, whose final stress is captured simply by IAMB. However, in longer words, additional constraints are necessary to ensure that the iambic foot is aligned with the right edge of the words. Since secondary stress has not been reported for

Hän, there should only be a single foot in each word containing the stressed syllable[13]. This can be derived via another common alignment constraint:

(38) ALIGN(FT, R, ω, R) The right edge of every foot is aligned with the right edge of some prosodic word (ALL-FEET-RIGHT)

If the preference for every foot to be at the right edge of a prosodic word is stronger than the preference to parse syllables into feet, only a single foot will be constructed at the right edge of a prosodic word. This is shown below for the verb *wëdätr'ëdähch'ee* 'we will depend on 3SG'. The metrical structure in the surface form consists of a single iambic foot constructed at the right edge of the prosodic word, yielding primary stress on the final syllable, with no secondary stress.

(39) *IAMB; ALL-FEET-RIGHT >> PARSESYL yields single iambic foot at right edge*

wëdätr'ëdähch'ee	IAMB	ALLFTR	PARSESYL
☞ a. wëdätr'ë(däh'ch'ee)			***
b. wëdätr'ë('dähch'ee)	*!		***
c. ('wë)(dä'tr'ë)(däh'ch'ee)		*!* ****	

For the sake of space and clarity, this ranking will be assumed in the tableaux below showing the effect of low tone on the placement of stress.

It is clear that, in order for penultimate stress to occur in forms with low-toned stems, at least one constraint must outrank IAMB. An obvious candidate for this constraint is *HD(IP)/L. If this constraint outranks the preference for right-aligned stress, we expect to observe several things. First, that stress shift only occurs in words that are IP-final. This means that any bisyllabic noun stems (or monosyllabic noun stems with prefixes), or verbs that are not IP-final would not be expected to show stress shift, while any IP-final form with underlying low tone on its final syllable would be expected to exhibit stress shift. Among the data used in this study, there was not a sufficient number of examples present to determine whether stress shift occurs with all low-toned stems, or only those in IP-final position. If it ends up being the case that stress shift always happens with low-toned stems, this would mean that regular *HD/L would be reintroduced and ranked above ALIGN-R, but below *TROUGHDELAY. This would mean that stress shift is due to tone-prominence interaction at prosodic word level, but tone spread blocking is due to tone-prominence interaction at IP level. In either case, the basic interaction is the same, the only change being the domain in which the interaction occurs.

Returning to the example from (16), *wëdädq̈hch'è'* '3SG depend.PFV on 3SG', we can see how the interaction of IAMB and *HD(IP)/L produces a basic case of leftward stress shift. In this case, it is clear that *HD(IP)/L must outrank IAMB. This accounts for the fact that in verbs with low-toned stems, it is preferable to violate the structure of the foot, rather than to allow low tone to coincide with the head of the intonational phrase.

[13] If it does turn out that Hän has secondary stress, some additional constraints will be necessary both the capture how these feet are parsed, and to ensure that the rightmost foot is the head foot. This is fairly straightforward, but outside the scope of this paper.

(40)

	*HD(IP)/L	IAMB
L | [wë.dä.dą̈h.ch'e']$_{IP}$		
L | ☞ a. [wë.dä.('dą̈h.ch'e')]$_{IP}$		*
L | b. [wë.dä.(dą̈h.'ch'e')]$_{IP}$	*!	

The ranking established by (40) accounts for the fact that stress shift is a possible strategy in Hän for avoiding low tone on a prominent element. However, it does not rule out another reasonable strategy – tone shift. It would be plausible for the low tone on the stem *-dèyy* 'know' to delink and reattach to the penultimate syllable, allowing for the usual stress pattern. There must be another high-ranked constraint that prevents this from occurring in Hän. A good candidate for this constraint is ANCHOR-T, a faithfulness constraint penalizing the breaking of underlying association lines.

(41) ANCHOR-T: Don't break underlying association lines (essentially *DISSOCIATE from Yip (2002))[14]

(42) *high-ranked ANCHOR-T prevents de-linking of underlying L and leftward-reassociation*

	ANCHOR-T	*HD(IP)/L	IAMB
L | …wë.(ney.deyy)]$_{IP}$			
L | ☞ a. …wë.('ney.deyy)]$_{IP}$			*
L b. …wë.(ney.'deyy)]$_{IP}$	*!		
L | c. …wë.(ney.'deyy)]$_{IP}$		*!	

5 Typology of stress-tone interaction in Athabaskan

Upon initial observation, the behavior of tone in Hän appears to be quite complex and in some regards rather different from the behavior of tone in related languages. However, based on the analysis developed in the previous section, it can be seen that the differences between Hän tone, particularly the ways in which it interacts with stress, are not extreme, but lie instead in small differences in the rankings of constraints and/or in the domains to which certain constraints

[14] This would be valid only for L tones under a Rich Base system as discussed briefly in §4.2.1

apply. In this section, I will show that interactions between stress and tone in several other Athabaskan languages can in fact be analyzed similarly to the interactions in Hän, using many of the same constraints, or else closely related constraints from the same constraint families.

Based on the above analysis for Hän, we would expect the typology of tone-prominence interactions in Athabaskan to include several phenomena. For example, we might expect some languages to rank ANCHOR-T much lower than Hän, leading to a system in which an underlying tone delinks from its host and reassociates elsewhere to satisfy constraints on association between tone and a particular level of metrical prominence. We do indeed find an example of such a language in Slave (Rice 1987). Slave, unlike Hän, is a high-marked language, meaning that its underlying tonal specification contrasts marked H tone with unspecified syllables. In this language, default stress is penultimate. Rice provides an analysis in which a high tone that is underlyingly associated with a final syllable delinks and reassociates one syllable to the left to coincide with the stressed syllable. In the tableaux below, we see that this interaction can be captured using a nearly identical set of constraints as in the analysis above for Hän. The constraint driving tone shift is *HD/L. The constraint regulating foot form is TROCHEE (as opposed to IAMB for Hän).

(43) *Slave (Rice 1987): low-ranked ANCHOR-T, tone de-links and reassociates leftward to coincide with stress*

H …le.(ts'ɛ.ya)	TROCHEE	*HD/L	ANCHOR-T
L H L …le.(ˈts'ɛ. ya)			*
L L H …le.(ts'ɛ.ˈya)	*!		
H …le.(ˈts'ɛ. ya)		*!	

We can see here that a pattern that appears on the surface to be quite different from the interaction between tone and prominence in Hän actually only differs in three minor ways. First, the alignment constraint regulating foot form is oriented to the left edge rather than the right edge. Second, the domain of the interaction between tone and prominence is (per Rice's analysis) the foot rather than the IP. The final difference is only in the ranking of the constraints. In Slave, it is more important to maintain a trochaic foot than it is to be faithful to underlying tonal associations. Thus, we observe tone shift rather than stress shift in forms where low tone could have been associated with a prominent syllable.

A second pattern that might be expected to arise in other Athabaskan languages is a pattern with left-edge oriented stress rather than right-edge. Such a case exists in Sekani, as analyzed by Hargus (2005). This language is similar to Hän in that it is a low-marked language, with default high tone on unmarked syllables. Hargus (2005) notes of the stress system in the Ft. Ware dialect of Sekani: "Stress is attracted to stem (vs. affix) syllables, to word initial (vs. second) syllables,

to syllables containing [u] or [a] (vs. [ə] or [ɪ])), and to H (vs. L) tone stem syllables" (Hargus 2005:23). Two of these parameters are of particular interest – the attraction of stress to initial syllables, and the attraction of stress to H tone syllables. Hargus presents a minimal pair consisting of a verb with a (marked) low tone prefix and (unmarked) high tone stem (44a) and a segmentally identical verb with high tone on both syllables (44b).

Sekani – stress shifts from initial to second syllable to avoid coinciding with low tone

(44) a. *tlı̨ nèh'tsən* 'the dog is fat'
dog is.fat

b. *tlı̨ 'nehtsən* 'the dog is sniffing you'
dog is.sniffing.you

(Hargus 2005:20)

This pattern is essentially the mirror image of Hän. Hän prefers to construct an iambic foot at the right edge of the word and stress shifts to the left to avoid coinciding with underlying low tone. In Sekani, the preference is for a left-aligned trochaic foot (this means ALLFEETLEFT would be the undominated alignment constraint), with stress shifting to the right to avoid coinciding with an underlying low tone. Additionally, as in Slave, it appears that the interaction between stress and tone is at the foot level.

Sekani (Hargus 2005): ALL-FEET-LEFT, trochees, otherwise same as Hän
(45)

L | (neh.tsən)	ANCHOR-T	*HD/L	TROCHEE
L H | ⋮ ☞ a. (neh.'tsən)			*
H L \ ∤ ⋯ b. ('neh.tsən)	*!		
L H | ⋮ c. ('neh.tsən)		*!	

The most interesting pattern that emerges when comparing the interactions between tone and stress in these languages is that, regardless of whether a language is high-marked (Slave) or low-marked (Hän, Sekani), the crucial constraint motivating tone spread blocking, stress shift, and tone shift is nearly identical. In each case, a constraint prohibiting co-occurrence of prominence at some level and low tone is the cause of a surface process affecting tone, stress, or both. This is a significant advantage for a non-derivational approach to analyzing these types of patterns: processes that appear to be unrelated within and across languages can be seen to be, at a basic level, different manifestations of the same underlying preference, in this case the preference for phonologically prominent elements to be associated with higher tone.

6 Hän and general typology of tone-stress interaction

Beyond the Athabaskan family, interactions between tone and stress have been proposed and analyzed for a wide variety of languages. One unrelated language exhibits an interaction that is remarkably similar to that found in Hän. Uspanteko (Mayan), as analyzed by Bennett and Henderson (2013) is treated as a privative tone system, contrasting H and ∅ underlyingly. Like Hän, Uspanteko stress involves the construction of an iambic foot at the right edge of the word. In this language, high tone is prohibited on final moras, so in words ending with two light syllables, high tone surfaces on the penultimate syllable. In such cases, stress shifts from its default final position to coincide with high tone on the penultimate syllable, reversing the form of the foot from iambic to trochaic.

(46) a. [(o.'kox)] 'mushroom' *no H tone, iambic foot (final stress)*

b. [('lé.kej)] 'up' *H on penult, stress retracts (trochaic foot)*

(Bennett & Henderson 2013:19-20)

This pattern looks quite similar to the pattern seen in Hän words like *wëneydèyy* – stress shifts leftward in order to coincide with high tone. The main difference between the two languages is which tone, low or high, is considered the marked tone. The most interesting aspect of the patterns in Hän and Uspanteko, then, is that the phenomenon of stress shift behaves nearly identically, despite difference in underlying tonal specification.

While Uspanteko presents a case in which a similar surface pattern is derived from the opposite underlying specification. A language that presents essentially the complementary pattern to Hän is Serbo-Croatian (specifically the Eastern standard variety; Inkelas & Zec 1988). Whereas in Hän, stress either blocks low tone spread (if it is nuclear), or shifts to avoid co-occurring with low tone. In Serbo-Croatian, stress seeks out a syllable to which and underlying high tone has spread. So, in a form like (47), the underlying high tone is associated with the penultimate vowel (the underlying position is determined by interactions with intonation), and proceeds to spread one syllable leftward. Stress is assigned to the initial syllable, to which the high tone has spread[15].

(47) a. H
|
raazlika 'difference (Nom. sg.)

b. H
/|
ˈraazlika

The patterns observed in Hän are nearly the mirror image of the basic pattern in Serbo-Croatian: low tone is underlying, it spreads to the right, and it repels, or is repelled by, prominence. However, the primary difference between the two systems (at a basic level) seems

[15] The full system in Serbo-Croatian is much more complex than this (specifically, its interaction with intonational contours), but the basic pattern given here serves to illustrate the relation to the basic patterns found in Hän

to lie in the preference for left alignment rather than right alignment – Serbo-Croatian spreads tone to the left and assigns stress to the leftmost high, while Hän spreads tone to the right and assigns stress to the rightmost syllable. In terms of how stress and tone interact, there is little difference. In both languages, there is a strong preference for high tone to coincide with a prominent position. So, two systems that appear on the surface to be nearly opposite appear to be derived in a general sense from the same set of principles governing tonal and metrical structures.

7 Conclusions

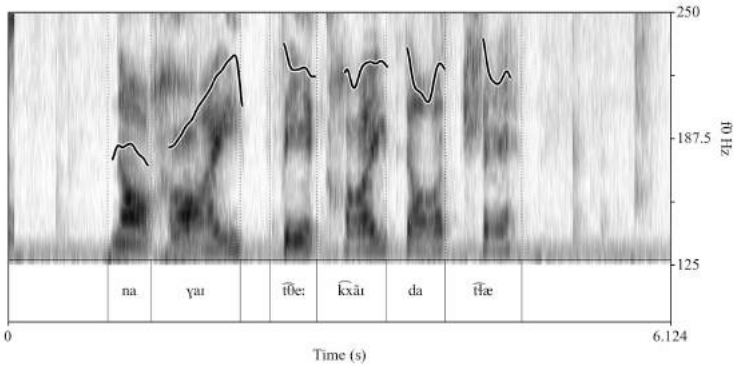
The primary goal of this paper was to determine what principles drive the interaction between tone and stress in Hän. The empirical pattern, as described in §1, involves the blocking of low tone spread onto a stressed syllable, as well as stress shift triggered by low tone on a final syllable. It was also seen that Hän has the characteristics of a privative tone system in which only low tone is underlyingly specified and phonologically active (see §2.1.3). In the analysis developed above, it was seen that regardless of underlying tonal specification, the empirical pattern in Hän comes down to a preference for stress to co-occur with high tone and a corresponding dispreference for stress to co-occur with low tone. Additionally, it was seen that this preference manifests itself in the domain of intonational phrase (IP), a pattern that to this point has not been attested.

In §5 and §6, we saw that a number of languages both within the Athabaskan family, and in unrelated families, display interactions between stress and tone that differ from Hän only in a small number of constraint rankings, or in the domain of interaction. Perhaps most interestingly, Hän and Uspanteko show nearly identical patterns of stress shift, even though Hän is a low-marked language, and Uspanteko a high-marked language. This is surprising, keeping in mind that Hän displays all the characteristics of a privative tone language in which only low tones are active in the phonology. Specifically, only low tone spreads, and only low tone is subject to the OCP. It would be expected, then, that high tone is inert in Hän (as opposed to Uspanteko), and should not participate in the phonology as it does in Uspanteko or Slave, where it is underlying specified. This seems to be evidence against a traditionally privative analysis of tone in Hän, given that the preference for high tone to occur on stressed syllables would suggest that it is at least partially active in the grammar, regardless of whether it is specified underlyingly or not. More generally, this reduces the distinction between “marked” tones and “default” tones, with both participating in the phonology, but behaving differently due simply to the ranking of the constraints regulating their behavior.

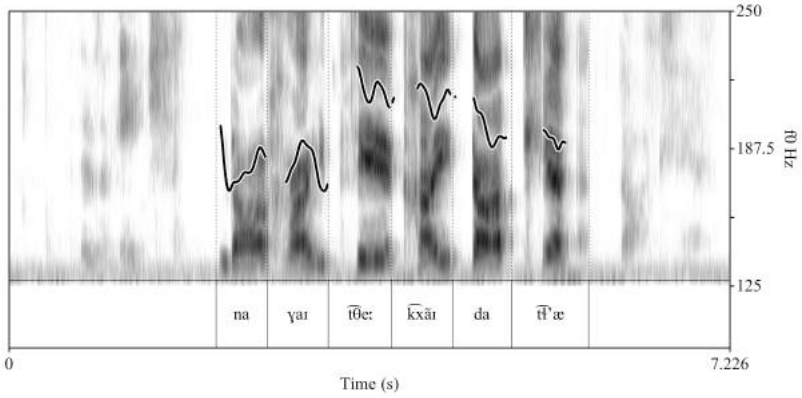
8 Appendix

Spectrograms contrasting *näghayy* in IP-final vs. IP-medial position:

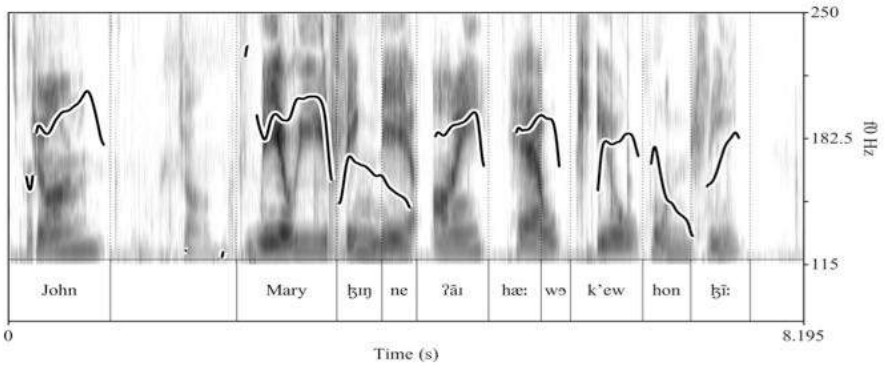
(34b) IP-final, utterance-medial



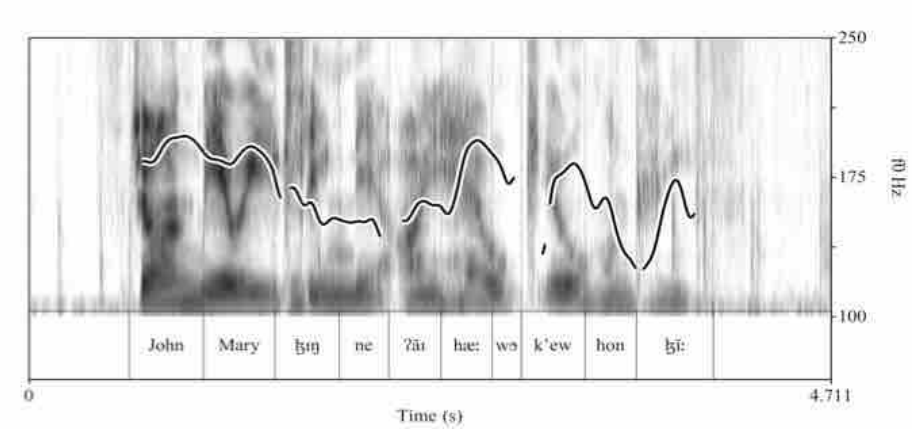
(34c) IP-medial



Spectrograms contrasting *nè'ąyy* in IP-final and IP-medial position
(35a.i) IP-final position



(35a.ii) IP-medial position



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