Early prosodification but late metrification in Blackfoot verbs*

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Overview

- Recent renewed interest in prosodic structure and correspondence with syntax (cf. Selkirk 2011 and subsequent work; see overviews in Bennett & Elfner 2019; Elfner 2018).
- Open question: precise nature and interaction of "interface" issues, such as linearization, morphological exponence, and prosodification (= creation of prosodic structure)
- Polysynthetic languages provide the necessary phonological length and morphological complexity for testing and comparing predictions of various theoretical approaches to syntax-prosody correspondence.
- But theories remain poorly tested on polysynthetic languages (Elfner 2018). (Although, see recent work in Bogomolets 2020, 2021; Gordon 2023; Miller & Sande 2021; Miller 2018; Weber 2020, 2021, 2022b; and case studies in Bogomolets & van der Hulst 2023.)
- Theoretical domain: Prosodic phonology typically assumes that prosodic constituents correspond to syntax and *simultaneously* form the domains for phonological processes, including syllabification.

(1) PROSODIC CONSTITUENTS

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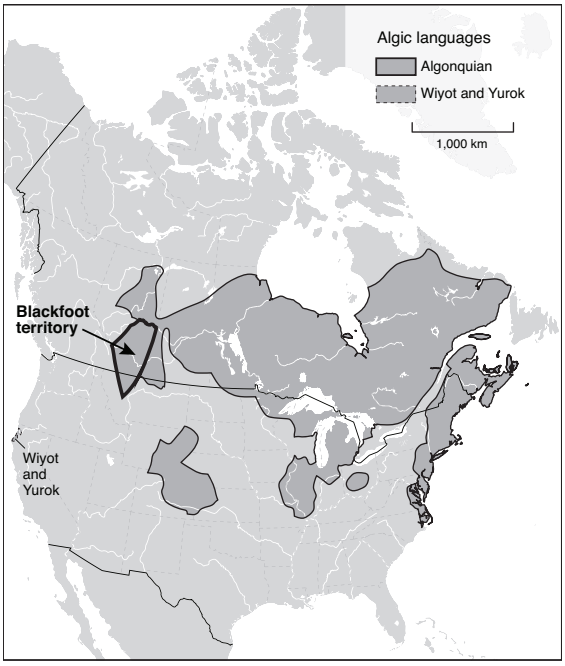
- However, higher prosodic constituents are interface categories extrisically defined by matching to syntax (Inkelas 1993; Itô & Mester 2012; Selkirk 1986) , while lower metrical structure are defined intrinsically by rhythmic factors. Some then argue that the full prosodic hierarchy (Nespor & Vogel 2007; Selkirk 1984) should be split into two (Downing 1999; Inkelas 1993).
- We predict two different kinds of mismatches: those that mismatch prosodic constituents from syntax, and those that mismatch metrical constituents from prosody.
- This paper: argue that **prosodification** (= creation of prosodic structure) must occur before **metrification** (= creation of rhythmic metrical structure, incl. feet and syllables).
- Empirical domain: root alternations in Blackfoot (Algonquian; ISO 639-3: bla), a polysynthetic language (Frantz 2017)
  - Roots exhibit phonological "adjustment" processes like epenthesis, deletion, and mutation.
  - But epenthesis is conditioned by prosodic structure, not syllable structure.
  - Phonological adjustments feed and are made opaque by syllabification.
- Proposal: "interface" architecture involves ordered operation:
  1. prosodification + exponence
  2. phonological adjustments (possibly co-occurs with first step)
  3. metrification (and other regular phonology)

Location and maps

- Westernmost Algonquian language, spoken in Montana and Alberta.
- **Figure 1**: Algonquian family. Map by Eric Leinberger, based on Goddard (1999).



- Blackfoot exhibits many polysynthetic properties, including: extensive agglutinative morphology, free word order, multiple "lexical" morphemes or roots within a morphological word, and head-marking. (On syntactic properties of polysynthesis within different theoretical approaches see e.g. Baker 1996; Mattissen 2004; Nichols 1986, 1992.)

Outline

1 Language background: syntax and phonology

1.1 Syntax of the verbal complex

- (Simplified) morphological template in (2). See Bloomfield (1946) & Goddard (1990) for the Algonquian template. Stem in [square brackets].[1]

[1]References to pages in Frantz & Russell (2017) are given as "[FR #]". Abbreviations used in this article follow the Leipzig Glossing Standards (Comrie, Haspelmath, & Bickel 2015), plus: AI = animate intran-

(2) $[_{CP}$person– preverb*– $[$initial–(medial)–final$]_{\nu P}$ –suffixes$]_{CP}$

- Algonquian stem is a *v*P, containing an "initial" (minimally a $\sqrt{\text{ROOT}}$) and a "final" verbalizing *v*P head which determines valency and event type, and which may agree with animacy of the argument (Branigan, Brittain, & Dyck 2005; Brittain 2003; Bruening 2001: 122; Hirose 2003; Mathieu 2007; Quinn 2006; Piggott & Newell 2006; Slavin 2012).
- Derivational paradigms; v^0 forms stative predicates in (3) or transitive or intransitive eventive predicates in (4).
- $\sqrt{\text{ROOT}}$ = a-categorial and unrestricted (Halle & Marantz 1993).

(3) a. áaksiksístoyiwa
aak–[ksisto–**yi**]–Ø–wa
FUT–[warm–**II**]–IND–3
'It will be warm.' [FR 63]

b. áaksiksísto'simma
aak–[ksisto–**'si**]–mm–wa
FUT–[warm–**AI**]–IND–3
'She will have a fever.' [FR 63]

(4) a. áaksiksistohsima
aak–[ksisto–**hs**]–i–m–wa
FUT–[warm–**by.heat.*v***]–TI–IND–3
'She will warm it.' [FR 63]

b. áaksiksístohsoyiwa
aak–[ksisto–**hsoyi**]–mm–wa
FUT–[warm–**by.heat.AI**]–IND–3
'He will warm himself.' [FR 64]

- Optional "medial" root: body part (Dunham 2009) or classifier (Biedny et al. 2021).

(5) áaksiksístokomiwa
aak–[ksisto–-**kom**–yi]–Ø–wa
FUT–[warm–**liquid**–II]–IND–3
'It will be warm water.' [FR 64]

(6) ksiistokóssakit
[ksisto–-**kom**–hsaki]–t–Ø
[warm–**liquid**–by.heat.AI]–2SG.IMP–CMD
'Heat water!' [FR 64]

- Suffixes = clausal heads, agreement (Bliss 2013; Grishin 2023; Ritter & Wiltschko 2014).[2]

(7)

$\sqrt{\text{ROOT}}$	v^0	Voi^0	Infl^0	AGR-PL	C^0
ksiisto	-yi		-Ø	—	-wa
ksiisto	-'si		-mm	—	-wa
itap	-iistoto	-o	-hp	-oaawa	—

sitive, AN = animate, CMD = command clause, CNJ = conjunctive order, COLLEC = collective noun, CONJ = conjunction, IC = initial change, II = inanimate intransitive, IN = inanimate, IND = independent order, OBV = obviative, PRX = proximate, SUB = subject, TA = transitive animate, TI = transitive inanimate.

[2] I treat the "theme suffix" as Voi^0, following Oxford (2019) & Oxford (2014). This has not been specifically proposed for Blackfoot, though Bliss (2013) puts the theme in a functional head between v^0 and Infl^0.

- Entire verbal complex can get really really large.

(8) kimátaakonawaipahkitapiistotoohpoaawa

ki–	maat–aak–onawa–ipahk–	[itap–iistoto]	–o–hp–oaawa
2–	NEG–FUT–ever–bad–	[towards–CAUS.TA]	–2OBJ–IND–PL
person–	preverb*–	[initial–final]	–suffixes

'I will never forsake you (pl).' [FR 78]

- Preverbs are not a natural syntactic class. They are "anything else" (except demonstratives, nouns, and a few adjuncts like 'yesterday', 'today').
  - Prefixes include event modifiers like verbal adjuncts (e.g. roots like *sok* 'good', which can also occur stem-internally) and aspectual modifiers (e.g. frequentative *ikaap*).[3]
  - These do not appear to be incorporated; they are truly phrasal adjuncts and not a compound.

(9) soksinihkít!
sok–[inihk–i]–t
good–[sing–AI]–2SG.IMP

'Sing well!' (Bliss 2013: 49)

(10) soká'pssiwa
[sok–a'pssii]–Ø–wa
[good–be.AI]–IND–3

'She's good' [FR 257]

(11) iikáapsssammiiwayi
ii\–ikaap–[ss–amm]–ii–w = ayi
IC\–frequent–[thus–watch.TA]–3SUB–3 = OBV.SG

'she looked at him frequently' [FR 41]

- maat- 'NEG' — high-scope negation, [8]
- aak- 'FUT', aahk- 'might' — TAM prefixes, [8]
- anist- 'manner' — relative root (introduces oblique), [12]
- sstsi- 'town', ipahk- 'bad', iksim- 'secret' — lexical roots (?), [8], [12]
- oto- 'go to' — restructuring verbs, [12]
- sok- 'good', ikaap- 'frequent' — verbal adjuncts, [9], [11]

- Verbal complex has the distribution of a CP (e.g. as matrix or embedded clause; Weber 2020, 2021.)

[3]Recent arguments for syntactic adjuncts inside "words": Déchaine & Weber (2015, 2018), Fenger (2020), Mathieu, Fry, & Barrie (2017), Newell & Piggott (2014), Piggott & Travis (2013), & Weber (2022b).

(12) itaníststsiksimsstaya
it–anist–iksim–[sst–aa]–yi = aawa
LOC–manner–secret–[wish–AI]–PL = PRX.PL

omaahkstsóótoohpommaahsáa	sátsáápiniowan
o–m–aahk–sstsi–oto–[ohpomm–a]–hsi = aawa	pisatsaapiniowan
3–3–might–town–go.to–[buy–AI]–CNJ = PRX.PL	candy

'They decided to go to town to buy some candy.' (BB; 2013-02-13)

1.2 Phonology and orthography

- Some aspects of the phonological inventory are still contested (Derrick & Weber 2023).
- I use orthography from Frantz (1978, 2017) for morphemic analyses.
  - double letters for long segments,
  - /ɛː/ = <ai>, /ɔː/ = <ao>, /ʔ/ = <'>, /j/ = <y>.

Table 1: Blackfoot phonemic inventory

	Labial	Coronal	Dorsal	Glottal
Stops	p pː	t tː	k kː	ʔ <'>
Pre-Assibilants		ˢt ˢtː	ks	
Affricates		ts tːs		
Fricatives		s sː	x	
Nasals	m mː	n nː		
Glides	w	j <y>	(w)	

	front	central	back
high	i iː		o oː
mid	ɛː <ai>		ɔː <ao>
low		a aː	

- Allowable clusters: /sC/; /xC/; /ʔC/ (and C is optionally followed by [j])
- Syllable shapes: CV, CVV, CVC; vowels predictably short and lax in some closed syllables (Elfner 2006; Frantz 2017; Weber 2020).
- Contrastive vowel length in open syllables (Elfner 2006; Frantz 2017; Goad & Shimada 2014; Weber 2020). NB: Short or long [s] can occur as a syllable nucleus (Elfner 2006; Frantz 2017; Goad & Shimada 2014), but this is not a focus for this particular talk.

(13)

CV	[ʔâːk**o**.kaː]	'he will rope'	(BB)
CVV	[ʔâːk**oː**.kaː]	'she will hold a Sundance'	(BB)

- Vowel length neutralization before word-medial codas (Elfner 2006; Frantz 2017; Weber 2020). Evidence that codas are moraic; heavy syllables = CVV, CVC.

(14)	CVC	[só.**kaʔ**.si.m]	‘shirt, dress’	(BB)
		[**ʔɪm**.mo.já:.n]	‘fur coat’	(BB)
	CVVC	—	—	

2 The verbal complex is a Prosodic Word (PWd)

- The PWd is associated with a metrification domain.
  - In terms of Prosodic Hierarchy, the PWd dominates feet.
  - It follows that a PWd should have a minimal size roughly like a foot, have obligatory stress, and be the domain of syllabification (syllables contained in the PWd) (McCarthy & Prince 1993).
- The PWd also has non-metrical generalizations, like a prohibition against glides at the left edge.
- The PWd exhibits classic mismatches from syntax which optimize metrical structure.

2.1 PWd is the domain of metrification

- There is a PWd domain roughly equivalent to the CP phrase.
- Phonotactic evidence = alternations at the left edge of the root. Glides and vowels are avoided at the left edge.

2.1.1 Domain of minimal size constraints

- Smallest PWds are CVVC or CVCC.

(15) MINIMAL VERBAL AND NOMINAL COMPLEXES

	IPA	*Orthography*	*Gloss*	
CVVC	[pí:t]	píít	‘enter!’	(BB)
	[só:t] ∼ [so.wó:t]	sóót ∼ sowóót	‘go to war!’	(BB)
	[kó:n]	kóón	‘ice’	(BB)
CVCC	[pónn]	pónn	‘bracelet’	(BB)
	[kóʔs]	kó’s	‘dish, bowl’	(BB)

- Unexpected: slightly larger than bimoraic because of extra final C slot (Weber 2020).
- Possibly: verbal complex is also a PPh, so perhaps the PPh must branch (Weber 2022b).
  - PPh = domain of final devoicing
  - PPh is larger than a PWd; e.g., DP is multiple PWds in a PPh: $(\text{DemP AdjP NP})_{\text{PPh}}$
  - Verbal complex exhibits devoicing and is thus a one-word PPh: $(\text{V})_{\text{PPh}}$
- Functional words, when not incorporated into the PWd, are bimoraic: [kiː] 'CONJ', [tsaː] 'WH' (Weber 2022b).

2.1.2 Domain of obligatory stress

- Stress is obligatory on the PWd, but not on subconstituents like the stem or prefixes.

(16) a. ⟦ʔɪs.tá:.wa̰⟧ stress obligatory on PWd
isstááwa
[√isst–aa]–Ø–wa
[√wish–AI]–IND–3
'she wants' [FR 272]

b. ⟦ʔi.ksí.ms:.ta:.wa̰⟧ stress not obligatory on stem
iksímsstaawa
√iksim–[√sst–aa]–Ø–wa
√secret–[√wish–AI]–IND–3
'he thought' [FR 61]

c. [ʔi.ta.ní.ˢtsɪ.ksɪ.ms:.ta.ja] stress not obligatory on prefixes
itanístsiksimsstaya
it–anist–iksim–[sst–aa]–yi = aawa
LOC–manner–secret–[wish–AI]–PL = PRX.PL
'They decided thus.' (BB; 2013-02-13) (= 12)

2.1.3 Domain of syllabification

- Epenthetic [ʔ] occurs at the the left edge of vowel-initial phrases, (17).

(17)

UR	*IPA*	*Gloss*	
/apíːt/	[ʔapíːt]	'sit!'	(BB)
/imitâː/	[ʔimitâː]	'dog'	(BB)
/otán/	[ʔotán]	'his/her daughter'	(BB)

- Otherwise, syllable structure maintained by vowel hiatus resolution (usually coalescence) and epenthesis between clusters (Bliss 2013; Elfner 2006; Weber 2020).

- Syllable structure maintained via epenthesis and coalescence.
- Some suffixes begin in consonants, as seen in "After V" context.
- Epenthetic [i] occurs between consonants in the "After C" context.

(18) a. AFTER C
⟦nitâ:ksox^{w}ks**ip**i^{s}ta:⟧
*nitáaksoohks**ip**istaa*
nit–aak–[$\sqrt{}$yoohk–**p**ist–aa]–(hp)
1–FUT–[$\sqrt{}$lid–**tie.*v***–AI]–(IND)
'I will close the tipi flap' [FR 319]

b. AFTER V
⟦ʔamo**p**í^{s}ta:ni⟧
*amo**p**ístaani*
[[$\sqrt{}$amo–**p**ist–aa]–n]–i
[[$\sqrt{}$gather–**tie.*v***–AI]–NMLZ]–IN.SG
'ceremonial bundle' [FR 13]

- Some suffixes begin in vowels, as seen in the "After C" and "After V" contexts.
- Vowels /o + i/ diphthongize across morpheme boundaries.

(19) a. AFTER C
⟦ʔomats**íp**i:s⟧
*omats**íp**iisa*
[$\sqrt{}$omat–**ip**i]–:s–Ø
[$\sqrt{}$start–**bring**.*v*]–2SG:3.IMP–CMD
'transport him!' [FR 193]

b. AFTER V
⟦ʔamó**íp**i:sa:wa̧⟧
*amó**íp**iisaawa*
[$\sqrt{}$amo–**ip**i]–:s–Ø = aawa
[$\sqrt{}$gather–bring.*v*]–2SG:3.IMP–CMD = PRX.PL
'gather them!' [FR 195]

- Many vowel hiatus resolution strategies in Blackfoot (Elfner 2006; Weber 2020).
- Vowel coalescence of /a + i/ → [ɛ:].

(20) AFTER V
⟦s**ɛ:p**í:s⟧
*sa**ip**íís*
[$\sqrt{}$sa–**ip**i]–:s–Ø
[$\sqrt{}$out–**bring**.*v*]–2SG:3.IMP–CMD
'bring her out!' [FR 236]

- Abstract representation of each root, before vowel coalescence:

(21)

	After C		*After V*	*UR*	*Gloss*
a.	[-ipi^{s}t]	∼	[-pi^{s}t]	/-pi^{s}t/	'tie.*v*'
b.	[-ipi]	∼	[-ipi]	/-ipi/	'bring.*v*'
c.	*[-p]	∼	*[-p]		

2.2 PWd left edge constraint against [-cons]

- PWd also has non-metrical generalizations, like a left edge phonotactic constraint.
- Roots begin in long vowels, which have epenthetic [ʔ] at "Left edge" and vowel coalescence across morpheme boundaries.

(22) LEFT EDGE
⟦ʔ**i:**.ts:.ká:t⟧
iitsskáát
[√**ii**tssk–aa]–t–Ø
[√scuffle–AI]–2SG.IMP–CMD
'fight!' [FR 38]

(23) AFTER V
⟦ʔé:.so:.k**é:i**.ts:.ka:.wą̊⟧
*áísook**áíi**tsskaawa*
a–isook**a**–[√**ii**tssk–aa]–Ø–wa
IPFV–used.to–[√scuffle–AI]–IND–3
'he used to fight' [FR 319]

- Roots begin in glides [j], as seen in the "After V" context.
- Deletion of glide at "Left edge", which feeds [ʔ] epenthesis.

(24) LEFT EDGE
⟦ʔi:.pi.ˢtó.tsit⟧
iipístotsit
[√**y**iip–istot]–i–t–Ø
[√decrease–CAUS.*v*]–TI–2SG.IMP–CMD
'decrease the volume of it!' [FR 35]

(25) AFTER V
⟦ni.tá.**j**i:.pi.ˢto.tsiʔ.pą̊⟧
*nitá**y**iipistotsii'pa*
nit–a–[√**y**iip–istot]–i–hp–a
1–IPFV–[√decrease–CAUS.*v*]–TI–IND–3
'I am decreasing the amount' [FR 313]

- Abstract representation of each root, before vowel coalescence:

(26)

	Left edge		*After V*	*UR*	*Gloss*
a.	[ʔi:ts:k]	∼	[i:ts:k]	/i:ts:k/	'scuffle'
b.	[ʔi:p]	∼	[ji:p]	/ji:p/	'decrease'
c.	*[ji:p]	∼	*[ji:p]		

- Phonotactic constraint: no roots begin with a vowel or glide at the left edge.

2.3 PWd mismatches from syntax

- Metrical constituents mismatch from the CP. Left edge discussed here.
- Phonological proclitics *ki=* 'CONJ' and *tsa=* 'Q' (Barrie 2014) are included in the domain of syllabification and bleed [ʔ] epenthesis.

(27) [**kj**ɔ́:tox^{w}kǫta **kj**ɔ́:toɪsomô?si]

ki	áótoohkohtaa
ki =	a–oto–ohk–oht–aa–Ø–wa
CONJ =	IPFV–go.to.do–firewood–*v*–AI–IND–3

ki	áótoissomo'si
ki =	a–oto–som–o'si–Ø–wa
CONJ =	IPFV–go.to.do–fetch.water–AI–IND–3

'…and she would go after firewood and go after water'

(BB; Creation Story, line 4)

3 The *v*P stem is a Prosodic Stem (PStem)

- There is a PStem domain roughly equivalent to the *v*P phrase.
- Primary evidence = alternations at the left edge of the root. A conspiracy of processes avoids [+cons] segments at morphological junctures.

3.1 Methodology

- Corpus: most forms are from most recent dictionary (Frantz & Russell 2017).
- Forms marked with "(BB)" are from original fieldwork with Beatrice Bullshields.
- Headwords are abstract, uninflected stems (**Figure 3**) and occasionally bare roots (**Figure 4**).

iponip *vta;* cease carrying (offspring) in one's teeth (said of an animal); **ponipisa!** stop carrying him (e.g. a pup)!; **áaksiponipiiwáyi** she will stop carrying him with her teeth; **iipónipiiwáyi** she stopped carrying him with her teeth; **anná imitáíkoana ákaiponipawa** the pup is no longer being carried by its mother.

ipon *vrt;* terminate, end, be rid of; see **iponiistam** take off; see **iponisayi** become a widower; **áaksiponikso'kowammiyiiwa** she will end their friendship; **nitsííponawaatohtoo'pa** I got rid of it (e.g. a cold, or a chore); see **iponota'si** sell cattle.

- Consider the shape of the root in two positions: (1) left edge, and (2) after prefix (consonant or vowel).

(28) LEFT EDGE
[$\sqrt{\text{ROOT}}$–v^0]–suffixes

(29) AFTER PREFIX
prefix–[$\sqrt{\text{ROOT}}$–v^0]–suffixes

- Entries frequently contain "diagnostic" forms, meant to show the reader the different forms of the root (Frantz & Russell 2017: *xxi*):

  a. left edge (imperatives, nouns, intransitive verbs),
  b. after a consonant (frequently *aak-* 'FUT'),
  c. after a vowel (frequently *a-* 'IPFV').

- Stems are not broken down morphemically in Frantz & Russell (2017), and in many cases the morphemic analysis is unclear. Most forms in this handout include a five line gloss, as an empirical contribution. Only the verb is included from multi-word examples.
- Data is in orthography. Converted to IPA transcriptions based on known descriptions of the language (Derrick & Weber 2023; Elfner 2006; Weber 2020; Windsor 2017) and orthography (Frantz 1978, 2017). Converted IPA is in ⟦ ⟧.
- Attempted to use the same stem in both positions. This was not always possible, due to gaps in the dictionary.

3.2 Root alternations

3.2.1 Vowel-initial roots: vowel coalescence

- Roots begin in {i, a, o}, as seen in the "Left edge" and "After C" contexts.
- The "After V" context shows there is vowel coalescence across morpheme boundaries.

(30) a. LEFT EDGE

⟦ʔ**i**.tsí.nx̣^{w}.to:.t⟧
***i**tsínohtoot*
[$\sqrt$**i**tsin–oht]–oo–t–Ø
[$\sqrt$among–put.*v*]–TI–2SG.IMP–CMD

'place it among the rest!' [FR 120]

b. AFTER C

⟦ʔâː.k**i**.tsi.nx̣ʷ.toː.má.jį̨⟧
*áak**i**tsinohtoomáyi*
aak–[√**i**tsin–oht]–oo–m–Ø = ayi
FUT–[√among–put.*v*]–TI–IND–3 = PRX.PL

'he will place it among the rest' [FR 120]

c. AFTER V

⟦ʔ**éː**.tsi.nx̣ʷ.toː.má.jį̨⟧
***áː**tsinohtoomáyi*
a–[√**i**tsin–oht]–oo–m–Ø = ayi
IPFV–[√among–put.*v*]–TI–IND–3 = OBV.SG

'he is placing it among the rest' [FR 120]

- Abstract representation of each root, before vowel coalescence:

(31)

	UR	Left edge		After C	=	After V	
a.	/itsin-/	⟦ʔitsin-⟧	∼	⟦itsin-⟧	=	⟦itsin-⟧	'among'
b.	/ok-/	⟦ʔok-⟧	∼	⟦ok-⟧	=	⟦ok-⟧	'snare'
c.	/ak-/	⟦ʔak-⟧	∼	⟦ok-⟧	=	⟦ok-⟧	'count, read'
d.	/atsinik-/	⟦ʔatsinik-⟧	∼	⟦itsinik-⟧	=	⟦itsinik-⟧	'count, read'
e.	*/a/	*[a]	∼	*[a]	=	*[a]	

3.2.2 Obstruent-initial roots: epenthesis

- Roots begin with obstruents, as shown by the "Left edge" condition.
- Epenthetic [i] before the obstruent in the "After C" and "After V" contexts.
- Opaque interaction in the "After V" context, because after vowel coalescence it just looks like the final vowel of the prefix lengthens and changes quality.

(32) a. LEFT EDGE

⟦po.ni.pi.sa̱⟧
ponipisa!
[√pon–p]–is–Ø
[√cease–by.mouth.*v*]–2SG:3.IMP–CMD

'stop carrying him (e.g. a pup)!' [FR 92]

b. AFTER C

⟦ʔâː.ks**i**.po.ni.piː.wá.jį̨⟧
*áaks**i**ponipiiwáyi*
aak–[√pon–p]–ii–Ø–w = áyi
FUT–[√cease–by.mouth.*v*]–3SUB–IND–3 = PRX.PL

'she will stop carrying him with her teeth' [FR 92]

c. AFTER V

⟦ʔá.k**ɛː**.po.ni.pa.wa̱⟧
*ák**ai**ponipawa*
áka–[√pon–p]–a–Ø–wa
PRF–[√cease–by.mouth.*v*]–3OBJ–IND–3

'he [pup] is no longer being carried by its mother' [FR 92]

- Abstract representation of each root, before vowel coalescence:[4]

(33)		UR	Left edge		After C	=	After V	
	a.	/pon-/	⟦pon-⟧	∼	⟦ipon-⟧	=	⟦ipon-⟧	‘cease’
	b.	/kamot-/	⟦kamot-⟧	∼	⟦ikamot-⟧	=	⟦ikamot-⟧	‘escape’
	c.	/som-/	⟦som-⟧	∼	⟦isom-⟧	=	⟦isom-⟧	‘spread’

Observation #1: Robust (non-suppletive) neutralizing process

- *No* roots begin with an obstruent after a prefix.
- *All* roots of the right shape exhibit this alternation. (Not suppletive allomorphy.)
- The [i] cannot be part of the root and then deleted at the “Left edge”, or else the vowel-initial roots should pattern the same (*contra* Goddard 2018).

(34)		UR	Left edge		After C	=	After V	
	a.	/itsin-/	⟦ʔitsin-⟧	∼	⟦itsin-⟧	=	⟦itsin-⟧	‘among’
	b.	/pon-/	⟦pon-⟧	∼	⟦ipon-⟧	=	⟦ipon-⟧	‘cease’
	c.		*[C]	∼	*[C]	=	*[C]	

Observation #2: all consonant-initial roots alternate

- Morphophonological adjustments are not limited to obstruents.
- *All* roots which begin in a (non-glide) consonant exhibit alternations.
- Conspiracy of processes, including epenthesis and deletion.
  - Choice of process determined by the consonant at the left edge of the root.
  - Deletion for nasals; epenthesis for obstruents.
- All are conditioned by the same environments (Left edge vs. After prefix).

[4] Very few roots begin in [t] or [ts], due to a change of *t > *k* in this position (Berman 2006: 275)

(35)		Left edge		After C	=	After V	
	a.	⟦ʔitsin-⟧	∼	⟦itsin-⟧	=	⟦itsin-⟧	‘among’
		⟦ʔok-⟧	∼	⟦ok-⟧	=	⟦ok-⟧	‘snare’
		⟦ʔatsinik-⟧	∼	⟦itsinik-⟧	=	⟦itsinik-⟧	‘relate a story’
		⟦ʔak-⟧	∼	⟦ok-⟧	=	⟦ak-⟧	‘count, read’
	b.	⟦misam-⟧	∼	⟦isam-⟧	=	⟦isam-⟧	‘long in time’
		⟦mokaki-⟧	∼	⟦okaki-⟧	=	⟦okaki-⟧	‘wise’
		⟦makiin-⟧	∼	⟦okiin-⟧	=	⟦okiin-⟧	‘spread’
	c.	⟦pon-⟧	∼	⟦ipon-⟧	=	⟦ipon-⟧	‘cease’
		⟦kamot-⟧	∼	⟦ikamot-⟧	=	⟦ikamot-⟧	‘escape’
		⟦som-⟧	∼	⟦isom-⟧	=	⟦isom-⟧	‘spread’

- Again, *extremely* robust alternations, with no phonological exceptions.
- Productively applies to loanwords and calques:

(36) LEFT EDGE
[póːsa̰]
póósa
[√hpoos]–a
[√cat]–PRX
‘cat’ (BB)

(37) AFTER C
[síkˣʷpoːsa̰]
*sík**oh**poosa*
sik–[√hpoos]–a
black–[√cat]–PRX
‘black cat’ (BB)

(38) ⟦si.kˣʷ.tsaː.kiː.kx.tsːɪ.nḭ⟧
*sik**oh**tsaakiikahtssin*
sik–htsaaki–[√kaaht–i]–hsin–i
black–jack–[√game–AI]–NMLZ–IN
‘blackjack (card game)’ [FR 250]

cf. ⟦kax.tsːí.nḭ⟧
kaahtssíni
[√kaaht–i]–hsin–i
[√game–AI]–NMLZ–IN
‘game (usu. gambling)’ [FR 133]

Observation #3: alternations do not optimize syllable structure

- Alternations do not optimize syllable structure.
  - Epenthesis after consonants *could* avoid unattested consonant clusters.
  - But epenthesis after vowels creates a marked vowel hiatus context.
  - Simple concatenation would be better.
- Attested output is harmonically bound; incurs extra violations of ID(low) and *V:, (79).

(39) Incorrect ranking (to be revised)

/aka-pon-ip-a-wa/	ONS	MAX	DEP	UNIF	*V:
☞ a. ʔá.ka.po.ni.pa.wa̧			*		
☹ b. ʔá.kɛː.po.ni.pa.wa̧			*	*!	*!
c. á.kɛː.po.ni.pa.wa̧	*!			*	*

- In fact, epenthesis is made opaque by vowel coalescence in the "After V" context.

3.2.3 Observation #4: Phonotactic constraint motivates root alternations

- No roots begin in a consonant after a prefix. (Noted in diachronic research; see Berman 2006: 267 and Goddard 2018).
- **Table 2** generalizes over all root alternations, including roots beginning in long vowels and glides. (Abstracted away from vowel coalescence but not other predictable operations, such as [ʔ]-epenthesis at the left edge).

Table 2: Segments allowed at left edge of roots in two positions

	p	t/ts	k/ks	s	m	n	j	w	iː	oː	ɛː	ɔː	aː	i	o	a
Left edge	✓	(✓)	✓	✓	✓	✓	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘
After prefix	✘	✘	✘	✘	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

- Proposal: phonotactic constraint at some left edge which prohibits [+cons] segments drives alternations (solid line).
- Question: what left edge has this constraint?
  - Not syllable: the phonological adjustments feed syllabification, because coalescence occurs across the edge with the constraint. The phonotactic constraint holds at some other level of abstraction.
  - Compatible with either a syntactic or prosodic boundary.

(40) ⟦ʔá.k**ɛː**.po.ni.pa.wa̧⟧
*ákai**p**oni**p**awa*
áka–[√pon–p]–a–Ø–wa
PRF–[√cease–by.mouth.*v*]–3OBJ–IND–3

'he [pup] is no longer being carried by its mother' [FR 92]

3.3 Phonotactic constraint holds of a prosodic boundary

- Constraint holds regardless of syntactic features like [+realis] (argued to be relevant for Blackfoot Infl in Déchaine & Wiltschko 2010).
- Constraints ignore category: occurs in prefixed verbs as well as prefixed nouns.
- Constraint holds at every left edge to the left of the stem (except for the largest constituent, which is mapped to a PWd).
  - Recall the prefixes are not a syntactic class.
  - Reason must be prosodic in nature.

3.4 Interim summary

- Robust root allomorphy at the left edge of the PStem.
- These are not suppletive allomorphs: the processes are regular and productive, and the surface forms are derived from a single UR.
- Largely phonologically determined:
  - Satisfies a phonological constraint against [+cons] segments after a prefix.
  - Processes are phonological (e.g., deletion/epenthesis of segments), are triggered by a phonological constraint (expressed as a prohibition against segments with particular features), and the repairs are conditioned by features of the segment at the left edge of the morpheme (e.g., nasals vs. obstruents).
  - Not constrained to roots; this actually happens at every boundary to the left within the CP as well. (See Weber 2022b for details.)

3.5 Prosodic Word $\neq$ Prosodic Stem

- Two distinct prosodic constituents inside Blackfoot verbal complex.
- PWd and PStem are not identical (recursive) categories, as in Ito & Mester (2007) i.a.
- **Table 3:** summarizes the differences between the PWd and the PStem.

Type	Diagnostic	PWd	PStem
Metrification	Minimal size constraints?	✓	✘
	Obligatory stress?	✓	✘
	Syllabification?	✓	✘
Edge restriction	Against [-cons] at left edge?	✓	✘
	Against [+cons] at left edge?	✘	✓
Mismatches	For alignment with metrical constituents?	✓	✘
	From syntactic categories?	✓	✓

4 Prosodification occurs before metrification

- At the surface level, the PStem is not a domain of metrification.
- Metrification also interacts opaquely with phonological adjustments driven by the constraint at the left edge of PStems.
- If prosodi fication and metrification occur at the same time, then the attested outputs are harmonically bound: it is always better to allow mismatches between syntax and prosodic structure than it is to use phonological adjustments.

4.1 PStem is not a domain of metrification

4.1.1 No minimal size constraints

- No evidence for minimal size constraints on PStem.
- Minimal verbal complex is CVVC or CVCC, but stems may be smaller.
- Problem: hard to tell! The stems below look like the size of a minimal PWd, but perhaps that is because the smallest verbal complex is inflected and must be simultaneously a PWd and PPh.

(41) MINIMAL VERB STEMS (=15)

Size	*IPA*	*Orthography*	*Gloss*	
CVV?	[pí:-]	[píí]$_{vP}$-t	‘enter!’	(BB)
	[só:-] ∼ [sowó:-]	[sóó]$_{vP}$-t ∼ sowóó-	‘go to war!’	(BB)

4.1.2 No obligatory stress

- Preverbs and stem do not have obligatory stress.
- Stress falls on a preverb (underlined), but not every preverb and not on the verb stem.

(42) [ʔi.ta.ní.^{s}tsɪ.ksɪ.ms:.ta.ja]
itanístsiksimsstaya
it–anist–iksim–[sst–aa]–yi=aawa
LOC–manner–secret–[wish–AI]–PL=PRX.PL
‘They decided thus.’ (BB; 2013-02-13) (=12)

4.1.3 Metrification ignores PStem boundaries

- Metrical constituents like feet and syllables ignore PStem boundaries.
- Stress on verbs without prefixes and provides evidence for iambic feet (Weber 2016).
  - Prominence falls on 2nd syllable if heavy, else the 3rd syllable.
  - 1st syllable weight has no effect; I assume it is not parsed into a foot.
  - Compatible with an iambic foot plus non-initiality.

(43)	‘speech, talk’	[a.(**nís**).sɪ.n]	L (**Ĺ**) L
	‘travelling’	[aʔ.(**póxʷ**).sɪ.n]	H (**Ĺ**) L
	‘tell a story!’	[a.(tˢɪ.**nĺ**).kɪ.t]	L (L **Ĺ**) L
	‘take!’	[maʔ.(ta.**kĺ**).t]	H (L **Ĺ**)

- Feet mismatch from the *v*P/PStem: feet cross the right edge of the *v*P constituent, (44), and the left edge of the *v*P, (45).
- (Feet shown in parentheses; *v*P underlined.)

(44) ⟦so.(ki.nís)⟧
sokinísa
[√sok–in]–ísa
[√good–by.hand.*v*]–2SG:3.IMP
‘doctor him!’ [FR 257]

(45) ⟦(i.tsi.(tsi.náʔ).psːi.wą̊⟧
itsináʼpaissiwa
itsin–aʼp–issi–Ø–wa
among–about–be.AI–IND–3
‘he’s among people, not alone’ [FR 120]

- Feet also cross the boundaries between prefixes. (Prefix underlined.)

(46) ⟦(ni.tsí).tsi.nɔː.ks.kaʔ.sį̊⟧
nitsitsínaokskaʼsi
nit–ítsin–a–[√oksk–aʼsi]–(hp)
1–among–IPFV–[√run–*v*]–(IND)
‘I joined in the run’ [FR 120]

- Syllable boundaries cross the left edge of the *v*P.
- (Syllable shown in parentheses; *v*P underlined.)

(47) ⟦ʔá.(kɛː).po.ni.pa.wa̰⟧
ákaiponipawa
áka–[√pon–p]–a–Ø–wa
PRF–[√cease–by.mouth.*v*]–3OBJ–IND–3
'he [pup] is no longer being carried by its mother' [FR 92] (=75c)

(48) [sí.(kxʷ).poː.sa̰]
síkohpoosa
sik–[√hpoos]–a
black–[√cat]–PRX
'black cat' (BB) (=37)

4.2 Opacity between phonological adjustments and metrification

4.2.1 The intuition

- Intuition: the constraint against [-cons] segments at the left edge of PStems *only* holds at an abstract level before metrification and *no longer holds* at metrification.
- PStem boundaries and syllable boundaries are shown below.

(49) (ʔá.k(**ɛː**.po.ni.p)$_{\text{PStem}}$ a.wa̰)$_{\text{PWd}}$
*ákai**p**onipawa*
áka–[√pon–p]–a–Ø–wa
PRF–[√cease–by.mouth.*v*]–3OBJ–IND–3
'he [pup] is no longer being carried by its mother' [FR 92] (=75c)

(50) (sí.k(**xʷ**.poː.s)$_{\text{PStem}}$ a̰)$_{\text{PWd}}$
*sík**oh**poosa*
sik–[√hpoos]–a
black–[√cat]–PRX
'black cat' (BB) (=37)

- Sometimes the edge constraint is opaque and does not hold on the surface. In (50), the left edge of the PStem is the motivation for epenthesizing [o], removing the /x/ segment from the left edge. Yet, after vowel-consonant coalescence (Miyashita 2018), the [x] segment still ends up surfacing next to the PStem left edge!
- But in both cases, there are better alternatives to epenthesis (or deletion, for nasals).
  - Do nothing and take the loss. (Tolerate [-cons] segments at left edge of PStem.)
  - Allow mismatches between syntactic and prosodic constituents.

4.2.2 The problem

- Analysis using Optimality Theory (McCarthy & Prince 1993; Prince & Smolensky 1993).
- Assume that the *v*P constituent in the input is mapped to a PStem constituent in the output via some theory of prosody-syntax correpondence like Alignment Theory (McCarthy & Prince 1994; Selkirk 1996; Werle 2009), Wrap Theory (Kabak & Revithiadou 2009; Truckenbrodt 1999), Match Theory (Selkirk 2011), or Command Theory (Branan 2023; Kalivoda 2018).
  - *v*P is shown in [square] brackets, and the PStem is in (parentheses).
  - Only the left edge is shown in output candidates.

- For **vowel coalescence**, I will assume that vowel hiatus is marked due to ONSET (Rosenthall 1994, 1997), rather than *HIATUS (Orie & Pulleyblank 2002). (Though see Elfner 2006 for an alternative analysis of Blackfoot.)
- Violations of ONSET resolved preferentially via coalescence (violations of UNIFORMITY).

(51) VOWEL-INITIAL ROOT: /ITSIN/ 'AMONG'

/a-[itsin-oht]-oo-m=ayi/	ONS	MAX	DEP	UNIF	*V:
a. ʔá.([i.tsi.nx̩ʷ.toː.má.jį̥	*!		*		*
b. ʔá.([tsi.nx̩ʷ.toː.má.jį̥		*!	*		*
☞ c. ʔé([é.tsi.nx̩ʷ.toː.má.jį̥			*	*	**
d. é([é.tsi.nx̩ʷ.toː.má.jį̥	*!			*	**

- In (51) for candidates (c) and (d), a syllable spans the left edge of the PStem. This is empirically necessary for Blackfoot. Compatible with two ideas:
  - PStem dominates metrical constituents in the Prosodic Hierarchy, but Proper Headedness (Itô & Mester 2003) is reconstrued as a violable constraint. (And Blackfoot tolerates violations.)
  - Prosodic and metrical constituents do not form a single hierarchy (Downing 1999; Inkelas 1993), and in Blackfoot the domain of metrification is the PWd (Weber 2020).
- For **consonant-initial roots**, if there is no constraint at the left edge of the PStem, then the attested output is harmonically bound, because it incurs extra violations of UNIF without satisfying some higher constraint.

(52) CONSONANT-INITIAL ROOT: /PON/ 'CEASE' (TO BE REVISED)

/aka-[pon-ip]-a-wa/	ONS	MAX	DEP	UNIF	*V:
☞ a. ʔá.ka.([po.ni.pa.wą̥			*		
b. ʔá.ka.(i.[po.ni.pa.wą̥	*!		**		
☹ c. ʔá.kɛ(ɛ.[po.ni.pa.wą̥			*	*!	*!

- The following constraint prohibits [+cons] at the left edge of a PStem.

(53) *+[CONS]

Assign a * for every [+cons] segment at the left edge of a PStem boundary.

- And the following partial ranking explains the conspiracy of processes that avoid violations of this constraint (epenthesis before obstruents, deletion before nasals).

(54) * + [cons], MAX-IO(-nas) ≫ DEP-IO ≫ MAX-IO(+ nas)

- Now the attested output is optimal. In (55) candidate (d) avoids violations of * + [cons] by epenthesizing a vowel/features. This removes the obstruent [p] from the left edge of the PStem. The cost of course is that epenthesis creates mismatches between prosodic and syntactic units. This is shown by the (and the [not aligning.

(55) CONSONANT-INITIAL ROOT: /PON/ 'CEASE' (TO BE REVISED)

/aka-[pon-ip]-a-wa/	ONS	* + [CONS]	MAX(-n)	DEP	MAX(+ n)	UNIF	*V:
a. ʔá.ka.([po.ni.p)a.wa̧		*!		*			
b. ʔá.kɔ([ɔ.ni.p)a.wa̧			*!	*		*	*
c. ʔá.ka.(i.[po.ni.p)awa̧	*!			**			
☞ d. ʔá.kɛ(ɛ.[po.ni.p)a.wa̧				**		*	*

- The problem is that mismatches between syntactic and prosodic constituents occur due to epenthesis but also due to overparsing and underparsing.
- A modified version of Alignment Theory is used below which assumes that the PStem corresponds to a *v*P (rather than the Lex^0 in Selkirk 1996). But the same problem arises with Wrap Theory and Match Theory; see Weber (2022b).

(56) ALIGN(PSTEM,L,*v*P,L) (Abbrev: ALL(PSTEM))
The left edge of every PStem aligns to the left edge of a *v*P.

(57) ALIGN(*v*P,L,PSTEM,L) (Abbrev: ALL(*v*P))
The left edge of every *v*P aligns to the left edge of a PStem.

(58) CONSONANT-INITIAL ROOT: /PON/ 'CEASE' (TO BE REVISED)

/aka-[pon-ip]-a-wa/	* + [CONS]	ALL(PSTEM)	ALL(*v*P)	DEP	UNIF	*V:
a. ʔá.ka.([po.ni.pa.wa̧	*!			*		
☞ b. ʔá.(ka.[po.ni.pa.wa̧		*	*	*		
☹ c. ʔá.kɛ(ɛ.[po.ni.pa.wa̧		*	*	**!	*!	*!

- If prosodification and metrification occur at the same time, then the candidate that overparses material into the PStem harmonically bounds the candidate that epenthesizes.
  - Constraint order does not matter: candidate (c) in (58) violates all the constraints that candidate (b) does *plus more*.)
  - Candidate (b) also does not violate Proper Headedness (syllables align to PStem edges).
- Conclusion: prosodification and metrification must occur at different times.

4.3 The solution: two levels of derivation

- Prosodification and phonological adjustments happen early.
  - Abstract level of representation which is post-syntactic but before metrification.
  - Explains why phonological adjustments are not conditioned by syntax, are phonologically regular, but are non-optimizing in terms of syllable structure.

(59) Step 1: Prosodification

/aka-[pon-ip-a-wa/	ONS	* + [CONS]	MAX(-nas)	DEP	MAX(+ nas)	UNIF	*V:
a. áka-([pon-ip-a-wa		*!					
b. áka-([on-ip-a-wa			*!		*		
☞ c. áka-(i[pon-ip-a-wa				*			

- Metrification happens late.
  - The input is a purely phonological/prosodic representation. The translation from syntactic to prosodic boundaries is complete, maintaining modularity.
  - Explains why mismatches at this level are optimizing in terms of syllable structure.
  - Probable: the PStem boundaries are concurrently erased, which would explain why the PWd feels like a single unit. However, it's possible they remain and are allowed to realign to syllable boundaries.

(60) Step 2: Metrification (junctures no longer present in output)

/áka-(ipon-ip-a-wa/	ONS	* + [CONS]	MAX(-nas)	DEP	MAX(+ nas)	UNIF	*V:
a. ʔá.ka.i.po.ni.pa.wa	*!						
b. ʔá.ka.po.ni.pa.wa			*!				
☞ c. ʔá.kɛː.po.ni.pa.wa				*		*	*
d. ʔá.ka.ʔipo.ni.pa.wa				**!			*

4.4 Interim summary

- Prosodification and metrification cannot occur simultaneously.
- Attested candidate would otherwise be harmonically bound.
- A two-step process where metrification follows prosodification explains why:
  - Phonological adjustments are non-optimizing for syllable structure.
  - Phonological adjustments feed coalescence and other metrification processes.

  - Constraints at the PStem are opaque on the surface.

- Possibly compatible with modular theories of the syntax-phonology interface like MSO-PI-PO model (Kratzer & Selkirk 2020), or Match as Correspondence (Itô & Mester 2019).

- Possibly compatible with cyclic or derivational models of phonological domains: Stratal OT (Kiparsky 2000), Cophonologies by Phase (Sande, Jenks, & Inkelas 2020), etc.

5 Conclusion

5.1 Summary

- **Conclusion #1:** not all prosodic constituents metrical constituents do not

- Blackfoot verbal complexes contain two distinct prosodic constituents.

  1. PWd $\approx$ CP. Domain of metrification, with a phonotactic constraint against [-cons] at the left edge.
  2. PStem $\approx$ *v*P. Phonotactic constraint against [+cont] at the left edge.

- Both types of prosodic constituents from syntactic constituents.

  - More general than syntactic labels and projections.
    - PWd $\approx$ CP, DP, NP
    - PStem $\approx$ *v*P, *n*P, and every larger morphosyntactic constituent that is not a PWd.

- Only PWd exhibits mismatches from syntax for alignment to metrical constituents.

- Perhaps: languages are parameterized for which prosodic constituent is the domain of metrification. In Blackfoot, this is the PWd.

- **Conclusion #2:** The two types of mismatches are handled at different points in the derivation.

  - Prosodification: modified Alignment Theory (McCarthy & Prince 1994) or Match Theory (Selkirk 2011). Mismatches due to well-formedness constraints on the prosodic tree, such as BINARITY, STRONGSTART, etc.
  - Metrification: adjustments of the prosodic structure in order to align with metrical constituents, or to incorporate phonological clitics into the domain of metrification.

- Two types of mismatches long-recognized as distinct (Itô & Mester 2019; Kaisse 1985).

- More recently, a similar split is found in MSO-PI-PO model (Kratzer & Selkirk 2020), or in Match as Correspondence (Itô & Mester 2019).

- **Conclusion #3:** prosodification feeds metrification.

  - Prosodification conditions phonological adjustments (root alternations). (Root alternations driven by a constraint at the left edge of the PStem, but not at the PWd. Both constituents must exist.)

  - Phonological adjustments feed metrification. (Coalescence and closed syllable shortening interact opaquely with root alternations. The constraint that conditions root alternations no longer holds, implying the PStem boundaries no longer exist.)

- Converging evidence from infixation: Kalin (2021) argues that infixation also occurs after linearization/prosodification but before metrification.

- Compatible with a model that interprets phonological domains from the inside out. PStem phonology is resolved first (root alternations). PStem boundaries are then erased before or while the PWd phonology is resolved (metrification and root alternations).

  - For Blackfoot: prosodification, exponence (Vocabulary Insertion), and phonological adjustments could be simultaneous. It is possible that these operations are also separate and ordered (Bjorkman 2022; Kalin 2021).

- Still uncertain how this fits into a more general theory of syntax-prosody correspondence. Weber (2022b) addresses

5.2 Current and future work

5.2.1 Blackfoot morphophonological alternations

- Gaps in the Blackfoot corpus

  - Problem: entries do not always include all three contexts. The "After V" context is especially rare, and roots are nearly always shown after an [a] (not other vowels).
  - Problem: while stem and preverb alternations are fairly robust, the morphophonological alternations *within* the *v*P are especially unknown.
  - need a larger corpus and a way to analyze words into morphemes .

- Blackfoot Words database (Weber 2022a; Weber, Brown, et al. 2023)[5]

  - relational database of inflected words and phrases, and their subparts
  - 63,493 lexical forms have been digitized to date from 30 sources
  - timespan: 1743–2017 (almost 300 years!)
  - Version 1.1 includes 9 of 30 sources
  - words are tokenized at the stem and morpheme level, each linked to abstract lemmas

5.2.2 Typological variation in prosodic structure

- In this model, the PStem in Blackfoot matches syntactic recursion exactly.

- What is the typology of re-prosodification?

- Microparametric variation in prosodic structure across Algonquian (Weber, Arppe, et al. 2022, 2023, n.d.)

[5] `https://www.blackfootwords.com/`

- Algonquian Prosodic Structure Working Group brings together researchers of eight Algonquian languages.
- Examining the same sets of diagnostics for prosodic structure in all languages.
- Languages have similar morphosyntax, so any variation in prosodic structure is (likely) to be due to differences in the phonological grammar.

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A Appendix: representative datasets of consonant-initial roots

Methods are as follows:

- Corpus formed with most recent reference materials: Frantz (2017) & Frantz & Russell (2017)
- Searched string `"; C"`, where C = any consonant.
  - This returns examples inside of entries that begin with C.
  - Does not return entries with a word in the middle of an example that begins with C.
  - Searched headwords separately.
- Avoid:
  - Using headwords, because they are uninflected, abstract stems. (Exception: headwords fine for the initial variant of nouns and stative verbs, after adding inflection on in the way described in Frantz & Russell 2017.)
  - Third person past tense indicative clauses. Although these have no prefixes, they undergo morphological ablaut which neutralizes many contrasts (Weber 2020).
- Constraints:
  - This talk: focusing on three types of roots that begin in CV at the left edge. (Focusing on roots which begin in short vowels. There are many other alternations for CVV roots, not shown here.)[6]
  - For /C/ roots, included only roots which occur at the beginning of a phrase, after a consonant, and after a vowel. Where possible, used the exact same stem in all three contexts; else, used the same root.

[6]No roots begin with glides before a short vowels, and [x] and [ʔ] do not occur in onset position. I haven't fully analyzed roots that begin with underlying clusters or whose first vowel is long.

- ⁎ Problem: entries do not always include all three contexts. The "After V" context is especially rare, and roots are nearly always shown after an [a] (not other vowels).
- ⁎ For /CC/ roots, most are not shown after a V, so I just included initial and "After C" contexts.

A.1 Vowel-initial roots

- Roots begin in {i, a, o}, as seen in the "Left edge" and "After C" contexts.
- The "After V" context shows there is vowel coalescence across morpheme boundaries.

(61) a. LEFT EDGE

⟦**ʔi**.tsí.nx̣ʷ.to:.t⟧
itsínohtoot
[√**i**tsin–oht]–oo–t–Ø
[√among–put.*v*]–TI–2SG.IMP–CMD

'place it among the rest!' [FR 120]

b. AFTER C

⟦ʔâ:.k**i**.tsi.nx̣ʷ.to:.má.jį̥⟧
áakitsinohtoomáyi
aak–[√**i**tsin–oht]–oo–m–Ø = ayi
FUT–[√among–put.*v*]–TI–IND–3 = PRX.PL

'he will place it among the rest' [FR 120]

c. AFTER V

⟦**ʔé:**.tsi.nx̣ʷ.to:.má.jį̥⟧
áítsinohtoomáyi
a–[√**i**tsin–oht]–oo–m–Ø = ayi
IPFV–[√among–put.*v*]–TI–IND–3 = OBV.SG

'he is placing it among the rest' [FR 120]

(62) a. LEFT EDGE

⟦**ʔo**.ká:.t⟧
***o**káát*
[√**o**k–aa]–t–Ø
[√snare–AI]–2SG.IMP–CMD

'rope!' [FR 182]

b. AFTER C

⟦ʔâ:.k**o**.ka:.wa̧⟧
*áak**o**kaawa*
a–[√**o**k–aa]–Ø–wa
FUT–[√snare–AI]–IND–3

'he will rope' [FR 182]

c. AFTER V

[**ʔó:**.ka:]
***áó**kaawa*
a–[√**o**k–aa]–Ø–wa
IPFV–[√snare–AI]–IND–3

'he is roping' (BB)

- Two subpatterns for [a]-initial roots: the after prefix context begins in [o] or [i].

(63) a. LEFT EDGE
[ʔ**a**.kṣ.tá.ki.t]
***a**kstákit*
[$\sqrt$**a**k–st–aki]–t–Ø
[$\sqrt$count–*v*–AI]–2SG.IMP–CMD
'read!' (BB)

b. AFTER C
⟦ʔâː.k**o**.kṣ.ta.ki.wą̣⟧
*áak**o**kstakiwa*
aak–[$\sqrt$**a**k–st–aki]–Ø–wa
FUT–[$\sqrt$read–*v*–AI]–IND–3
'she will read' [FR 188]

c. AFTER V
⟦ʔ**ɔ́ː**.kṣ.ta.ki.wą̣⟧
***áó**kstakiwa*
a–[$\sqrt$**a**k–st–aki]–Ø–wa
IPFV–[$\sqrt$read–*v*–AI]–IND–3
's/he is reading/counting' [FR 188]

(64) a. LEFT EDGE
[ʔ**a**.tsi.ní.ki.t]
***a**tsinikit*
[$\sqrt$**a**tsinik–i]–t–Ø
[$\sqrt$relate.story–AI]–2SG.IMP–CMD
'relate a story!' (BB)

b. AFTER C
⟦nox^{w}.k**i**.tsí.ni.ki.wą̣⟧
*noohk**i**tsínikit*
noohk–[$\sqrt$**a**tsinik–i]–t–Ø
please–[$\sqrt$relate.story–AI]–2SG.IMP–CMD
'please tell a story!' [FR 120]

c. AFTER V
⟦ʔ**éː**.tsi.ni.ki.wą̣⟧
***áí**tsinikiwa*
a–[$\sqrt$**a**tsinik–i]–Ø–wa
IPFV–[$\sqrt$tell.story–AI]–IND–3
's/he is relating a story' [FR 120]

- The roots with initial [#a] ∼ [i] are highly restricted phonologically: the following consonant is always a voiceless coronal {t, ts, s}.
- The [#a] ∼ [o] pattern occurs before labials, velars, and voiced/sonorant coronals.
- Essentially in complementary distribution (with a few exceptions, discussed in Section A.1.1).
- Abstract representation of each root, before vowel coalescence:

(65)

	UR	Left edge		After C	=	After V	
a.	/itsin-/	⟦ʔitsin-⟧	∼	⟦itsin-⟧	=	⟦itsin-⟧	'among'
b.	/ok-/	⟦ʔok-⟧	∼	⟦ok-⟧	=	⟦ok-⟧	'snare'
c.	/ak-/	⟦ʔak-⟧	∼	⟦ok-⟧	=	⟦ok-⟧	'count, read'
d.	/atsinik-/	⟦ʔatsinik-⟧	∼	⟦itsinik-⟧	=	⟦itsinik-⟧	'count, read'
e.	*/a/	*[a]	∼	*[a]	=	*[a]	

- Phonotactic constraint: no roots begin with [a] after a prefix.[7]
- The two subpatterns are phonologically conditioned by the following segment.
- Vowel coalescence with a preceding vowel.

A.1.1 Minor pattern: #a ∼ -o before coronals

- The minor pattern for roots with initial [#a] ∼ [i] is highly restricted phonologically: the following consonant is always a voiceless coronal {t, ts, s}.
- The [#a] ∼ [o] pattern occurs before labials, velars, and voiced/sonorant coronals.
- Essentially in complementary distribution (with a few exceptions, listed in the Appendix).
- But: some overlap with the initial [#a] ∼ [o] pattern as well. For example, the two roots below have similar segmental strings to 'relate a story' above, but alternate with [o].

(66) a. ⟦ʔ**a**.tsi.na.jíː.^{s}tsi̯⟧
***a**tsinayíístsi*
$\sqrt$**a**tsinayí–ístsi
$\sqrt$fat–IN.PL
'fats' [FR 19]

b. ⟦ʔá.k**ɔː**.tsi.na.ji.ji̯⟧
*ák**aa**tsinayiyi*
ák**aa**–$\sqrt$**a**tsinayi–yi
PRF–$\sqrt$fat–IN.SG
'old fat' [FR 19]

(67) a. ⟦ʔ**a**.tsí.mo.taːt⟧
***a**tsimotáát!*
[$\sqrt$**a**tsimot–áá]–t–Ø
[$\sqrt$escape–AI]–2SG.IMP–CMD
'escape!' [FR 214]

b. ⟦ʔâː.k**o**.tsí.mo.taːt⟧
*áak**a**tsimotaawa!*
aak–[$\sqrt$**a**tsimot–áá]–Ø–wa
FUT–[$\sqrt$escape–AI]–IND–3
'she will flee' [FR 214]

- For this reason, the two allomorphs are not phonologically predictable. I will treat roots with [#a] ∼ [o] before coronals as having lexically listed allomorphs, though nothing hinges on this.

(68) a. {/atsinayi-/, /otsinayi-/} 'fat'
b. {/atsimot-/, /otsimot-/} 'escape'

- For the [a]-initial roots: no roots begin in [a] in both locations, so I assume the UR begins in /a/, and that an [a] at the left edge of a PStem is marked.
- This constraint only holds of the PStem; later metrification can result in a short [a] at the left edge of the root.

(69) *+[a]
Assign a * for every short [a] to the immediate right of a juncture within the phrase.

[7] This is a simplification, because roots which begin with an underlying long [aː] at the left edge can and do begin in [a] after a prefix. This might be some kind of chain shift.

A.2 Initial nasal: #N ∼ -Ø

- Roots begin with nasals, as shown by the "Left edge" condition.
- Initial nasal deletes in the "After C" and "After V" contexts.
- Very few roots with initial *n* followed by a short vowel; not included.

(70) a. LEFT EDGE
⟦**mi**.sá.mi.pɛ:.ta.pi.'si.nąᵒ⟧
***mi**sámipaitapi'ssina!*
√**mi**sám–[ipa–itapi]–'ssin–a
√long.in.time–[life–person]–COLLEC–PRX
'people of long ago' [FR 150]

b. AFTER C
⟦ʔâ:.ks**i**.sa.mo.wąᵒ⟧
*áaks**i**samowa*
aak–[√**mi**sam–o]–w = áyi
FUT–[√long.in.time–II]–IND–3 = PRX.PL
'it will be a long time' [FR 97]

c. AFTER V
⟦ʔá.k**ɛ:**.sa.mo.wąᵒ⟧
*ák**a**isamowa*
akaa–[√**mi**sam–o]–wa
PRF–[√long.in.time–II]–IND–3
'it's been a long time' [FR 145]

(71) a. LEFT EDGE
⟦**mo**.ká.kit⟧
***mo**kákit!*
[√**mo**kak–i]–t–Ø
[√wise–AI]–2SG:3.IMP–CMD
'be smart!' [FR 182]

b. AFTER C
⟦ʔâ:.k**o**.ka.ki.wąᵒ⟧
*áak**o**kakiwa*
aak–[√**mo**kak–i]–Ø–wa
FUT–[√wise–AI]–2SG:3.IMP–IND–3
'she will be smart' [FR 182]

c. AFTER V
⟦ni.k**ɔ́:**.kɪs.ko.a.wąᵒ⟧
nikáókakisskoawa
n–ikaa–[√**mo**kak–i]–ssko–aa–Ø–wa
1–PRF–[√wise–AI]–by.foot.*v*–3OBJ–IND–3
'I have 'wised him up'' [FR 183]

(72) a. LEFT EDGE
⟦**ma**.kí:.ni.ma:wąᵒ⟧
***ma**kíínimaawa*
[√**ma**kiin]–imaa–Ø–wa
[√bury.*v*]–AI–IND–3
'curlew' (lit.: burial lodge) [FR 145]

b. AFTER C
⟦ʔâ:.k**o**.ki:.ni:.wá.jįᵒ⟧
*áak**o**kiiniiwáyi*
aak–[√**ma**kiin]–ii–Ø–w = ayi
FUT–[√bury.*v*]–AI–IND–3 = OBV.SG
'she will bury him in an elevated cache' [FR 184]

c. AFTER V
⟦ʔa:.k**ɔ́:**.ki:.na:.wąᵒ⟧
*aakáók**i**inaawa*
aaka–[√**ma**kiin]–aa–Ø–wa
many–[√bury.*v*]–3OBJ–IND–3
'curlew' (lit.: burial lodge) [FR 145]

- Abstract representation of each root, before vowel coalescence:

(73)

	Left edge		After C	=	After V	
a.	⟦misam-⟧	∼	⟦isam-⟧	=	⟦isam-⟧	'long in time'
b.	⟦mokaki-⟧	∼	⟦okaki-⟧	=	⟦okaki-⟧	'wise'
c.	⟦makiin-⟧	∼	⟦okiin-⟧	=	⟦okiin-⟧	'spread'
d.	*[N]	∼	*[N]	=	*[N]	

- Observation #1: no roots begin with a nasal after a prefix.
- Observation #2: nasal deletion feeds the [#a] ∼ [o] alternation, (73c).
- Observation #3: allomorphy does not optimize syllable structure.
  - Deletion after consonants *could* avoid unattested consonant clusters,
  - But deletion after vowels creates a marked vowel hiatus context.
  - Simple concatenation would be better.
  - Attested output is harmonically bound; incurs extra violations of MAX, UNIF, and *V:.

(74) Incorrect ranking if metrification is concurrent with prosodification

/aka-misam-o-wa/	ONS	MAX	DEP	UNIF	*V:
☞ a. ʔá.ka.mi.sa.mo.wąᵒ			*		
b. á.ka.mi.sa.mo.wąᵒ	*!				
☹ c. ʔá.kɛ:.sa.mo.wąᵒ		*!	*	*	*

- Vowel coalescence with a preceding vowel.

A.3 Initial obstruent: #C ∼ -iC

- This pattern is robust, except that initial [t] or [ts] is rare in Blackfoot due to historical change PA *t > Bl *k* (Berman 2006: 275). No [t]-initial roots in the corpus fit this pattern of allomorphy.
- Roots begin with obstruents, as shown by the "Left edge" condition.
- Epenthetic [i] before the obstruent in the "After C" and "After V" contexts.
- Opaque interaction in the "After V" context, because after vowel coalescence it just looks like the final vowel of the prefix lengthens and changes quality.

(75) a. LEFT EDGE
⟦po.ni.pi.sa̧⟧
ponipisa!
[√pon–p]–is–Ø
[√cease–by.mouth.*v*]–2SG:3.IMP–CMD
'stop carrying him (e.g. a pup)!' [FR 92]

b. AFTER C
⟦ʔâː.ksi.po.ni.piː.wá.ji̧⟧
áaksiponipiiwáyi
aak–[√pon–p]–ii–Ø–w = áyi
FUT–[√cease–by.mouth.*v*]–3SUB–IND–3 = PRX.PL
'she will stop carrying him with her teeth' [FR 92]

c. AFTER V
⟦ʔá.kɛː.po.ni.pa.wa̧⟧
ákaiponipawa
áka–[√pon–p]–a–Ø–wa
PRF–[√cease–by.mouth.*v*]–3OBJ–IND–3
'he [pup] is no longer being carried by its mother' [FR 92]

(76) a. LEFT EDGE
⟦ka.mo.táːt!⟧
kamotáát!
√kamot–áá–t–Ø
√survive–AI–2SG:3.IMP–CMD
'escape!' [FR 43]

b. AFTER C
⟦ʔâː.ksi.ka.mo.taː.wa̧⟧
áaks-ikamot-aa-wa
aak–[√kamot–áá]–Ø–wa
FUT–[√survive–AI]–IND–3
'she will escape, give birth' [FR 43]

c. AFTER V
⟦máː.to.mɛː.ka.mo.taː.wa̧⟧
máátomaikamotaawa
maat–omaa–[√kamot–áá]–Ø–wa
NEG–yet–[√survive–AI]–IND–3
'she has not yet given birth' [FR 43]

(77) a. LEFT EDGE
⟦so.ma.toːt!⟧
somatoot!
[√som–át]–oo–t–Ø
[√spread–*v*]–TI–2SG:3.IMP–CMD
'place a covering on it!' [FR 99]

b. AFTER C
⟦ni.tâː.ksi.só.maː.ki̧⟧
nit-áaks-isóm-aaki
nit–aak–[√som–iʔ]–áki–(hp)
1–FUT–[√spread–*v*]–AI–(IND)
'I will spread (e.g. the tablecloth)' [FR 99]

c. AFTER V
⟦ʔéː.so.maː.ki⟧
á-ísom-aaki
a–[√som–áá]–Ø–(wa)
IPFV–[√spread–AI]–IND–(3)
'she spread a hide out' [FR 99]

- Abstract representation of each root, before vowel coalescence:[8]

(78)

	Left edge		After C	=	After V	
a.	⟦pon-⟧	∼	⟦ipon-⟧	=	⟦ipon-⟧	'cease'
b.	⟦kamot-⟧	∼	⟦ikamot-⟧	=	⟦ikamot-⟧	'escape'
c.	⟦som-⟧	∼	⟦isom-⟧	=	⟦isom-⟧	'spread'
d.	*[C]	∼	*[C]	=	*[C]	

- Observation #1: no roots begin with an obstruent after a prefix.
- Observation #2: epenthesis is made opaque by vowel coalescence in the "After V" context.
- Observation #3: allomorphy does not optimize syllable structure.
  - Epenthesis after consonants *could* avoid unattested consonant clusters.
  - But epenthesis after vowels creates a marked vowel hiatus context.
  - Simple concatenation would be better.
- Observation #4: the [i] cannot be part of the root and then deleted at the "Left edge", or else the vowel-initial roots should pattern the same.
- Attested output is harmonically bound; incurs extra violations of ID(low) and *V:, (79).

(79) Incorrect ranking if metrification is concurrent with prosodification

/aka-pon-ip-a-wa/	ONS	MAX	DEP	ID(low)	DEP(μ)	*V:
☞ a. ʔá.ka.po.ni.pa.wa̧			*			
☹ b. ʔá.kɛː.po.ni.pa.wa̧			*	*!	*!	*!
c. á.kɛː.po.ni.pa.wa̧	*!			*	*!	*

A.3.1 With root-internal changes

- Two processes of root-internal changes

1. Vowel syncope and gemination (Berman 2006); SNAKE-STEMS in Thomson (1978).

(80) a. LEFT EDGE
⟦po.no.ká.wa̧⟧
ponokáwa
√ponoka–wa
√elk–PRX
'elk' [FR 230]

[8] Very few roots begin in [t] or [ts], due to a change of *t > *k* in this position (Berman 2006: 275)

b. AFTER C

⟦si.ksín.no.kɛː.ksi̯⟧
siksínnokaiksi
sik–√nnoka–iksi
black–√elk–AN.PL

'black elks' [FR 230]

c. AFTER V

⟦ma.kɛn.no.kɔː.mi.taː.wa̯⟧
makainnokaomitaawa
maka–√nnoka–√omitaa–wa
stunted–√elk–√dog–PRX

'horse of stunted growth, e.g. a Shetland pony' [FR 144]

(81) a. LEFT EDGE

⟦ki.pi.tá.aː.kiː.wa̯⟧
kipitáaakiiwa
√kipitá–√aakii–wa
√old.woman–√woman–PRX

'old woman' [FR 138]

b. AFTER C

⟦po.ksíp.pi.táaː.kiːks⟧
poksíppitáaakiiksi
pok–√ppitá–√aakii–iksi
small–√old.woman–√woman–AN.PL

'little old women' [FR 138]

c. AFTER V

⟦ʔa.mɛ́p.pi.tá.aː.kiː.wa̯⟧
amáíppitáaakiiwa
amá–√ppitá–aakii–wa
pathetic–√old.woman–√woman–PRX

'pathetic old woman' [FR 12]

2. Vowel syncope before <ssC> (Berman 2006); SCRATCH-STEMS in Thomson (1978).

(82) a. LEFT EDGE

⟦pɪs.tsí.pxʷ.toːt⟧
pisstsípohtoot!
pisst–íp–oht–oo–t

'bring it in' [FR 96]

b. AFTER C

⟦ʔâː.ksi.ps.tsi.pʷ.toː.ma̯⟧
áaksipsstsipohtooma
áak–psst–ip–oht–oo–m–a

'she will bring it in' [FR 96]

c. AFTER V

⟦ni.tɛ́ː.ps.tsoʔ.kjaː.wa̯⟧
nitáípsstso'kiaawa
nit–á–psst–yo'ki–aa–wa

'I am enclosing them' [FR 97]

(83) a. LEFT EDGE

⟦ksis.ka.nɔ́ː.to.ni.wa̯⟧
ksisskanáótoniwa
ksisskan–áótoni–wa

'it is/was morning' [FR 67]

b. AFTER C

⟦ʔa.kâː.ksi.ks.ka.nɔ́ː.tʊn.ni.wa̯⟧
akáaksiksskanáótonniwa
aká–ak–iksskan–áótonni–wa

'it will soon be morning' [FR 67]

c. AFTER V

⟦ʔá.kɛː.ks.ka.nɔ́ː.tʊn.ni.wa̯⟧
ákaiksskanáótonniwa
áka–iksskan–áótonni–wa

'it has become morning' [FR 67]

- Idiosyncratic and exceptional; ∼20 forms total (Thomson 1978).
- Not all stems with the right shape undergo these processes.
- Example (84) is phonologically similar to (85b) but has no root-internal changes.

(84) a. LEFT EDGE

⟦pɪs.ka.ni̯⟧
pisskani
√pissk–an–i
√fence–NMLZ–IN.SG

'buffalo jump' [FR 228]

b. AFTER C

⟦po.ksi.pís.ka.niˢtsi̯⟧
poksipísskanistsi
pok–√píssk–an–istsi
small–√fence–NMLZ–IN.SG

'small (miniature) buffalo jumps' [FR 228]

- Summary of allomorphs:

(85)

	Left edge		After C	=	After V	
a.	⟦ponoka-⟧	∼	⟦inːoka-⟧	=	⟦inːoka-⟧	'elk'
	⟦kipita-⟧	∼	⟦ipːita-⟧	=	⟦ipːita-⟧	'old woman'
b.	⟦pist-⟧	∼	⟦ipst-⟧	=	⟦ipst-⟧	'in'
	⟦ksiskan-⟧	∼	⟦ikskan-⟧	=	⟦ikskan-⟧	'early'

- Neither form is easily derivable from the other.
- Possibly an abstract analysis is possible for (85a): /pnoka-/ 'elk', /kpita-/ 'old woman'. One problem is that these forms include consonant clusters which are never seen on the surface, and they require particular phonological processes that exist nowhere else in the grammar, such as changing a cluster to a geminate.
- Possibly an abstract analysis is possible for (85b): /pst-/ 'in', and *kskan-* 'early'. One problem is that there are roots which begin at the left edge with CsC clusters, but which follow some other pattern. Possibly those have some other, different, abstract analysis.
- It is unclear whether we are simply recreating an internal reconstruction.
- If abstract URs are not used, then lexically listed allomorphs would work. (The [i] after prefixes is treated as epenthetic.)

(86)

a.	{/ponoka-/, /nnoka-/}	'elk'
	{/kipita-/, /pːita-/}	'old woman'
b.	{/pist-/, /pst-/}	'in'
	{/ksiskan-/, /kskan-/}	'early'