Phase-based Constraints within Match Theory

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1 Introduction

Research on prosodic phonology over the past 40 years has shown that prosodic structure is closely related to syntactic structure, but may mismatch in ways that are phonologically optimizing (cf. Downing, 1999; Inkelas, 1990; Ladd, 2008; Nespor & Vogel, 2007; Selkirk, 1986, 2011; Truckenbrodt, 1999). One aspect of this research concerns the syntactic constituents which are relevant for prosodic structure. In general, lexical heads (X0 in X-bar theory; Jackendoff 1977) correspond by default to prosodic words, and maximal projections (XP) correspond to phonological phrases. However, there are phonological and syntactic reasons to extend theories of phrasal correspondences “below the word”. In terms of phonology, many languages have phonological domains which correspond to morphological units smaller than the inflected word. Because of this, many theories of the syntax-phonology interface allow correspondences between morphological constituents like the stem and morphophonological constituents like the Prosodic Stem (e.g. Downing, 1999; Inkelas, 1990; McCarthy & Prince, 1993a; Nespor & Vogel, 2007). In terms of syntax, Bare Phrase Structure (Chomsky, 1995) erases any distinction between X0 and XP. Because of this, recent constructionist theories argue that complex words are constructed using the same syntactic principles which underlie phrases (Borer, 2013; Halle & Marantz, 1993; Marantz, 1997; Starke, 2009).

These developments in phonology and syntax raise the possibility that phrasal and word-internal prosodic constituents could be defined by correspondence to phrasal syntactic constituents, without relying on language-specific morphological definitions. This paper takes this idea seriously by analyzing the prosodic and syntactic structure of the verbal complex in Blackfoot (Algonquian; Frantz 2017), a polysynthetic, strongly head-marking language. I show that the verbal complex contains two distinct prosodic constituents as well as phrasal syntactic constituents, making Blackfoot an ideal test case for bringing phrasal prosodic phonology “below the word”. Match Theory (Selkirk, 2011) is chosen as the framework for syntax-prosody correspondence, because it posits a small number of universal prosodic constituents which correspond to universal syntactic constituents in constrained ways. There is therefore no need to refer to morphological constituents. I argue that the “syntactic word” and the “syntactic phrase” must be redefined in order to account for the phrasal correspondences within the Blackfoot verbal complex. I propose that syntactic vP and CP phases (Chomsky, 2001) are the units which correspond by default to prosodic words and phrases, respectively. The result is a unified theory of the prosodic phonology of stems and phrases which is built on universal syntactic definitions.

2 Prosodic structure of the verbal complex

In this section I argue that there are two distinct prosodic constituents within the verbal complex, which I call the Prosodic Word (PWd) and the Phonological Phrase (PPh). I focus the discussion on epenthesis and root alternations, because they provide evidence for the PWd constituent which corresponds to the stem. (For a fuller discussion of Blackfoot phonology and syllable structure, see Elfner 2006; Goad & Shimada 2014; Weber 2020.) The process of epenthesis is interrupted at the left and right edges of the stem, which I take as evidence for a prosodic constituent. The root alternations conspire to avoid stops at the left edge of the stem, which I take as further evidence for this prosodic constituent.

* Thank you to Natalie Creighton, Rod Scot, and especially Beatrice Bullshields, for teaching me and sharing their language. Nitsikothaahṣi’taki! Thanks also to Douglas Pulleyblank, Rose-Marie Déchaine, Andrei Anghelescu, Taylor Miller, Inge Genee, Mizuki Miyashita, Jason Shaw, and the Phonology Reading Group at Yale for helpful comments.

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2.1 Epenthesis within the stem  

The evidence for epenthesis comes from two patterns of alternation for stem-internal suffixes. One group of suffixes exhibit an [i] ∼ Ø alternation at the left edge after consonants and vowels, respectively. For example, the suffix /­pist/ ‘tie’ is [­ipist] after a consonant, (1a), but [­pist] after a vowel, (1b). I have bolded the suffix-initial [-i] and [-p] sequences below.¹

(1) a. AFTER C
[ŋitâːksoxʷkispiːsta]
[ŋitâaksoohkispiːsta] nit–aak–[√yoohk–pist–aa]–(hp)
1–FUT,[√lid–tie.v–AI]–(IND)
‘I will close the tipi flap’

b. AFTER V
[ʔamopiːtaːni]
amopiːstaani
[√amo–pist–aa]–n–i
[√gather–tie.v–AI]–NMLZ–IN.SG
‘ceremonial bundle’

(2) a. AFTER C
[ʔomatsipːiːs]
omatsipːiisa
[√omat–ipi–ːs]–Ø
[√start–bring.v–2:3.IMP]–CMD
‘transport him!’

b. AFTER V
[ʔamőipiːsaːwã]
amŏipiːsaawa
[√amo–ipi–ːs]–Ø=aawa
[√gather–bring.v–2:3.IMP]–CMD=PRX.PL
‘gather them!’

There are multiple vowel hiatus resolution strategies in Blackfoot, which means that the suffix [­ipi] ‘bring’ has other realizations after other vowels. For example, this suffix is realized as [­ɛːp] after an [a], like the root-final [a] in [√Sa‘out’], (3), where [ɛː] is a coalesced vowel that reflects an underlying /a+i/ sequence.

(3) AFTER V
[sɛːpiːs]
saipiis
[√sa–ipi–ːs]–Ø
[√out–bring.v–2:3.IMP]–CMD
‘bring her out!’

Those alternations are summarized below. Suffixes like ‘tie’ begin in a vowel after consonants and a consonant after vowels. Abstracting away from vowel coalescence, suffixes like ‘bring’ begin in a vowel in both environments. I take this as evidence that ‘tie’ begins in an underlying consonant, while ‘bring’ begins in a vowel. The [i] ∼ Ø alternation at the left edge of ‘tie’ can be analyzed as epenthesis between consonants which is driven by principles of syllabification (Itô, 1986).

(4) After C After V UR Gloss
(a. [-ipi] ~ [-pi] /-pi/ ‘tie.v’
(b. [-ipi] ~ [-ipi] /-ipi/ ‘bring.v’

¹ All data is from Frantz & Russell (2017) unless otherwise stated; any examples marked with “(BB)” are from the author’s fieldwork with Beatrice Bullshields. For the morphemic analysis of examples, I use the orthography in Frantz (2017) and Frantz & Russell (2017), which maps closely to phonemic or broad phonetic transcription (except that /ʔ/ = <’>, /j/ = <y>, /x/ = <h>, /ɛː/ = <ei>, /ɔː/ = <ao>, and other long sounds are doubled.) IPA transcriptions are based on the orthography and are surrounded by double brackets, [ ]. The stem is given in square brackets, [ ]. Abbreviations which are not included in the Leipzig Glossing Rules (Comrie et al., 2015): o = object, s = subject, AI = animate intransitive, AN = animate, CMD = command clause, CNJ = conjunctive order, DEG = degree marker, DEP = dependent clause, IN = inanimate, IND = independent order, INV = inverse, OBV = obviative, PRX = proximate, SHEET = two-dimensional flexible material, TA = transitive animate, TI1 = transitive inanimate (Class 1), TI2 = transitive inanimate (Class 2).
Finally, a morpheme-final /k/ always assimilates to [ks] before the epenthetic vowel [i]. In (1a) the root √yoohk ‘lid’ surfaces with a final [ks] before the epenthetic vowel [i]. This root ends in [k] before other vowels, such as [a] in (5) and [o] in (6), which I take as evidence that the morpheme ends in an underlying /k/. To complicate matters a bit, note that morphemes can end in either [k] or [ks] before an underlying /i/ (Armoskaite, 2006; Weber, 2020). The important point here is that only [ks] is allowed before epenthetic [i].

(5) [ʔáka:jóxʷkann:ima]  
ákaayóóhkaninnima  
akaa-[√yoohk-an-inn-i]-m-a  
PRF-[√lid-sheet-by.hand.v--THI]-IND--3  
’he has shut it (as a window’

(6) [ʔáksoxʷkójiji:wájį̱]  
áaksoohkóiyiwiwį̱  
aak-[√yoohk-oiy-i-yį̱]-O--w=wąį̱  
FUT-[√lid-mouth-v--3]-IND--3=OBV.SG  
’she will cover it with a lid’

To summarize the properties of epenthesis: epenthetic [i] occurs between consonants only and always causes assimilation of a preceding /k/ to [ks]. In the next section I show how this process of assimilation is blocked across the right edge of the stem, which I take as evidence for a prosodic boundary.

2.2 Diagnosing the right edge of the PWd The evidence for the right edge of the stem is that /k/-assimilation before an epenthetic vowel is blocked across the right edge of the stem. The inverse suffix -ok/ is the only /k/-final suffix which can occur at the right edge of the stem. The suffix [-nːaːn] ∼ [-nːaːn] ‘1PL.’ begins with a vowel after a consonant, (7), and a consonant after a vowel, (8).

(7) AFTER C  
nitsikákomim:okn:a:ni]  
nitsikákomimkinn:naani  
nit–ik–[√akom–imm–ok]–O–nnaan–i  
1–DEG–[√favor–by.mind.v–INV]–IND–1PL–3PL  
‘They love us (excl.).’ (Frantz, 2017:61, (i))

(8) AFTER V  
nitsikákomim:n:a:ni]  
nitsikákomimm:naani  
nit–ik–[√akom–imm–aa]–O–nnaan–i  
1–DEG–[√favor–by.mind.v–30]–IND–1PL–3PL  
‘We (excl.) love them.’ (Frantz, 2017:57, (g))

The suffix [-oaː] ∼ [-waː] ‘PL’ begins with a vowel after a consonant, (9), and a glide after a vowel, (10).

(9) AFTER C  
kitsikákomim:oka:jii]  
kitsikákomimm:okaayii  
kit–ik–[√akom–imm–ok]–O–ooa–yi  
2–DEG–[√favor–by.mind.ta–INV]–IND–PL–3PL  
‘They love you (pl.).’ (Frantz, 2017:61, (j))

(10) AFTER V  
kitsikákomim:awa:jii]  
kitsikákomimm:awaayi  
2–DEG–[√favor–by.mind.ta–30]–IND–PL–3PL  
‘You (pl.) love them.’ (Frantz, 2017:57, (h))

In other words, both suffixes begin with a vowel after a consonant, and a consonant after a vowel. Only the ‘1PL.’ suffix exhibits alternations compatible with epenthesis, because the vowel-initial realization is formed by adding an extra vowel [i] to the left edge of the morpheme. (Note that vowels are predictably lax before geminates.) In contrast, the ‘PL.’ suffix shows a pattern of [w]-vocalization after consonants. However, epenthesis does not cause the stem-final /k/ to assimilate to [ks]. I take this as evidence for a prosodic boundary at the right edge of the stem which blocks assimilation.

(11)  
<table>
<thead>
<tr>
<th>After C</th>
<th>After V</th>
<th>UR</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [-nːaːn] ∼ [-nːaːn]</td>
<td>/nːaːn/</td>
<td>‘1PL’</td>
<td></td>
</tr>
<tr>
<td>b. [-oaː] ∼ [-waː]</td>
<td>/oaː/</td>
<td>‘PL’</td>
<td></td>
</tr>
</tbody>
</table>

In the next section I show how epenthesis occurs after consonants and vowels at the left edge of stems which begin in plosives. This unusual epenthesis and other root alternations can be explained by a restriction against stops at the left edge of the stem, which I take as evidence for a prosodic boundary.

Another possibly is that both suffixes begin with an underlying vowel which deletes after another vowel, assuming that there is a glide [w] between the two vowels of the plural suffix. More research is needed to determine whether other suffixes also exhibit deletion. If so, then there is no strong evidence for a prosodic boundary at the right edge of the stem.
2.3 Diagnosing the left edge of the PWd  In this section I consider root alternations in two positions: at the left edge of the verbal complex, and after a prefix. There are three generalizations which I take as evidence for a prosodic boundary at the left edge of the stem. First, some roots which begin with a plosive at the left edge of the verbal complex exhibit epenthesis after a prefix of any kind, regardless of whether the root follows a consonant or a vowel. For example, √POMM ‘transfer’ begins with a [p] at the left edge, (12), but [ip] after any prefix. After a consonant, the evidence is that there is an extra vowel [i] between the two consonants which causes assimilation of a preceding /k/, (13a). After a vowel, the evidence is that the vowel length and quality changes exactly as it would if an underlying /i/ followed. In (13b) the prefix /a-/ ‘IPFV’ surfaces as [ɛː] before √POMM, as if from an /a+i/ sequence. Note that this alternation is not driven by syllable structure, since the form *[ʔapɔm:akiwḁ] without epenthesis is perfectly well-formed.

(12) LEFT EDGE

\[
\begin{array}{l}
[\text{pomːoːs}] \\
\sqrt{\text{pomm-o-ːs}-\emptyset} \\
[\sqrt{\text{transfer-v-2:3:IMP}}-\text{CMD}] \\
\text{‘transfer (e.g. the medicine bundle) to him!’}
\end{array}
\]

(13) a. AFTER C

\[
\begin{array}{l}
[?\text{ksipom:ojiːwájí}] \\
\text{aakslpɒmmmɔyiwáyí} \\
\text{FUT-[\sqrt{\text{transfer-v-3:3}}-\text{IND-3=OBV.SG}} \\
\text{‘he will transfer it to her’}
\end{array}
\]

b. AFTER V

\[
\begin{array}{l}
[?\text{ıpom:akiwḁ}] \\
\text{áipɔmɔmakiwa} \\
\text{a-[\sqrt{\text{pomm-0-ːaki}}-\text{0-w=ayi}} \\
\text{IPFV-[\sqrt{\text{transfer-v-AI}}-\text{IND-PRX}} \\
\text{‘the one transferring (previous owner)’}
\end{array}
\]

Second, all roots which exhibit alternations have one form at the left edge of the verbal complex, and a second form after a prefix of any kind. Weber (2020) considers a range of diverse alternations, shown in (14). For example, after a prefix roots may exhibit epenthesis, (a)–(b), an [ox] accretion, (c), deletion (d), or glide substitution, (e). However, the distribution of forms at the left edge vs. after a prefix is uniform.

(14) LEFT EDGE AFTER C AFTER V GLOSS

<table>
<thead>
<tr>
<th></th>
<th>LEFT EDGE</th>
<th>AFTER C</th>
<th>AFTER V</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>[pomː]</td>
<td>[ipomː]</td>
<td>[ipomː]</td>
<td>‘transfer’</td>
</tr>
<tr>
<td></td>
<td>[kipitiː]</td>
<td>[ipitiː]</td>
<td>[ipitiː]</td>
<td>‘aged’</td>
</tr>
<tr>
<td>b.</td>
<td>[pomː]</td>
<td>[oxpomː]</td>
<td>[oxpomː]</td>
<td>‘buy’</td>
</tr>
<tr>
<td>c.</td>
<td>[iːp]</td>
<td>[jiːp]</td>
<td>[jiːp]</td>
<td>‘decrease’</td>
</tr>
<tr>
<td>d.</td>
<td>[maːn]</td>
<td>[an]</td>
<td>[an]</td>
<td>‘recent’</td>
</tr>
<tr>
<td></td>
<td>[niːpo]</td>
<td>[ipo]</td>
<td>[ipo]</td>
<td>‘upright’</td>
</tr>
<tr>
<td>e.</td>
<td>[maːk]</td>
<td>[jaːk]</td>
<td>[jaːk]</td>
<td>‘arrange’</td>
</tr>
<tr>
<td></td>
<td>[naːm]</td>
<td>[jaːm]</td>
<td>[jaːm]</td>
<td>‘alone’</td>
</tr>
</tbody>
</table>

Third, certain segments are prohibited at the beginning of roots in each of these two positions. Table 1 summarizes these restrictions, aggregated across all root alternations. Roots never begin with a glide (e.g. a [-cons] segment; solid line) when they stand at the left edge of a verbal complex, and roots never begin with a stop (e.g. a [-cont] segment; dashed line) after a prefix.

**Table 1:** Segments allowed at left edge of roots in two positions

<table>
<thead>
<tr>
<th></th>
<th>p</th>
<th>k</th>
<th>m</th>
<th>n</th>
<th>j</th>
<th>w</th>
<th>i</th>
<th>o</th>
<th>e</th>
<th>ɔ</th>
<th>a</th>
<th>i</th>
<th>o</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left edge</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>After prefix</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
All three facts can be explained if there is a prosodic boundary at the left edge of the stem with an edge restriction against [-cont] segments. Epenthesis occurs at the left edge of obstruent-initial roots in order to displace stops away from the prosodic boundary, thereby satisfying the edge restriction; this is the reason that epenthesis occurs after consonants and vowels. The other types of root alternations serve the same function. Evidently the effects of this edge restriction are blocked when the left edge of the prosodic boundary aligns with the left edge of the verbal complex.

2.4 Two distinct prosodic constituent types

The generalizations in the preceding sections can be accounted for if there is a Prosodic Word (PWd) constituent which corresponds to the stem, designated with ( ) in (15). The PWd domain is motivated by the distinct phonotactic restrictions on either edge. The left edge prohibits [-cont] segments, and the right edge prohibits [ks], even before an epenthetic vowel.

(15) PROSODY OF THE VERBAL COMPLEX
\{person–prefix*–(stem)_{PWd}–suffixes\}_{PPh}

Although it is not the focus of this paper, there is a distinct Phonological Phrase (PPh) constituent which corresponds to the entire verbal complex, designated with { } above. The left edge of this constituent prohibits glides (as shown in Table 1). This constituent is also well-established as the domain of vowel coalescence and /u/-assibilation (Bliss, 2013; Weber, 2020), and Weber (2020) also establishes PPh as the domain with minimal size constraints, obligatory stress, and an extra consonant slot at the right edge. Note that the PWd and the PPh cannot be analyzed as a single recursive constituent type, because they have distinct phonological generalizations (cf. arguments in Vogel, 2009).

Now that I have established the existence of two distinct prosodic constituents within the verbal complex, in the next section I turn to a discussion of the internal syntax of the stem and verbal complex. I argue that the stem and verbal complex are both derived via phrasal syntax.

3 Syntactic structure of the verbal complex

In this section I argue that the stem and the verbal complex are phrasal syntactic constituents. Specifically, the stem is a vP/VP phrase and the verbal complex is a CP phrase.

3.1 The stem is a vP/VP phrase

I focus on two arguments that the stem itself is phrasal. First, the stem contains suffixes instantiating the heads V^0 and v^0, indicating that the stem contains VP and vP phrasal projections. Second, the stem-internal √ROOT is a phrasal adjunct which freely modifies verbs or nouns. Both of these facts indicate that the stem is derived via phrasal syntactic operations.

The smallest intransitive verb stems consist of an a-categorical √ROOT and a verbal suffix. The suffix (bolded below) occurs only in intransitive stems and agrees with the grammatical (in)animacy of the single argument, which is always a DP. In (16) the root √OMAHK ‘big’ combines with -i if the DP is animate, (16a), or -o if the DP is inanimate, (16b). The stem is given in square brackets.

(16) \textbf{INTRANSITIVE VERBS}

a. áakomahksimma
   áak–[√omahk–i]–mm–a  
   FUT–[√large–AI]–IND–3 
   ‘s/he will be older, large’

b. áakomahkōwa
   áak–[√omahk–o]–O–wa 
   FUT–[√large–II]–IND–3 
   ‘it will be big’ (BB)

The smallest transitive verbs consist of an a-categorical √ROOT and two verbal suffixes. The first suffix occurs only in transitive stems, while the second suffix (bolded below) agrees with the (in)definiteness and grammatical (in)animacy of the internal argument. In (17) the root √SSP ‘high’ combines with the transitive suffix -imm ‘by hand’. The second suffix is -ii\(^3\) if the internal argument is a DP and animate, (17a), -i if it is a DP and inanimate, (17b), and -aki if it is not a full DP, regardless of animacy.

\(^3\) This suffix takes different forms depending on the person features of both arguments. For certain configurations of subject and object the suffix agrees with one of the two arguments, while for others the suffix is simply -ok ‘inverse’. This type of direct/inverse agreement system occurs across the Algonquian family (Oxford, 2014).
Based on derivational paradigms like those above, Déchaine & Weber (2018) and Weber (2020) argue that the verbal suffixes instantiate verbal heads in the standard argument structures shown in (18). In this way there is a one-to-one mapping between the morphology and syntax of the verb stem. The restrictions on DP features discussed above are analyzed as the result of an Agree operation, where a head probes for a matching feature (Chomsky, 2000). Intransitive verbs contain a V₀ which is instantiated by the single suffix in intransitive verbs, and which selects one DP, (18b). This V₀ enters the derivation with an unvalued [µanim] feature enters a syntactic Agree relation with the local DP, which values the animacy feature as [+anim] or [−anim]. Transitive verbs contain two heads, big V₀ and little v₀ (Hale & Keyser, 1993; Kratzer, 1996; Marantz, 1997), with V₀ selecting the internal argument, DP_o, and v₀ selecting the external argument, DP_s, (18b). Because the first suffix is restricted to transitive verbs I assume it instantiates v₀, and the second suffix instantiates V₀. The big V₀ in transitive verbs probes for animacy and definiteness (Weber & Matthewson, 2017). Following Kim (2017); Wiltshko & Ritter (2015), the higher v₀ enters the derivation with an unvalued [µm(ental state)] feature and enters a syntactic relation with the external argument.⁴

For the purposes of this paper, the main takeaway is that the verbalizing suffixes in Blackfoot instantiate individual heads within the phrasal syntax. This shows that the verbal complex is phrasal and contains a VP and vP phrase. Further evidence for this claim is that the stem-internal √ROOT in Blackfoot is a phrasal adjunct to an intransitive VP or transitive vP, as in (19).⁵

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⁴ This syntactic analysis follows Déchaine & Weber (2018) and Weber (2020). Other syntactic analyses of Algonquian verb stems agree that the first suffix after the √ROOT is a light verbal head, but differ in how the √ROOT and the second suffix in transitive verbs are syntacticianized (Hirose, 2000; Brittain, 2003; Quinn, 2006; Branigan et al., 2005).

⁵ Déchaine & Weber (2018) argues that a √ROOT in Blackfoot and Plains Cree may syntactize in one of three ways: as XP-adjuncts, as X⁰-adjuncts computed online, and as precompiled X⁰-adjuncts. Here I focus only on XP-joined roots.
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(19) Root syntactization as phrasal adjunct

a. Intransitive: \[ [vp\sqrt{\text{root}}] \]

b. Transitive: \[ [vp\sqrt{\text{root}} \ [dp_0 \ [vp \ [v_0 \ dp_o]]]] \]

Phrasal adjuncts have three correlates: (1) no categorical restrictions on their sister, (2) no limit on the number of adjuncts in a phrase, (3) phrasal adjuncts can themselves be phrasal. All three correlates are true for Blackfoot roots. First, the root \( \sqrt{\text{OMAHK}} \) ‘big’ can occur as a modifying prefix to a full verb stem, (20), or noun stem, (21). Second, roots can freely stack, as shown (20), with the order of the prefixes determining scope relations (Bliss, 2013).

(20) Adjunct to verb stem

\( \sqrt{\text{omahk}} \)nikkssapiwa

\( \sqrt{\text{big}} \)–sulking–[\( \sqrt{\text{thus}} \)–look.ai]–\( \sqrt{\text{IND}} \)–3

‘she gave a [big—NW] sulking glance’

(21) Adjunct to noun stem

\( \sqrt{\text{omahk}} \)omitaa

\( \sqrt{\text{big}} \)–dog–\( \sqrt{\text{PRX}} \)

‘big dog’

Third, the adjunct need not be a monomorphemic root; modifying prefixes can themselves be phrasal. In the example below, the modifier for the stem opii ‘sit’ is a multimorphemic phrase (a nominalized verb stem).

(22) Phrasal adjunct to verb stem

\( \sqrt{\text{aakso}} \)kaanōpiwa

\( \sqrt{\text{fut}} \)–[\( \sqrt{\text{sleep}} \)–\( \sqrt{\text{AI}} \)–\( \sqrt{\text{NMLZ}} \)–sit.ai]–\( \sqrt{\text{IND}} \)–3

‘he will doze (off)’

Adjuncts are usually optional, so it is surprising that the roots I analyze as \( vP/VP \) adjuncts are obligatory. As I showed above, the verbal heads contribute grammatical information (e.g. valency, and agreement with DP arguments) but they contribute very little, if anything, in terms of lexical/concrete meaning. Perhaps adjoined roots are obligatory because the verbal heads are so ‘light’ that event modifiers are required to restrict their denotation.\(^6\) On this view, some languages restrict light verbs via nominal complements (e.g. English take a seat, do the dishes), while other languages restrict them via adverbial modifiers (e.g. Blackfoot).

3.2 The verbal complex is a CP phrase

In this section I argue that the verbal complex itself is a minimal CP. First I argue that the verbal complex contains a C\(^0\) merged with an IP complement, \( [cp\ C^0 \ [ip \ I^0 \ldots ] \] \). Then I argue that the verbal complex has the distribution of a CP.

There are five morphological clause types in Blackfoot, which are each associated with a distinct set of clause-typing suffixes. Following Déchaine & Wiltschko (2010) and Ritter & Wiltschko (2014), I assume that these suffixes instantiate I\(^0\). Two of the five morphological clause types are shown below (independent and imperative), with the clause-typing suffix bolded.

(23) Independent

\[ [cp\ Kitsówatoo*poaawa] \]

\( \sqrt{\text{kit}} \)–[\( \sqrt{\text{ow–ta–oo}} \)–\( \sqrt{\text{p–ooa–wa}} \)–2–[\( \sqrt{\text{eat–v–T12}} \)–\( \sqrt{\text{IND}} \)–2pl.\( \sqrt{\text{2}} \)]

‘You all ate it.’

(24) Imperative

\[ [cp\ Oowátoo] \]

\[ [oo–wat–oo]–\( \sqrt{\text{k–O}} \)–\( \sqrt{\text{eat–v–T12}} \)–2pl.\( \sqrt{\text{IMP}} \)–\( \sqrt{\text{IMP}} \)]

‘(you all) eat it!’

There is also a suffix in the verbal complex (underlined above) which Weber (2020) argues instantiates C\(^0\). The evidence is that there are dependencies between the C\(^0\) and its complement IP, such that C\(^0\) selects the finiteness of the complement IP phrase. This is similar to the relationship between complementizers and

\(^6\) A semantic argument for why verbal heads are bound is also pursued in Déchaine & Weber (2015) for Blackfoot and Plains Cree and in Slavin (2012) for Oji-Cree. In contrast, Déchaine & Weber (2018) takes the view that this is a morphosyntactic requirement.
(in)finite clauses in English, such as how that occurs with tensed clauses and for occurs with infinitive clauses. In Blackfoot, the relevant finiteness distinction is realis/irrealis rather than tense (Déchaine & Wiltschko, 2010), which has semantic and morphological correlates; namely, person proclitics are only allowed in [+REALIS] clauses. Thus, the independent clause in (23) is [+REALIS] while the imperative clause in (24) is [-REALIS]. Weber (2020) considers the full range of C⁰ heads, and argues that some types of C⁰ require a [+REALIS] IP complement, some require a [-REALIS] IP complement, and some are neutral to the realis/irrealis distinction. The generalizations are given in Table 2.

**Table 2: Dependencies between C⁰ and IP features**

<table>
<thead>
<tr>
<th>C⁰</th>
<th>Features of the IP</th>
<th>Clause types</th>
</tr>
</thead>
<tbody>
<tr>
<td>-wa ’3’, -yini ’3SG.OBV’, -yi ’3PL’</td>
<td>[+REALIS]</td>
<td>independent</td>
</tr>
<tr>
<td>-wa ’3’</td>
<td>[+REALIS]</td>
<td>independent (non-assertive)</td>
</tr>
<tr>
<td>-Ø ’3’, -yini ’3SG.OBV’, -yi ’3PL’</td>
<td>[+REALIS]</td>
<td>unreal</td>
</tr>
<tr>
<td>-’DEP’</td>
<td>neutral</td>
<td>conjunctive, subjunctive</td>
</tr>
<tr>
<td>-Ø ’IMP’</td>
<td>[-REALIS]</td>
<td>imperative</td>
</tr>
</tbody>
</table>

The entire verbal complex has the distribution of a CP: some clauses only occur in matrix clauses, some only occur in embedded contexts, and some are neutral with respect to embedding. For example, the C⁰ head -i shown in (25) only occurs in embedded clauses, while the C⁰ heads in (23) and (24) occur in matrix clauses.

(25) **Conjunctive**

\[
\begin{align*}
\text{[CP} & \text{Nitsskì’i’ña}& \text{[CP} & \text{kitsówatoohsoayì] } \text{[CP]} \\
\text{Nit} & \text{[ssk–in/Ø–i]–’p–a}& \text{kit} & \text{[io–wat–oo]–hs–oaa–yi} \\
\end{align*}
\]

‘I know you ate it.’ (Frantz 2017:123, (f); re-glossed)

The generalizations for the full range of C⁰ heads are given in Table 3.

**Table 3: Dependencies between C⁰ and embeddedness**

<table>
<thead>
<tr>
<th>C⁰</th>
<th>Matrix/embedded?</th>
<th>Clause types</th>
</tr>
</thead>
<tbody>
<tr>
<td>-wa ’3’, -yini ’3SG.OBV’, -yi ’3PL’</td>
<td>matrix</td>
<td>independent</td>
</tr>
<tr>
<td>-wa ’3’</td>
<td>matrix</td>
<td>independent (non-assertive)</td>
</tr>
<tr>
<td>-Ø ’3’, -yini ’3SG.OBV’, -yi ’3PL’</td>
<td>neutral</td>
<td>unreal</td>
</tr>
<tr>
<td>-’DEP’</td>
<td>embedded</td>
<td>conjunctive, subjunctive</td>
</tr>
<tr>
<td>-Ø ’IMP’</td>
<td>matrix</td>
<td>imperative</td>
</tr>
</tbody>
</table>

I conclude that the stem and the verbal complex are both syntactic phrases. Since they are phrasal, phrasal theories of the syntax-phonology correspondence should apply. In the next section I turn to a discussion of Match Theory and argue that the syntactic constituents must be better defined.

### 4 Problems for Match Theory

Match Theory (Selkirk, 2011) derives the correspondence of syntactic and prosodic constituents via a set of ranked and violable MATCH constraints, represented informally in (26), within an Optimality Theory (OT) framework (McCarthy & Prince, 1993a,b; Prince & Smolensky, 1993).

(26) **Syntax-prosody correspondences in Match Theory**

| “syntactic word” | \( \Phi \) (prosodic word, PWd) |
| “syntactic phrase” | \( \Phi \) (phonological phrase, PPh) |
| “syntactic clause” | \( \Psi \) (intonational phrase, IPh) |
There are three components to any theory of syntax-prosody correspondence: (1) identification of the syntactic units or structures which are relevant for prosodic structure, (2) an independent theory of prosodic representation, and (3) a mapping algorithm which equates the two. I take issue with only the first of these, and adopt the tenets of Match Theory for the other two components. In the following sections I argue that the “syntactic word” and the “syntactic phrase” must be redefined more restrictively to account for Blackfoot.

### 4.1 Problems at the “word” level
Selkirk (2011) suggests that a Prosodic Word corresponds to a lexical category word in the syntax. Within X-bar theory (Jackendoff, 1977), these are terminal elements, X₀, which are lexical, e.g. N₀, V₀, or A₀. However, in the syntactic analysis given above, where categorization occurs by merging a functional categorizing head, it is clear that a ‘lexical category word’ must be more rigorously defined for Blackfoot. There are three plausible interpretations: (a) the √ROOT, which contributes the main ‘lexical’ or ‘concrete’ meaning to the verb, (b) the V₀ head, which is a syntactic terminal element and which introduces the internal argument, or (c) the entire vP/VP. For Blackfoot, only (c) can be correct. Neither the √ROOT nor the V₀ head have the same prosodic correlates as a verb or noun. For example, the smallest verbs and nouns are either CVCC or CVVC (Weber, 2020), but roots can be much smaller, like CV sa- ‘out’ or VC on- ‘hurry’, and V₀ can be as small as a single vowel. Yet even this requires some interpretation for Blackfoot because the √ROOT is a phrasal adjunct which merges outside of the vP/VP. I posited above that the √ROOT is required to restrict the denotation of a light verbal vP/VP, essentially by providing a semantic predicate. Here I suggest that this constituent is a vP/VP phase of events, which does not ‘close’ until the √ROOT has merged.

If the verbal complex can be reanalyzed as a complex X₀ via head movement (Baker, 1988), then the original definition of a lexical category word could still apply. There are phonological and syntactic reasons this cannot be correct for Blackfoot. Phonologically, it is clear that the verbal complex contains a second, smaller, distinct prosodic constituent. The “word” level is the lowest interface category in Match Theory, which means there is no way to account for the inner prosodic constituent. (This argument was also made in Miller (2018) on the basis of Saulteaux Ojibwe and Kiowa, two other polysynthetic languages.) Syntactically, the V₀ would raise to v₀ if it exists, and then raise into an adjunct position to adjoin with the √ROOT. This is not head movement in the typical sense. I conclude that the vP/VP phase of events is the syntactic constituent which corresponds to a Prosodic Word.

### 4.2 Problems at the “phrase” level
Match Theory posits that each syntactic maximal projection (XP) corresponds by default to a Phonological Phrase. As discussed above, the vP/VP phase and the CP each correspond to a distinct prosodic constituent in Blackfoot, and there is no evidence for prosodic constituents at any other boundary. The problem with this is that by definition, not all XPs in Blackfoot correspond to a PPh. The solution is to revise the correspondence relation to refer only to the relevant XPs. Although Selkirk (2011) raises the possibility that only lexical XPs (e.g. NP, AP, VP) are relevant for MATCHPHRASE, my analysis restricts MATCHPHRASE even farther. Specifically, I suggest that the CP phase corresponds to a PPh, because this directly reflects the prosodic evidence in Blackfoot.

### 5 Revision and analysis
The problems discussed above can be avoided by allowing MATCH constraints to refer directly to phases (Chomsky, 2001). The vP/VP phase corresponds to a Prosodic Word (PWd), and the CP phase corresponds to a Phonological Phrase (PPh), as in (27).

\[(27) \ a. \ \text{Phase II: CP } \leftrightarrow \text{ PPh/IPh} \]
\[b. \ \text{Phase I: vP/VP } \leftrightarrow \text{ PWd} \]

This revision does not require cyclic spell-out of phases, as in many recent proposals of phase-based pprosodic phrasing (e.g. Dobashi, 2004; Ishihara, 2007; Kahemuyipour, 2009; Kratzer & Selkirk, 2007; Pak, Windsor (2017) treats each √ROOT as a PWd, under the assumption that these elements are categorized adverbs/adjectives. A fuller consideration of the phonological and syntactic properties of √ROOT shows this is incorrect.

8 This is perhaps surprising, since research in prosodic phonology shows that the CP or clause corresponds to an Intonational Phrase (IPh) (Ladd, 2008; Nespor & Vogel, 2007; Selkirk, 2011). In fact, none of the evidence in Blackfoot crucially decides between these two analyses. Because the verbal complex is a minimal CP and a minimal utterance, it is at once a PPh and an IPh. Further research is needed to see if these two prosodic constituents are distinct in Blackfoot.
Given a syntactic representation \( S \) and a phonological representation \( P \), such that \( S \rhd P \),
a. \( \text{MATCH}(\alpha \rightarrow \pi) \): Assign a violation for every \( \alpha \) phase in \( S \) which does not have a correspondent \( \pi \) in \( P \).
b. \( \text{MATCH}(\pi \rightarrow \alpha) \): Assign a violation for every \( \pi \) in \( P \) which does not have a correspondent \( \alpha \) phase in \( S \).

Edge misalignments are regulated by the following constraints which penalize underparsing and overparsing, respectively. (These definitions are similar to constraints in Downing 1998 and Guekguezian 2017.)

Suppose there is a syntactic constituent \( \alpha \) in \( S \) that exhaustively dominates a set of terminal nodes \( A \in S \).
a. \( \text{MAX-SP}(\alpha, \pi) \): Assign a violation for every element that (1) is an exponent of a morpheme in \( A \) and (2) has a correspondent in \( P \) which is not dominated by a \( \pi \) corresponding to \( \alpha \).
b. \( \text{DEP-SP}(\alpha, \pi) \): Assign a violation for every element that (1) is an exponent of a morpheme that is not in \( A \) and (2) (has a correspondent in \( P \) which) is dominated by a \( \pi \) corresponding to \( \alpha \).

I also include the following two markedness constraints on prosodic wellformedness.

- \( \text{EQUALSISTERS} \) (EqSis)

- \( \text{BINMIN} \) (Bin)

The tableau below shows how these constraints prevent the suffixes from being parsed into a PWd. (The \( vP \) and CP phases are shown in the input, \( PPh = \{ \} \), and \( PWd = ( ) \).) The optimal candidate (a) parses only the \( vP \) phase into a PWd, violating EqSis and Bin. Candidate (b) shows that \( \text{MATCH}(PWd \rightarrow vP) \gg \text{EqSis, Bin.} \) Candidate (c) shows that \( \text{DEP-SP} \gg \text{EqSis.} \)

---

9 As argued in Itô & Mester (2019), the MATCH constraints as originally formulated (as double edge alignment in Selkirk 2011 and in terms of exhaustive dominance in Elfner 2012) are redundant in the sense that they not only (a) require the existence and correspondence of particular syntactic and prosodic constituents, but also (b) require an exact match of edges between the two. They suggest that we formally disentangle the two uses of MATCH constraints: MATCH should be redefined to only require the existence of particular constituents (which they call MATCH-∃ for clarity), and MATCH constraints regulate the details of exact correspondence. I adopt this idea here as well.
6 Conclusion

In this paper I presented independent arguments for prosodic and syntactic structure inside of the Blackfoot verbal complex. There is evidence that the morphological stem and the entire verbal complex correspond to two distinct prosodic constituents. In terms of the syntax, the stem is a vP/VP phrase and the verbal complex is a CP phrase. Because the stem is multimorphemic in Blackfoot, I show that the definition of a lexical category word in the syntax does not straightforwardly apply. I argue that the definitions of the syntactic units which correspond to prosodic constituents must be redefined based on phases and show how a phase-based revision of Match Theory accounts for Blackfoot. The result is a unified theory of the prosodic phonology of stems and phrases which is built on universal syntactic definitions. This means that it should be applicable to all languages.

In the revised theory, a categorized vP/VP stem is the syntactic constituent which corresponds to a PWd by default. One implication is that the Prosodic Stem (Downing, 1999; Inkelas, 1990) is another label for the PWd (as posited in McCarthy & Prince 1993a and for some languages in Nespor & Vogel 2007). As a result of this, it is unclear whether another prosodic constituent between the PWd and the PPh, corresponding to the fully inflected stem, is necessary. For Blackfoot specifically, the data in this paper includes only minimal CPs. It remains to be seen what kind of phrasal prosodic constituents exist in CPs with overt DP arguments. For example, Prins (2019) and Windsor (2017) argue that final devoicing is a phrasal phenomenon; future research should investigate further whether this is a property of the PPh or IPh.

Although Match Theory is the theoretical focus of this paper, the evidence from Blackfoot implies that phrasal syntax-prosody correspondences can and should be brought ‘below the word’ in any theory of prosodic phonology. It is important to search for independent evidence of prosodic and syntactic structure whenever possible, and not to rely on notions like the morphological stem or inflected grammatical word, which are less robustly defined under Bare Phrase Structure (Chomsky, 1995).

References


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