Contrastive Syllabification in Blackfoot

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1. Introduction

Current phonological theory generally assumes that syllabification is absent from underlying representations because it is never used contrastively among the world's languages: tautomorphemic contrasts of the type *a.ka* vs. *ak.a* or *ak.la* vs. *a.kla* have never been convincingly documented (e.g. Blevins 1995, McCarthy 2003). However, it is a matter of debate whether the absence of contrastive syllabification is a universal property of languages, or whether it is simply an empirical problem.

This paper presents data from Blackfoot, an Algonquian language, which contain tautomorphemic contrasts in syllabification, and discusses the implications of the data for the debate raised above. While apparently filling a typological gap in syllabification patterns, I argue that the syllabification contrasts found in Blackfoot do not require the specification of syllable structure in the underlying representation. Instead, I propose that the data can be accounted for by assuming only that moras are specified in the underlying representation, and that contrastive syllabification is the means by which Blackfoot speakers retain these underlying moraic contrasts on the surface. By assuming that weight rather than syllabification is contrastive in Blackfoot, the analysis fulfills implicit predictions made by moraic theory, which already assumes that moras can be used contrastively. In addition, the moraic analysis accounts for some of the phonotactic and phonetic patterns specific to Blackfoot that receive only an arbitrary treatment under a syllabic account.

2. Language Background

Blackfoot possesses a relatively small phoneme inventory, which is expanded by a large number of length contrasts:

(1) *Blackfoot Phoneme Inventory*

	Labial	Coronal	Dorsal	Glottal
Stops	p pː	t tː	k kː	ʔ
Fricatives		s sː	x	
Affricates		t͡s t͡sː	k͡s k͡sː	
Nasals	m mː	n nː		
Glides	w	j		

Vowels
i iː
o oː
a aː

Like many other languages, Blackfoot contrasts length intervocalically:

(2) a. [ninaː] 'man/chief' (also /pː, tː, kː, sː, t͡sː, k͡sː, mː/)
b. [nɪnːa] 'my father'

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More unusually, however, Blackfoot also contrasts consonant length preconsonantally in two environments: /s/ before stops (3) and stops before /s/ (4):[1]

(3) a. [istawáʔsiwa̰] ‘he grew’
b. [ɪsˑtatánsiwa̰] ‘he bragged’
(4) a. [ipiksit] ‘flee’ (also /t/ and /p/)
b. [ipɪkːsit] ‘be anxious’

Interestingly, phonotactics and phonetic duration suggest that the consonant sequences are treated differently with respect to syllable weight, and are syllabified differently, as follows:

(5) a. [i.stawáʔsiwa̰] ‘he grew’
b. [ɪsˑ.tatánsiwa̰] ‘he bragged’
(6) a. [ipi.ksit] ‘flee’
b. [ipɪk.ksit] ‘be anxious’

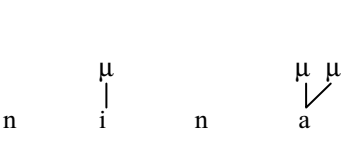
My claim in this paper, as discussed above, is that while Blackfoot shows contrastive syllabification superficially, syllabification does not need to be specified in the underlying representation. Rather, I argue that the syllabification patterns reflect faithfulness to underlying moras. The following section discusses the role of underlying moras under traditional moraic theory, where underlying moras have been said to be responsible for contrastive segment length, both in the formal analysis of geminates and of contrastive vowel length.

3. Contrastive Weight and Moraic Theory

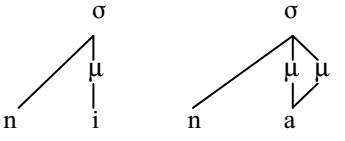
Moraic theory (Hyman 1985, Hayes 1989) represents syllable weight by associating segments with weight units known as moras (μ). Contrastive weight, as found in languages with contrastive vowel or consonant length, has been represented formally as the surface manifestation of underlyingly specified moraic associations. This analysis of contrastive length has long been an integral aspect of moraic theory (e.g. Hayes 1989, Morén 1999), and is widely accepted as an accurate interpretation of the phenomena at hand (e.g. Ham 2001). For example, contrastive vowel length and intervocalic geminates in Blackfoot receive the following representations under a traditional moraic analysis:

(7) Underlying and surface representations of [ninaː] ‘man/chief’

a. Underlying Representation

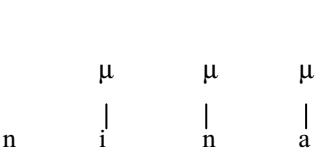


b. Surface Representation

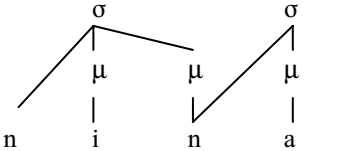


(8) Underlying and surface representations of [nɪnːa] ‘my father’

a. Underlying Representation



b. Surface Representation



[1] Note: [sˑ] indicates an intermediate length between [s] and [sː].

Under a moraic analysis, the ambisyllabic status of intervocalic geminates such as /n:/ in (8) reflects a compromise between the desire to preserve the mora in a weight-bearing position (in this case coda position) as well as the desire to avoid an onsetless syllable. While this analysis generally works well in terms of phonological properties of geminates (e.g. Ham 2001), it remains a matter of debate whether it is the geminate's mora which is responsible for its increased duration, or its ambisyllabic structure. While not a primary goal of this paper, the analysis proposed for Blackfoot, as well as the proposed alterations based on phonotactic and phonetic facts, supports the assumption that both aspects play a role.

4. Contrastive Syllabification in Blackfoot as Mora Preservation

In the preceding section, both contrastive vowel length and intervocalic gemination in Blackfoot were shown to be well accounted for under a traditional moraic analysis of these phenomena, where underlyingly specified moraic contrasts were assumed. In this section, I turn to the somewhat unusual preconsonantal consonant length contrasts found in Blackfoot, and propose that these length contrasts can be accounted for in precisely the same way as the more commonly found length contrasts—by assuming that these contrasts arise from underlyingly specified moraic associations.

For example, recall the preconsonantal contrast in duration for the phoneme /s/, as in the following words:

(9) a. [istawáʔsiwa̧] 'he grew'
b. [ɪsˑtatánsiwa̧] 'he bragged'

Under a moraic analysis, these two words are assumed to contrast underlyingly via the moraic status of /s/ in the underlying representation, as illustrated below:

(10) a. [ɪsˑtatánsiwa̧] 'he bragged' b. [istawáʔsiwa̧] 'he grew'

As in the preceding section, syllabification is applied to underlying representations with the goal of preserving the underlying moraic contrast while creating an unmarked syllable structure. In (10a), underlyingly moraic /s/ is syllabified in a weight-bearing position (coda position), as was the case for intervocalic geminates. However, unlike intervocalic geminates, the syllabification of the moraic consonant in coda position does not create an onsetless syllable: the following consonant fills this role. Because the onsetless syllable was proposed to be responsible for the ambisyllabicity of intervocalic geminates, it is predicted by this analysis that preconsonantal geminates need not be ambisyllabic, and may be syllabified simply as a coda consonant. This representation is illustrated in (11a) below.

On the other hand, underlying non-moraic preconsonantal /s/ as in (10b) must be syllabified in a position where it can preserve its weightlessness. I propose that it is syllabified as part of the onset of the following syllable, forming a complex /s/-stop onset, which is also attested word-initially in Blackfoot (e.g. /stamik/ 'steer'). This analysis avoids the introduction of weightless codas to Blackfoot, for which there is no evidence.

The proposed surface representations of the structures in (10) are illustrated below:

(11) Surface representations of underlying representations in (10)

a. [isˈtatánsiwa̧] ‘he bragged’ b. [istawáʔsiwa̧] ‘he grew’

Side by side, these two independently motivated representations result in what is superficially contrastive syllabification, but which are actually derived via underlying moraic contrasts.

5. Gemination in Stop-/s/ Sequences

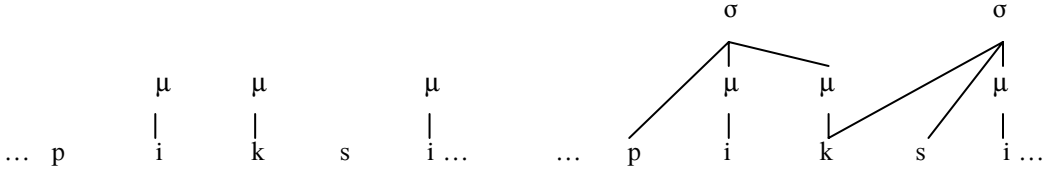
Above, it was argued that the contrastive syllabification patterns in Blackfoot can be derived from the assumption that superficial length contrasts originate from underlying moraic contrasts. I proposed that preconsonantal geminates need not be specified as ambisyllabic owing to the fulfillment of the onset constraint by the following consonant. However, this analysis does not exclude the possibility that ambisyllabicity could indeed arise in these environments if it were motivated by some other constraint. This section discusses the phonetic properties of the two types of preconsonantal geminates found in Blackfoot, /sː/ followed by a stop and geminate stop followed by /s/, and argues that the longer duration of preconsonantal geminate stops as compared to preconsonantal /sː/ can be captured by assuming different syllable structures.

The difference in representation between the non-ambisyllabic structure of preconsonantal geminate /sː/ as given above in (11a) and the ambisyllabic structure of intervocalic geminate /sː/ (similar to /nː/ in 8b) is corroborated by durational evidence: the duration of preconsonantal geminate /sː/ is intermediate between non-moraic preconsonantal /s/ and the intervocalic geminate /sː/. That the different phonological representations motivate the durational difference seems a reasonable explanation, especially when the duration of preconsonantal geminate stops are considered.

While no detailed phonetic studies have been performed investigating this question, the duration of preconsonantal geminate stops in Blackfoot (e.g. [ipɪkːsit] ‘be anxious’) are roughly equal to their duration intervocalically (e.g. [ɪkːamíʔniwa̧] ‘he fainted’). If the above assertion is correct concerning the relationship between the phonological representation and the durational difference between preconsonantal geminate /sː/ and intervocalic geminate /sː/, it is equally possible that the similarity in duration between preconsonantal geminate stops and intervocalic geminate stops can be attributed to a similarity in phonological representation. In other words, durational evidence suggests that, in contrast to preconsonantal geminate /sː/, preconsonantal geminate stops are true geminates, being both moraic and ambisyllabic. This is illustrated in the following representations of [ipɪkːsit] ‘be anxious’:

(12) Underlying and surface representations of [ipɪkːsit] ‘be anxious’

a. Underlying Representation b. Surface Representation



However, unlike the intervocalic geminates, the ambisyllabic structure of (12b) cannot be motivated by a dispreference for onsetless syllables. As discussed above, the preconsonantal nature of the preconsonantal geminates eliminates the need for ambisyllabicity owing to the avoidance of onsetless syllables: in (12b), the /s/ presumably fulfills this constraint.

I propose that the structure in (12) is motivated by another syllable structure consideration, namely, the ‘Syllable Contact Law’ (Murray & Vennemann 1983):

(13) Syllable Contact Law:
A syllable contact A$B is the more preferred the greater the sonority of the offset *A* and the less the sonority of *B*.

This law refers to sonority as it is represented on the 'standard' sonority scale:

(14) *Standard Sonority Scale* (Sievers 1881 *et seq.*)

Stops Fricatives Nasals Liquids Glides Vowels

Least sonorous ⟷ Most sonorous

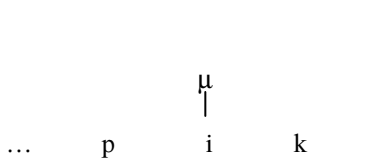
Placing the syllable boundary between /k/ and /s/ as in [ipık.sit] results in a suboptimal syllable contact because sonority decreases over the syllable boundary. Blackfoot improves syllable contact by geminating the stop such that sonority remains level across the syllable boundary.[2] This analysis is supported by evidence throughout the phonotactics of the language which demonstrate that sonority never rises over a syllable boundary in the language (Elfner 2005).

6. Non-moraic Pre-consonantal Stops

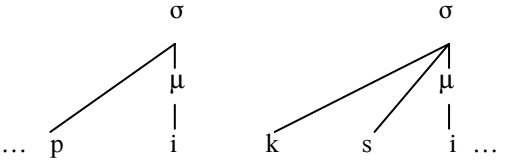
It is now a simple matter to extend the analysis developed above to propose representations of short preconsonantal stops, as in [ipiksit] 'flee': in contrast to their long counterparts ([ipıkːsit] 'be anxious'), they are underlying non-moraic. Additionally, in parallel to non-moraic preconsonantal /s/, phonotactic evidence, as well as the syllable contact law (section 5) and weight-by-position (Hayes 1989), argue in favour of syllabifying non-moraic preconsonantal stops as part of a complex onset rather than as a weightless coda:

(15) Underlying and surface representations of [ipiksit] 'flee'

a. Underlying Representation



b. Surface Representation



Interestingly, the tautosyllabification of the stop and /s/ as in (15b) creates a contrast between complex stop-/s/ onsets, and Blackfoot's /t͡s/ and /k͡s/ affricates. Phonetically, this is manifested as a post-consonantal length contrast, where the segmental /s/ is longer in duration than affricate /s/:[3, 4]

(16)	a.	[niːtsítsikín]	'shoe'
		[nítsiʔkaki]	'I kicked'
	b.	[áak͡sikamiʔniwa̰]	'he will faint'
		[aksín]	'bed'
	c.	[amɛ́ipsi]	'belt'
		*[p͡s]	

[2] See Murray & Vennemann 1983 for a similar analysis in Germanic.

[3] Orthographically (e.g. Frantz 1978, 1991; Frantz & Russell 1989), stop-/s/ sequences are transcribed with long *ss*, while stop-/s/ affricates are transcribed with short *s*.

[4] This contrast is found in several word-medial environments: intervocalically, following moraic or non-moraic /s/, following /x/ and /ʔ/.

This contrast serves the dual purpose of supporting the claim that stop-/s/ clusters are legitimate onsets in Blackfoot, as well as the assertion that /k/-short /s/ clusters are best analysed as affricates.

7. Pre-consonantal Nasals: Neutralisation of Underlying Moraic Contrasts

The discussion to this point has proposed that word-medial stop-/s/ and /s/-stop clusters preserve underlying moraic contrast by employing contrastive syllabification on the surface. The usefulness of contrastive syllabification as a means of mora preservation arises from the language-specific phonotactics of Blackfoot, which allow such clusters to be syllabified either heterosyllabically or as complex onsets, with the slight modification of gemination for stops. The strong prediction arising from this analysis is that no preconsonantal length contrasts will be found in environments where contrastive syllabification is ruled out by phonotactic constraints forbidding the syllabification of the cluster as a complex onset.

This prediction is realised within Blackfoot when another environment is considered: nasals followed by /s/. Contrary to their behaviour intervocalically, where geminate nasals contrast with non-geminate nasals, no length contrast is found preconsonantally:

(17)	a.	[ninaː]	'man/chief'	(also /m/)
	b.	[nɪnːa]	'my father'	
(18)	a.	[isˈtatán̲.s̲iwa̤]	'he bragged'	
	b.	*[V.ns], [Vnːs], etc.		

In accordance with the above analysis, I propose that no length contrast is possible in this preconsonantal environment because the sequence nasal-/s/ does not form a legitimate complex onset in Blackfoot, perhaps because such a sequence incurs a strong violation of the sonority sequencing principle.[5] As such, the nasal is uniformly syllabified in coda position whether it is underlyingly moraic or not. It follows that the nasal becomes uniformly moraic in this environment: if it is underlyingly moraic, the mora is preserved in coda position; if it is not, the mora is added to the surface representation via weight-by-position (Hayes 1989).

Pre-consonantal nasals demonstrate that underlying moraic contrasts are neutralised if "contrastive syllabification" is not a possibility; in other words, if the sequence in question cannot be syllabified both heterosyllabically and as a complex onset. The neutralisation of moraic contrasts for preconsonantal nasals therefore serves to support the assertion that contrastive syllabification is used to preserve these contrasts for pre-consonantal stops and /s/, as opposed to a contrast in coda weight.

8. Theoretical Implications

8.1. Contrastive Moras vs. Contrastive Syllabification

This paper has argued that while Blackfoot does show superficial contrastive syllabification, the data can be accounted for using moraic theory, where contrasts in syllabification arise as a strategy to preserve underlyingly specified moras. In other words, the above analysis has proposed that the phenomenon in question is actually a surface manifestation of contrastive syllable weight, and is not true contrastive syllabification. However, the differences in typological predictions between the moraic account proposed here and a theoretical syllabic account, where syllabification is specified in the underlying representation and subject to faithfulness constraints, have not yet been discussed. This section makes clear some of the different predictions made by the two theories in terms of possible typological systems.

As discussed above, moraic faithfulness in Blackfoot interacts with two syllable structure preferences/constraints, both of which are highly ranked. These included a constraint preferring syllables to have onsets and the syllable contact law. If an optimality theoretic analysis is assumed, the

[5] It is true that /s/-stop onsets are allowed, which also violate the SSP. However, it is well-known that /s/-stop onsets are unmarked crosslinguistically, rather than marked (e.g. Morelli 1999).

moraic account predicts the following systems should be possible under different constraint permutations, given that moraic faithfulness is highly ranked in the language:

(19) Possible "contrastive syllabification" systems as predicted by moraic theory, given ranking of constraint (high vs. low); underline indicates a moraic segment (see section 8.2 for possible interpretations of Swedish and English).

	ONSET = high		ONSET = low	
SYLLCON = high	i.ka i.ksa i.ska	i<u>k</u>.ka i<u>k</u>.ksa i<u>s</u>.ka =Blackfoot	[6]	
SYLLCON = low	i.ka i.ksa i.ska	i<u>k</u>.ka i<u>k</u>.sa i<u>s</u>.ka =Swedish?	i.ka i.ksa i.ska	i<u>k</u>.a i<u>k</u>.sa i<u>s</u>.ka =English?

As in Blackfoot, the moraic account predicts that underlying moras are retained by syllabification in coda position, while a segment's ambisyllabicity changes depending on language-specific syllable structure preferences.

A possible complication arises when it is considered that other constraints may come into play, such as weight-by-position. For example, as is shown in the Swedish data given below, some languages allow weightless codas, meaning that contrasting weight in coda position may be preferable to contrastive syllabification. However, this development is ultimately not problematic, as it is a language-specific preference. If it is indeed moraic faithfulness which is crucial and not syllabic faithfulness, such languages should still be considered a part of the predicted typology if the preserved moras contrast pre-consonantally on the surface.

On the other hand, the syllabic account makes somewhat different predictions. For instance, we might expect that ambisyllabicity could be encoded in the underlying representation, resulting in not only a two-way syllabic contrast as suggested in the introduction, but a three-way contrast in syllabification (i.ka, ik.a, ik.ka/i.ksa, ik.sa, ik.ksa). Moraic theory predicts that a single language with a three-way contrast in syllabification could not exist, as ambisyllabicity is used as a reparative measure rather than as a contrastive feature.

The moraic account, rather than the syllabic account, correctly predicts the system found in Blackfoot as well as other attested systems (see next section). The above discussion predicts that a language with a three-way contrast in syllabification would provide evidence for true contrastive syllabification, as such a language is incompatible with the moraic account proposed above. The patterns found in Blackfoot therefore do not provide evidence for true "contrastive syllabification", but do however provide evidence that contrastive syllabification can indeed arise from contrastive weight.

8.2. Typological Implications

Even if syllabification is not specified in the underlying structure, Blackfoot still fills a typological gap in terms of what is possible under moraic theory. For example, Morén (1999) notes that moraic theory predicts a system where coda consonants contrast between weight-bearing and weightless:

> There is yet one more pattern that can result from ranking the constraints under discussion… This pattern has distinctive intervocalic consonant moraicity where ambisyllabic codas contribute to syllable weight [i.e. intervocalic geminates], and non-ambisyllabic coda consonants that contribute to syllable weight or not depending on whether or not they are underlyingly moraic… It is an empirical issue as to whether this type of language exists. (Morén 1999:388-391)

Similarly, McCarthy (2003) questions whether phonological theory should be altered to make the generation of such languages impossible:

[6] *ik.a, ik.ksa,* etc. impossible because SYLLCON must be low for *ik.a,* high for *ik.ksa*.

> It is widely though not universally accepted that contrasts of quantity and syllabicity are represented by deploying moras in the underlying representations […] To complete the picture, though, it is necessary to show that faithfulness to underlying moras does not offer a back-door into the non-occurring *pa.ta/pat.a* or *pak.la/pa.kla* contrasts. (McCarthy 2003:60)

A language like Blackfoot poses the question of whether or not Blackfoot is alone in allowing the preservation of moras to result in contrastive syllabification: have these languages simply not been discovered yet? Or have existing analyses overlooked these possibilities?

While more research remains to be done with the possibility of contrastive weight in mind, two possible language parallels are found in Swedish (Morén 1999:392-393) and English (Chomsky & Halle 1968:83, Wells 1990, Alcántara 1998, Hammond 1999). Above, I proposed that Swedish and English can be used to fill out the typological table proposed in (19); a brief discussion of these languages is given below.

Swedish, like Blackfoot, contrasts moraicity intervocalically via a geminate/non-geminate contrast (/veke/ > [veːke] 'wick'[7] vs. /vek$_{\mu}$a/ > [vekːa] 'week'). Preconsonantally, moraic contrasts are not subject to gemination, presumably because syllable contact is not ranked highly in the language (/vitna/ > [viːt.na] 'to whiten', /vit$_{\mu}$na/ > [vit$_{\mu}$.na] 'to witness').[8] English, on the other hand, does not geminate consonants either intervocalically or preconsonantally. However, certain alternations in stress patterns can be accounted for if moras are assumed to be underlyingly specified. For example, contrastive weight can be found intervocalically in the contrast between *vénison* and *Vanéssa* (/vɛnəsn̩/ > [vɛ.nə.sn̩], /vənɛs$_{\mu}$ə/ > [və.nɛs$_{\mu}$.ə]) and preconsonantally in the contrast between *pédigree* and *pellágra* (/pɛdəgɹi/ > [pɛ.də.gɹi], /pəlæg$_{\mu}$ɹə/ > [pə.læg$_{\mu}$.ɹə]). Surface contrasts in moraicity and syllabification can therefore be argued to exist even in relatively well-understood languages—analyses of this type beg the question of whether other languages might benefit from an analysis where moras can be contrastive.

9. Conclusion

This paper has argued that while Blackfoot provides evidence of superficial contrastive syllabification, these surface patterns are best analysed as the result of faithfulness to underlying moras rather than as the result of faithfulness to underlying syllabic affiliations. The analysis was supported both by evidence from within Blackfoot as well as crosslinguistic data. In conclusion, while Blackfoot does not provide evidence of underlyingly specified syllabification, the language does fill a typological gap in terms of implicit predictions made by moraic theory. It is hoped that further research will find parallels in other languages.

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[7] Moras associated with vowels are assumed but not specified in the representations in this section.

[8] Swedish requires stressed syllables to be bimoraic; stressed short vowels are lengthened in the absence of coda weight (Morén 1999:392).

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