Syllables and Reduplication in Bella Coola (Nuxalk)*

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Abstract: Bella Coola (Nuxalk) is well-known for its larger consonant clusters and words without vowels, which pose questions for theories of syllabification and sonority. However, despite permitting typologically rare syllable structure, Bella Coola still fits universal assumptions about syllable structure and sonority. This paper argues that fricatives in Bella Coola (i) may be parsed as the nucleus of a syllable when nothing more sonorous is present, and (ii) may be moraic in a nucleus or a coda position. These two proposals underlie the *Good Enough Nucleus Hypothesis*. The Good Enough Nucleus Hypothesis stipulates that a fricative may be a good enough nucleus to satisfy requirements for a well-formed prosodic word. Fricative nuclei are permissible if DEP is ranked above *P/STOP and below *P/FRICATIVE, which results in the syllabification of a fricative as a nucleus in the absence of anything more sonorant. The constraint ranking prefers having a fricative as a nucleus over vowel epenthesis, but will not tolerate a stop as a nucleus. Evidence for the distinction between fricatives and stops is found in the distribution of obstruents within the set of OBSTRUENT-ONLY words and how obstruents pattern in C_1C_2 reduplication. Implications of the Good Enough Nucleus Hypothesis are discussed for the analysis of Bella Coola phonology, Bella Coola in the context of Salish languages, and how Bella Coola syllables fit into the larger cross-linguistic typology.

Keywords: Bella Coola, syllables, fricative nuclei, sonority, reduplication

1 Introduction

Phonologists have long been fascinated by syllable structure in Bella Coola (Nuxalk, ISO 639-3: blc) (e.g., Hockett 1955, Greenberg 1962; Cook 1994; Raimy & Idsardi 1997; Bagemihl 2011).[1] It is well-known in theoretical literature (and the wider public) for allowing large consonant clusters and the prevalence of words without vowels. The phonologists working on these languages have largely relied on data from a number of key papers, including Hoard (1978), Newman (1971), and Bagemihl (1991). Other valuable sources of data that describe the grammar of Bella Coola (including the form and function of reduplicative morphemes) include Nater (1984, 1990) and Saunders and Davis (1972).

Bella Coola is so well-known for its syllable structure and consonant clusters that this is often one of the first things that a linguist might learn about Salish phonology. However, many who study Salish consider Bella Coola to be typologically unusual even within the Salish language family on several dimensions (e.g., Kinkade & Czaykowska-Higgins 1998), as it often appears to diverge from the patterns found elsewhere in the family. Syllables in Bella Coola are therefore of typological interest within Salish linguistics as well as cross-linguistically. In particular, it provides a valuable setting for testing the cross-linguistic generalizability and robustness of phonological theories related to syllable structure and sonority.

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[1] While I refer to Salish languages in this paper by the names commonly used in the literature for ease of comparison across older phonological literature and documentation, these labels are not necessarily the same ones used by speakers (Bella Coola = Nuxalk).

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In this paper, I argue that "vowelless" words are not "words without syllables", and present a constraint-based phonological analysis that posits that fricatives in Bella Coola may be moraic and can be parsed as the nucleus of a syllable in the absence of anything more sonorant. A desirable outcome of this analysis is that the patterns in Bella Coola remain typologically uncommon while still remaining consistent with cross-linguistically universal patterns about sonority and prosodic structure.

The main proposal in this paper is that fricatives are moraic when they are parsed as the nucleus or the coda of a syllable. Fricatives are not an ideal syllabic peak in Bella Coola, or cross-linguistically, and therefore they are only parsed as a nucleus when nothing more sonorant is available. Within a constraint-based phonology, this is captured by a relatively highly ranked constraint against epenthesizing a full vowel that could bear stress. Under the *Good Enough Nucleus Hypothesis*, a fricative (a non-ideal syllabic peak) is syllabified as a nucleus when nothing more sonorant is present and epenthesis is a more marked option. Where other repair strategies that would result in a well-formed prosodic word are less preferable, the fricative can be a good enough nucleus for the purposes of syllabification.

Aside from being more consistent with cross-linguistic patterns, the evidence to support the Good Enough Nucleus Hypothesis comes from asymmetries between the distribution of obstruents in lexical items and how words with obstruents undergo reduplication. An additional (and desirable) outcome of the Good Enough Nucleus Hypothesis is that the reduplicative patterns can be analysed more systematically (using a Generalized Nonlinear Affixation Approach as described by Bermúdez-Otero 2012). The C_1C_2 reduplication pattern in Bella Coola involves the affixation of two moras which are subsequently filled by fission (adopting a similar set of assumptions to the analyses of other languages spoken in the Pacific Northwest by Bye & Svenonius 2012; Saba Kirchner 2013; Zimmermann 2013; and Mellesmoen & Urbanczyk 2020). Adopting these assumptions allows for a more succinct explanation of what is reduplicated and where it is positioned, along with capturing some facts pertaining to vowel epenthesis and spirantization in reduplication.

A description of words without vowels in Bella Coola including a discussion of syllable structure, fricatives as nuclei, and consonant clusters is given in Section 2, along with a definition of the proposed good enough nucleus and syllable structure. Reduplicative patterns are then analysed in Section 3, while Section 4 summarizes the implications of the good enough nucleus, and Section 5 concludes the paper.

The goal of this paper is to highlight how Bella Coola syllables are exceptional (obstruents as nuclei) without positioning the language as an exception to universal patterns in human languages (well-formed words have syllables). Bella Coola syllabification remains interesting in the typology of languages, and theoretical approaches to syllables need to be able to account for Bella Coola without setting it aside as an exception. Understanding how Bella Coola syllabification is consistent with cross-linguistic universals and where it diverges shows us what kind of variation we might see across languages with respect to syllable structure and sonority, along with which parts of the theoretical framework must be adaptable and able to accommodate different patterns.

2 Fricatives are a Good Enough Nucleus

This paper proposes the *Good Enough Nucleus Hypothesis* to account for syllabification in Bella Coola. The hypothesis, stated in (1), captures the fact that (i) every word has at least one syllable, and (ii) fricatives may be in a nuclear position (assuming nothing more sonorous is present).

(1) Good Enough Nucleus Hypothesis (Bella Coola)

> Every word has at least one syllable, and in words with a single syllable, anything equal or greater in sonority to a fricative may be in the nuclear position.

The Good Enough Nucleus Hypothesis is consistent with cross-linguistic universals about the optimal peak segments by sonority (e.g., McCarthy & Prince 1994), while also capturing the language-specific patterns about where the line is drawn between segments that can be a nucleus and segments that cannot be. Formally, this is captured through the use of a set of constraints on segments that can be in a prosodic peak. The order of these constraints is fixed across languages, but the relative ranking of other markedness and faithfulness constraints will allow for less sonorant peaks. What is a good enough nucleus will vary between languages, and therefore, a more general hypothesis is stated in (2).

(2) Good Enough Nucleus Hypothesis (General)

> Every word has at least one syllable, and in words with a single syllable, anything equal or greater in sonority to X may be in the nuclear position, where X refers to the minimal class of segments that can be the peak of a well-formed syllable.

While other languages may not tolerate obstruents in a nuclear position, a fricative (and anything more sonorous) can be a good enough nucleus in Bella Coola. Evidence for a good enough nucleus in Bella Coola comes primarily from the distribution of obstruents in lexical items and the behaviour of obstruent-only words in reduplication. Data considered in this paper come from Nater (1990) and the First Voices (www.firstvoices.com) website, and are marked as N and FV, respectively.

2.1 Defining a set of OBSTRUENT-ONLY words

The set of words that are "vowelless" could be defined in several ways, and therefore, it is important to specify what OBSTRUENT-ONLY means in the present paper. The three types of potential "vowelless" words include words transcribed without vowels (3a), the citation form of roots which are not necessarily attested on their own (3b), and true OBSTRUENT-ONLY words that are grammatical and attested without further affixation (3c–d).[2]

(3)	a.	plhtkn	/płtkən/	'bark of cherry tree'	(FV)
	b.	lhqw'-	/łqʷ'-/	root meaning 'sob'	(FV)
	c.	t'xt	/t'x̣t/	'stone'	(FV)
	d.	tlh	/tɬ/	'strong'	(FV)

The first type of words are those that are transcribed without vowels, but where the absence of vowels reflects an orthographic or transcription choice. For example, Nater (1984, 1990) elects not to write /ə/ in places where it is predictable, such as before many sonorant segments, which poses challenges for those unfamiliar with the range of rules that determine the placement of /ə/. Consider the spectrogram in Figure 1 for the word *qlhm* /qɬəm/ 'cod, black'. Though the word is written

[2] Examples are given in the orthography of the language, not APA.

without a vowel, there is actually a vowel before the sonorant. Lexical items of this nature are identifiable by the presence of sonorants, and are set aside in the present analysis as they are "vowelless" by orthography, not in production.

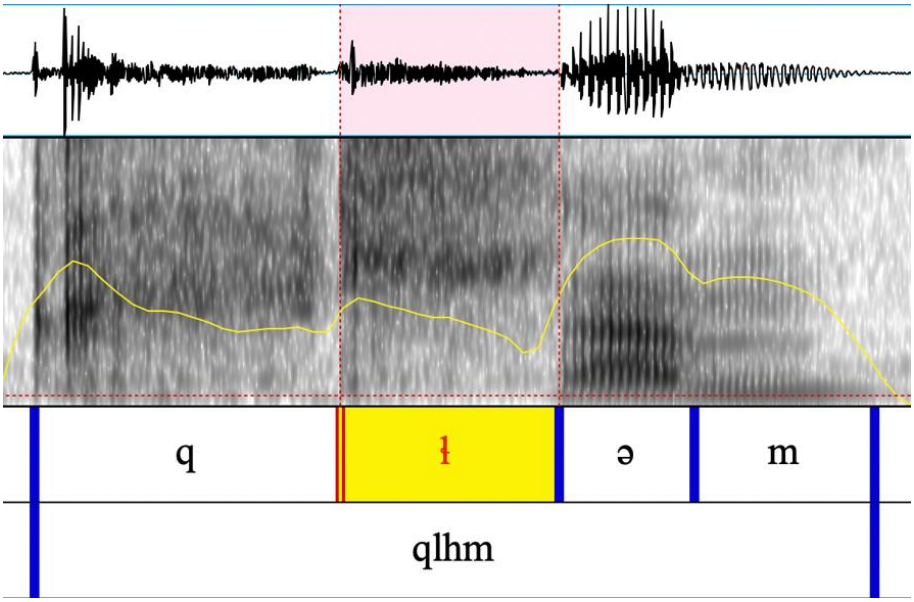


Figure 1: *qlhm* /qɬəm/ 'cod, black' (FV)

The second set of possible "vowelless" words reflects decisions about citation forms and examples in documentation (e.g., 3b). There are many entries in the dictionary that are marked with a * to show that they are not grammatical or attested on their own (Nater 1990). These are set aside because they will often occur with further affixation, which often will add vowels or more sonorant segments.

The true "vowelless" words considered in this paper (called OBSTRUENT-ONLY words in the remainder of the paper) are those that are contain only obstruents and are grammatical without further affixation (which usually introduces vowels or sonorant consonants). Further examples (in addition to 3c–d above) are given in (4). The words considered as "vowelless" in this paper belong to this set of words.

(4)	a.	tsk'lhp	'rib'	(N:138)
	b.	klh	'to fall'	(N:46)
	c.	klhc	'to be awake'	(N:46)
	d.	p'lht	'warm'	(N:90)

2.2 Distribution of [+continuant] segments

From a total of 1506 words on FirstVoices, there were only a total of 51 words that fit the definition of an OBSTRUENT-ONLY word.[3] The break down is shown in Table 1.

[3] These numbers were based on a survey of FirstVoices in May 2021 and are subject to change with additions and revisions to the site.

Table 1: Count of OBSTRUENT-ONLY words on FirstVoices

		Words
Do Not Meet Criteria		1455
Meet the Criteria	Have a Fricative or an Affricate	45
	Only Stops	1
	Other	5

Within this set of OBSTRUENT-ONLY words, 45 of the words have a fricative (n = 41) or affricate (n = 4). Only six words had no sonorant or [+continuant] segment. A closer examination of these words reveals that three of them have a vowel in their production, one has spirantization of a stop, and one is set aside because the audio does not match the transcription. This leaves a single obstruent-only word that is comprised only of stops (*tp* 'spotted'). Though the audio recording matches this transcription, the root **tp* is not given as a standalone word in Nater (1990:133).

The generalization that can be drawn across these data is that there is at least one [+continuant] segment in every Bella Coola, and this represents a relatively small proportion of the overall lexicon. Though the focus of this paper is on the OBSTRUENT-ONLY words, it is important to remember that the total number of words that fit this definition is under 4% of the lexical items on FirstVoices. While OBSTRUENT-ONLY words are attested, they do not represent the majority of words in Bella Coola. Most words have a vowel or a resonant, and where they lack these, they have a fricative (or, more marginally, an affricate). It is noteworthy that only 1/1455 entries is comprised only of stops.

While virtually every word in Bella Coola has at least one [+continuant] segment, and fricatives may be naturally paired with fricatives, rather than stops, this involves larger questions pertaining to the nature of affricates that are beyond the scope of the present paper. For a narrower scope and due to a small number of OBSTRUENT-ONLY words without fricatives, this paper focuses on fricatives as potential nuclei and leaves the investigation of affricates for future study.[4]

The distribution of consonants in OBSTRUENT-ONLY words underlies a central piece of evidence for the fricative as a good enough nucleus in Bella Coola. If a well-formed prosodic word contains at least one syllable and if fricatives are more sonorant than stops (to the point where a fricative but not a stop can be in a nucleus), then the absence of OBSTRUENT-ONLY words with just stops (which should be possible given the number of stops in the phonemic inventory) is unsurprising. It is not possible to build a well-formed prosodic word with only stops, and therefore, these words cannot surface without some additional modification. The distribution of fricatives and stops in OBSTRUENT-ONLY words is predicted under the good enough nucleus hypothesis because syllabification is required to satisfy the requirement for at least one syllable, but only OBSTRUENT-ONLY words with a fricative have an obstruent that is good enough to be parsed as a nucleus. In the following sections of this paper, I further refine the definition of good enough to be more specific: a good enough nucleus in Bella Coola requires that a segment can be moraic. The distribution of fricatives in OBSTRUENT-ONLY words supports analysing fricatives as moraic because they can be parsed in a nucleus, but evidence from reduplication supports them being moraic in a coda as well, while stops are not.

[4] Affricates raise interesting questions for phonological features and the acoustic realization when compared to fricatives. It would be interesting to explore these in the context of Bella Coola.

2.3 Fricatives are moraic (in a nucleus or coda)

The Good Enough Nucleus Hypothesis allows for a distinction between fricatives and stops in syllabification; namely, a fricative is a good enough nucleus in the absence of something more sonorant, while a stop is not. This distinction between fricatives and stops contributes to the asymmetry found across lexical items whereby virtually every OBSTRUENT-ONLY word has a fricative. This is unsurprising, as a word with only stops would have no segments that could be parsed as a nucleus and, therefore, epenthesis (or some other phonological repair) would be required for well-formedness (assuming that well-formed prosodic words require at least one syllable). The distinction between the fricatives and stops is that fricatives can be moraic in a nucleus or coda position.

In this paper, I adopt an Optimality Theory constraint-based approach (Prince & Smolensky 1993). A cross-linguistic preference for well-formed prosodic words motivates a range of high-ranked constraints that drive syllabification. While Bella Coola has often been noted to be an exception in prosodic structure, the goal of the present paper is to show that the patterns are consistent with some universal patterns, while highlighting what is exceptional. Under the Good Enough Nucleus hypothesis, the obstruent-only words are not within syllables and therefore are consistent with cross-linguistic expectations, but these words are exceptional in that they allow fricatives to be parsed as nuclei. Allowing obstruents as nuclei is cross-linguistically uncommon, though attested in other languages (cf. Dell & Elmedlaoui 1985).

In order to motivate syllabification of fricatives in OBSTRUENT-ONLY words, a constraint that penalizes outputs that are not well-formed prosodic words is required, such as GRWD=PRWD, which motivates building syllables and assigning stress. Instead of using GRWD=PRWD, I follow Cho and King (2003) and adopt the constraint WORD-MINIMALITY (W-MIN) that requires a well-formed prosodic word to have at least one mora (5).[5] This constraint is preferable because it is narrower and makes the connection between fricatives as nuclei and fricatives as moraic clearer. We know that W-MIN is high-ranked in Bella Coola, resulting in syllabification (and assigning moras to segments) even in words with no vowels or sonorant consonants.

(5) WORD-MINIMALITY (W-MIN): A prosodic word contains at least one mora.
(Cho & King 2003:194)

In order to allow for (and predict) a good enough nucleus in Bella Coola, we must distinguish between consonants using the hierarchy of constraints that specify an ideal syllabic peak (Prince & Smolensky 1993). The hierarchy is assumed to be universal and motivated by cross-linguistic patterns; an obstruent is less sonorous than a sonorant. These constraints are assumed to be in a fixed order across languages (6), but language-specific patterns arise through the ranking of other constraints relative to the syllable peak constraints. The distributional patterns described in Section 2.2 show that Bella Coola allows fricatives, but not stops, in a nuclear position. Crucially, DEP must be ranked between *P/STOP and *P/FRICATIVE to result in the syllabification of a fricative as a nucleus in the absence of anything more sonorant because the constraint ranking prefers fricative nuclei over vowel epenthesis. This order, given in (7), rules out syllabification of a stop as a nucleus

[5] Cho and King (2003) also analyse syllables in Bella Coola and draw some similar conclusions to those described in this paper, though the types of evidence and some of the theoretical assumptions differ from the ones in this paper.

as the ranking *P/STOP >> DEP supports epenthesis (or some other repair strategy) over having a stop as a nucleus.

(6) *P/OBSTRUENT >> *P/SONORANT >> *P/VOWEL (cf. Carlson 1997)

(7) W-MIN, *P/STOP >> DEP >> *P/FRICATIVE >> *P/SONORANT

Though allowing obstruents as nuclei is quite rare cross-linguistically, the Bella Coola patterns are still consistent with the universal ranking of peak sonority constraints. The patterns in Bella Coola do not violate assumptions about what an ideal nucleus is, they just allow more options when a better (sonorant) segment is not available. Cross-linguistic differences in what qualifies as a good enough syllable arise from the position of faithfulness and markedness constraints relative to the peak sonority hierarchy. This is desirable because the ranking of other constraints allows for configurations where only sonorants can be in a nucleus (the *OBSTRUENT constraints are high ranked with respect to markedness constraints) or ones where a larger set of obstruents can be in a nucleus (the *OBSTRUENT constraints are low ranked with respect to markedness constraints). This is necessary to allow for languages like Imdlawn Tashlhiyt Berber, which have stops in a nuclear position (see Dell & Elmedlaoui 1985).

This ranking proposed in (7) for Bella Coola correctly predicts that a sonorant (consonant or vowel) will be preferred as a nucleus over a fricative, but it still allows for a fricative to be a nucleus in the absence of anything more sonorous. Ranking *P/STOP over DEP accounts for the distributional facts: there are almost no words comprised only of stops, and the constraint ranking in (7) means that it is preferable to epenthesize where only stops are present in the input.

(8) Fricatives as nuclei in OBSTRUENT-ONLY words

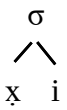
	t̀x̣t	W-MIN	*P/STOP	DEP	*P/FRICATIVE	*P/SONORANT
a.	t̀x̣t	*!				
b. ☛	t̀x̣$_{\mu}$t				*	
c.	t̀x̣i$_{\mu}$t			*!		
d.	t̀$_{\mu}$x̣t		*!			

The constraint ranking proposed in (7) also allows for the correct syllabification of words with sonorant consonants or vowels because the ranking *P/FRICATIVE >> *P/SONORANT ensures that fricatives will not be in a nuclear position unless the word consists of only obstruents. A simplified tableau in (9) demonstrates that the fricative in the word *xi* /x̣i/ 'to peak through a hole at somebody' (Nater 1990:162) will not be syllabified as a nucleus position, but instead as the onset of a single syllable (10).

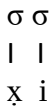
(9) Sonorants as nuclei in words with fricatives

	x̣i	*P/FRICATIVE	*P/SONORANT
a. ☛	x̣i$_{\mu}$		*
b.	x̣$_{\mu}$.i$_{\mu}$	*!	*

(10) a. Attested Form of *x̣i*



b. Unattested Form (violates *P/FRICATIVE)



Though the distribution of stops and the shape of roots in the lexicon fits with the ranking of *P/STOP >> DEP, the distribution of stops and fricatives in lexical items is only one piece of evidence that supports this analysis. Further evidence for this constraint ranking is found in reduplicative patterns, which are explored in the following section.

3 Fricatives are not "good enough" in reduplication

There is a C_1C_2 reduplication process in Bella Coola that has been associated with a range of meanings in previous literature, including diminutive and continuative functions (Nater 1978; Newman 1971).[6] Examples of this type of reduplication are given in (11). Descriptively, the copy is a consonant-vowel-consonant sequence and it is positioned relative to the first vowel in the word.

(11)	a.	ts'xlhn	'kick somebody'	ts'xlhnlhnim	'he was kicked repeatedly'	(N:143)
	b.	pk'm	'mosquito'	pk'mk'mi	DIM	(N:87)
	c.	sqwsn	'loon'	sqwsnsni	DIM	(N:114)
	d.	q'tsm	'to creak'	q'tsmtsm	'it is creaking'	(N:103)
	e.	st'cwm	'mat, mattress'	st'cwmcwmi	DIM	(N:119)
	f.	tskw	'heavy'	tskwalhkwalh	'walk with heavy feet'	(N:138)
	g.	t'nxw	'head'	t'nt'nqwi	DIM	(N:146)

Despite being omitted in the orthography, a word like *pk'm* /pk̓əm/ (11b) has a vowel and this is copied in reduplicated form *pk'mk'mi* /pk̓əmk̓əmi/. A spectrogram of *pk'mk'mi* is given in Figure 2.[7]

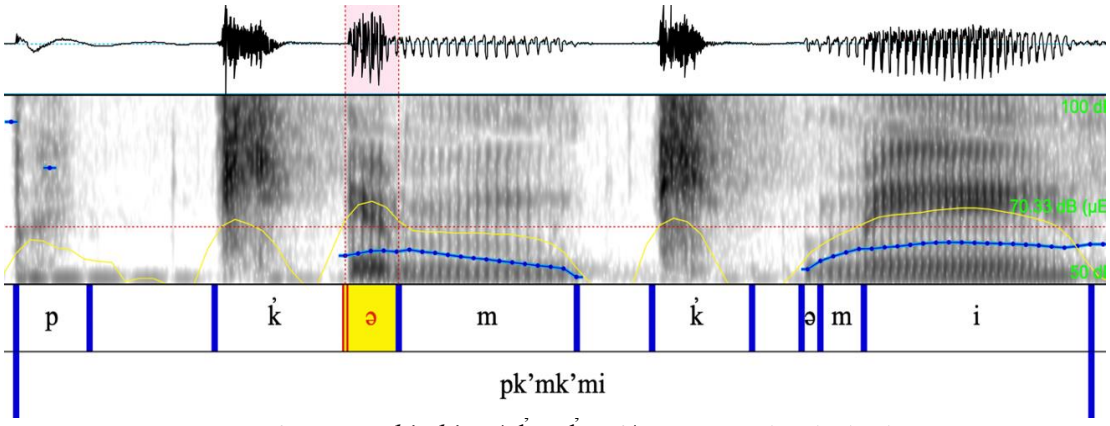


Figure 2: *pk'mk'mi* /pk̓əmk̓əmi/ 'mosquito (DIM)' (FV)

[6] Though the number, identity, and position of the copied segments cannot be clearly delineated into different meanings, the diminutive can be identified by the presence of an additional suffix *-i*, and the context.
[7] The second vowel is quite reduced, which warrants further (and systematic) investigation.

Reduplication with OBSTRUENT-ONLY words follows the same pattern (as in 11) when there is additional affixation present that introduces a more sonorant segment (a vowel). The word *sts'* 'to disperse, scatter' in (12a) is OBSTRUENT-ONLY, but reduplication is positioned relative to the affix *-alh* when available, as shown in (12c).

(12)	a.	sts'	'to disperse, scatter'	
	b.	asts'alh	'waterfall'	
	c.	asts'alhts'lh	'heavy rain'	(N:118)

Though fricatives can be moraic and be the nucleus of a syllable, reduplication skips over fricatives that are closer to left edge of the word in favour of a sonorant later in the word (13). This is consistent with the predictions made in Section 2.3; even though a fricative *may* be syllabified as a nucleus, a sonorant is a better syllabic peak if available. While a fricative is a good enough nucleus in syllabification, it is not good enough to be reduplicated without a more sonorant segment. A remaining question is how many syllables are built in (13b) which depends on what the maximal onset and coda size are, as well as what should be treated as extrametrical. This question is beyond the scope of the present paper.

(13)	a.	plhtkn	'bark of bitter cherry tree'	(N:87)
	b.	plhtknknlhp	'bitter cherry tree'	(N:62)

OBSTRUENT-ONLY words with no additional affixes, or only the *-i* suffix that co-occurs with diminutive reduplication, have an epenthetic /i/ that is doubled in reduplication (14). The ranking of DEP >> *P/FRICATIVE established in the previous section, and other proposed constraints, do not predict this pattern without further elaboration.

(14)	a.	sqw'	'to fly, jump'	sicsiiqw	'airplane'	(N:114)
	b.	lhqw'	'to fade'	lhiclhiqw	'it is fading'	(N:63)
	c.	* lhqw'-	'to sob'	lhiclhiqw'	'to be sobbing'	(N:60)

The C_1C_2 reduplication patterns in this section can be analysed as the affixation of two moras (μμ).[8] Reduplication is motivated by the high-ranked constraint *FLOAT, which is violated by every prosodic unit that is not affiliated with a segment (15).[9] This constraint requires the violation of a faithfulness constraint to fill empty prosodic units, and reduplication is the fission of an input segment into two output segments, and this can fill the empty prosodic unit (e.g., a mora) that was affixed. The fission process violates INTEGRITY (16). Reduplication may occur to fill a prosodic unit when DEP is ranked above INTEGRITY because fission is preferred over epenthesis. This partial ranking is shown in (17).

(15) *FLOAT: ∀*p* ∈ O, where *p* is a prosodic unit: ∃*s*, where *s* is a segment, and *p* dominates *s*
(Saba Kirchner 2010:232)

[8] Note: /ə/ is non-moraic in some Salish languages: see Blake (2000) for Comox-Sliammon and Mellesmoen and Urbanczyk (2020) for Halkomelem.
[9] Other high-ranked constraints ensure that the affixed mora is not deleted.

(16) INTEGRITY: No element of the input has multiple correspondents in the output.
(McCarthy & Prince 1999)

(17) *FLOAT >> DEP >> INTEGRITY

A tableau in (18) shows how the partial constraint ranking in (17) has the desired outcome. Candidate (18b) has moras that are not affiliated with segments and fatally violates high-ranked *FLOAT, while candidate (18c) that copies the consonants but epenthesizes a vowel fatally violates DEP. The winning candidate (18a) incurs three violations under integrity, which each correspond to fission of a segment.

(18) Reduplication – Fission, not epenthesis or floating moras

	μμ+pk̀əμmiμ	*FLOAT	DEP	INTEGRITY
a. ☛	pk̀$_{1}$ə$_{2\mu}$m$_{3\mu}$.k̀$_{1}$ə$_{2\mu}$.m$_{3}$iμ			***
b.	μμ pk̀əμ.miμ	*!*		
c.	pk̀$_{1}$iμm$_{2\mu}$.k̀$_{1}$əμ.m$_{2}$iμ		*!	**

While the tableau in (18) is simplified, but other possible candidates are eliminated under constraints that limit how the mora can be filled (e.g., a *C: constraint violated by lengthening a consonant). Proposing that fricatives can be moraic (and stops cannot) predicts a difference between stops and fricatives in reduplication: we do not expect stops to fill a mora, while fricatives can. This is borne out: the stop in *lhqw'* (14c) is reduplicated as the fricative /x/ in *lhiclhiqw'*. The shift from a fricative to a stop can satisfy *μ/STOP (19), which is a constraint modified from *μ/OBSTRUENT (Struijke 2000; Saba Kirchner 2010). The shift from stop to fricative violates IDENT-IO$_{[Cont]}$ (20).

(19) *μ/STOP: Stops are nonmoraic

(20) IDENT-IO$_{[CONT]}$: Assign a violation mark for every segment in the output with a different specification for [+/- continuant].

The tableau in (21) shows how *μ/STOP and IDENT-IO$_{[CONT]}$ are ranked to predict spirantization in the attested form. The winning candidate (21b) has the epenthesis of one vowel (violating DEP), fission of two segments (violating INTEGRITY), and spirantization (violating IDENT-IO$_{[CONT]}$). Compare this to candidate (21d), which has no violation of IDENT-IO$_{[CONT]}$ because a stop corresponds to a stop. A candidate *like* (21e) but with each mora assigned to a different syllable could also be considered, and must be ruled out, suggesting that reduplication is not just two (discontinuous) moras, but instead is a bimoraic syllable.

(21) Reduplication – stops cannot be moraic

	μμ+ɬq̓^{w}	*FLOAT	*μ/STOP	DEP	*P/FRICATIVE	IDENT$_{[cont]}$	INTEGRITY
a.	μμ ɬ$_{μ}$q̓^{w}	*!*			*		
b. ☛	ɬ$_{1}$i$_{2μ}$x$_{3μ}$.ɬ$_{1}$i$_{2μ}$q̓$^{w}_{3}$			*		*	***
c.	ɬ$_{1}$i$_{μ}$x$_{2μ}$.ɬ$_{1}$i$_{μ}$q̓$^{w}_{2}$			**!		*	**
d.	ɬ$_{1}$i$_{2μ}$q̓$^{w}_{3μ}$.ɬ$_{1}$i$_{2μ}$q̓$^{w}_{3}$		*!				***
e.	μ ɬ$_{1}$i$_{2μ}$q̓$^{w}_{3}$.ɬ$_{1}$i$_{2μ}$q̓$^{w}_{3}$	*!		*			***

There are other potential candidates that could be considered in (21), and these would require additional constraints. For example, another possible candidate is ɬi$_{μ}$x$_{μ}$ɬ$_{μ}$q̓^{w}. This could be explained with reference constraints on codas and syllable weight, but this approach requires further consideration and analysis of syllable structure and maximal onsets and codas in the language. This is left open for future research.

Another solution would be to approach these forms in a serial derivation, whereby the /i/ is epenthesized first and is then available at the point reduplication without incurring another DEP violation. A strength of adopting a serial approach is that it provides a clearer picture of how INTEGRITY might cope with the fission of something that is epenthesized.

A third solution would be to treat this /i/ as a fixed segmental affix that accompanies reduplication and is present in the input, positioned as an infix, and then undergoes fission. While there could be multiple allomorphs involved in C_1C_2 reduplication, this allomorphy is not lexically specified. The examples in (22) show that the epenthesis of /i/ is not lexically determined; the same root (*scw* /sx^{w}/ 'to burn something') is attested in reduplicated forms that have /i/, as well as those that do not. Therefore, while the third option (allomorphy) is perhaps the easiest to implement for the phonological grammar, it is not ideal because it shifts the analytical onus to the morphology in a way that is not straightforward because it is not lexically specified and the allomorphy is quite restricted and phonologically regular with respect to word shape, supporting that the insertion of /i/ should be treated as a part of the phonological grammar.

(22)	a.	scw	'to burn something'	(N:107)
	b.	sicsicwitsalu	'I keep trying to burn it'	(N:107)
	c.	scwmcwm	'lightning'	(N:107)

The first (higher-ranked constraints on syllable and coda shape and size) or second (serial derivation) solutions are the more appropriate of the three directions proposed. Though a full analysis is outside the scope of the present paper, I conclude with the observation that a serial derivation solution would also offer a solution to other questions about the domain where C_1C_2 reduplication is applied. Compare the position of reduplication in (22b) and (22c) — the reduplicant in (22b) does not align to later affixes with more sonorous segments. Under a parallel OT analysis, it is not clear what motivates the insertion of /i/ in (22b) instead of reduplication of suffixed material. However, if reduplication is applied prior to the affixation of these segments, this is not a

problem. Future work on Bella Coola phonology and morphology should explore whether there are consistent patterns in the reduplication of affixed material that are consistent with a serial derivation where reduplication is applied before certain suffixes are available in the derivation.

4 Discussion

4.1 Alternate analyses

Reduplication in Bella Coola has been labelled idiosyncratic in the past with many exceptions and lexicalized patterns, but the system is a lot more systematic and regular with the right set of assumptions. The Good Enough Nucleus Hypothesis differentiates fricatives and stops with respect to syllable structure and whether they can be the nucleus of a syllable. This is consistent with the distribution of obstruents in vowelless words, but also accounts for some of the patterns that Nater (1978:1) describes as "morpho-phonemic changes". Assuming fricatives (but not stops) can be moraic in a nucleus or coda position accounts for why stops in the C_2 position are not reduplicated (or reduplicated as fricatives).

Alternatives to the Good Enough Nucleus Hypothesis and the assumption that fricatives can be moraic in a nucleus or coda can be found across the literature. Bagemihl (1991) considers four possible analyses of an OBSTRUENT-ONLY word. For the word *t'xt* /t̓x̣t/ 'stone', three of these have no syllables and one has three syllables (23). This represents an all (23d) or nothing (23a–c) approach to syllabification; in other words, either each obstruent is its own syllable, or there are no syllables whatsoever.

(23) a. No Syllable Hypothesis
b. Simple Syllable Hypothesis
c. Complex Syllable Hypothesis

t̓x̣t *(no syllables)*

d. Obstruent Syllabicity Hypothesis

σ σ σ
| | |
t̓ x̣ t *(each obstruent is a different syllable)*

The hypotheses considered in (23) do not provide a straightforward explanation for the larger number of fricatives (relative to other obstruents) in the lexicon, nor are they as consistent with cross-linguistic prosodic patterns. Therefore, the Good Enough Nucleus Hypothesis, proposed in this paper, which allows for a single syllable with a fricative as a nucleus in OBSTRUENT-ONLY words is a good alternative (24).

(24) Good Enough Nucleus Hypothesis

σ
/ \
t̓ x̣ t *(single syllable, fricative as nucleus)*

The structure in (24) is supported by the analysis given in Cho and King (2003). They propose a similar analysis (that fricatives can be moraic) and observe asymmetries in obstruent patterns (stops vs. fricatives) in Bagemihl (1991). Cho and King (2003) further comment on Carlson's (1997) analysis of Bella Coola syllables and note that the analysis is specific to the behaviour of syllables in reduplication. While this observation is correct (Carlson's 1997 analysis is focused on reduplication), this critique is also specific to the theoretical framework that Cho and King (2003) adopt. They (and Carlson 1997) discuss Bella Coola syllables and reduplication with the assumptions of Base-Reduplicant Correspondence Theory (McCarthy & Prince 1999). In adopting a Generalized Linear Affixation approach as I do in this paper, there is no distinction between the types of syllable found in a base and reduplicant. Consequently, an analysis of reduplication in this framework provides more insight into syllabification in the language as a whole.

4.2 Directions for future research

A relatively high ranking of DEP in the phonological grammar leads nicely into an analysis of the forms discussed by Saunders and Davis (1972) and Shaw (2005), where an infixed *-n-* is copied instead of epenthesizing a vowel (25).

(25) a. k'ts- 'to chop'
b. k'nk'ntsats 'I chop again and again, but not now.' (Saunders & Davis 1972)

Other future directions include expanding description of the fricatives to include acoustic patterns and compare the realization of fricatives in different positions of the syllable — onset (non-moraic) vs. nucleus (moraic) vs. coda (moraic). A potential area of exploration is to compare Bella Coola fricatives in a nucleus position with the "fricative vowels" found in varieties of Chinese (Faytak 2018). Connell (2007) describes fricative vowels as having a combination of formant structure and fricative noise — but it is not clear that there are observable formants in the Bella Coola fricatives.[10]

A preliminary observation is that the amplitude of an onset or coda fricative falls over the duration of the segment, where it appears to stay more level in nuclear fricatives. Examples of this are shown in Figures 3–4 (onsets), Figures 5–6 (codas), and Figures 7–8 (nuclei).

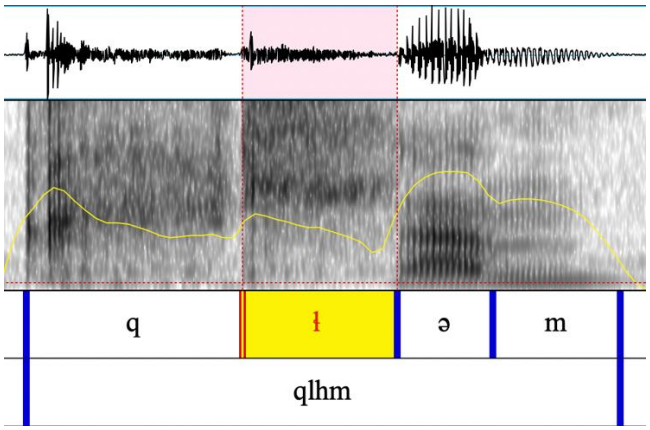


Figure 3: Spectrogram of onset fricative in *qlhm* /qɬəm/ 'cod, black' (FV)

[10] The nuclear fricatives do somewhat sound like whispered vowels.

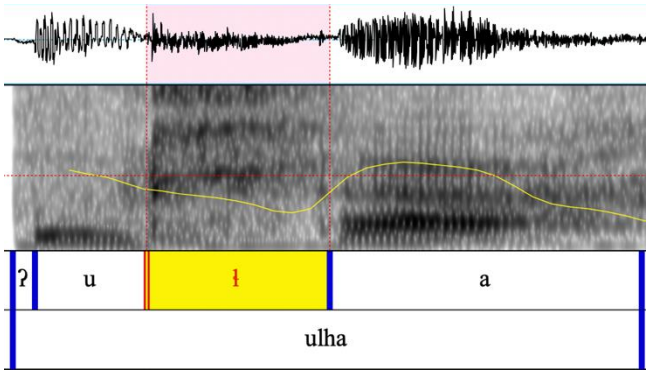


Figure 4: Spectrogram of onset fricative in *ulha* /ʔuła/ ‘dependable, reasonable’ (FV)

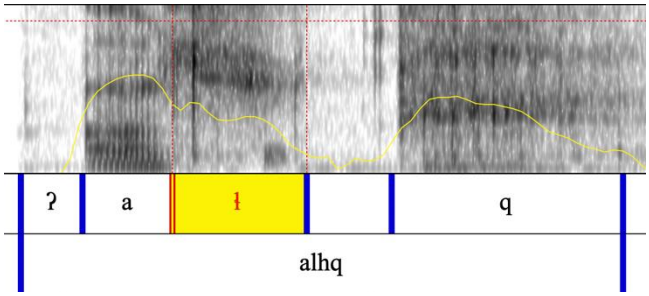


Figure 5: Spectrogram of coda fricative in *alhq* /ʔałq/ ‘elderberry, cooked’ (FV)

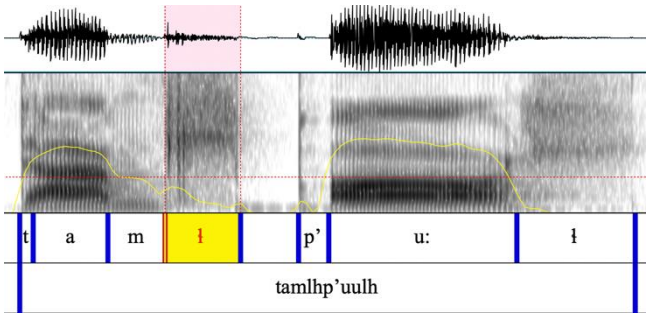


Figure 6: Spectrogram of coda fricative in *tamlhp’uulh* /tamɬp̣u:ɬ/ ‘to make bread’ (FV)

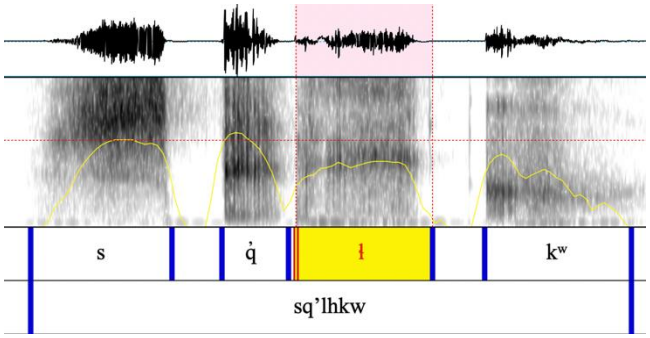


Figure 7: Spectrogram of nucleus fricative in *sq’lhkw* /sq̓ɬkʷ/ ‘baggage’ (FV)

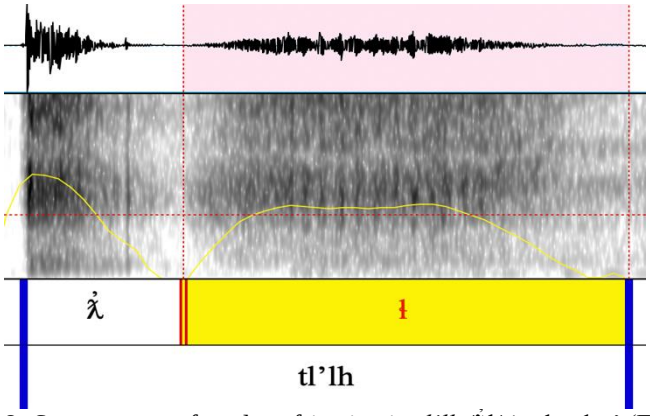


Figure 8: Spectrogram of nucleus fricative in *tl’lh* /ɬ̓ɬ/ ‘to be dry’ (FV)

Another area for future research is contrasting the fricatives in a nucleus position in Bella Coola with the voiced obstruents in other Salish languages that developed from Proto-Salish sonorants and still behave like sonorants in phonology, such as the /z/ in Lillooet that has developed from Proto-Salish *y (Kuipers 2002).

4.3 Bella Coola in the context of Salish languages

While Bella Coola is well-known in general linguistics as an example of Salish phonology, it is important to recognize that Bella Coola is quite unlike other Salish languages. While the Good Enough Nucleus Hypothesis and the adherence to the universal hierarchy regarding ideal peaks and sonority reduce the perceived distance between Bella Coola and other languages, the data discussed in this paper highlight some key differences between Bella Coola and other Salish languages.

Though consonant clusters are common across the language family and syllable structure varies with respect to what is permissible as an onset, sonority effects are well-documented across Salish languages. The position of /ə/ has been shown to be predictable on the basis of prosody in many languages, such as Comox-Sliammon (Blake 2000) and Lillooet (Matthewson 1994). While Bella Coola shows adherence to principles of sonority, and obeys similar prosodic constraints, it raises questions for cross-Salish phonological analysis about the status of moras and what can be considered to be moraic. For example, coda consonants in Comox-Sliammon and Halkomelem have been treated as moraic previously, while /ə/ is considered nuclear but non-moraic in these languages (Blake 2000; Mellesmoen & Urbanczyk 2020). Leonard (2019) argues that neither /ə/ nor codas are moraic in Straits. Under the present analysis, Bella Coola represents a different pattern, whereby consonants (to the exclusion of stops) and /ə/ may be moraic when in a nucleus or coda.

Salish languages are quite diverse in syllable structure and what can be moraic, and Bella Coola is only one part of a much larger story. There has been lots of notable work on syllables from those who study Salish languages, including proposals for simple syllables in Spokane (e.g., Bates &

Carlson 1992) and Moses-Columbia (e.g., Czaykowska-Higgins & Willett 1997), but these Interior Salish languages are quite different than Bella Coola and, therefore, further analysis and comparison is needed to understand the range of prosodic structures in Salish.

5 Conclusion: Bella Coola in the cross-linguistic typology

The main contribution of this paper is the *Good Enough Syllable Hypothesis*, which allows fricatives to be nuclear in the absence of vowels or sonorant consonants in Bella Coola, which is possible when fricatives in a nucleus or coda position are considered to be moraic. Forming a good enough syllable with a fricative as a nucleus is preferable to epenthesizing a vowel (*P/STOP >> DEP >> *P/FRICATIVE). In contrast, stops cannot be moraic or nuclear and the constraint ranking results in epenthesis. Bella Coola C_1C_2 reduplication is the affixation of two moras (μμ) which are filled through fission, but vowel epenthesis occurs to satisfy a high ranked *FLOAT constraint and spirantization of stops is triggered to satisfy *μ/STOP.

The Good Enough Nucleus Hypothesis has cross-linguistic precedence (see Bagemihl's 1991 discussion of Dell & Elmedlaoui 1985), and Bella Coola remains important for what it can tell us about phonology and phonological theory.[11] It is true that syllables in Bella Coola are unlike most other languages, including other Salish languages, because they allow an obstruent nucleus, but syllables in Bella Coola still obey universal assumptions about sonority. Further, while vowelless words are attested in Bella Coola, these words are not syllable-free.

Alternative analyses of Bella Coola syllables (i.e., the other hypotheses considered in Bagemihl 1991) do not account for the distribution of stops, relative to fricatives, in obstruent-only words, or the patterns in reduplication (including epenthesis and spirantization) as well as the Good Enough Nucleus Hypothesis does. This analysis of Bella Coola prosodic structure is largely focused on arguing for the existence of syllables with fricatives in nuclei in OBSTRUENT-ONLY words, but it does allow for further predictions about syllable structure and fricatives in consonant clusters that exceed what is expected to be a maximal onset or coda, or in sequences that do not obey principles of sonority. The takeaway is Bella Coola syllables are more systematic than might be expected from previous description and they do adhere to cross-linguistic universals involving sonority, though the phonological grammar allows for more marked syllable structures (fricative nuclei).

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[11] Someone asked about why we would want Bella Coola to look like an "ordinary boring language". It is my sincere hope that no reader walks away from this paper with that conclusion. Bella Coola has a deeply fascinating process of syllabification and still is quite exceptional. But it is equally consistent with many observations about what is universal across human languages. I believe this to a more accurate characterisation of Salish phonology — it is different than many languages, but still bears the systematicity expected of a language.

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