Structure at the right edge of prosodic words in Blackfoot

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1 Overview

- Consonants [m, n, s] pattern as a class in two ways at the right edge of stems in Blackfoot:
  1. **Derived Environment Effect**: When followed by suffixes, a process of consonant deletion targets stem-final [m, n, s] in certain contexts, but never [p t k].
  2. **Morpheme Structure Constraint**: Stems may end in long [m:, n:, s:], but not long *[p:, t:, k:]*.

**Proposal**: both processes are driven by mora licensing restrictions at the right edge of prosodic words. (e.g. both processes are driven by structure at the right edge of a constituent!)

2 Framework

- Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993b)
- Standard Moraic Theory (Hayes 1989)
- Prosodic Hierarchy (McCarthy and Prince 1986)

### (1) Prosodic Elements

<table>
<thead>
<tr>
<th>Pwd</th>
<th>PWd</th>
<th>σ</th>
<th>μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ft</td>
<td>[root]</td>
<td>[root]</td>
<td>[root]</td>
</tr>
<tr>
<td>σ</td>
<td>μ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(where [root] = the root node of a feature tree, aka “a segment”)

### (2) Sub-Prosodic Elements

<table>
<thead>
<tr>
<th>Labial</th>
<th>Alveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front</td>
<td>Central</td>
<td>Back</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i i̯</td>
<td>(c)</td>
<td>o o̯</td>
<td></td>
<td></td>
</tr>
<tr>
<td>r r̯</td>
<td>a a̯</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3 Blackfoot phonology and syllable structure

- Blackfoot is an Algonquian language spoken in southern Alberta and northern Montana (Frantz 2009)

**3.1 Contrastive length**

- **Vowel length** is contrastive before singleton consonants, as in (3).
- **Analysis**: vowels are underlyingly mono- or bi-moraic (Hyman 1985; Hayes 1989; Pulleyblank 1994).

1. (3) *a. [a:k-olac-wa] ‘he will rope’ (Frantz 2009, p. 2)
   b. [a:k-o:kla-wa] ‘she’ll sponsor a Sundance’

2. (4) a. *V = μ*  
       b. *V = μ μ*

   (root)  

3. **Consonant length** is contrastive intervocically, as in (5).
4. **Analysis**: geminates are underlyingly moraic (Hayes 1989; Spaelti 2002; McCarthy and Prince 1986),

5. (5) a. *[m-utokis-a] ‘knee’
   b. *[m-o:tokis-a] ‘skin, hide’

6. (6) a. C = [root]  
       b. C = μ  

6. (8) a. [kI:po:ko:kUk:i] ‘please give me it!’
   b. *[kI:po:ko:kUk:i]*

3.2 Vowel length neutralization in closed syllables

- **Vowel length** is neutralized before geminates (7).

7. (7) Short vowels before geminates

8. (8) No long vowels before geminates

   a. [kpI:po:ko:kUk:i] ‘please give me it!’
   b. *[kpI:po:ko:kUk:i]*
   c. [nitI:kan] ‘my friend’
   d. *[nitI:kan]*
   e. [mI:zo:jI:n] ‘fur coat’
   f. *[mI:zo:jI:n]*
   g. [kI:si:stokI:so:ka:ki] ‘heat water!’
   h. *[kI:si:stokI:so:ka:ki]*

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I adopt the moraic analysis of Blackfoot [s] in Goad and Shimada (2013), where post-consonantal [s] is analyzed as a mono- or bimoraic syllable nucleus. The “V” in the Blackfoot syllable templates therefore stands for a vowel or moraic [s], and I do not include a discussion of C+s clusters here.
• Clusters of up to two consonants are allowed word-medially.2

• Vowel length is neutralized before clusters (9).

(9) SHORT VOWELS BEFORE CLUSTERS

(10) NO LONG VOWELS BEFORE CLUSTERS

a. [køʔkɪ] ‘corner’

b. [pæskɪn] ‘(a) dance’

c. [dəkʊtok^2] ‘rock’ (voiced)

d. [mmusːʔɪpæːx^3] ‘heart’ (voiceless)

(11) SINGLETON CONSONANT

(12) GEMINATE CONSONANT

(13) CONSONANT CLUSTER

CVC = σ σ

CVG = σ σ

CVC_C2 = σ σ

Analysis: Codas are moraic in Blackfoot.

– Singleton consonants (C) are parsed to the onset of a following syllable.

– Geminates (G) are parsed to a coda, because onsets cannot license moraic segments. Ambisyllabic ‘flopping’ ensures the following syllable has an onset (Hayes 1989).

– The first half of a cluster is parsed to a coda position, because complex codas and onsets are disallowed.

3.3 Analysis of vowel length neutralization

• Weight-By-Position is normally formulated as “Coda consonants must surface as moraic” (cf. Moren 1999, following Hayes 1989). No “coda” position in the Standard Moraic Theory! But we can use a correspondence constraint (McCarty and Prince 1993a).

(14) WEIGHT-BY-POSITION (WBP)

≈ ALIGN(σ, R, μ, R)

For every syllable (σ), there is a mora (μ) such that the right edge of the mora aligns with the right edge of the syllable.

(15) *[root]μ/μ

Assign a violation for every [root] segment linked to two moras. (“No bimoraic segments.”)

(16) BinMAX(σ, μ)

Assign a violation for every syllable which contains more than two moras. (“No trimoraic syllables.”)

(17) *μ/C

A mora must not be headed by a consonant. (Broselow, Chen, and Huffman 1997; Moren 1999)

(18) MAX-μ-IO

Assign a violation mark for every mora in the input that does not have a corresponding mora in the output. (“No mora deletion.”)

(19) DEP-μ-IO

Assign a violation mark for mora in the output that does not have a corresponding mora in the input. (“No mora epenthesis.”)

(20) FAITH-μ

If α is a segment in the input, and β is a corresponding segment in the output, then assign a violation mark if the number of moras linked to α and the number of moras linked to β is not equal. (“Don’t change links between segments and moras.”)

(21) BinMAX(σ, μ) WBP

FAITH-μα

*[root]μ/μ

*μ/C

Analysis: mora deletion must occur to avoid violations of BinMAX(σ, μ).

• Vowels are preferentially affected in order to avoid violations of WBP.

(22) /køʔkɪ^2/ | BinMAX(σ, μ) | WBP | FAITH-μ | *[root]μ/μ | *μ/C

a. σ σ

b. σ σ

c. σ σ

2The distribution of consonants in clusters is highly constrained, which I abstract away from here. Briefly, the first consonant in a cluster is limited to [ʔ x]. Short [ʃ] occurs only before [t] and forms a complex onset with it, because vowel length is not neutralized before [st] as it is before codas. For an alternative analysis with complex Onsets, see Elifner (2006).

3This position also contains MAX-μ-IO and DEP-μ-IO, which are as of yet unranked. I leave them out of this tableau for space.
4 Word-final syllable structure

- Problem: this analysis does not explain word-final syllable structure!
- Wider range of syllable structures allowed: CV, CVV, CVC, CVVC, CVCC
- Word-final consonants do not pattern with word-medial codas.

1. Two consonants allowed word-finally, unlike medial codas.
2. Vowel length remains contrastive before a final singleton consonant, unlike before medial codas.

(23) a. [iapit] 'look!' (24) a. [apit] 'sit'
b. [pskán] 'buffalo jump' b. [pskán] '(a) dance'

4.1 Analysis of word-final consonants

- Analysis: word-final consonants can be parsed to the PWord (ω) (cf. Rubach and Booij 1990).
- Doing so satisfies WBP and BinMax(σ,μ), but violates a markedness constraint against this structure (Parse-Into-σ).

(25) Final Short V

(26) Final Long V

(27) Final Cluster

(28) Parse-Into-σ

Every element of the terminal string is parsed at the syllable-level.\(^5\) (One of the Parse-Into-X family of constraints in Ito and Mester 2009).

- Two strategies at the right edge of the word.
  1. If you can do it without deleting a mora, parse final consonant to syllable coda.
  2. If you have to delete a mora, parse final consonant to the prosodic word.

\(^4\) Additionally, the final consonant slot hosts a wider range of segments than allowed in word-medial coda positions.

\(^5\) Parse-Into-σ must also be ranked this high, since we do not find extra-syllabic consonants at the edge of word-medial feet.
5 The right-edge of the Blackfoot noun stem

- Consonants [m, n, s] pattern as a class in two ways at the right edge of stems:

  1. **Derived environment effect**: When followed by suffixes, a process of consonant deletion targets stem-final [m, n, s] in certain contexts, but not long *[p, t, k]*.

  2. **Morpheme structure constraint**: Stems may end in long [m; n; s], but not long *[p; t; k]*.

5.1 Derived environment effects

- Final short [m, n, s] delete before most suffixes, but other final segments do not.

- Observation: deletion is regulated by segment type and syllable structure.

(32) **Short [m, n, s] after short vowels**

<table>
<thead>
<tr>
<th>Stem</th>
<th>Singular</th>
<th>Plural</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. sōkaʔšaʔm</td>
<td>sōkaʔšaʔm-ʔ</td>
<td>sōkaʔšaʔs-ʔ</td>
<td>‘shirt, dress, outerwear’</td>
</tr>
<tr>
<td>b. átōʔqaxm</td>
<td>átōʔqaxm-ʔ</td>
<td>átōʔqaxs-ʔ</td>
<td>‘sock’</td>
</tr>
<tr>
<td>c. ašikin</td>
<td>ašikin-ʔ</td>
<td>ašikis-ʔ</td>
<td>‘shoe’</td>
</tr>
<tr>
<td>d. akčkoan</td>
<td>akčkoan-ʔ</td>
<td>akčkor-ʔ</td>
<td>‘girl’</td>
</tr>
<tr>
<td>e. mojįs</td>
<td>mojįs-ʔ</td>
<td>mojįs-ʔ</td>
<td>‘lodge’</td>
</tr>
<tr>
<td>f. atsąs</td>
<td>atsąs-ʔ</td>
<td>atsąs-ʔ</td>
<td>‘pants’</td>
</tr>
</tbody>
</table>

(33) **Short [m, n, s] consonants after long vowels**

<table>
<thead>
<tr>
<th>Stem</th>
<th>Singular</th>
<th>Plural</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. awr̂stam</td>
<td>awr̂stam-ʔ</td>
<td>awr̂stam-iks-ʔ</td>
<td>‘flag’</td>
</tr>
<tr>
<td>b. atap̂m</td>
<td>atap̂m-ʔ</td>
<td>atap̂m-iks-ʔ</td>
<td>‘doll’</td>
</tr>
<tr>
<td>c. napajin</td>
<td>napajin-ʔ</td>
<td>napajin-iks-ʔ</td>
<td>‘bread’</td>
</tr>
<tr>
<td>d. sîʔkan</td>
<td>sîʔkan-ʔ</td>
<td>sîʔkan-iks-ʔ</td>
<td>‘blanket’</td>
</tr>
<tr>
<td>e. pós</td>
<td>pós-ʔ</td>
<td>pós-iks-ʔ</td>
<td>‘cat’</td>
</tr>
</tbody>
</table>

(34) **Long [m, n, s] consonants after short vowels**

<table>
<thead>
<tr>
<th>Stem</th>
<th>Singular</th>
<th>Plural</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. kîšm</td>
<td>kîšm-ʔ</td>
<td>kîšm-iks-ʔ</td>
<td>‘door’</td>
</tr>
<tr>
<td>b. mîʔkx̂m</td>
<td>mîʔkx̂m-ʔ</td>
<td>mîʔkx̂m-iks-ʔ</td>
<td>‘metal’</td>
</tr>
<tr>
<td>c. mânn̂</td>
<td>mânn̂-ʔ</td>
<td>mânn̂-iks-ʔ</td>
<td>‘wing’</td>
</tr>
<tr>
<td>d. ox̂ım</td>
<td>ox̂ım-ʔ</td>
<td>ox̂ım-iks-ʔ</td>
<td>‘necklace’</td>
</tr>
<tr>
<td>e. katojįs</td>
<td>katojįs-ʔ</td>
<td>katojįs-iks-ʔ</td>
<td>‘sweet pine’</td>
</tr>
</tbody>
</table>

(35) **Short consonants after short or long vowels (shown together)**

<table>
<thead>
<tr>
<th>Stem</th>
<th>Singular</th>
<th>Plural</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. niʔp</td>
<td>niʔp-ʔ</td>
<td>niʔp-iks-ʔ</td>
<td>‘leaf’</td>
</tr>
<tr>
<td>b. moxkấʔs-ʔ</td>
<td>moxkấʔs-ʔ</td>
<td>moxkấʔs-iks-ʔ</td>
<td>‘leg’</td>
</tr>
<tr>
<td>c. matấk̂-ʔ</td>
<td>matấk̂-ʔ</td>
<td>matấk̂-iks-ʔ</td>
<td>‘potato’</td>
</tr>
<tr>
<td>d. motấk̂-ʔ</td>
<td>motấk̂-ʔ</td>
<td>motấk̂-iks-ʔ</td>
<td>‘shadow’</td>
</tr>
</tbody>
</table>

(36) **Final consonant cluster**

<table>
<thead>
<tr>
<th>Stem</th>
<th>Singular</th>
<th>Plural</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. kejʔskâxp̂</td>
<td>kejʔskâxp̂-ʔ</td>
<td>kejʔskâxp̂iks-ʔ</td>
<td>‘porcupine’</td>
</tr>
<tr>
<td>b. pâkiʔp̂</td>
<td>pâkiʔp̂-ʔ</td>
<td>pâkiʔp̂iks-ʔ</td>
<td>‘cheokeerry’</td>
</tr>
<tr>
<td>c. mo̕psp̂</td>
<td>mo̕psp̂-ʔ</td>
<td>mo̕psp̂iks-ʔ</td>
<td>‘eye’</td>
</tr>
<tr>
<td>d. --</td>
<td>nokŝts-ʔ</td>
<td>nokŝtsiks-ʔ</td>
<td>‘my mother’</td>
</tr>
<tr>
<td>e. --</td>
<td>n̂mn̂ŝ-ʔ</td>
<td>n̂mn̂ŝiks-ʔ</td>
<td>‘my older sister’</td>
</tr>
<tr>
<td>f. ̂sk̂ĉ</td>
<td>̂sk̂ĉ-ʔ</td>
<td>̂sk̂ĉiks-ʔ</td>
<td>‘pail’</td>
</tr>
<tr>
<td>g. onistsăxs</td>
<td>onistsăxs-ʔ</td>
<td>onistsăxsiks-ʔ</td>
<td>‘‘cali’</td>
</tr>
<tr>
<td>h. --</td>
<td>n̂koʔr̂ŝ-ʔ</td>
<td>n̂koʔr̂ŝiks-ʔ</td>
<td>‘my child’</td>
</tr>
</tbody>
</table>

- (Today: focusing on alternations before plural suffixes.)
- Deletion happens to singleton consonants after short vowels
  - Not to geminates or clusters
  - Not to singleton consonants after long vowels
  - … but only to [m, n, s]

- Question: Before plurals, why do short consonants delete after short vowels but not long vowels?
  - Parsing the consonant to an onset position in both position satisfies syllable structure constraints!

(37) | Stem    | Singular       | Plural       | Gloss             |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. a ŵŝt̂a:m̂-ʔ</td>
<td>a ŵŝt̂a:m̂-iks-ʔ</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. a ŵŝt̂a:m̂-ʔ</td>
<td>a ŵŝt̂a:m̂-iks-ʔ</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

(38) | Stem    | Singular       | Plural       | Gloss             |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. so kấʔŝi: mi:ŝi:ʔ</td>
<td>so kấʔŝi: mi:ŝi:iks-ʔ</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. so kấʔŝi: mi:ŝi:ʔ</td>
<td>so kấʔŝi: mi:ŝi:iks-ʔ</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

- The answer has to do with a morpheme structure constraint.

5.2 Morpheme structure constraint

- Noun stems never end in long *[p; t; k]*.

- Examples below shown followed by singular suffixes; consonant length is distinctive intervocally.
If the right edge of a PStem is also the right edge of the prosodic word:

- Analysis: nasals are [+cont] in Blackfoot and pattern with the fricative [s] (Mielke 2008).
- Positional markedness constraint: moraic [-cont] segments prohibited at the right edge of a prosodic stem.

5.3 Proposal

- Question: Before plurals, why do short consonants delete after short vowels but not long vowels?
- Because the bare stem has a different syllable structure at the right edge in either case:

5.3 Proposal

- Proposal: Output-to-output mora faithfulness is ranked high (e.g. Benua 1997).
- If a form cannot maintain the same moraic representation, it is better to delete.
Faithfulness to moras in the input is even more important, which accounts for word-final geminates.

(54)

<table>
<thead>
<tr>
<th>ki&gt;tsim</th>
<th>FAITH-μ</th>
<th>IDENT-μ-OO</th>
<th>MAX-IO</th>
<th>*[root][μ]μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ki.ści.μısı</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. μ ki.ści.m.ısı</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ki.ści.ści</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Question (again): Why do stem-final [p, t, k] never exhibit deletion in any context? 
- Because the *[cont]-μ[PStem] constraint ensures that stem-final [p, t, k] is non-moraic.
- Therefore the IDENT-μ-OO constraint is always satisfied, and there is no need to resort to deletion.

(55) AFTER SHORT V: FINAL [k] NON-MORAIC  
(56) AFTER LONG V: FINAL K NON-MORAIC

(57) (For IDENT-μ-OO, compare to (55))

<table>
<thead>
<tr>
<th>motak.ksi</th>
<th>FAITH-μ</th>
<th>IDENT-μ-OO</th>
<th>MAX-IO</th>
<th>*[root][μ]μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. μ mot.tk.ksi</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. motak.ksi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. mot.tr.ksi</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(58) (For IDENT-μ-OO, compare to (56))

<table>
<thead>
<tr>
<th>matak.isti</th>
<th>FAITH-μ</th>
<th>IDENT-μ-OO</th>
<th>MAX-IO</th>
<th>*[root][μ]μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. μ matak.ksi</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. matak.ksi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. matak.ksi</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
</tr>
</tbody>
</table>

5.4 Summary

- Consonants [m, n, s] pattern as a class in two ways at the right edge of stems in Blackfoot.
- Both processes are driven by mora licensing restrictions at the right edge of prosodic words.

1. A consonant can be parsed directly to a prosodic word at the right edge of a prosodic stem (section 4)
2. Moraic [-cont] are prohibited at the right edge of a prosodic stem (subsection 5.2)
3. When the right edge of a stem coincides with the right edge of a prosodic word, the effect is that [-cont] segments are parsed directly to a prosodic word.
4. The phonological output of a bare stem regulates the outputs of larger words as well, and requires that corresponding segments have the same moraic output (subsection 5.3)
   - Geminates that are not [-cont] are moraic in both contexts: good!
   - Any final consonant parsed to the ki in the bare stem context, including all [-cont] segments, will be non-moraic in both contexts: good!
   - Final syllable-internal codas, including short [m n s], will be moraic in the bare stem context, but non-moraic in the larger word context: bad! (Last resort: delete.)

6 Predictions and questions

- Word-final singleton consonants after short vowels are parsed in two different ways, depending on whether they are [+cont] or [-cont].
  - Expect a (non-contrastive) difference in vowel duration
- Word-final singleton and geminate consonants have the same prosodic structure.
  - Consonant duration should be neutralized.
- Why deletion? (MAX-IO ranked low; we expect other languages to exhibit different repair strategies.)
- Do we need a PStem constituent which is separate than a PWord constituent in the prosodic hierarchy?

References


