Initial extrametricality and cyclicity in Blackfoot accent*

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Abstract: I argue that Blackfoot accent instantiates primary word stress, and show that the prosodic structure involves quantity-sensitive iambs plus initial extrametricality. I also show that prosodic heads are preserved in words with two applications of phonology. On each application of phonology, new prosodic material is parsed into feet as much as possible. I demonstrate these properties through an Optimality Theory analysis of the accent of unpossessed and possessed event nominalizations.

Keywords: accent, cyclicity, extrametricality, Optimality Theory, prosody, prosodic structure, stress

1 Introduction

Blackfoot (Algonquian) word-level prosody is characterized by pitch accents (Frantz 2009; Kaneko 1999; Stacy 2004; Van Der Mark 2003). In this paper I use the location of accent in unpossessed and possessed event nominalizations to argue that accent instantiates primary, but not secondary, stress in a prosodic word. I show that the prosodic structure which underlies accent involves the typologically unusual combination of quantity-sensitive iambic feet plus initial extrametricality. In Section 2 I discuss aspects of Blackfoot phonology which are relevant to accent location. In Section 3, I develop an analysis of Blackfoot prosody in unpossessed event nominalizations and show that it can be derived via ranked but violable constraints in an Optimality Theory framework. In Section 4 I discuss morphosyntactic effects on accent location in possessed nominalizations. I show that these involve two applications of phonology, and that prosodic heads are preserved across cycles.

2 Blackfoot phonology

In this section, I briefly describe Blackfoot phonology, syllable structure, and accent. Fuller phonological descriptions can be found in Elfner (2006); Frantz (2009); Stacy (2004); Taylor (1969). Because accent is attracted to heavy syllables, I focus on factors which affect syllable weight.

2.1 Phonological inventory

Blackfoot is spoken in Alberta and northern Montana with four mutually intelligible dialects. The data in this paper represents a speaker of the Káínaa dialect. I assume the phonological inventory in Table 1 below Morphological representations use the orthography developed in Frantz (1978), which closely mirrors the IPA, except that geminates are written as doubled consonants, [j] = <y>, [ʔ] = <'>, and <h> represents pre-aspiration of the following obstruent.

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Table 1: Blackfoot phonemic inventory

	Labial	Coronal	Dorsal	Glottal
Stops	p p: ^{h}p	t t: ^{h}t	k k: ^{h}k	ʔ
Fricatives		s s: ^{h}s		
Nasals	m m:	n n:		
Glides	w	j	(w)	

Front	Central	Back
i iː		
		o oː
	a aː	

(and /s/ as a σ nucleus)[1]

All vowels have a short, lax counterpart [ɪ ɛ ə ɔ ʊ] which occurs allophonically in closed syllables and unpredictably in some open syllables (Elfner 2006; Frantz 2009; Taylor 1969). The assibilant [t^{s}] is a regular allophone of /t/ before /i/; [k^{s}] and [^{s}t] occur before and after, respectively, some instances of /i/. The sequences /…ki-^{h}sV…/ and /…ti-^{h}sV…/ contract to single syllables. I transcribe these as […ksV…] and […tsV…], respectively. I use a non-superscript *s* to convey that the [s] is longer in duration than in the assibilants [k^{s}] and [t^{s}] (Derrick 2006, 2007).

2.2 Pre-aspiration and vowel devoicing

I follow Reis Silva (2008) in assuming that all obstruents except [ʔ] contrast plain and pre-aspirated stops. Short vowels devoice word-internally before pre-aspirated consonants, as in [i.t**o̥.^{h}k**óː.nɪm.ʔḁ] 's/he found it then'. Long vowels only partially devoice: [i.t**óo̥.^{h}k**o.yiː] 's/he waited for him/her then'. Word-initially, both long and short vowels are partially voiced: [**oo̥.^{h}k**óː.nɪt] 'find it!', [**oo̥.^{h}k**óːs] 'wait for him/her!'. Devoicing is often accompanied by secondary frication which assimilates to the place of the preceding vowel ([iᵩ], [aχ], [ox]). Other accounts treat the frication as a separate coda segment (Denzer-King 2009; Elfner 2006; Kaneko 1999), but I treat the frication as a secondary characteristic of pre-aspiration because it does not shorten preceding long vowels like other codas in Blackfoot (Elfner 2006; Reis Silva 2008).

2.3 Syllable structure

Blackfoot contrasts heavy and light syllables. Light syllables are (C)V, while heavy syllables include (C)VV and (C)VC syllables. Evidence that closed (C)VC syllables are heavy is that long vowels and diphthongs shorten before codas. Example (1) shows that the underlying sequence /ai/ normally coalesces to a long vowel [ɛː]. This vowel shortens before codas, such as the geminate [kː] in (2).

(1) **ɛ́ː**.ka.mo.tsiː.pi.jiː
a–ikamotsiipi–yii–wa
IPFV–rescue.TA–DIR–3
'S/he is rescuing him/her'

(2) **ɛ́k**.ka.mo.ks.kaʔ.si
a–ikkam–okska'si–wa
IPFV–fast–run.AI–3
'S/he runs fast.'

Elfner (2006) argues that the coda consonant of (C)VC syllables contributes a mora, and that the nucleus must lose one mora in order to prevent trimoraic syllables (Elfner 2006; Hayes 1989). Under her analysis, both (C)VV and (C)VC syllables are bimoraic. In Section 3.2 I show that accent

[1]For evidence that /s/ can be the nucleus of a syllable, see Denzer-King (2009), Derrick (2006, 2007), and Goad and Shimada (2013). This paper does not include examples with syllabic /s/, because more work is needed to understand how accent interacts with voiceless nuclei.

is attracted to both (C)VV and (C)VC syllables, which is further evidence that both are heavy. Coda consonants are limited to /ʔ/, /s/, geminate consonants, which I transcribe as ambisyllabic, and sonorants which precede a voiceless syllable nucleus, discussed in the next section.

2.4 Interaction of devoiced vowels with syllable structure

The syllable preceding a devoiced vowel will always be heavy if the devoiced vowel is immediately preceded by a sonorant. A glottal stop is inserted between sonorants and devoiced vowels. The glottal stop is parsed as the onset to the voiceless nucleus, while the sonorant is parsed to the coda of the preceding syllable, as in [i**n**.ʔɪ̥.^{h}kí] from underlying /ini^{h}ki/ 's/he sang'.

2.5 Accent

Certain syllables in Blackfoot have a high F_0 relative to neighboring syllables (Frantz 2009; Van Der Mark 2003), which I term 'accent'. On word-medial syllables, accent is realized as a level high pitch. Pitch gradually rises to a peak on the accented syllable before quickly falling off. In Figure 1, the third syllable of [iː.t^{s}ɪ.ní.ki] 's/he told a story' is accented and carries a pitch peak.

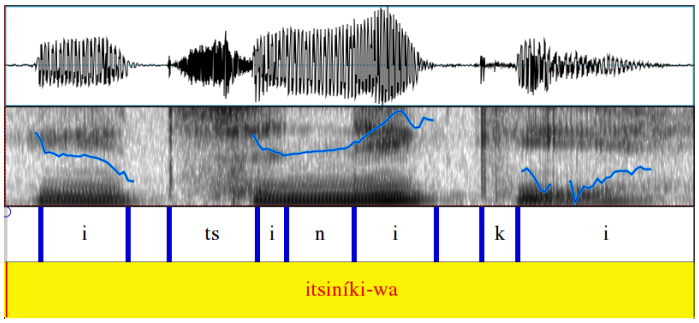


Figure 1: Pitch track of *itsiníkiwa*

The phonological context conditions other phonetic realizations. Accent is realized with a falling pitch before a glottal stop (Frantz 2009), and either with a falling pitch or with no pitch peak at all on a word-final vowel (Taylor 1969; Weber and Allen 2012). Because these different phonetic manifestations are in complementary distribution, I assume they have the same underlying representation. I abstract away phonetic details and transcribe all accents with an acute (´) diacritic.

3 Prosodic structure of event nominalizations

In this section, I demonstrate that the prosodic structure of event nominalizations is quantity-sensitive and contains an initial extrametrical syllable. Accent in nominalizations is more highly restricted than other types of words, but the patterns discussed here also hold for other verbal phrases in which the stem aligns with the left edge of the word (Weber 2016).

3.1 Event nominalizations

Event nominalizations are derived from animate intransitive (AI) verb stems by a suffix (Bliss, Ritter, and Wiltschko 2016; Frantz 2009). The allomorph *-n* occurs after *a*, (3a), and *-hsin* occurs elsewhere, (3b, 3c).

(3) NOMINALIZATION SUFFIX ALLOMORPHS

a.	b.	c.
aw.ʔa̰.^{h}káːn	sɪ.náː.ksɪn	aʔ.póo̰.^{h}sɪn
[awahkaa]–n	[sinaaki]–hsin	[a'poo]–hsin
[play.AI]–NMLZ	[write.AI]–NMLZ	[travel.AI]–NMLZ
'play(ing)'	'writing'/'drawing'	'trip'/'travel'

3.2 Location of accent in nominalizations

All event nominalizations have exactly one accent per word. The accent falls on either the second or third syllable, and the location is sensitive to syllable weight. In words of three or more syllables, accent falls on the second syllable when it is heavy (4), and the third otherwise (5). Heavy syllables are those with either a long vowel or a coda consonant. The second syllable is indicated in a boldface font in (4) and (5) to highlight the difference between second and third syllable accent.

(4) SECOND SYLLABLE ACCENT

anii-hsin	'speech, talk'	a.nís.sɪn	L **Ĥ** H
sinaaki-hsin	'writing'	sɪ.náː.ksɪn	L **Ĥ** H
a'po'taki-hsin	'work'	aʔ.púʔ.ta.ksɪn	H **Ĥ** L H
ka'kiaaki-hsin	'chopped wood'	kaʔ.kjáː.ksɪn	H **Ĥ** H

(5) THIRD SYLLABLE ACCENT

atsiniki-hsin	'story'	a.t^{s}ɪ.ní.ksɪn	L **L** Ĺ H
asimimmohki-hsin	'gossip'	a.sɪ.mím.ʔo̰.^{h}ksɪn	L **L** Ĥ L H
issitsimaa-n	'baby'	ɪs.sɪ.t^{s}í.maːn	H **L** Ĺ H
awahkaa-n	'playing'	aw.ʔa̰.^{h}káːn	H **L** Ĥ

Disyllabic stems always exhibit accent on the second syllable of the word, (6). This syllable is always heavy, since the nominalizing suffix creates a closed syllable.

(6) SECOND SYLLABLE ACCENT (DISYLLABIC STEMS)

inaa-n	'possession'	i.náːn	L **Ĥ**
ohki-hsin	'bark'	ʊʊ̰.^{h}ksín	H **Ĥ**

Accent always falls on the second or third syllable regardless of the length of the word. Nominalizations can be longer than three syllables, but accent never falls on the fourth or fifth syllable.

(7) NO FOURTH OR FIFTH SYLLABLE ACCENT

pək.k^{s}ɪ.ní.ki.maːn	*pək.k^{s}ɪ.ni.kí.maːn	'crushed choke cherries'
a.sɪ.mím.ʔo̰.^{h}ksɪn	*a.sɪ.mɪm.ʔo̰.^{h}ksín	'gossip'

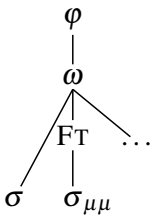
In sum, accent in event nominalizations is obligatory (at least one per word), culminative (at most one per word), quantity-sensitive (attracted to heavy syllables), and oriented to the left edge of a word. These are typical properties of primary stress (Hayes 1995; Hyman 2006). Based on these characteristics, I propose that accent instantiates primary word stress. In the next section, I lay out my assumptions about prosodic structure and show how Blackfoot prosodic structure must contain a initial extrametrical syllable in order to account for third syllable accent.

3.3 Evidence for initial extrametricality

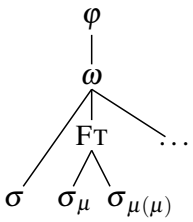
I assume that phonological words have an internal structure following the Prosodic Hierarchy (e.g. Hayes 1995; Selkirk 1980). A set of universal prosodic categories is arranged in a fixed hierarchy: φ (phonological phrase) > ω (prosodic word) > FT (foot) > σ (syllable) > μ (mora). Each category is headed by an element of the next-lower level category, and all elements must be contained within some higher level category. The head syllable of the head foot is associated with primary stress, while head syllables of other feet are associated with secondary stresses.

I assume that syllables are maximally parsed into feet, creating secondary stresses. Although there are no obvious phonetic correlates of secondary stresses, I transcribe them for clarity using a grave (`) diacritic[2]. A unified analysis of second and third syllable accent is possible if the first syllable is not parsed into a foot, and accent corresponds to the head of an iamb near the left edge, as in (8). The second syllable forms a monosyllabic iamb when it is heavy, (8a). Otherwise, the second and third syllables together form a disyllabic iamb, (8b).

(8) a. SECOND SYLLABLE ACCENT
σ (H́) ...



b. THIRD SYLLABLE ACCENT
σ (L Ĺ) ...
σ (L H́) ...



Assuming that feet contain maximally two syllables (Elenbaas and Kager 2008), the initial syllable must be left unparsed to a foot in order to derive third syllable stress. The nominalizations in (9) contain an initial light syllable. Example (9) shows that if a binary foot were aligned to the left edge of the word, then stress would fall on the second syllable of these words. The correct pronunciation of these words has third syllable stress and is shown in (5).

(9)	atsiniki-hsin	'story'	*(a.tˢí).(ni.ksìn)	*(L Ĺ) (L H̀)
	asimimmohki-hsin	'gossip'	*(a.sí).(mìm).(ʔo̥.ʰksìn)	*(L Ĺ) (H̀) (L H̀)

Because accent instantiates primary word stress, it only falls on syllables which are the head of a foot. In other words, if a syllable has accent, it must be contained within a foot. A corollary is that an initial syllable in Blackfoot will never carry accent, which is true regardless of whether the initial syllable is light, (10a), or heavy (10b). Although accent normally exhibits quantity-sensitivity, initial syllables do not attract accent in the same way that footed syllables do. They are 'extrametrical' in the sense that they do not attract stress and are not parsed into a foot (Hayes 1995).

[2]The presence of secondary stresses will be crucial in Section 4.3 to explain the location of accent in words with multiple applications of phonology. Thus, while secondary stresses have no phonetic manifestation, they do have phonological effects in the grammar.

(10) NO ACCENTED EXTRAMETRICAL SYLLABLES

a.	anii-hsin	'speech, talk'	a.nís.sɪn	L (Ḿ) (Ὴ)
	atsiniki-hsin	'story'	a.tˢɪ.ní.ksɪn	L (L Ĺ) (Ὴ)
b.	a'po'taki-hsin	'work'	aʔ.púʔ.ta.ksɪn	H (Ḿ) (L Ὴ)
	issitsimaa-n	'baby'	ɪs.sɪ.tˢí.maːn	H (L Ĺ) (Ὴ)

I conclude that accent instantiates primary stress, and that Blackfoot prosodic structure contains quantity-sensitive iambs with initial extrametricality. This analysis accounts for accent location and interaction with syllable weight in event nominalizations. Extrametricality is usually a right-edge phenomenon; proposed cases of initial extrametricality are so rare that phonological rules and constraints often explicitly ban left-edge extrametricality (c.f. Gordon 2002; Hayes 1995). In the next section, I show how initial extrametricality can be captured in an Optimality Theory framework.

3.4 Optimality Theory analysis

This section formalizes the above analysis using ranked and violable constraints in Optimality Theory (McCarthy and Prince 1993b; Prince and Smolensky 1993). I use categorical constraints, which require that each element under evaluation receives at most one violation (McCarthy 2003)[3]. Initial extrametricality can be captured via the interaction of two constraints. The first is the positional markedness constraint NONINITIALITY (NONINIT), which is modelled on McCarthy's (2003) NONFINALITY constraint. NONINIT requires that no foot stand at the left edge of the word.

(11) NONINIT
*Ft / [$_\omega$ —
'Word-initial feet are prohibited.'

The second constraint is PARSE SYLLABLE (PARSE-σ) (from McCarthy 2003), which assigns a violation for each syllable that is immediately dominated by a prosodic word. Ranking NONINIT above PARSE-σ allows the prosodic structures in (8), because allowing the initial syllable to be immediately dominated by the prosodic word is preferential to parsing it to a foot.

(12) PARSE SYLLABLE (PARSE-σ)
A σ must not be immediately dominated by ω.

(13) NONINIT $\gg$ PARSE-σ

This ranking is illustrated in (14) with *awahkáán* 'playing'. The winning candidate (a) leaves the initial syllable unparsed to a foot in order to satisfy NONINIT and parses it directly to the prosodic word, violating PARSE-σ. Candidate (b) satisfies PARSE-σ by parsing all syllables into feet, but it fatally violates NONINIT, because the first foot stands at the left edge of the word.

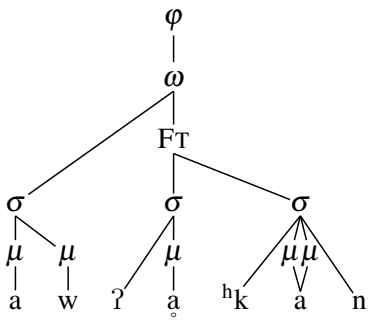
[3]This prohibits some alignment constraints, such as Align(Ft, Edge$_1$, Wd, Edge$_2$), where a foot incurs a violation for every syllable that separates the foot Edge$_1$ from the word Edge$_2$. See McCarthy (2003) for details.

(14)

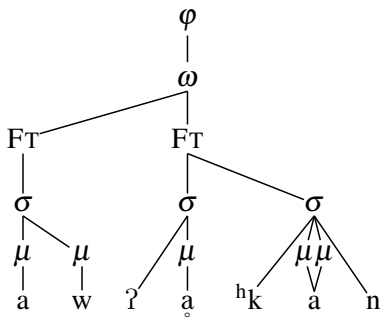
/awahkaa-n/	NONINIT	PARSE-σ
a. ☞ aw.(ʔa̰.^{h}káːn)		*
b. (áw).(ʔa̰.^{h}kàːn)	*!	

The candidates in (14) are shorthand for the prosodic structures in (15), where syllables in parentheses are parsed to a foot, and syllables not in parentheses are parsed to the prosodic word. The remaining tableaux make use of the shorthand parsing.

(15) a.



b. *



The rhythmic *LAPSE constraint requires stressed syllables to be separated by no more than one unstressed syllable (Gordon 2002; Kager 2005; McCarthy 2003). The ranking NONINIT ≫ *LAPSE ensures that iambs are as near to the left edge as possible without including the initial syllable in order to minimize violations of *LAPSE.

(16) *LAPSE
*σ̆ / __ σ̆
i.e. assign one violation-mark for each pair of adjacent unstressed syllables.

(17) NONINIT ≫ *LAPSE

This is demonstrated in (18) with the verb *iitsiníki-wa* 's/he told a story'[4]. Candidate (a) fatally violates NONINIT, even though it has no violations of *LAPSE or PARSE-σ. The three non-initial syllables are all light and could be parsed in two ways. Candidates (b) and (c) both satisfy NONINIT but differ in which two syllables are parsed into a foot. Candidate (b) has a left-aligned foot which minimizes violations of *LAPSE, and will always be the optimal candidate.

(18)

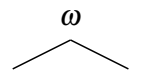
/iitsiniki-wa/	NONINIT	PARSE-σ	*LAPSE
a. (íː).(t^{s}ɪ.nì).ki	*!		
b. ☞ iː.(t^{s}ɪ.ní).ki		**	*
c. iː.t^{s}ɪ.(ni.kí)		**	**!

[4]I have used a verb, because I do not have examples of nominalizations with three light non-initial syllables in a row. The inflectional suffix *-wa* has no phonetic manifestation in this dialect (Bliss and Glougie 2010).

The following constraints derive a quantity-sensitive iambic system with primary stress on the leftmost iamb (McCarthy 2003; McCarthy and Prince 1993a).

(19) ALIGN(Ft, R, Hd(FT), R) (FTTYPE=I)
For every foot, there is a head of the foot such that the right edge of the head of the foot aligns with the right edge of the foot. (Feet are iambic.)

(20) HEADLEFT



i.e. the head foot is not preceded by another foot in the prosodic word

(21) WEIGHT-BY-POSITION (WBP)
Codas project a mora. (Hayes 1989)

(22) FOOT BINARITY (FTBIN)
Feet must be binary under a moraic or syllabic analysis.

The foot type constraint in (19) requires feet to be iambic, and dominates an analogous trochaic foot constraint, (23). This ranking ensures that feet are right-headed. The HEADLEFT constraint in (20) requires the head foot to be the leftmost foot, and dominates an analogous HEADRIGHT constraint, (24). It is modelled on McCarthy's (2003) ENDRULE-L constraint (itself a reformulation of the End Rule in Prince 1983). This ranking ensures that the head foot is near the left edge.

(23) FTTYPE=I ≫ FTTYPE=T

(24) HEADLEFT ≫ HEADRIGHT

These two rankings are demonstrated in (25) with *atsiníkssin* 'story'. All four candidates equally satisfy PARSE-σ, NONINIT, and *LAPSE, but have different foot types and location of the head foot. Candidate (a) is the optimal candidate because it satisfies both FTTYPE=I and HEADLEFT. Candidates (b) and (d) are non-optimal because they use trochees instead of iambs. Candidates (c) and (d) are non-optimal because the head foot is rightmost.

(25)

/atsiniki-hsin/	FTTYPE=I	FTTYPE=T	HEADLEFT	HEADRIGHT
a. ☞ a.(tˢɪ.ní).(ksìn)		*		*
b. a.(tˢí.ni).(ksìn)	*!			*
c. a.(tˢɪ.nì).(ksín)		*	*!	
d. a.(tˢì.ni).(ksín)	*!		*!	

Assuming Richness of the Base (Prince and Smolensky 1993), a coda in the input might not be linked to a mora. In Blackfoot, codas are linked to moras, so the WEIGHT-BY-POSITION (WBP) constraint in (21) must dominate a general markedness constraint against moraic consonants (*μ/C).

(26) *μ/C
A mora must not be headed by a consonant. (Broselow, Chen, and Huffman 1997)

(27) WBP $\gg$ *μ/C

The input for *a'pó'takssin* 'work' in (28) below contains no moraic consonants, but the ranking WBP $\gg$ *μ/C ensures that each coda surfaces linked to a mora (μ). Candidate (a) in (28) satisfies WBP because each coda is linked to a mora. The second syllable is parsed as a monosyllabic iamb and therefore carries accent. Candidate (b) violates WBP because the codas do not contribute a mora. Since the second syllable is light, both the second and third syllables are parsed as an iamb, and the third syllable carries accent because it is the head of the foot. This word does in fact have accent on the second syllable, which is evidence that WBP is undominated.

(28)

/a'po'taki-hsin/	WBP	*μ/C
a. ☞ aʔ$_\mu$.(póʔ$_\mu$).(ta.ksìn$_\mu$)		*
b. aʔ.(poʔ.tá).(ksìn)	*!**	

The Minimal Word Template in Blackfoot provides some evidence that FTBIN in (22) is also undominated. Because the prosodic hierarchy requires each prosodic constituent to be headed by a constituent of the next lower level, each word contains at least one foot, and minimal words contain exactly one foot (Itô and Mester 2003; McCarthy and Prince 1993b). Minimal words in Blackfoot are either a bimoraic monosyllable (H́), as in [pí:t] 'enter!', or a sequence of two light syllables (L Ĺ), as in [na.pí] 'friend!', but never a single light syllable *(Ĺ). This suggests that degenerate feet are not allowed in Blackfoot, and that feet always satisfy FTBIN.

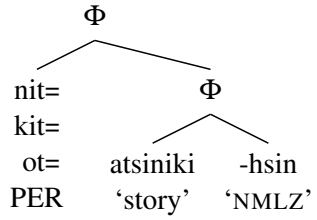
The above partial rankings are summarized in (29).

(29) a. NONINIT $\gg$ PARSE-σ, *LAPSE
b. FTTYPE=I $\gg$ FTTYPE=T
c. HEADLEFT $\gg$ HEADRIGHT
d. WBP $\gg$ *μ/C
e. FTBIN (undominated)

4 Cyclicity effects in possessed nominalizations

In this section, I argue that possessed nominalizations contain two cycles of phonology: the first applies before the possessor proclitic is added, and the second applies after, schematized by Φ in (30). Possession is signalled with the nominal person proclitics *nit-* '1first person1', *kit-* '2second person2', or *ot-* '3', which occur at the left edge of the base (Bliss 2011; Bliss, Ritter, and Wiltschko 2016; Frantz 2009).

(30)



← Cycle 2: apply prosodic structure

← Cycle 1: apply prosodic structure

In Section 4.1 I show that some locations of accent in possessed nominalizations cannot be accounted for by a single application of phonology using the above analysis. In Section 4.2, I argue that these accents arise from an earlier application of phonology.

4.1 Primary stress after proclisis

Proclitics are always followed by either a stem-initial vowel or an epenthetic *i* between consonants. I assume that intervocalic consonants are preferentially parsed as syllable onsets, so that person proclitics are always prosodized as a single light syllable.

(31)	**Proclitic followed by…**	**Transcription**	**Morpheme**	**Gloss**
	Stem-initial V	**nɪ.tá**ː.kɪ̥.^{h}taːn	nit=aakihtaa-n	‘my packing’
	Epenthetic *i*	**o.t**^{s}ɪ.ká?.kjaː.ksɪn	ot=ka’kiaaki-hsin	‘his/her firewood’

The accent of possessed nominalizations falls on the second, third, or fourth syllables[5]. Accent falls on the second syllable if heavy, (32), and otherwise on the third syllable if heavy, (33). Fourth syllable accent only occurs when both the second and third syllables are light, (34).

(32) SECOND SYLLABLE ACCENT

ot=awahkaa-n	‘his play’	o.**táw**.ʔḁ.^{h}kaːn	L= **Ĥ** L H
kit=a’po’taki-hsin	‘your work’	kɪ.**tá?**.puʔ.ta.ksɪn	L= **Ĥ** H L H

(33) THIRD SYLLABLE ACCENT

ot=anii-hsin	‘her talk’	o.ta.**nís**.sɪn	L= L **Ĥ** H

(34) FOURTH SYLLABLE ACCENT

nit=atsiniki-hsin[6]	‘my story’	nɪ.t^{s}ɪ.t^{s}ɪ.**ní**.ksɪn	L= L L **Ĺ** H
ot=asimimmohki-hsin	‘her gossip’	o.t^{s}ɪ.sɪ.**mím**.ʔo̥.^{h}ksɪn	L= L L **Ĥ** L H

A single application of the above analysis cannot generate fourth syllable accent. This is demonstrated in (35) with *nitsitsiníkssin* ‘my story’. Candidate (a) has accent incorrectly on the third syllable, but is chosen as the optimal candidate because it incurs no violations of NONINIT and minimal violations of PARSE-σ and *LAPSE. Candidates (b) and (c) both have accent correctly on the fourth syllable, but are non-optimal, indicated by the ☹ symbol. Candidate (b) incurs extra

[5]I set aside *s*-initial stems, which carry accent on the first syllable when possessed. My analysis cannot account for first syllable accent. It may arise from the interaction of accent with moraic or syllabic *s*, since the proclitic contracts with the epenthetic vowel and stem-initial *s* to […tsV…], with a long *s* (see Section 2.1).

[6]Some stem-initial short *a* vowels become *i* word-medially. This does not affect the analysis here.

violations of PARSE-σ and *LAPSE because feet are not aligned as near to the left edge of possible. Candidate (c) violates NONINIT and HEADLEFT, both of which are undominated constraints.

(35)

nit=atsiniki-hsin	HEADLEFT	NONINIT	PARSE-σ	*LAPSE
a. ☞ nɪ.(tˢɪ.tˢí).(ni.ksìn)			*	*
b. ☹ nɪ.tˢɪ.(tˢɪ.ní).(ksìn)			**	*!*
c. ☹ (nɪ.tˢì).(tˢɪ.ní).(ksìn)	*!	*		

In the next section I show that the cases of fourth syllable accent reflect the prosodic structure from an earlier application of phonology.

4.2 Faithfulness to prosodic heads

For every possessed nominalization with fourth syllable accent, the same syllable is accented in both the unpossessed and possessed forms, as in (36). The unpossessed forms are those with third syllable accent. This evidence suggests that prosodic structure is first added to the base, and that the accent remains unchanged once the possessor proclitics are added.

(36) FOURTH SYLLABLE ACCENT REMAINS FROM THE BASE FORM

a.tˢɪ.**ní**.ksɪn atsiniki-hsin 'story'	[L L **Ĺ** H]	→	nɪ.tˢɪ.tˢɪ.**ní**.ksɪn nit=atsiniki-hsin 'my story'	L= [L L **Ĺ** H]
a.sɪ.**mím**.ʔo̥.ʰksɪn asimimmohki-hsin 'gossip'	[L L **Ḿ** L H]	→	o.tˢɪ.sɪ.**mím**.ʔo̥.ʰksɪn ot=asimimmohki-hsin 'his/her gossip'	L= [L L **Ḿ** L H]

This can be formulated as prosodic faithfulness to syllabic heads. If a syllable is the head of a foot in one application of phonology, it must remain a head across later cycles of morphology and phonology. ANCHOR-HD in (37) is a particular instantiation of ANCHOR-POS (McCarthy 2000).

(37) ANCHOR-HD (FT, FT, HD) (ANCHOR-HD)
If σ_1 and Ft_1 are members of the input, and the syllable σ_1 is the head of Ft_1, then there exists σ_2 and Ft_2, such that $\sigma_1 \Re \sigma_2$ and σ_2 is the head of Ft_2.

This constraint is undominated. The tableau in (38) has the same candidates as in (35), but the input has been changed to reflect the fact that it contains prosodic structure. Candidate (a) is no longer optimal, because the parse violates ANCHOR-HD by making the syllable *ni*, which was a head in the input, a non-head in the output. Candidate (b) is optimal because it preserves heads, even though it incurs multiple violations of PARSE-σ and *LAPSE. Candidate (c) also preserves heads, but is non-optimal since it violates HEADLEFT (HD-L) and NONINIT.

(38)

	nit=[a.(tˢɪ.ní).(ksìn)]$_\omega$	ANCHOR-HD	HD-L	NONINIT	PARSE-σ	*LAPSE
a.	nɪ.(tˢɪ.tˢí).(ni.ksìn)	*!			*	*
b. ☞	nɪ.tˢɪ.(tˢɪ.ní).(ksìn)				**	**
c.	(nɪ.tˢì).(tˢɪ.ní).(ksìn)		*!	*		

In summary, cases of fourth syllable accent provide evidence that possessed nominalizations involve two applications of phonology. Possessor proclitics are added after the first application, and prosodic heads are preserved across cycles. In the next section I show how possessed nominalizations with second and third syllable accent follow straightforwardly from this analysis.

4.3 Addition of prosodic structure

When the initial syllable of the base is heavy, as in (39), it always surfaces with accent after proclisis. Because accent instantiates primary stress, this is evidence that the syllable has been footed.

(39)

kit=a'po'taki-hsin	'work'	kɪ.**tá?**.pu?.ta.ksɪn	L (**Ĥ**) (Ȟ) (L Ȟ)
nit=aakihtaa-n	'my packing'	nɪ.**tá:**.kɪ̥.^{h}ta:n	L (**Ĥ**) (L Ȟ)
ot=awahkaa-n	'his/her playing'	o.**táw**.ʔḁ.^{h}ka:n	L (**Ĥ**) (L Ȟ)

This is shown below with *nitáákihtaan* 'my packing' in (40), I have only considered candidates which satisfy HEADLEFT and FTBIN. Candidate (a) is non-optimal, because although it preserves the prosodic head from the base, it incurs several violations of PARSE-σ and *LAPSE. Candidate (b) is the optimal candidate, because it has parsed new syllables into feet, thereby incuring fewer violations of PARSE-σ and *LAPSE. Candidate (c) incurs no violations of PARSE-σ or *LAPSE, but fatally violates NONINIT. Candidate (d) lacks secondary stresses, and therefore fatally violates ANCHOR-HD, because there is a head in the input which does not have a corresponding head in the output. Interestingly, the effects of cyclicity on accent provide evidence that secondary stresses must exist at least for these types of words which involve multiple applications of phonology.

(40)

	nit=[a:.(kɪ̥.^{h}tá:n)]$_\omega$	ANCHOR-HD	FTBIN	NONINIT	PARSE-σ	*LAPSE
a.	nɪ.ta:.(kɪ̥.^{h}tá:n)				**!	**
b. ☞	nɪ.(tá:).(kɪ̥.^{h}tà:n)				*	
c.	(nɪ.tá:).(kɪ̥.^{h}tà:n)			*!		
d.	nɪ.(tá:).kɪ̥.^{h}a:n	*!			***	*

When the initial syllable of the base is light, as in (41), it never surfaces with accent after proclisis. Accent falls either on the third or fourth syllables and corresponds to the accent location of the base. The syllable may or may not be included in a foot, but will never be the head of a foot.

(41)

ot=anii-hsin	'his/her talk'	o.**ta**.nís.sɪn	L (**L** Ĥ) (Ȟ)
nit=atsiniki-hsin	'my story'	nɪ.**tˢɪ**.tˢɪ.ní.ksɪn	L **L** (L Ĺ) (Ȟ)
ot=asimimmohki-hsin	'his/her gossip'	o.**ta**.sɪ.mím.ʔo̥.^{h}ksɪn	L **L** (L Ĥ) (L Ȟ)

For cases with third syllable accent, like *otaníssin* 'his/her story' in (42), the optimal candidate (b) incorporates the first syllable of the base into a foot to incur fewer violations of PARSE-σ and *LAPSE. Candidates (c) and (d) show that this syllable cannot be the head of a foot without violating either NONINIT or FTBIN. For cases with fourth syllable accent, like *nitsitsiníkssin* 'my story' in (43), the optimal candidate (a) does not parse the first syllable of the base into a foot. Candidates (b), (c), and (d) show that to do so would violate ANCHOR-HD, FTBIN, or NONINIT.

(42)

ot=[a.(nís).(sìn)]$_\omega$	ANCHOR-HD	FTBIN	NONINIT	PARSE-σ	*LAPSE
a. o.ta.(nís).(sìn)				**	*!*
b. ☞ o.(ta.nís).(sìn)				*	*
c. o.(tá).(nìs).(sìn)		*!		*	
d. (o.tá).(nìs).(sìn)			*!		

(43)

nit=[a.(t^{s}ɪ.ní).(ksìn)]$_\omega$	ANCHOR-HD	FTBIN	NONINIT	PARSE-σ	*LAPSE
a. ☞ nɪ.t^{s}ɪ.(t^{s}ɪ.ní).(ksìn)				**	**
b. nɪ.(t^{s}ɪ.t^{s}í).(nɪ.ksìn)	*!			*	*
c. nɪ.(t^{s}í).(t^{s}ɪ.nì).(ksìn)		*!		*	
d. (nɪ.t^{s}í).(t^{s}ɪ.nì).(ksìn)			*!		

In sum, the locations of accent provides evidence that phonology and morphology apply in cycles in possessed nominalizations. The accents of unpossessed nominalizations result from quantity-sensitive iambs plus initial extrametricality. In each application of phonology, as many syllables as possible will be parsed into feet while preserving prosodic heads and without violating other highly-ranked constraints on prosodic structure. The result is that heavy stem-initial syllables are parsed into feet in possessed nominalizations, but light stem-initial syllables are not.

5 Conclusion

In this paper I argued that Blackfoot accent instantiates primary stress. The location of accent in event nominalizations provides evidence of a regular underlying prosodic structure in Blackfoot, which I expect to manifest in other areas of the grammar as well (c.f. the study of verbal accent in Weber 2016). This prosodic structure is typologically unusual in that it contains initial extrametricality. I also showed that prosodic heads are preserved across cycles, such as in possessed nominalizations, but that additional prosodic structure is added when possible.

One consequence of this analysis is that secondary stresses must arise across cycles in situations where an original prosodic head is preserved but additional structure has also been added, creating two or more feet. Since secondary stresses arise across cycles, it seems likely that secondary stresses may also exist in words with only one application of phonology, which was my assumption in this paper. The presence of secondary feet may be empirically testable. An acoustic study of words with one and two cycles of phonology could reveal whether secondary stresses in Blackfoot have a

particular phonetic manifestation which has escaped field researchers, and if so, whether secondary stresses only arise via cyclic interactions or also exist elsewhere.

I leave open the question of which syntactic units map to prosodic words. Verb stems with person proclitics look morphologically similar to possessed nominalizations. However, verbs never have fourth syllable accent, suggesting that they do not involve two applications of phonology. It is unclear why nominalizations should map to a prosodic word when verbs do not. An answer may lie in phrases with multiple accents. If accent instantiates primary word stress, phrases with multiple accents must consist of multiple prosodic words. Studying which syntactic constituents map to new prosodic words may help to illuminate the prosody-syntax mapping within words.

Finally, this paper contributes to the small number of studies on initial extrametricality and the 'persistence' of extrametricality across cycles (Buckley 1994; Inkelas 1989). Blackfoot extrametrical syllables are 'non-persistent' in the sense that they can be parsed into feet in subsequent applications of phonology. The unique properties of Blackfoot prosody (quantity-sensitivity plus initial extrametricality) interact with cyclicity in such a way that only heavy extrametrical syllables are later parsed to feet. Non-persistent final extrametricality in a quantity-sensitive suffixing language should show the same effects; namely, that only heavy syllables are later parsed into feet.

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