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*Word-initial clusters and minimality in Yakima Sahaptin**

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In the Yakima dialect of Sahaptin, the smallest forms of words are CCV and CVC, as established by a study of lexical patterns and the obligatory augmentation of subminimal roots. We argue that CCV words cannot be considered a type of disyllable, nor do the initial consonants in CCV words exhibit properties (apart from minimality) that would allow them to be classified as moraic. We therefore propose that Yakima Sahaptin represents a previously unrecognised type of minimality, biconsonantal minimality. This kind of minimality requires a theoretical framework in which consonants can be distinguished from vowels, as do other phonological phenomena.

1 Minimality

Following work by McCarthy & Prince (1986), the minimal shapes of roots or words in various languages have been characterised as well-formed feet: two prosodic units, either two syllables or two moras. Disyllabic minimality is attested in Yidin^{y} (Nespor & Vogel 1986), Diyari and Makkassarese (McCarthy & Prince 1986) and Yoruba nouns (Pulleyblank 1988), among other languages (see also Garrett 1996). Bimoraic minimality (CVV, CVC) has been proposed for Lardil and Ponapean (McCarthy & Prince 1986), English (Hammond 1999), Japanese (Itô 1990), Athabaskan roots (Leer 1979, Hargus & Tuttle 1997),

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Arabic nouns (McCarthy & Prince 1990), Bengali (Cole 1990), Spanish (Crowhurst 1992), Trukese (Hart 1991, Davis 1999), Yoruba verbs (Orie & Pulleyblank 2002) and Hungarian (Siptár & Törkenczy 2000), among other languages.

The minimal word as foot was originally thought to follow from the prosodic hierarchy (Selkirk 1980), in which every prosodic word should contain (at least one) well-formed foot, disyllabic or bimoraic feet being the most common type of stress feet (Hayes 1987). However, recent research has undermined the motivation for lexical minimality as stemming from optimal foot shape. As first noted by Spring (1990), the stress-foot patterns which satisfy minimality may be different from those needed for stress assignment in a particular language. Spring (1990) noted that the stress feet in Axininca Campa are iambic, whereas words are minimally disyllabic, but not shaped like a canonical iamb. For the same language, McCarthy & Prince (1993) also noted that the footings required for bases to satisfy minimality requirements imposed by suffixes may differ from the footings required for stress placement. A survey of minimality patterns by Garrett (1996) found little evidence for a correlation between the feet required by stress systems and those posited for minimality within a particular language. For example, Garrett noted that in Khalkha Mongolian, CVC syllables count as light for stress in contrast to heavy CVV, but the minimal word is CVC. He also noted that in Russian, stress is 'lexically idiosyncratic' but there is a minimal word requirement (CVC). Like Garrett (1996), Gordon (1999) found mismatches between the syllable types which count as heavy for stress and those which count as heavy for minimality.

Evidence of minimality phenomena beyond the common disyllabic/bimoraic types has also begun to accumulate. Itô (1990) analysed loanword abbreviations in Japanese as predominantly trimoraic. Davis (2003: 91) suggested that genitive nouns in Sinhala are minimally trimoraic. Gordon (1999), in his survey of weight-sensitive phenomena, noted 139 languages with minimal word requirements. While CVC was the most common minimality requirement in his sample, other patterns were also attested: CVVC (Menomini); CVVC or CVCC (Attic Greek); CVVV or CVCCC (Estonian); full vowel (i.e. the minimal word must contain a full vowel; Au and Maru).[1]

Another minimality pattern uncovered by Gordon (1999) is one in which the minimal word is either CCV or CVC, a pattern found in Czech and Kashuyana.[2] In this article, we consider another case of CVC/CCV

[1] Gordon also states that in Kwakw'ala, the minimal word must contain a low vowel, but according to Pat Shaw (personal communication), this is not correct. Kwakw'ala contains many words with non-low vowels; e.g. [nəxʷi] 'swallow', [dzəw'ən] 'salmon'.

[2] Gordon (1999) also includes Tsou in this set. However, according to Richard Wright (personal communication), Tsou does not have CCV minimality. In Wright (1996: 31), minimality in Tsou is described as follows: 'the minimal word in Tsou is two morae (*μμ*) consisting of either a long vowel: **a:** 'no' or of two light syllables: **akʔi** 'grandfather, elder''.

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minimality and its theoretical implications. In the Yakima dialect of Sahaptin (YS), CVC and CCV are the smallest forms of words. We will argue that CCV words do not reduce to either disyllabic or bimoraic minimality. We will suggest instead that the YS minimality pattern reflects consonant-based minimality: YS words must contain two consonants.

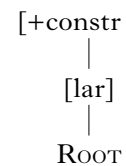
The focus of this article is therefore on finding the right representation for Sahaptin minimal words. We believe that representations are a continuing concern for any theory of phonology, even Optimality Theory. This point perhaps requires emphasis in light of statements such as the following:

> in an optimality-theoretic framework the inertness of syllables closed by a geminate for stress does not really argue against the moraic theory of geminates; rather it would just be a consequence of certain high-ranking constraints that have the effect of ignoring the bimoraicity of any CVC syllable (Davis 2003: 95).

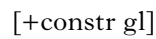
In other words, this passage seems to suggest that since representational requirements can always be trumped by some higher-ranked constraint, the search for correct representations may be futile. However, faithfulness constraints evaluate correspondence between surface representations, or input and surface representations, with deviations subject to penalty. Faithfulness constraints form a major part of OT, including subtheories such as the Emergence of the Unmarked (McCarthy & Prince 1994). Faithfulness constraints have been crucial to the success of many types of OT analyses. For example, Pulleyblank (2005) has posited a distinction between glottal stop-initial and glottalising suffixes in Nuu-chah-nulth, represented as in (1).

(1) *Glottal stop-initial* vs. *glottalising suffixes in Nuu-chah-nulth*

a. glottal stop-initial



b. glottalising



The analysis also includes a faithfulness constraint, Dep(root) ('any root node in the output must have a correspondent in the input'), which penalises candidates which contain a [+constricted glottis] glottal stop (as opposed to candidates in which [+constricted glottis] is attached to a compatible segment with underlying root node). The representations and the constraint together account for the two types of glottalising suffixes in Nuu-chah-nulth. Representations are therefore still very much a concern for Optimality Theory.

The structure of this article is as follows. After presenting background information on Sahaptin and YS consonant clusters (§2), we present

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evidence for CCV/CVC minimality (§3). Next (§4) we argue that word-initial clusters in YS do not form syllables on their own, nor is there evidence that they are moraic. In §5 we consider some of the predictions of biconsonantal minimality. We suggest that there are other languages with biconsonantal minimality, that there exist vowel-counting (as opposed to syllable-counting) phenomena and that there is a range of other phenomena which refer to consonants as opposed to vowels. However, as we review in §6, it is not clear how consonants are to be formally distinguished from vowels.

In this article, our discussion is couched to the greatest extent possible in terms which presuppose neither a rule-based nor a constraint-based theoretical framework, although we will model some phenomena with tableaux in §3.2.1 and we will supply a list of constraints which refer to consonants *vs.* vowels in an appendix. Our use below of terms like 'epenthetic' or 'inserted' should not be construed as endorsement of a derivational framework. 'Epenthetic', for example, is simply a handy way of referring to a morphologically contentless segment which would be considered absent from an input form under any reasonable phonological analysis.

2 Background on Yakima Sahaptin

Sahaptin is a Native American language of the Sahaptian family, which is hypothesised to be a branch of the Penutian family (Sapir 1929, Mithun 1999). Jacobs (1931) and Rigsby & Rude (1996) are reference grammars on the language. There are no published Sahaptin dictionaries. The consonant and vowel inventories of Sahaptin are uncontroversial, and are given in (2):

(2) a. *Sahaptin consonant inventory*

p	p'	t	t'	tɬ	tɬ'	ts	ts'	tʃ	tʃ'[3]	k	k'	kʷ	kʷ'	q	q'	qʷ	qʷ'	ʔ
				ɬ		s		ʃ		x		xʷ		χ		χʷ		h
m		n		l														
w								j										

b. *Sahaptin vowel inventory*

i	iː	ɨ		u	uː
		a	aː		

Rigsby & Rude (1996) note that stress in Sahaptin is contrastive (see also §4.1 and Hargus & Beavert 2002a). We transcribe primary stress in words with two or more vowels with an acute accent over the stressed vowel.

[3] In Sahaptin, contrasts between the affricate [t͡ʃ] and the consonant sequence [tʃ] are possible intervocalically. However, in this article, no words contain examples of the rare consonant sequence [tʃ]. Accordingly, [tʃ] in this article represents an affricate.

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The data in this article come entirely from the second author. She is one of approximately five remaining native speakers of Yakima Sahaptin (YS), a Northwest Sahaptin dialect (Rigsby & Rude 1996).

2.1 Word-initial clusters in Yakima Sahaptin

Sahaptin liberally allows word-initial and word-final consonant clusters both underlyingly and in phonetic forms. In Hargus & Beavert (2002b), we described the acoustic properties and phonotactic patterns of such clusters. In this article we focus on other phonological properties of word-initial consonant clusters. Our lexical files (Beavert & Hargus, in preparation) currently contain 1514 roots, and of these, 297 (around 20%) contain an underlying initial cluster. Initial consonant clusters are thus a central feature of Sahaptin phonology, although not all underlying clusters surface as such, some regularly undergoing [ɨ]-epenthesis (discussed below).[4]

In phonetic forms, YS allows both obstruent-initial and sonorant-initial clusters. Up to four consonants are possible in a word-initial cluster, although phonetic CCCC is only attested in two words.[5] Our earlier acoustic study (Hargus & Beavert 2002b) confirmed that the clusters in words like those in (3) are true phonetic consonant sequences:

(3) *Consonant clusters of different lengths*

CC	[χnɨn]	'golden currant'
CCC	[tχnána]	'rolling thunder'
CCCC	[ʃtχni]	'horsefly'

Examples of obstruent + sonorant clusters of various types are provided in (4). (Abbreviations are as follows: N = nasal, L = lateral, J = glide, F = fricative, S = stop.)

(4) *Obstruent + sonorant clusters*

SN	[qniːp]	'shameful, disgraceful'
SL	[ʧ'laj]	'pulverised dried salmon'
SJ	[twáti]	'medicine person'
FN	[ɬmáma]	'old woman'
FL	[χlaːm]	'large cedar root basket'
FJ	[xjaw]	'dry'

Within the typology of obstruent clusters proposed by Morelli (1999, 2003), YS is a Type 6 language, allowing fricative–stop, stop–fricative, stop–stop and fricative–fricative clusters.

[4] Initial clusters are also a historically unique feature of Sahaptin. Sahaptin's sister language within the Sahaptian family, Nez Perce, bans initial consonant clusters (Crook 1999). See also §4.1.

[5] YS is thus in accord with the cross-linguistic observation of Greenberg (1978) that longer consonant clusters are less frequent.

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(5) *Obstruent clusters*

FS	[χtu]	'strong'
	[ɬkʷ'i]	'day'
SF	[ʧχaw]	'fat'
	[qʷ'ʃɨm]	'mischievous'
SS	[qtɬaːk]	'gapped, jagged, agape'
	[ptis]	'muskrat'
FF	[sχɨχ-]	'be angry'
	[ʃχʷíjaːʃ]	'alkali brush'

As seen in (5), word-initial obstruents in clusters are not limited to coronals, unlike some nearby Salish languages (Shaw 2002): other major places of articulation – labial, dorsal and laryngeal – are attested in such clusters as well.[6]

YS also allows limited sonorant-initial phonetic clusters.

(6) *Sonorant-initial clusters*

NJ	[mjánaʃ]	'child'
NS	[nʧ'i]	'big'
LS	[ltájltaj]	'hemp shoulder bag'

Most sonorant-initial clusters, however, undergo [ɨ]-epenthesis (Hargus & Beavert 2002b).

(7) *Sonorant-initial clusters with* [ɨ]*-epenthesis*

NS	/nkʷɨt/	[nɨkʷít]	'meat'
NN	/mnan/	[mɨnán]	'where'
LN	/lmɨs+RED/	[lɨmís lɨmɨs]	'thick tanned hide'

Additional examples of [ɨ]-epenthesis will be seen in (9), (10), (12) and (24).

Sequences of identical consonants occur in word-initial clusters as well. Some examples of sequences of identical affricates are given in (8).

(8) *Sequences of identical affricates*

[ʧʧája]	'juneberry, saskatoon berry'
[ʧʧuː]	'quiet, speechless'
[tɬ'tɬ'umχʷ]	'red-wing blackbird'

Examples of sequences of identical stops can be found in §4.2.

[6] The only laryngeal consonant allowed in initial clusters is [ʔ], which is limited to the first consonant of the cluster (Hargus & Beavert 2002b). Clusters containing [ʔ] must undergo [ɨ]-epenthesis: e.g. /ʔwanʃ/ [ʔɨwanʃ] 'thigh'.

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2.2 The status of glides in Yakima Sahaptin

Levi (2004), in a cross-linguistic survey, has established strict criteria for the identification of languages with underlying glides. For such languages, it is not sufficient to demonstrate that there is a contrast between a glide and its corresponding high vowel, since minimal pairs can be represented in a variety of ways, such as non-nuclear /i/ *vs.* nuclear /i/ (as argued for Argentinian Spanish by Harris & Kaisse 1999). It is necessary to show that glides pattern with consonants and not vowels for some phenomenon that distinguishes between these two classes of segments. In this section, we present evidence for the inclusion of glides /j w/ in the consonant inventory in (2a), since their status as consonants is crucial in the discussion of minimality in §3.

In YS, glides pattern with other sonorant consonants in triggering [ɨ]-epenthesis. Examples of word-initial nasal + consonant and lateral + consonant are given in (9).[7]

(9) /m n l/ + C: [ɨ]-*epenthesis*

/mqɬ́ɬ/	[mɨqɬ́ɬ]	'orange'
/nkʷɬ́t/	[nɨkʷɬ́t]	'meat'
/lkʷ'it/	[lɨkʷ'ít]	'submerging'

(lkʷ'i- 'submerge', -t GER)

The glides /j w/ also trigger [ɨ]-epenthesis in this position:

(10) *glide* + C: [ɨ]-*epenthesis*

/jkɬ́t/	[jɨkɬ́t]	'wild'
/jqʷ'í:t/	[jɨqʷ'í:t]	'narrow'
/wq'áʧa:ʃ/	[wɨq'áʧa:ʃ]	'I'm stretching'

(wq'at- 'stretch', -ʃa IMPF, =Vʃ 1SG)

There are few vowel-initial roots in Sahaptin. There is only one /i/-initial root, which undergoes total reduplication in the singular and single consonant reduplication in the plural. YS disallows vowel-initial syllables everywhere within the word, and words based on the root /iks/ 'little' undergo epenthesis of [ʔ] word-initially.

(11) /i/ + C: [ʔ]-*epenthesis*

/iks/	[ʔiksíks], *[jɨksíks]	'little, small, young'

(cf. [ʔíkks] ~ [ʔikksíks] PL)

[7] In this article, we use the affix-glossing conventions of Rigsby & Rude (1996): 2OBJ.SG (2nd person object/possessor with 1st person subject), 3ABS (3rd person absolutive), ABL (ablative), ADJ (adjectival), ALL (allative), CAUS (causative), CIS (cislocative), COM (comitative), FUT (future), GER.NOM (gerundive nominalisation), HAB (habitual), IMPV (imperfective), IMP.SG (imperative singular), INSTR (instrumental), INV (inverse), LOC (locative), NOM (nominative), PL (plural), PPF (present perfect), PPL (participle), PST (past), RED (reduplicant), REFL (reflexive).

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If this root were glide-initial (/jks/) rather than vowel-initial (/iks/), it should undergo [ɨ]-epenthesis, like /jkɬ/ 'wild' in (10).

Word-finally, the glide /j/ triggers [ɨ]-epenthesis before /m/, as do /n l/:

(12) a. /l n/ + /m/: [ɨ]-*epenthesis*

/ʔánm/	[ʔánɨm]	'winter'
/ʔínm/	[ʔínɨm]	'excessively'
/tɬ'jálm/	[tɬ'jálɨm]	'Cle Elum (place name)'

b. /j/ + /m/: [ɨ]-*epenthesis*

/talújm/	[talújɨm]	'nail'

Although tautomorphemic /Ívim/ does not occur, this sequence arises in heteromorphemic forms containing the cislocative suffix /-m/. In such forms, there is no [ɨ]-epenthesis, showing that /i/ and /j/ contrast between a vowel and a consonant.

(13) /i/ + /-m/ CIS: *no epenthesis*

/ʔiwáχi-/	'wait'	[paʔiwáχim]	'wait for me'
/ní-/	'give'	[pánim]	'give me'
/naknúwi-/	'take care of'	[naknúwim]	'take care of me'

To summarise, glides and high vowels contrast in YS. Moreover, glides pattern with consonants and not vowels in YS with respect to epenthetic segments. In certain word-initial and word-final clusters, glides trigger [ɨ]-epenthesis, unlike their high vowel counterparts. In the remainder of this article, YS 'VC' will therefore refer to any sequence of vowel + consonant. When that consonant is a glide, 'VC' is one of the licit combinations of vowel and glide in YS: [aj], [aw], [iw] or [uj].

3 Minimality in Yakima Sahaptin

In this section, we will suggest that YS contains a constraint against words which are smaller than two consonants:

(14) PrWd ≥ CC

The evidence for biconsonantal minimality comes from two sources: lexical statistics and the augmentation patterns of subminimal roots.

3.1 Lexical statistics

Since nouns and adjectives present fewer morphological complications than verbs, we begin our description of minimality patterns in YS by

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considering non-loanwords formed from morphologically simplex nominal and adjectival roots. The numbers presented in Tables I and II are based on inspection of 810 underived, non-loan nouns and adjectives in our current lexical files.

First, we consider nouns and adjectives with one short vowel, summarised in Table I. For vowel-final words containing one short vowel, forms with initial clusters (CC(C)V) outnumber words without clusters (CV). This fact is surprising, given the findings of Greenberg (1978) that consonant clusters tend to be rarer than singleton consonants, both cross-linguistically and within a single language. As discussed in §2.1, the length of a consonant cluster is inversely proportional to its type frequency in YS. However, for consonant-final words containing one short vowel, forms with clusters are as common as forms without clusters.

type			number	total
C(C(C)(C)))V				
CV			0	
CCV	[kki]	'drooping, fringed'[8]	20	
CCCV	[tkni]	'string, cord, rope'	5	
CCCCV	[ksksa]	'elephant ear (mushroom)'	2	27
C(C(C))VC(C(C))				
CVC	[pap]	'(man's) daughter'	48	
CCVC	[pʧɨʃ]	'door, gate'	61	
CCCVC	[tkʷsaj]	'pot, basket'	4	
CVCC	[ʔiʃt]	'son, (woman's) daughter'	48	
CCVCC	[tɬ'tɬ'umχ]	'red-wing blackbird'	3	
CVCCC	[t'alpt]	'shell bead'	5	
CCVCCC	[skɨtks]	'fringe'	1	
CVCCCC	[sajlps]	'kidney'	2	172

Table I

Minimality statistics for underived nouns and adjectives containing one short vowel (V), excluding loans.

Of interest is the absence of CV nouns/adjectives. This fact cannot be explained by a constraint against vowel-final words, as there are 70 CVCV words (e.g. [k'úsi] 'horse') in the current sample.

Nouns and adjectives which contain one long vowel are presented in Table II.

[8] A list of all 20 CCV words is given in §4.

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type			number	total
C(C(C))VV				
CVV	[ts'a:]	'size, fit'	1	
CCVV	[ts'x^{w}i:]	'conical'	5	
CCCVV	[ʃq^{w}'na:]	'sad, dejected'	2	8
C(C)VVC(C)				
CVVC	[k^{w}a:t]	'asleep'	42	
CCVVC	[χmi:t]	'rough'	38	
CVVCC	[t'a:lk]	'extremely loud, deafening'	6	
CCVVCC	[twi:χt]	'soup, broth'	2	88

Table II

Minimality statistics for underived nouns and adjectives containing one long vowel (VV), excluding loans.

In Table II, the small number of CVV words is also conspicuous. The one example, /ts'a:/, is not a loan; cf. Nez Perce [ts'aʔá] 'size, fit' (Noel Rude, personal communication), [ts'aʔáaʔ] 'fitting perfectly, compatibly' (Aoki 1994: 62).[9] Moreover, the absence of CVV relative to CVVC runs counter to the well-known cross-linguistic tendency towards closed-syllable shortening (e.g. Maddieson 1985).

Another way of looking at minimality patterns in YS is shown in Table III. Here, morphologically underived nouns and adjectives are grouped by numbers of segments in the word (where we count long vowels as two segments). The numbers of words with one consonant are underlined:

segments		number	total
2	CV	<u>0</u>	0
3	CVC	48	
	CCV	18	
	CVV	<u>1</u>	67
4	CCCV	5	
	CCVC	61	
	CVCC	48	
	CVCV	70	
	CVVC	42	
	CCVV	5	231

Table III

Shortest forms of underived nouns and adjectives, excluding loans. The numbers of words with one consonant are underlined.

[9] Rude (personal communication) notes that Sahaptian *ʔ is 'subject to intervocalic loss' in Sahaptin (along with *h n l w j).

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The general absence of YS words that contain one consonant is striking. There is one counterexample, CVV /ts'aː/, as noted above, but non-100% conformity seems to be typical of phonological generalisations which emerge from lexicon-wide studies. McCarthy (1994: 204), in a study of lexical restrictions on homorganic consonants within Arabic, noted that 'evidence in support of [such restrictions] is statistical rather than categorical'. Urbanczyk (2006: 206) notes that 'fewer than one percent of native Lushootseed roots in the *Lushootseed Dictionary* end in a vowel, indicating a very strong preference for consonant-finality'.[10]

When loan vocabulary is searched, one example of CV and two examples of CVV turn up. The sole CV noun/adjective is [ts'i] 'sweet', borrowed from Chinook Jargon. The two CVV nouns are [tiː] 'tea' and [kaː] 'car'. If we are correct that YS has biconsonantal minimality, then it is not enforced when new words enter the language. At worst this would entail recognition of lexical strata in YS, biconsonantal minimality perhaps holding of native vocabulary in general but not of loans (cf. Japanese, as analysed by Itô & Mester 1995).

3.2 Subminimal roots

3.2.1 *Verbs*. Nominal and adjectival roots can form independent words in YS, as seen above in (3)–(8) and Tables I and II. Verb roots, on the other hand, are bound morphemes which must be affixed to create a well-formed verb word. With the exception of two irregular verbs, which we return to below, verbal affixes are minimally a single consonant, such as /-k/ (IMP.SG), or a CV morpheme, such as /ʔi-/ (3SG NOM) or /-ʃa/ (IMPV).

Given this morphological difference between nouns and verbs, we believe it is no accident that there are larger numbers of CV and CVV verb roots than nominal and adjectival roots. Recall that in the non-loan vocabulary, there are no CV noun or adjective words, and only one attested CVV one, the noun [ts'aː], based on the root /ts'aː/. In contrast, there are 13 CV or CVV verb roots in our current database.

(15) a. CV *verb roots*

/ku-/	'do'	/mi-/	'do'
/k'u-/	'gather, meet, sit together'	/ni-/	'give'
/tɬ'u-/	'guess (in game)'	/wa-/	'be'

b. CVV *verb roots*

/ʧiː-/	'drink'	/paː-/	'separate'
/liː-, luː-/	'into water'	/tiː-/	'put into'
/nuː-/	'say'	/taː-/	'lightning strikes'

[10] Urbanczyk's proposed constraint to this effect can be found in the appendix.

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Because biconsonantal minimality is a requirement of words, not roots, and verbs always undergo some sort of affixation, verb roots can be smaller than noun or adjective roots.

Two irregular verbs in YS, /wa/ 'be' and /nuː/ 'say', are allowed to surface without affixation. These verbs have irregular imperfective stems which are identical to their roots: the normal imperfective suffix /-ʃa/ is not used with these verbs. Interestingly, however, there is evidence from the distribution of stress that these subminimal verbs are dispreferred as prosodic words. YS has a set of second position clitics which surface without stress, whereas other words surface with one primary stress.[11] When /wa/ 'be-IMPV' is phrase-medial, it surfaces without stress, as shown in (16a), unless a stress lapse of more than two syllables in syntactically independent words would result, as shown in (16b).

(16) a. /wa/ *surfaces without stress*
ʔíʧi =maʃ wa tχtájma-t
this 2OBJ.SG be exchange-NOM
'This is your [wedding] exchange [gift].'
ʔíʧiːʃ wa tχtájma-t
ʔíʧi=iʃ
this=1SG be exchange-NOM
'This is my [wedding] exchange [gift].'
ʔíʧi =natk wa ʔɨníːt
this 1PL.INCL be house
'This is our house.'

b. /wa/ *surfaces with stress: avoidance of stress lapse*
ʔíʧi =mataʃ wá ʔɨníːt
this 2PL.PSR be house
'This is your (PL) house.'

As an analysis of these facts, we hypothesise that in YS, minimality involves the phonological-prosodic word rather than the morphological-grammatical word. In YS, well-formed phonological-prosodic words are stressed and must contain two or more consonants. A CV word like /wa/ therefore surfaces without stress, and is phonologically part of an adjacent word, unless a stress lapse would result. In Optimality Theory, this analysis is easily modelled by positing an anti-lapse constraint, *LAPSE, which outranks the minimality constraint, PRWD≥CC. In (17), PRWD≥CC evaluates violations in /wa/, shown either as cliticised or as an independent word in the candidate forms in (17):

[11] Primary stress is realised with higher pitch (Jacobs 1931), instrumentally confirmed by Hargus & Beavert (to appear).

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(17)

		Lapse	PrWd ≥ CC
a.	ʔítʃi, =maʃ, wa		
	☞ i. ʔítʃi=maʃ=wa		
	ii. ʔítʃi=maʃ wá		*!
b.	ʔítʃi, =mataʃ, wa		
	i. ʔítʃi=mataʃ=wa	*!	
	☞ ii. ʔítʃi=mataʃ wá		*

3.2.2 *Nouns and adjectives*. In a few cases in our lexical files, CV nominal or adjectival roots are posited. Interestingly, such roots never surface as CV words, but always undergo some sort of augmentation, so that they surface with two consonants.

(i) The root /si/ 'fine sand' is attested in two words, /sisí/ 'fine sand' and /siɬá/ 'Selah, Zillah' (place names), referring to areas of fine sand on the Yakima River. The place names contain the agentive/inhabitant suffix /-ɬá/. (ii) The root /p'i/ 'squeeze' is also attested in two words, the noun /p'íp'i/ 'intestines' and the verb /wáp'ik-/ 'wring' (/wá-/ 'with instrument', /p'í-/ 'squeeze', /-k/ (verb stem formative)). (iii) The root /ʧu/ is attested in the adjective /ʧʧuː/ 'quiet, speechless' and the verb /wáʧuk-/ 'be quiet'. In the derived adjective, the root vowel has lengthened, a common strategy for adjective formation in YS (Jacobs 1931: 140). However, by our analysis, vowel lengthening alone of a CV root will not result in a well-formed adjective.

In all three cases above, the common noun or adjective of the pair is reduplicated, resulting in a word with two consonants. The form of reduplication is not entirely predictable, here or elsewhere in YS. Reduplication in YS productively serves two functions, forming (a) (collective) plurals of (i) inanimate or (ii) animate, immobile nouns and adjectives (e.g. [ʔɨníːt] 'house', [ʔɨníːt ʔɨniːt] 'houses'), or (b) repetitive/intensive forms of (i) intransitive verbs or (ii) plural object forms of transitive verbs (e.g. [tusk-] 'point (at), pick out', [túsk tusk-] 'point (at) repeatedly'). Reduplication is usually total, but when a word contains a stop or affricate, the plural and repetitive/intensive may be marked with single-consonant reduplication: whether the plural is formed with total or partial reduplication is not predictable. In the examples in (18), the plural form is marked with partial reduplication:

(18) *Single-consonant reduplication*

base		*reduplicant*	
taχʃ	'willow'	ttaχʃ	'willows'
ʧmuk	'black, dark'	ʧʧmuk	'black, dark (PL)'
ʧχaw	'fat'	ʧʧχaw	'fat (PL)'
k'ajwá	'short'	kk'ajwá	'short (PL)'
káːtnam	'long, tall'	kkáːtnam	'long, tall (PL)'
skɨtks	'fringe'	skkɨtks	'fringes'

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In the examples in (19), the plural is formed with total reduplication:

(19) *Total reduplication*

base		*reduplicant*	
ʧilwít	'bad'	ʧilwít ʧilwit	'bad (PL)'
k'pɨt	'bead'	k'pɨt k'pɨt	'beads'
ʔɨtɨt	'tooth'	ʔɨtɨt ʔɨtɨt	'teeth'
łq'am	'moccasin'	łq'ám łq'am	'moccasins'

The fact that the subminimal root /ʧu/ satisfies biconsonantal minimality with partial reduplication, whereas /si/ and /p'i/ do so with total reduplication, is thus of little consequence in YS grammar, where one or the other strategy is routinely, though not predictably, used to form the plural or repetitive/intensive of other lexical items.[12]

4 The prosodic status of Yakima Sahaptin CCV

As mentioned above, Gordon (1999) found that the minimality pattern CCV/CVC occurs in a small number of languages, for which he noted that 'in all three languages, the CCV words result from loss of the first vowel, either synchronically or diachronically, in an originally disyllabic word' (1999: 264). Lin (1997) also concludes that consonant clusters in Piro resulted from vowel deletion in the evolution of Piro from Proto-Arawakan. If Yakima Sahaptin CCV words could be analysed as disyllabic or bimoraic, then CVC would be the smallest minimality pattern in YS which would need to receive a formal characterisation, and the current case would be without theoretical interest. Thus we now consider the issue of the most appropriate prosodic characterisation of the YS CCV words.

In our current corpus, there are 20 CCV words, given in (20):

(20) CCV *words*

	nouns		*adjectives*	
SS	[pʧa]	'mother'	[kki]	'drooping, fringed'
	[pti]	'blue grouse'	[qqu]	'taut, smooth'
	[tk'u]	'tule, reed'	[pʧ'i]	'wealthy, rich'
SF	[psa]	'bark'		
	[pʃi]	'niece (woman's daughter's child)'		
	[pχ^{w}i]	'thought'		
	[tχu]	(unidentified vine)		

[12] We note other $C_1V_1C_1V_1$ words in the YS lexicon which are possibly the result of historical reduplication of a CV root to satisfy minimality: /k^{w}ík^{w}i/ 'quill', /niní/ 'aspen', /lúlu/ 'mother's milk, breast (baby talk)', /júju/ 'goitre', /wawá/ 'mosquito', /nána/ 'older sister, female cousin (VOC)'. However, unlike /sisí/, /p'íp'i/ and /ʧʧu:/, these words have no known related forms and no known etymology.

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	nouns		*adjectives*	
SJ	[twa]	'pole'		
	[k'wi]	'waist'		
FS	[ɬkʷ'i]	'day'	[ɬqu]	'taut'
			[χtu]	'strong'
FL	[χli]	'print (fabric), stripe'		
FJ	[ʃwa]	'forehead'		
	[ʃwu]	'beard, moustache'		
NS			[ntʃ'i]	'big'
NJ	[mju]	'brother-in-law (man's wife's brother)'		

In the remainder of this section, we will focus on whether disyllabic or bimoraic representations of a CCV word like [tk'u] 'tule, reed' can be justified:

(21) a. *disyllable* b. *moraic initial* C



In §4.1, we will argue that YS CCV is not a type of disyllable, as in (21a). In §4.2, we will argue against moraic representations, as in (21b). We will conclude that the minimality pattern seen in YS cannot be defined in units relating to the syllable or subsyllabic structure.

4.1 CCV is not a disyllable

Syllables consisting only of consonants (analogous to (21a)) have been proposed for many languages, including English (Ács & Törkenczy 1985, Wells 1995), Mandarin Chinese (Cheng 1973), Semai (Sloan 1988; see also Shaw 1993), Lushootseed (Urbanczyk 1996), Nuxalk (= Bella Coola) (Cho & King 2003), Oowekyala (Howe 2000), Georgian (Cho & King 2003), Polish (Cho & King 2003) and Imdlawn Tashlhiyt Berber (Dell & Elmedlaoui 1985, 1988). However, for many of these languages, alternative analyses which do not posit syllabic consonants have been put forward by other analysts. For example, Cho & King's (2003) analysis of Georgian should be compared with that of Chitoran (1998: 140), who concludes that 'all obstruent clusters in Georgian are sequences of independently articulated segments'.

What distinguishes the uncontroversial cases like English and Mandarin from the controversial ones like Georgian is that in the former there is straightforward evidence for consonant syllabicity from

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distribution and/or contrast. In English, for example, there are clear contrasts between syllabic and non-syllabic sonorants (e.g. *hung*[r]*y vs. Hunga*[ɹ̩]*y*; *light*[n]*ing vs. lighte*[n̩]*ing*). In Mandarin, [ʐ̩] and [ʑ̩] are predictable variants of /i/ after sibilant consonants, leading to consonant-only syllables such as [tsʐ̩] 'child' and [ɕʑ̩] 'be'. In the more controversial cases, arguments for consonant syllabicity are more indirect, and have ranged from predicting the form of reduplication (Semai, Nuxalk), distinguishing possible *vs.* impossible clusters (Lushootseed, Georgian), predicting the distribution of epenthetic vowels, aspiration and/or fricatives (Lushootseed, Georgian, Polish, Nuxalk, Oowekyala) and predicting gemination (Berber).

Synchronically, there is no evidence that YS clusters are independent syllables.[13] First of all, there is a lack of evidence from distribution and contrast: there are no minimal pairs for syllabic *vs.* non-syllabic consonants (as in English), nor are syllabic consonants in complementary distribution with vowels (as in Mandarin).

Secondly, putative consonantal syllables as in (21a) are never stressed. Stress in roots is not predictable in Sahaptin (Rigsby & Rude 1996), although some greater-than-chance generalisations about stress placement can be identified (Hargus & Beavert 2002a). In uncontroversially disyllabic CVCV roots, stress can fall on either the first or second syllable: e.g. /wána/ 'river', /ʔasá/ 'fingernail, toenail'. However, with CCV lexical items like /tk'u/, primary stress (realised as higher pitch (Hargus & Beavert, to appear); thus [tk'ú] even in isolation)) always falls on the vowel, never on the word-initial consonant. Cho & King (2003: 187) stipulate lack of stress as one of the properties of consonantal syllables ('semi-syllables' in their terms). However, this stipulation weakens the case for consonantal syllables, in that they differ from other syllables in their inability to bear stress.

Finally, if [t] functions as a syllable nucleus in [tk'u] (putatively syllabified [t.k'u]), then the syllable [t̩] differs from other syllable nuclei in YS in being allowed to occur at the beginning of a word. YS otherwise allows no vowel-initial syllables. A root-initial vowel at the beginning of a word must undergo glottal stop epenthesis as described above in

[13] Sahaptin CCV words for which clear Nez Perce cognates can be found are disyllables in Nez Perce:

(i) *Yakima Sahaptin*		*Nez Perce* (data from Aoki 1994)	
[pʧa]	'mother'	[pike-]	(in [pikenúːt] 'motherless')
[tk'u]	'tule, reed'	[tók'o]	'cattail, tule mat, tule'
[twa]	'teepee pole'	[tíwe]	'teepee pole'
[ʃwa]	'forehead'	[síwe]	'forehead'

Rude (2004) reconstructs initial consonant clusters for Proto-Sahaptian even though Nez Perce disallows phonetic initial consonant clusters. Reconstructing Proto-Sahaptian clusters with synchronic epenthesis in Nez Perce, Rude states: 'I find this to be the best explanation for those vowels in Nez Perce which delete in certain environments and do not lengthen under stress. This vowel, which is realized in Nez Perce as [i], seems to be entirely predictable.'

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§2.2: e.g. RED+/iks/ [ʔiksíks] 'little'. Of course, the strength of this argument rests on expectations about whether or not consonantal syllable peaks might be expected to behave similarly to or differently from vocalic syllable peaks.

4.2 CCV is not bimoraic

Moraic, unsyllabified initial consonants in clusters analogous to (21b) have been proposed for various languages, including Arabic (McCarthy & Prince 1990, Kiparsky 2003), Nuxalk (Bagemihl 1991, 1998), Piro (Lin 1997), Trukese (Hart 1991, Davis 1999), Ponapean (Goodman 1995) and Italian (Davis 1990, 1999). However, in our view, convincing empirical arguments for moraic consonants in surface consonant clusters have only been made for Piro, Trukese and Ponapean.[14]

In Trukese, Hart (1991) argues that word-initial geminates are moraic on the basis of minimality and compensatory lengthening. CCV and CVV are the smallest words in Trukese. CV_1CV_2 words undergo compensatory lengthening, becoming $CV:_1C$ as a result of final vowel deletion (because CVC would be subminimal), but when CCV_1CV_2 words undergo final vowel deletion, they do not lengthen compensatorily, surfacing as CCV_1C. The lack of lengthening in CCVC words suggests that the initial consonant contributes to the weight of such words. In Ponapean, CVC, CV:C, C:VC and CVC: are possible word shapes. Long vowels do not occur before final geminates or after initial geminates. Goodman (1995) has argued that words are maximally two moras long. The distributional restriction on long vowels with respect to geminates thus follows in Goodman's analysis from the moraic analysis of initial and final geminates, along with the two-mora maximum. In Piro, Lin (1997) follows the standard analysis of weight-induced compensatory lengthening and argues that all consonants in clusters are moraic and unsyllabified because the deletion of such consonants leads to long vowels. Here again, the most convincing

[14] In the case of Nuxalk, the rationale for moraic, unsyllabified consonants is theoretical, rather than empirical. Bagemihl argues that such consonants are not syllabic, but, assuming that all segments must be prosodically licensed or else deleted, concludes that the only available licenser for Nuxalk unsyllabified consonants is the mora.

In Arabic, McCarthy & Prince (1990: 12) propose that word-initial consonants in clusters (e.g. [ftaʕal]) be represented with 'an extrametrical mora, one that is not linked to any syllable'. However, this representation does not hold of phonetic forms. Such consonants are only underlyingly moraic, and become 'intrametrical … either by prefixation or in the postlexical phonology'.

In Italian, Davis (1990, 1999) argues that palatal consonants are underlyingly moraic, which accounts for two facts: palatal consonants are always long except when phrase-initial, and palatals require the vowel-final allomorph of the masculine definite article, just like consonant clusters separated by a relatively small sonority distance, in contrast to singleton consonants and consonant clusters with a relatively large sonority distance. However, on the surface, such consonants are fully syllabified, according to his analysis. See also Ringen & Vago (2002) for an analysis of the Italian data without moras.

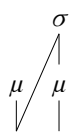
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cases for consonant moraicity involve empirical evidence concerning the distribution of long vowels.

We now consider a possible moraic consonant analysis of YS [tk'u], as in (21b). Basically, the problem with (21b) is that there is no evidence (apart from minimality, which is the point at issue) that word-initial consonants in clusters are weight-bearing. YS lacks weight-diagnosing phenomena such as compensatory lengthening and fully predictable stress.

There is one other phenomenon found in YS which could in principle shed light on the moraic status of YS initial consonants in clusters: the behaviour of geminates. As noted in §2.1, YS has word-initial sequences of identical stops and affricates. One of the possible representations for word-initial geminates considered by Hayes (1989) in a moraic model is shown in (22). Notice that the initial unsyllabified consonant is dominated by a mora, which represents the length as well as presumably the weight of such consonants.

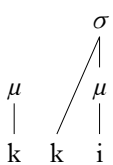
(22)



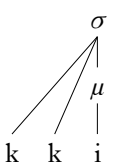
[m:a]

We can immediately rule out the linked representation in (22) for YS initial geminates, since they violate Geminate Integrity (Kenstowicz & Pyle 1973, Hayes 1986). Unlike other languages with initial geminates, word-initial sequences of identical stops in YS are easy to identify auditorily, because the first stop in the sequence is always phonetically released, creating aspiration noise (Hargus & Beavert 2002b) (e.g. [pʰpa:w] 'bullsnake', [kʰki] 'drooping').[15] Word-initial sequences of identical sonorants surface with epenthetic [ɨ] between the two consonants (e.g. [nɨní:ʃ] 'dew, moisture'). While the obligatory geminate-medial release (aspiration or epenthetic vowel) rules out the linked matrix in (22), it unfortunately tells us nothing about whether the first consonant in a CCV word like /kki/ 'drooping' might bear weight, as in (23a), or not, as in (b):

(23) a.



b.



[kki]

In sum, there is no evidence in YS for moraicity of word-initial consonants in clusters, even when apparent geminates are considered. The

[15] In a recent survey of the weight properties of geminate consonants, Curtis (2003) comments that the obligatory initial release of YS initial geminates is unique among the languages in her survey (other languages with initial geminates in her survey being Malayalam, Leti and Truk).

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usual evidence for consonant weight, such as compensatory lengthening and predictable stress, is lacking in YS.

4.3 The syllabification of CCV

The main goal of this section has been to determine whether word-initial consonants could be considered moraic or syllabic, and we have suggested that both of these possibilities are unlikely. The available evidence for the remaining possible ways in which YS word-initial clusters could be syllabified – fully or partially – is ambiguous, as briefly reviewed in this section, which is included only for descriptive completeness and does not bear on the analysis of minimality.

One argument that has sometimes been advanced for unsyllabified clusters is that they are allowed at word edges, but not word-internally.[16] In YS, there are no such word-edge asymmetries in the distribution of the kinds of segments that can occur in the clusters of CCV words. Most of the types of clusters found in CCV words also occur word-internally (all but FL and NS), not only clusters consisting of obstruent + sonorant, but obstruent sequences as well. These word-internal clusters are illustrated in (24), in which they are preceded by a consonant:

(24) *Word-internal clusters*

SS	walptájkt	'(social) song'
	(walptájk- 'sing', -t GER.NOM)	
	ʃapaq'pts'káwaas	'pliers'
	(ʃapá- CAUS, q'pts'ɬk- 'grip', -áwaas LOC/INSTR)	
SF	ʔánpʃpa	'in the storage basket'
	(ʔánpʃ 'storage basket', -pa LOC)	
	ʔiʔútpʃa	'he's draping it'[17]
	(ʔi- 3NOM, ʔútp- 'drape', -ʃa IMPV)	
SJ	ʔajktwíːm	'sit with me'
	(ʔajík- 'sit', twíː- COM, -m CIS)	
	ʔitstswájʃa	'she's amazed'
	(ʔi- 3NOM, tstswáj- 'be amazed', -ʃa IMPV)	
FS	nápɬkʷ'i	'Tuesday'
	(náp- 'two', ɬkʷ'í 'day')	
	ʔánakɬq'iwja pat	'they took advantage of her'
	(ʔá- ABS, nák+ɬq'íwi 'take (sexual) advantage of' (lit. 'with+play'), -a PST, =pat 3PL)	

[16] However, Blevins (2003) cautions that word-edge *vs.* word-medial asymmetries in the distribution of clusters may not in fact be diagnostic of syllable affiliation, but simply of phonotactic restrictions which may be defined with respect to phonological constituents larger than the syllable.

[17] There is no 3rd person singular gender distinction in YS. In this article, 3rd person singular forms of verbs, 3rd person singular pronouns, etc., are randomly translated with 'he', 'she', 'him', 'her', etc.

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FN łáłχnan 'dirt (ACC)'
(łáłχ 'dirt', -nan OBJ)
pásamχnana 'he proposed to her'
(pá- INV, sámχna- 'propose marriage to, speak to', -na PST)
FJ sit'áχsjaw 'to Berry Mountain'
(sit'áχs 'Berry Mountain' (lit. 'liver'), -jaw ALL)
ʔitáχʃja 'he woke up'
(ʔi- 3NOM, táχʃi- 'wake up', -a PST)
NJ pɨnmjúk 'to her'
(3ALL)
ʔiχásupnja 'it slid forward'
(ʔi- 3NOM, χásupni- 'ride out, jut out, project', -a PST)

Thus the same consonant clusters can occur word-internally as well as word-initially in YS, suggesting that word-initial clusters have no special properties, such as lack of syllabification.

Another argument that has been advanced for unsyllabified consonants in word-edge clusters is that word-internally such clusters are heterosyllabic if postvocalic. For example, in Icelandic, as summarised by Green (2003), sequences like [kn] in [ɛk.na] 'bait' must be heterosyllabic, because if the syllabification were *[ɛ.kna] then the initial vowel would lengthen in the open syllable. But [kn] occurs word-initially in [knaiva] 'to project'. If [kn] cannot be an onset cluster word-internally, then [kn] cannot be an onset cluster word-initially. In YS, there is no categorical lengthening of short vowels to long before clusters of rising sonority *vs.* clusters of falling sonority or sonority plateaus, as can be seen in the examples in (24). Possibly there is subphonemic lengthening of short vowels before some of the consonant clusters in (24), but this would require an instrumental phonetic investigation.

To summarise, it is not yet clear whether word-initial clusters such as the [tk'] sequence in [tk'u] are fully or partially syllabified in YS. But deciding between these two possibilities is irrelevant for purposes of minimality. The main point of §4 has been to show that there is no convincing evidence that CCV words in YS are disyllabic or bimoraic.

5 Predictions of biconsonantal minimality

The smallest well-attested shapes of words in YS have three segments (CVC, CCV). What these shapes have in common is that they contain two consonants. We have considered and rejected an analysis of CCV as disyllabic or bimoraic, and are thus forced to recognise a new type of minimality, biconsonantal minimality.

5.1 Other languages with biconsonantal minimality

If we are correct about the minimality pattern found in YS, then we predict that other languages might also exhibit biconsonantal minimality.

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Cross-linguistic support for biconsonantal minimality comes from one of the otherwise puzzling findings of Gordon (1999), namely that some languages have CVC minimality even though CVV is a possible syllable in such languages. Taking a closer look at Gordon's findings, in a survey of minimal word phenomena in 138 languages, Gordon found that 21 have apparent disyllabic minimality.

> Of the 114 remaining languages with minimal word requirements greater than CV but less than disyllables and which are not sensitive to the onset, 13 lack both long vowels and diphthongs. Of the remaining 101 languages, 79 have a CVC minimal word requirement, and 17 have a CVV minimal word requirement (Gordon 1999: 262).

In other words, 79 languages in Gordon's survey exhibit CVC minimality, even though CVV is also a licit syllable in those languages. Each of these languages deserves closer inspection, but it is possible that some of them will turn out to display biconsonantal minimality, like YS.[18]

5.2 Counting vowels

Biconsonantal minimality is essentially a requirement that the number of consonants per word is counted, and that the count must equal two or more. If consonants can be counted, then the prediction is also that vowels could be counted. In practice, however, it would be difficult to distinguish vowel counting from syllable counting. For example, disyllabic minimality has been considered a syllable-counting phenomenon. Alternatively, disyllabic minimality could be analysed as the counting of syllable nuclei, which, in languages that do not allow syllabic consonants, would be identical to counting vowels.

Although disyllabic minimality is (at least in some languages) ambiguous between a minimum of two vowels and a minimum of two syllables, we believe we have found evidence of vowel counting in Yakima Sahaptin. The phenomena in question involve allomorphs which are sensitive to the number of underlying vowels in the base, which can differ from the number of surface syllables in output forms.

5.2.1 *Present perfect allomorphy*. Rigsby & Rude (1996) note that the form of the present perfect and past suffixes varies in Sahaptin according to dialect and morphological class, *n*-class or not.[19] As first identified by Rude (1988), *n*-class verb roots are those which ended in /n/ historically. Synchronically, such verbs are characterised by [n] ~ ∅ alternations before

[18] The CVC minimum in some of these cases may turn out to follow from two or more independent constraints, such as syllable-onset or root-final consonant requirements (on the latter, see the appendix).

[19] Rigsby & Rude (1996: 686) list the forms of the present perfect suffix as [-∅], [-ɨn] and [-ʃ], noting that 'in certain phonetic environments in at least some dialects of Northwest and Northeast Sahaptin, *-a* has been generalized as the present perfect, and *-na* as the past'.

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various suffixes. The [n] never appears before certain suffixes, such as imperfective /-ʃa/, but is required before others, such as habitual /-χa/. Compare the forms in (25) for an *n*-class root /pnu-/ 'sleep' and a non-*n*-class root /sɨ́nwi-/ 'talk':

(25)			pnu- 'sleep' (*n*-class)	sɨ́nwi- 'speak, talk'
a.	-ʃa	IMPV	pnúʃa	sɨ́nwiʃa
	-ta	FUT	pnúta	sɨ́nwita
b.	-χa	HAB	pnúnχa	sɨ́nwiχa
	-i	ADJ	pnúni	sɨ́nwji
	-k	2SG.IMP	pnunk	sɨ́nwik

As a synchronic analysis of the *n*-class roots, we suggest that the [n] ~ ∅ alternation is a property of certain suffixes, which have two allomorphs, [n]-initial and non-[n]-initial, and that *n*-class verbs require the [n]-initial allomorphs of those suffixes. We analyse the *n*-class alternations as synchronically involving suffix rather than root allomorphy because a few verb roots in YS are invariantly nasal-final before all suffixes: /námun-/ 'call by relationship term', /támun-/ ~ /tájmun-/ 'report, inform', /tanamún-/ 'ask for help', /qʷ'ɨ́n-/ 'be rotten, soft'. Since the true nasal-final roots contrast with the *n*-class roots, the latter cannot be analysed as ending in an underlying nasal consonant. However, as seen in (25), not all suffixes trigger the [n] form of an *n*-class root, suggesting that the alternation is a property of certain suffixes.[20]

In YS, the form of the present perfect suffix varies according to whether the base (a) is an *n*-class verb or not, (b) ends in a consonant or vowel and (c) ends in a high (/i u/) or non-high vowel (/a/). In Hargus & Beavert (2002b) we suggested that present perfect suffix allomorphy was also sensitive to the number of syllables in the root. However, with additional data, presented here, we believe that present perfect allomorphy is better analysed as governed by the number of underlying vowels in the root.

Here we focus on the distribution of allomorphs which attach to an *n*-class verb ending in a high vowel. For two-vowel *n*-class verbs ending in a high vowel, shown in (26), the present perfect suffix /-a/ is optional. (The past tense form suffixed with /-na/, one of the diagnostics of *n*-class verbs, is also provided in (26)–(28).) After stressed root-final vowels, (26a), an epenthetic glide is inserted before the vowel of the present perfect suffix. After unstressed root-final vowels, (26b), the final vowel devocalises before the vocalic perfect suffix.

[20] Noel Rude (personal communication) has suggested that the [n] ~ ∅ alternation could be analysed as a property of roots if the invariant *n*-final roots were analysed as ending in /nn/. However, this analysis would still not account for the absence of [n] before /-ʃa/ (IMPV) and /-ta/ (FUT).

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(26) *Two-vowel* n*-class verbs*

		present perfect (-a ~ ∅)	*past*
a. hulí	'be windy'	hulíja ~ hulí	hulína
b. qáwqi-	'fall down'	qáwqja ~ qáwqi	qáwqina
q'ínu-	'see'	q'ínwa ~ q'ínu	q'ínuna
tmíju-	'decide'	tmíjwa ~ tmíju	tmíjuna

For *n*-class verbs which contain either one short (27a) or one long vowel (27b), the present perfect suffix /-a/ is not optional.

(27) *One-vowel* n*-class verbs*

		present perfect		*past*
a. tɬ'u-	'guess in game'	tɬ'úwa	*tɬ'u	tɬ'úna
tk'i-	'look at'	tk'íja	*tk'i	tk'ína
pχ^{w}í-	'think'	pχ^{w}íja	*pχ^{w}i	pχ^{w}ína
q'li-	'bend'	q'líja	*q'li	q'lína
ʧqu-	'have something in eye'	ʧqúwa	*ʧqu	ʧqúna
łk^{w}'i-	'spend the day'	łk^{w}'ija	*łk^{w}'i	łk^{w}'ína
skli-	'walk in circle'	sklíja	*skli	sklína
lk^{w}'i-	'cover, wash over'	lk^{w}'ija	*lk^{w}'i	lk^{w}'ína
lst'a-	'join'	lst'ája	*lst'a	lst'ána
pnu-	'sleep'	pnúwa	*pnu	pnúna
tq'nu-	'become frosty'	tq'núwa	*tq'nu	tq'núna
b. k'iː-	'peek, peer (at)'	k'íːja	*k'iː	k'íːna
χiː-	'give birth (to)'	χíːja	*χiː	χíːna

There is one sonorant-initial CCV verb which is [CCV] after a vocalic prefix and [CɨCV] when word-initial. For this verb, the perfect suffix /-a/ must be used, regardless of the number of surface vowels in the word. (28a) is an example of this root in postvocalic position and (28b) in word-initial position, with epenthetic [ɨ].

(28) /wχi-/ 'throw, lose'

present perfect		*past*
a. ʔiwχíja (*ʔiwχi) laklíː	'he's lost his keys'	ʔiwχína
(ʔi- 3SG NOM, wχi- 'lose', -a PERF, laklíː 'key')		
b. wɨχíjaːʃ (*wɨχíiʃ) laklíː	'I've lost my keys'	wɨχínaːʃ
(wχi- 'lose', -a PERF, =Vʃ 1SG, laklíː 'key')		

(28b) shows that present perfect suffix allomorphy is not determined by the number of surface vowels in the base, since epenthetic [ɨ] in (28b) does not count, only the number of underlying vowels. If syllable structure is absent in input representations, then the present perfect suffix allomorph represents a case of sensitivity to underlying vowel count: the /-a/

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allomorph of the present perfect suffix must be used with bases containing one underlying vowel; /-a/ is optional with bases containing two or more underlying vowels.

5.2.2 */-ta/ ~ /-ata/ allomorphy*. The distribution of allomorphs of the suffix 'go' is partly conditioned by the nature of the root-final segment and partly by the number of underlying vowels in the base.

The allomorph /-ata/ is used after all roots which end in a consonant:

(29) C]: /-ata/
wɨnpatak ʔájn 'go get the iron'
(wɨnp- 'receive', -ata 'go', -k IMP.SG)
ʔajíkatak 'go sit down'
(ʔajík- 'sit', -ata 'go', -k IMP.SG)
ʔílkʷatak ʔílkʷʃ 'go make a fire'
(ʔilkʷ- 'kindle fire', -ata 'go', -k IMP.SG)
wátʃ'χatak ʔílkʷaːs 'go chop wood'
(wátʃ'χ- 'chop', -ata 'go', -k IMP.SG)
ʔáwɨnatak 'go tell him'
(áw- ABS, ʔɨn- 'tell', -ata 'go', -k IMP.SG)

The allomorph /-ata/ (with preceding epenthetic [w]) is also used after roots ending in /u/, regardless of their length.

(30) u]: /-ata/
ʔákuwatak 'go do it'
(ʔá- ABS, ku- 'do', -ata 'go', -k IMP.SG)
ʔátɬ'uwatak 'go guess'
(ʔá- ABS, tɬ'u- 'guess', -ata 'go', -k IMP.SG)
pnúwatak 'go sleep'
(pnu- 'sleep', -ata 'go', -k IMP.SG)
ʔásusuwatak 'go lecture him'
(ʔá- ABS, súsu- 'lecture', -ata 'go', -k IMP.SG)
ʔáq'inwatak 'go see her'
(ʔá- ABS, q'ínu- 'see', -ata 'go', -k IMP.SG)

/-ata/ (with preceding epenthetic [j]) is also used after other vowel-final roots (those ending in [i] or [a]), if they contain one vowel:

(31) [CV(ː)]: /-ata/
ʔinijataʃa táːla 'he's going and giving him money'
(ʔi- 3NOM, ni- 'give', -ata 'go', -ʃa IMPV, táːla 'money')
ʔák'iːjatak 'go peek at it'
(ʔá- ABS, k'iː- 'peek', -ata 'go', -k IMP.SG)
χíːjatak 'go give birth'
(χiː- 'give birth', -ata 'go', -k IMP.SG)

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The examples in (32) show that the length of the base is calculated from the root (/tɬ'i/ and /pa:/ respectively in (32)), not the root + derivational prefixes:

(32) -CV]: /-ata/
ʔáqatɬ'jatak 'go spit it out' (cf. /tɬ'íja:s/ 'saliva')
(ʔá- ABS, qá-tɬ'i- 'spit', -ata 'go', -k IMP.SG)
ʧápa:jatak 'go separate'
(ʧá-pa:- 'separate', -ata 'go', -k IMP.SG)

The short allomorph /-ta/ is used after bases ending in [i] or [a] which contain two or more tautomorphemic vowels:

(33) …V]$_{>\sigma}$: /-ta/
a. *roots ending in unstressed* [a]
ʧámatak 'go trade'
(ʧáma- 'trade', -ata 'go', -k IMP.SG)
ʔápwatak 'go put (it) in the cradleboard'
(ʔá- ABS, púwa- 'place in cradleboard', -ata 'go', -k IMP.SG)
jáχʃatak tma:nít 'go empty the fruit'
(jáχʃa- 'empty', -ata 'go', -k IMP.SG, tma:nít 'fruit')
b. *roots ending in unstressed* [i]
túti<u>ta</u>k 'go stand'
(túti- 'stand', -ta 'go', -k IMP.SG)
sɨ́nwi<u>ta</u>k 'go talk'
(sɨ́nwi- 'talk', -ta 'go', -k IMP.SG)
c. *roots ending in stressed* [a]
ʔákʷ'ima<u>ta</u>k 'go visit her'
(ʔá- ABS, kʷ'imá- 'visit', -ta 'go', -k IMP.SG)
d. *roots ending in stressed* [i]
ʔáwani<u>ta</u>k 'go make it'
(áw- ABS, ʔaní- 'make', -ta 'go', -k IMP.SG)
ʔapí<u>ta</u>k 'go fish'
(ʔapí- 'fish', -ta 'go', -k IMP.SG)
ʔatma:ní<u>ta</u>k 'go pick it'
(ʔá- ABS, tma:ní- 'pick', -ta 'go', -k IMP.SG)

Roots which end in [i] or [a], contain only one vowel and begin with a consonant cluster pattern with other roots which contain only one vowel (those in (31)) in selecting the long form of the suffix, /-ata/:

(34) (C)CCV: /-ata/
ʔátk'ija<u>ta</u>k tɬ'pí:pnan 'go look at the wingdress'
(ʔá- ABS, tk'i- 'look at', -ata 'go', -k IMP.SG)
pinátk'ija<u>ta</u>k 'go look at yourself'
(piná- REFL, tk'i- 'look at', -ata 'go', -k IMP.SG)
χnija<u>ta</u>k 'go dig roots'
(χni- 'dig', -ata 'go', -k IMP.SG)

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nkníjatak ‘go walk around, in circle’
(nkni- ‘walk’, -ata ‘go’, -k IMP.SG)
lst’ájatak wáːʃatjaw ‘go join the dance’
(lst’a- ‘join’, -ata ‘go’, -k IMP.SG)
ʔámsamsajatak ‘go joke around with him’
(ʔá- ABS, msamsa- ‘joke around with’, -ata ‘go’, -k IMP.SG)

Allomorphy of the suffix /-ata/ ~ /-ta/ thus indicates that CCi/a verb roots pattern with one-vowel Ci/a roots, and not with clear disyllabic CVCi/a roots. At first glance, this seems to confirm that the word-initial consonants of the clusters [tk’], [χn], [nkn], [wχ], [lst’] in verb bases are not functioning as syllable peaks, as we concluded in §4.1. However, even if such consonants were syllable peaks, it is likely that their syllabicity would be ignored for purposes of allomorph selection, because even epenthetic [ɨ] is ignored for allomorph selection. In (35), the root /wχi-/ ‘lose, throw’ surfaces with epenthetic [ɨ] when word-initial. Nonetheless, the long allomorph of the suffix ‘go’ is used, regardless of whether the root is word-initial or postvocalic, suggesting that epenthetic [ɨ] is not counted.

(35) C([ɨ])CV: /-ata/
postvocalic ʔiwχíjatana ʔíkʷɨn ‘he went and lost it there’
(wχi- ‘lose’, -ata ‘go’, -na PST, ʔíkʷɨn ‘there’)
word-initial ʧáw nam wɨχíjatata laklíː ‘don’t go and lose your keys’
(wχi- ‘lose’, -ata ‘go’, -ta FUT, laklíː ‘key’)

In this section we have seen that the allomorph /-ata/ of the suffix ‘go’ is used after roots ending in [i] or [a] which contain two underlying vowels, and the allomorph /-ta/ is used elsewhere. Thus, the best predictor of whether the short or long allomorph of the suffix ‘go’ is used is the number of underlying vowels in the root.

5.2.3 *Summary*. If consonants are countable, then the prediction is that vowel-counting phenomena also exist. We believe that this prediction is also borne out in YS. For both allomorphy phenomena discussed in this section, the base+suffix complex must contain at least two vowels on the surface. Epenthetic [ɨ] does not count towards the satisfaction of this requirement, showing that vowels in input forms are counted. If syllable structure is absent from input forms, then the allomorphy phenomena reviewed here must involve true vowel counting and not syllable counting.

5.3 Further uses for ‘C’ and ‘V’

Consonant counting and vowel counting both show that vowels and consonants are distinct formal entities. This point may seem so obvious and uncontroversial as to require no comment. However, the representational difference between consonants and vowels is not clear, as we summarise in

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§6.2. Therefore, to underscore the point that vowels and consonants are independent of each other in phonological systems, not only for counting/minimality phenomena, but for a range of other phonological phenomena, in an appendix to this article we have provided a list of constraints culled from recent phonological literature which refer to vowels (as opposed to consonants), consonants (as opposed to vowels) or both consonants and vowels (as interacting phonological classes). Our appendix focuses on recent work, but references to the distinction between vowels and consonants could be traced much further back in time, of course, in both phonological and phonetic literature.

In the works cited in the Appendix, there is rarely discussion of the theoretical status of consonants and vowels which appear in the posited constraints. In contrast, in the seminal work in OT (Prince & Smolensky 2004: 108), 'C' and 'V' are explicitly stated as being derived from Ons, Nuc and Coda, well-known subsyllabic constituents:

(36) *Definition of C and V*
   a. *M/V
      V may not associate to Margin nodes (Ons and Cod).
   b. *P/C
      C may not associate to Peak (Nuc) nodes.

But Prince & Smolensky also write (2004: 108) that 'each Ons, Nuc or Cod node may dominate at most one terminal element C or V', suggesting that some other way of defining C and V independently of higher prosodic structure is available. Compare also their statement (2004: 30) that 'if an analysis contains a node Ons or Coda, it may dominate a consonant' or 'if an analysis contains a node Nuc, it may dominate a vowel'. Such statements raise questions about whether 'consonant' and 'vowel' should be considered primitives in phonological theory, and how they should be represented.

Interestingly, in a recent treatment of apparent consonantal roots in modern Hebrew, Ussishkin (2005) avoids referring to consonants and vowels directly by positing a high-ranking constraint MAX(Affix), which has the effect of overwriting underlying root vocalism when affixes are present in input representations. A claimed advantage of this analysis is that the consonantal root can be considered an epiphenomenon, but in reality, reference to the consonantal root has only been replaced by reference to affixes which happen to consist of vowels alone (and for which formal input representations are not provided).

6 Implications and further research

6.1 Characterising minimal word shapes

As reviewed in §1, the empirical connection between stress foot shape and minimal word shape was first called into question by Spring (1990) and

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later by Garrett (1996). However, the minimal word shapes observed by those researchers at least corresponded to possible foot shapes in some language, according to the foot inventory proposed by Hayes (1995) and earlier work. Consider the minimal word shapes observed by Garrett: CV, CVV, CVC, CVG, CVCV and CVVC. All of these are possible foot shapes, albeit degenerate (CV) or unusual (CVVC) ones. One of the two-consonant minimal word patterns seen in YS, CVC, looks like a normal foot pattern, but the other CCV, does not.[21] In this regard, YS joins some of the other languages uncovered by Gordon (1999) with unusual minimality patterns, discussed above in §1.

The explanation for why the old minimal word inventory had the shape that it did was originally provided by the Prosodic Hierarchy. Given the lack of connection between stress and word-minimality,[22] a new explanation for the word minimum needs to be sought. Rejecting the mora as a representational device in phonology, Gordon (1999: 244) speculated on several possible phonetic explanations for CVC minimality. CVC minimality might be motivated by requirements for sufficient amounts of energy or duration, to support a minimal intonation contour or to maximise total material in a morpheme to enhance recoverability. Gordon (1999: 267) concludes that 'the basis for minimal word requirements clearly needs further investigation', with which we concur. Nonetheless, YS biconsonantal minimality is a minimality pattern which can be characterised in purely phonological (as opposed to phonetic) terms, namely as consonants.

6.2 Representing 'C' and 'V'

In order for consonants to be counted or for constraints specific to consonants (as opposed to vowels) to be formulated, a theoretical framework is needed in which consonants are formally distinguishable from vowels. That phonological theory needs a way to represent consonants as opposed to vowels may seem obvious. However, at various times in the recent development of phonological theory the distinction between consonants and vowels has been eliminated. Perhaps the central problem is how to distinguish vowels from the consonants which are most similar to them, namely glides.

Levi (2004) reviews various models in which underlying vowels and glides can be distinguished, including predictions for the representation of surface contrasts. While three-way contrasts between non-alternating glides, non-alternating vowels and vowels which alternate with glides are

[21] It is possible too that the standard inventory of feet (syllabic trochee, moraic trochee and iamb) may be descriptively inadequate. For example, Zec (1999: 233) has proposed that in the Neo-Štokavian dialect of Serbian/Croatian, 'any syllable associated with tone corresponds to a foot'.

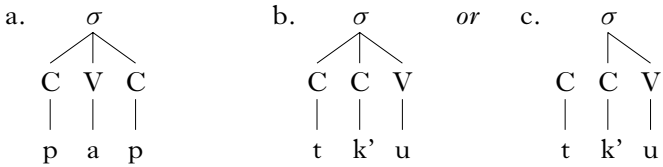
[22] However, as discussed in §3.2.1, there is still a connection between YS word-minimality and stress: well-formed phonological-prosodic words in YS not only contain two consonants but are stressed.

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found, on the surface there are only two types of segments to distinguish, vowels and glides. These segments could be distinguished either with syllable structure (including terminal nodes of syllables) or at the featural level.

The distinction between 'C' and 'V' is of course most straightforward within the CV-skeletal framework (e.g. McCarthy 1979, Clements 1980, Clements & Keyser 1983). In this long-abandoned theoretical framework, it would be easy to check for satisfaction of biconsonantal minimality, regardless of whether CCV is fully or partially syllabified. The representation of YS biconsonantal minimality in this theoretical framework is shown in (37) for CVC (a) and CCV (b):

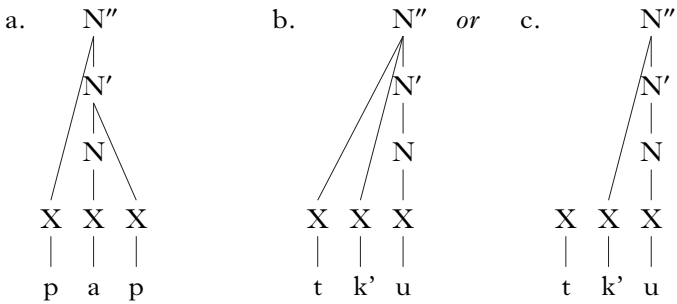
(37) CVC *and* CCV *with the* CV-*skeleton*



Because of arguments presented by Levin (1985) against the arbitrary treatment of glide ~ vowel alternations in this framework, 'C' and 'V' have been viewed as inauthentic units of prosody, a view which continues in recent work (e.g. Ussishkin 2005), despite rampant reference in the OT literature to undefined 'C' and 'V', as shown in the appendix.

In the X-skeleton + N″-syllable model proposed by Levin (1985), there is no easy way to refer to consonants as opposed to vowels. Consider the representation of YS CVC and CCV in this theoretical framework:

(38) CVC *and* CCV *with the* X-*skeleton*

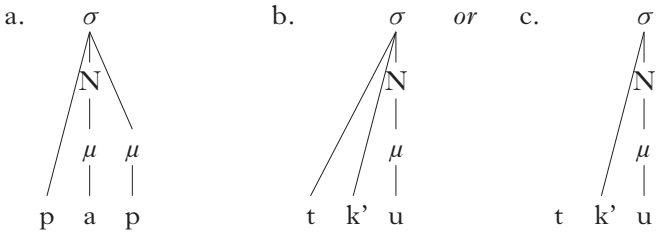


In this model, biconsonantal minimality would be satisfied if both N″ or N′ have direct dependents (as in the CVC case (38a)), or if N″ has two direct dependents (fully syllabified CCV (38b)) or if the direct dependent of N″ is preceded by a segment (presumably within the same phonological word) (partially syllabified CCV (38c)).

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Moraic theory, like X-theory, makes no distinction between consonants and vowels at the terminal node level. In this framework, assuming a version of moraic theory which includes the Nucleus constituent (Shaw 1992), YS CVC and CCV would be represented as in (39). The representations in (39) assume that coda consonants contribute to syllable weight:[23]

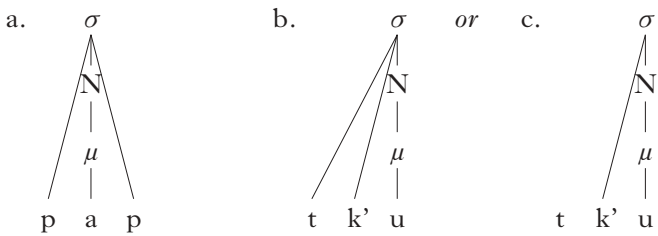
(39) CVC *and* CCV *with moras and weight-by-position*



In this framework too, vowels are easy to identify and count from their uniquely dominating N's. If CCV is fully syllabified (39b), then biconsonantal minimality would be satisfied by ternary branching from the syllable node. If CCV is partially syllabified (39c), biconsonantal minimality would be more cumbersome to describe, but would be satisfied by the presence of a segment, presumably belonging to the same phonological word, before a non-nuclear dependent to the syllable.

If codas were not moraic and if CCV were fully syllabified (40b), then biconsonantal minimality could still be phonologically defined by the presence of two non-moraic branches from the syllable node. However, biconsonantal minimality would be difficult to describe once again if word-initial consonant clusters are partially syllabified, as in (40c):

(40) CVC *and* CCV *with moras and no weight-by-position*



Another conceivable way of distinguishing consonants and vowels is at the featural rather than syllabic level. Root nodes were proposed by Clements (1985) as the appropriate targets for rules of total assimilation,

[23] Although stress is not entirely predictable, it tends to fall on closed syllables in YS (Hargus & Beavert 2001, 2002a), suggesting that coda consonants contribute in some way to syllable weight.

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thus providing a way of defining/counting segments, as exploited by Selkirk (1990) in her proposal that geminates be represented with two root nodes. Root nodes have been conceived of as bundles of major class features (McCarthy 1988), an idea adopted by Clements & Hume (1995). However, in their model, the root-node features they adopt cannot distinguish vowels and glides, as both are [+vocoid]. Even if some root-node feature could be found which distinguished consonants (including glides) from vowels, this approach would predict that other types of minimality patterns, so far unattested, should occur. For example, in Clements & Hume (1995), the inventory of root-node features also includes [sonorant] and [approximant], in addition to [vocoid]. If biconsonantal minimality involves counting [−vocoid] nodes, then minimality patterns which involve two [±sonorant] or [±approximant] nodes should also exist, but these patterns are unattested, as far as we know.[24]

In Hume (1994), it is proposed that vowels and glides can be distinguished by the presence of a V-Place node in the former but not the latter. (In Clements & Hume 1995, however, all vocoids – vowels and glides alike – have a V-Place node.) Although it is possible to distinguish consonants and vowels in the framework of Hume (1994), it would be more difficult to count consonants than vowels, as consonants (including glides) would be those segments which lack a V-Place node.

To summarise, 'consonant' and 'vowel' are useful notions in phonology. We have seen that consonants play a role in describing the structure of minimal words in YS and that (underlying) vowels play a role in determining allomorphs of verbal suffixes. Gordon (1999) uncovered what seem to be other cases of biconsonantal minimality, showing the potential need for consonant counting in other languages as well. Many constraints which have been posited in the recent phonological literature refer to consonants and vowels *per se*. Theoretical phonology should provide a simple and straightforward way to represent these two segment classes.

Appendix: constraints which refer to consonants and/or vowels

In Optimality Theory it is not hard to find constraints that are specific to consonants or vowels. The lists in this section are from a small sampling of the recent literature. All of these constraints refer to classes or subclasses of consonants and vowels, rather than specific (single) consonants or vowels.

1 Constraints defined in terms of consonants as opposed to vowels

a. C-FINAL-ROOT: Align(Root, R; C, R)
The right edge of every root coincides with the right edge of a consonant (Urbanczyk 2006: 206).

b. *GEMINATE
Consonants are singly associated (Crowhurst 2004: 155).

[24] Thanks to an anonymous reviewer for pointing this out.

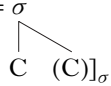
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c. SROLE-CC
Corresponding consonants must have identical syllable roles (Rose & Walker 2004: 511).

d. IDENT(PAL)
Corresponding input and output segments have identical values for consonantal palatalisation (Padgett 2003: 57).

e. CC-COORD: Align(C^1, C-Centre; C^2, Onset)
'CC-COORD coordinates *consonants* by reference to their *oral gestures*' (Gafos 2002: 284).

f. *APPENDIX[periph]
where Appendix = σ (Hall 2002: 63)



g. MAX(C)
A consonant in the input corresponds to a consonant in the output (Hall 2002: 43; cf. McCarthy & Prince 1995).

h. DEP-C
'Consonant epenthesis violates the constraint DEP-C' (de Lacy 2002: 147).

i. *C_1
'the constraint requiring consonant deletion, [designated] in an entirely ad hoc fashion as *C_1 (since the first consonant is deleted)' (Orie & Pulleyblank 2002: 129).

j. CONDITIONALAGREE
Given a consonant cluster C_1C_2, if C_1 is voiced, then C_2 must be (Wetzels & Mascaró 2001: 237).

k. FINALC
'prohibits vowel-final prosodic words' (McCarthy 2003: 87). Cf. Orgun (2001: 739): 'Prosodic words must be consonant-final', and McCarthy & Prince (1994: 357): Align(PrWd, R; Consonant, R): 'Every PrWd is consonant-final'.

l. SLASH
'Word-final C's must follow slashes … I will assume that there are a set of OT constraints which 'cannot see' slashed consonants' (Garrett 1996: 4). (This constraint was intended to subsume final extrametricality of consonants.)

m. ONSET
Syllables should begin with consonants (McCarthy & Prince 1993: 13).

2 Constraints defined in terms of vowels as opposed to consonants

a. IO-MAX-V
Violated by 'deleting input vowels' (McCarthy 2005: 191).

b. HAR
If the stem-vowel(s) is/are *front*, then the affix-vowel is *front* … If the stem vowel(s) is/are *back*, then the affix vowel is *back or neutral* (Rebrus & Törkenczy 2005: 279).

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c. *v̆
Unstressed full vowels are not permitted (Urbanczyk 2005: 306).

d. DEP(V)
A vowel in the output corresponds to a vowel in the input (Hall 2002: 43; cf. Kang 2003: 224, McCarthy 2005: 188).

e. IDENT[ant] / V__
The [anterior] specification of an output segment following a vowel in the same word must be the same as its corresponding input segment (Flemming 2003: 356).

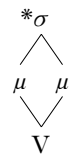
f. *NASALVOWEL
The nasal feature is not licensed as a property of vowels (Piggott 2003: 383).

g. *MUT
Don't mutate vowels (Anttila 2002: 16).

h. *RoLo
*[Round, −high]
'a licensing restriction on nonhigh vowels' (Walker 2001: 841).

i. SPREAD[Rd]if[−hi]
'for any vowel in a word linked to both a [Round] autosegment and a [−high] autosegment, that same [Round] autosegment must also be associated to all other vowels in the word' (Walker 2001: 845).

j. NOLONGVOWELS
'Long vowels … are subject to the following constraint' (Rosenthall 1997: 141)



k. RAISING
Maximise vowel height (in verbs when occurring with certain tense and aspect affixes) [in Nzɛbi] (Kirchner 1996: 344).

l. REDUCE
Minimise the duration of a short vowel in an open syllable (Kirchner 1996: 347).

m. FREE-V
Word-final vowels must not be parsed (in the nominative) (Prince & Smolensky 2004: 123).

3 Constraints defined in terms of both consonants and vowels

a. C↔V
A consonant is adjacent to a vowel (Côté 2004: 19).

b. MAX(C) / V
Do not delete a consonant that is adjacent to a vowel (Côté 2004: 22).

c. AGREE[backness]
A consonant closure or release must have the same value of backness as the vowel adjacent to that phase of the consonant (Flemming 2003: 346).

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d. PAL(ATALISE)
A consonant before a front vowel is palatalised (Padgett 2003: 60).

e. IDENT(C) and IDENT(V)
'implement … the requirement that realisations not deviate from targets … the actual F2 at consonant and vowel equal the target value for that segment' (Flemming 2001: 19).

f. NOWEAKCONS
Let x be any candidate and α be any consonant in x that is not released by a vowel. If candidate y is exactly like x except that α has been removed, then y is more harmonic than x (i.e. $y \succ x$) (Wilson 2001: 160).

g. FAITH(CV)
Every CV sequence in the input must correspond to a CV sequence in the output, and *vice versa* (Wilson 2001: 184).

h. *COMPLEX
No more than one C or V may associate to any syllable position node (Prince & Smolensky 2004: 108).

REFERENCES

Ács, Péter & Miklós Törkenczy (1985). Directionality and post-tonic schwa deletion in Standard Danish and Standard British English. *Acta Linguistica Academiae Scientiarum Hungaricae* **35**. 331–340.

Anttila, Arto (2002). Morphologically conditioned phonological alternations. *NLLT* **20**. 1–42.

Aoki, Haruo (1994). *Nez Perce dictionary*. Berkeley: University of California Press.

Bagemihl, Bruce (1991). Syllable structure in Bella Coola. *LI* **22**. 589–646.

Bagemihl, Bruce (1998). Maximality in Bella Coola (Nuxalk). In Ewa Czaykowska-Higgins & M. Dale Kinkade (eds.) *Salish languages and linguistics: theoretical and descriptive perspectives*. Berlin & New York: Mouton de Gruyter. 71–98.

Beavert, Virginia & Sharon Hargus (in preparation). *Ichishkíin sínwit* [*Sahaptin language*]. *Yakima Sahaptin bilingual dictionary: Sahaptin–English and English–Sahaptin*. Ms, Heritage University & University of Washington.

Blevins, Juliette (2003). The independent nature of phonotactic constraints: an alternative to syllable-based approaches. In Féry & van de Vijver (2003). 375–403.

Cheng, Chin-Chuan (1973). *A synchronic phonology of Mandarin Chinese*. The Hague & Paris: Mouton.

Chitoran, Ioana (1998). Georgian harmonic clusters: phonetic cues to phonological representation. *Phonology* **15**. 121–141.

Cho, Young-mee Yu & Tracy Holloway King (2003). Semisyllables and universal syllabification. In Féry & van de Vijver (2003). 183–212.

Clements, G. N. (1980). *Vowel harmony in nonlinear generative phonology: an autosegmental model*. Bloomington: Indiana University Linguistics Club.

Clements, G. N. (1985). The geometry of phonological features. *Phonology Yearbook* **2**. 225–252.

Clements, G. N. & Elizabeth V. Hume (1995). The internal organization of speech sounds. In Goldsmith (1995). 245–306.

Clements, G. N. & Samuel J. Keyser (1983). *CV phonology: a generative theory of the syllable*. Cambridge, Mass.: MIT Press.

https://doi.org/10.1017/S0952675706000753 Published online by Cambridge University Press

Cole, Jennifer Fitzpatrick (1990). The minimal word in Bengali. *WCCFL* **9**. 157–170.
Côté, Marie-Hélène (2004). Syntagmatic distinctness in consonant deletion. *Phonology* **21**. 1–41.
Crook, Harold (1999). *The phonology and morphology of Nez Perce stress*. PhD dissertation, UCLA.
Crowhurst, Megan J. (1992). Diminutives and augmentatives in Mexican Spanish: a prosodic analysis. *Phonology* **9**. 221–253.
Crowhurst, Megan J. (2004). Mora alignment. *NLLT* **22**. 127–177.
Curtis, Emily (2003). *Geminate weight: case studies and formal models*. PhD dissertation, University of Washington.
Davis, Stuart (1990). Italian onset structure and the distribution of *il* and *lo*. *Linguistics* **28**. 43–55.
Davis, Stuart (1999). On the representation of initial geminates. *Phonology* **16**. 93–104.
Davis, Stuart (2003). The controversy over geminates and syllable weight. In Féry & van de Vijver (2003). 77–98.
de Lacy, Paul (2002). Maximal words and the Maori passive. *MIT Working Papers in Linguistics* **44**. 137–156.
Dell, François & Mohamed Elmedlaoui (1985). Syllabic consonants and syllabification in Imdlawn Tashlhiyt Berber. *Journal of African Languages and Linguistics* **7**. 105–130.
Dell, François & Mohamed Elmedlaoui (1988). Syllabic consonants in Berber: some new evidence. *Journal of African Languages and Linguistics* **10**. 1–17.
Downing, Laura J., T. A. Hall & Renate Raffelsiefen (eds.) (2005). *Paradigms in phonological theory*. Oxford: Oxford University Press.
Féry, Caroline & Ruben van de Vijver (eds.) (2003). *The syllable in Optimality Theory*. Cambridge: Cambridge University Press.
Flemming, Edward (2001). Scalar and categorical phenomena in a unified model of phonetics and phonology. *Phonology* **18**. 7–44.
Flemming, Edward (2003). The relationship between coronal place and vowel backness. *Phonology* **20**. 335–373.
Gafos, Adamantios I. (2002). A grammar of gestural coordination. *NLLT* **20**. 269–337.
Garrett, Edward (1996). *The minimal word syndrome*. MA thesis, UCLA.
Goldsmith, John (ed.) (1995). *The handbook of phonological theory*. Cambridge, Mass. & Oxford: Blackwell.
Goodman, Beverley (1995). *Features in Ponapean phonology*. PhD dissertation, Cornell University.
Gordon, Matthew (1999). *Syllable weight: phonetics, phonology, and typology*. PhD dissertation, UCLA.
Green, Antony Dubach (2003). Extrasyllabic consonants and onset well-formedness. In Féry & van de Vijver (2003). 238–253.
Greenberg, Joseph H. (1978). Some generalizations concerning initial and final consonant clusters. In Joseph H. Greenberg, Charles A. Ferguson & Edith A. Moravcsik (eds.) *Universals of human language*. Vol. 2: *Phonology*. Stanford: Stanford University Press. 243–279.
Hall, T. A. (2002). Against extrasyllabic consonants in German and English. *Phonology* **19**. 33–75.
Hammond, Michael (1999). *The phonology of English: a prosodic optimality-theoretic approach*. Oxford: Oxford University Press.
Hargus, Sharon & Virginia Beavert (2001). Initial clusters and minimality in Yakima Sahaptin. *University of Washington Working Papers in Linguistics* **20**. 1–24.
Hargus, Sharon & Virginia Beavert (2002a). Predictable versus underlying vocalism in Yakima Sahaptin. *IJAL* **68**. 316–340.

https://doi.org/10.1017/S0952675706000753 Published online by Cambridge University Press

Hargus, Sharon & Virginia Beavert (2002b). Yakima Sahaptin clusters and epenthetic [ɨ]. *Anthropological Linguistics* **44**. 231–277.
Hargus, Sharon & Virginia Beavert (to appear). A note on the phonetic correlates of stress in Yakima Sahaptin. *University of Washington Working Papers in Linguistics* **24**.
Hargus, Sharon & Siri G. Tuttle (1997). Augmentation as affixation in Athabaskan languages. *Phonology* **14**. 177–220.
Harris, James W. & Ellen M. Kaisse (1999). Palatal vowels, glides and obstruents in Argentinian Spanish. *Phonology* **16**. 117–190.
Hart, Michele E. (1991). The moraic status of initial geminates in Trukese. *BLS* **17**. 107–120.
Hayes, Bruce (1986). Inalterability in CV phonology. *Lg* **62**. 321–351.
Hayes, Bruce (1987). A revised parametric metrical theory. *NELS* **17**. 274–289.
Hayes, Bruce (1989). Compensatory lengthening in moraic phonology. *LI* **20**. 253–306.
Hayes, Bruce (1995). *Metrical stress theory : principles and case studies*. Chicago: University of Chicago Press.
Howe, Darin (2000). *Oowekyala segmental phonology*. PhD dissertation, UBC.
Hume, Elizabeth (1994). Representing the duality of glides. Paper presented at Langues et Grammaire I, Paris.
Itô, Junko (1990). Prosodic minimality in Japanese. *CLS* **26:2**. 213–239.
Itô, Junko & R. Armin Mester (1995). Japanese phonology. In Goldsmith (1995). 817–838.
Jacobs, Melville (1931). A sketch of Northern Sahaptin grammar. *University of Washington Publications in Anthropology* **4**. 85–291.
Kang, Yoonjung (2003). Perceptual similarity in loanword adaptation: English post-vocalic word-final stops in Korean. *Phonology* **20**. 219–273.
Kenstowicz, Michael & Charles Pyle (1973). On the phonological integrity of geminate clusters. In Michael Kenstowicz & Charles W. Kisseberth (eds.) *Issues in phonological theory : proceedings of the Urbana Conference on Phonology*. The Hague & Paris: Mouton. 27–43.
Kiparsky, Paul (2003). Syllables and moras in Arabic. In Féry & van de Vijver (2003). 147–182.
Kirchner, Robert (1996). Synchronic chain shifts in Optimality Theory. *LI* **27**. 341–350.
Leer, Jeff (1979). *Proto-Athabaskan verb stem variation*. Part 1: *Phonology*. Fairbanks: Alaska Native Language Center.
Levi, Susannah V. (2004). *The representation of underlying glides : a cross-linguistic survey*. PhD dissertation, University of Washington.
Levin, Juliette (1985). *A metrical theory of syllabicity*. PhD dissertation, MIT.
Lin, Yen-Hwei (1997). Syllabic and moraic structures in Piro. *Phonology* **14**. 403–436.
McCarthy, John J. (1979). *Formal problems in Semitic phonology and morphology*. PhD dissertation, MIT.
McCarthy, John J. (1988). Feature geometry and dependency: a review. *Phonetica* **45**. 84–108.
McCarthy, John J. (1994). The phonetics and phonology of Semitic pharyngeals. In Patricia A. Keating (ed.) *Phonological structure and phonetic form : papers in laboratory phonology III*. Cambridge: Cambridge University Press. 191–233.
McCarthy, John J. (2003). OT constraints are categorical. *Phonology* **20**. 75–138.
McCarthy, John J. (2005). Optimal paradigms. In Downing *et al*. (2005). 170–210.
McCarthy, John J. & Alan Prince (1986). *Prosodic morphology*. Ms, University of Massachusetts & Brandeis University.

https://doi.org/10.1017/S0952675706000753 Published online by Cambridge University Press

McCarthy, John J. & Alan Prince (1990). Prosodic morphology and templatic morphology. In Mushira Eid & John McCarthy (eds.) *Perspectives on Arabic Linguistics II*. Amsterdam & Philadelphia: Benjamins. 1–54.
McCarthy, John J. & Alan Prince (1993). *Prosodic morphology I : constraint interaction and satisfaction*. Ms, University of Massachusetts & Rutgers University.
McCarthy, John J. & Alan Prince (1994). The emergence of the unmarked: optimality in prosodic morphology. *NELS* **24**. 333–379.
McCarthy, John J. & Alan Prince (1995). Faithfulness and reduplicative identity. In Jill Beckman, Laura Walsh Dickey & Suzanne Urbanczyk (eds.) *Papers in Optimality Theory*. Amherst: GLSA. 249–384.
Maddieson, Ian (1985). Phonetic cues to syllabification. In Victoria A. Fromkin (ed.) *Phonetic linguistics : essays in honor of Peter Ladefoged*. Orlando: Academic Press. 203–221.
Mithun, Marianne (1999). *The languages of native North America*. Cambridge: Cambridge University Press.
Morelli, Frida (1999). *The phonotactics and phonology of obstruent clusters in Optimality Theory*. PhD dissertation, University of Maryland, College Park.
Morelli, Frida (2003). The relative harmony of /s + stop/ onsets: obstruent clusters and the Sonority Sequencing Principle. In Féry & van de Vijver (2003). 356–371.
Nespor, Marina & Irene Vogel (1986). *Prosodic phonology*. Dordrecht: Foris.
Orgun, Cemil Orhan (2001). English *r*-insertion in Optimality Theory. *NLLT* **19**. 737–749.
Orie, Ọlanikẹ Ọla & Douglas Pulleyblank (2002). Yoruba vowel elision: minimality effects. *NLLT* **20**. 101–156.
Padgett, Jaye (2003). Contrast and post-velar fronting in Russian. *NLLT* **21**. 39–87.
Piggott, G. L. (2003). Theoretical implications of segment neutrality in nasal harmony. *Phonology* **20**. 375–424.
Prince, Alan & Paul Smolensky (2004). *Optimality Theory : constraint interaction in generative grammar*. Malden, Mass. & Oxford: Blackwell.
Pulleyblank, Douglas (1988). Vocalic underspecification in Yoruba. *LI* **19**. 233–270.
Pulleyblank, Douglas (2005). Glottalization and lenition in Nuu-chah-nulth. Paper presented at University of Washington colloquium.
Rebrus, Péter & Miklós Törkenczy (2005). Uniformity and contrast in the Hungarian verbal paradigm. In Downing *et al*. (2005). 263–295.
Rigsby, Bruce & Noel Rude (1996). Sketch of Sahaptin, a Sahaptian language. In Ives Goddard (ed.) *Languages* (Vol. 17 of *Handbook of North American Indians*). Washington, D.C.: Smithsonian Institution. 666–692.
Ringen, Catherine O. & Robert M. Vago (2002). Geminates: heavy or long? Ms, University of Iowa & City University of New York.
Rose, Sharon & Rachel Walker (2004). A typology of consonant agreement as correspondence. *Lg* **80**. 475–531.
Rosenthall, Sam (1997). The distribution of prevocalic vowels. *NLLT* **15**. 139–180.
Rude, Noel (1988). A report from the field. Ms, University of Oregon.
Rude, Noel (2004). Proto-Sahaptian vocalism. Ms, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oreg.
Sapir, Edward (1929). Central and North American Languages. In *Encyclopaedia Britannica*. 14th edn. London & New York: Encyclopaedia Britannica Co. 138–141.
Selkirk, Elisabeth (1980). The role of prosodic categories in English word stress. *LI* **11**. 563–605.
Selkirk, Elisabeth (1990). A two-root theory of length. *University of Massachusetts Occasional Papers* **14**. 123–171.
Shaw, Patricia A. (1992). Templatic evidence for the syllable nucleus. *NELS* **23**. 463–477.

https://doi.org/10.1017/S0952675706000753 Published online by Cambridge University Press

Shaw, Patricia A. (1993). The prosodic constituency of minor syllables. *WCCFL* **12**. 117–132.
Shaw, Patricia A. (2002). On the edge: obstruent clusters in Salish. *UBC Working Papers in Linguistics* **10**. 119–136.
Siptár, Péter & Miklós Törkenczy (2000). *The phonology of Hungarian*. Oxford: Oxford University Press.
Sloan, Kelly (1988). Bare-consonant reduplication: implications for a prosodic theory of reduplication. *WCCFL* **7**. 319–330.
Spring, Cari (1990). How many feet per language? *WCCFL* **9**. 493–508.
Urbanczyk, Suzanne (1996). *Patterns of reduplication in Lushootseed*. PhD dissertation, University of Massachusetts, Amherst.
Urbanczyk, Suzanne (2005). A note on paradigm uniformity and priority of the root. In Downing *et al*. (2005). 296–312.
Urbanczyk, Suzanne (2006). Reduplicative form and the root–affix asymmetry. *NLLT* **24**. 179–240.
Ussishkin, Adam (2005). A fixed prosodic theory of nonconcatenative morphology. *NLLT* **23**. 169–218.
Walker, Rachel (2001). Round licensing, harmony, and bisyllabic triggers in Altaic. *NLLT* **19**. 827–878.
Wells, J. C. (1995). New syllabic consonants in English. In Jack Windsor Lewis (ed.) *Studies in general and English phonetics : essays in honour of Professor J. D. O'Connor*. London & New York: Routledge. 401–412.
Wetzels, W. Leo & Joan Mascaró (2001). The typology of voicing and devoicing. *Lg* **77**. 207–244.
Wilson, Colin (2001). Consonant cluster neutralisation and targeted constraints. *Phonology* **18**. 147–197.
Wright, Richard (1996). *Consonant clusters and cue preservation in Tsou*. PhD dissertation, UCLA.
Zec, Draga (1999). Footed tones and tonal feet: rhythmic constituency in a pitch-accent language. *Phonology* **16**. 225–264.

https://doi.org/10.1017/S0952675706000753 Published online by Cambridge University Press