Epenthesis and prosodic (in)visibility in Mohawk and Upper Chehalis*

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I propose a non-derivational account of the difference between prosodically 'visible' epenthetic vowels and 'invisible' (or, 'excrescent') vowels in Mohawk and Upper Chehalis. It is argued that phonotactic structure involves two types of relations between segments, relations between vocalic positions, either filled by a vowel or empty, and relations between consonantal positions. Vowel epenthesis can be triggered by well-formedness constraints on either type of relations. However, only epenthetic vowels occupying strong positions in inter-nuclear relations are prosodically relevant, or 'visible'. Syllabic nuclei occupying weak positions and pronounced as 'excrescent' vowels can be ignored by stress and related phenomena. The analysis also offers an account of consonant clusters in both languages.

The purpose of this paper is to present an analysis of the prosodic behaviour of epenthetic vowels in two Native American languages and to suggest an account of complex consonantal clusters in these languages. The first one of them, Mohawk, belongs to the Northern Iroquoian language family, while the other, Upper Chehalis, belongs to the Tsamosan (or Olympic) branch of Salish.

Both languages have two kinds of epenthetic vowels. Some vowels are prosodically relevant and included in metrical structure, while others are ignored by stress and stress-related processes. Vowels of the latter type are often labelled 'excrescent', while the term 'epenthetic' is reserved to the former type only. However, for reasons laid out below, I will use Michelson's (1989) terms and talk of prosodically 'visible' and 'invisible' vowels.

The essential question addressed here is why there are two kinds of epenthetic vowels and what is the place of the invisible vowels in prosodic structure.

1 Data

1.1 Mohawk

The epenthetic vowel in Mohawk is [e].[1] Prosodically invisible [e] is inserted between a consonant and a sonorant (/n, r, w/) or a glottal stop. On the other hand, visible [e] appears after the first consonant in complex consonantal clusters. Some clusters containing the consonants /s, h, ʔ/ in specific positions remain unaffected.

Both types of epenthesis are illustrated in (1) below. In words with no epenthetic vowels, stress is penultimate, as shown in (1a). Some examples show the effects of tonic lengthening which takes place in open stressed syllables unless the following vowel is invisible [e]. Such lengthening will not be discussed in this paper.[2] Antepenultimate stress in (1b) indicates that epenthetic [e] in an open syllable or in a syllable closed by the glottal stop is prosodically invisible and skipped in metrical foot formation. On the other hand, epenthetic [e] does count for stress when it is in a syllable closed by a consonant other than a glottal stop, as shown in (1c). Throughout this paper, epenthetic vowels are underlined.

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[1] All Mohawk data in this paper come from the work of Karin Michelson (1981, 1983, 1988, 1989). Other sources and studies on Mohawk include Alderete (1995), Beatty (1974), Bonvillain (1969), Chafe (1977), Hagstrom (1997), Mithun (1979a,b), Piggott (1995), Postal (1968, 1969), Potter (1994) and Rowicka (1998, 1999).

[2] For the analysis of the interaction between tonic lengthening and epenthesis within the framework adopted here, see Rowicka (1998, 1999). The latter work also discusses the special clustering properties of /s, h, ʔ/ and the behaviour of the so-called 'stem joiner' vowel [a], which in some contexts resembles that of invisible [e].

(1) MOHAWK

a. PENULTIMATE STRESS WITH NO EPENTHESIS

/s-atorat/	satóːrat	'hunt' *imper.*
/wak-ashet-u/	wakashéːtu	'I have counted it'
/k-atirut-haʔ/	katirútha?	'I pull it'

b. INVISIBLE [e]

/w-akra-s/	wákeras	'it smells'
	*wakéːras	
/ʌ-k-arat-ʔ/	ʌkáːrate?	'I lay myself down'
	*ʌkaráːte?	
/t-ʌ-k-rik-ʔ/	tʌ́kerike?	'I will put together side by side'
	*tʌkeríːke?	

c. VISIBLE [e]

/s-k-ahkt-s/	skáhkets	'I get back'
/wak-nyak-s/	wakényaks	'I get married'
/s-rho-s/	sérhos	'you coat it with something'

At this point, one could conclude that epenthetic vowels are generally ignored by stress, but non-final closed (hence heavy) syllables attract stress. However, the following examples illustrate an additional complication. An epenthetic vowel in an open syllable is also visible when the vowel in the next syllable is invisible [e]. This is evidenced by the position of stress (antepenultimate, rather than pre-antepenultimate), the lengthening of the stressed vowel before a visible epenthetic vowel and the non-application of *i*-prothesis, which augments words with less than two visible vowels.[3]

(2) EPENTHETIC VOWELS IN ADJACENT SYLLABLES

/yo-t-r-ʔ/	yóːtereʔ	'it's in the dish/glass'
	*yoténːreʔ	
	*íːyotereʔ	
/te-wak-ahsutr-ʔ/	tewakahsúːtereʔ	'I have spliced it'
	*tewakáhsutereʔ	
/t-a-w-aresr-ʔ/	turéːsereʔ	'it boiled over'
	*túːresereʔ	
	*turesénːreʔ	

In other words, invisible [e] does not make the preceding syllable *behave* like an open syllable. The leftmost epenthetic [e] in the above examples behaves prosodically as if it were followed by the consonant cluster /rʔ/, rather than the syllable /reʔ/.

1.2 Upper Chehalis

Compare now the behaviour of epenthetic schwa in Upper Chehalis.[4] Just like in Mohawk, a prosodically invisible vowel is inserted between a consonant and a sonorant (/m, n, y, l, w/) or a glottal stop in Upper Chehalis, as exemplified in (3). It is usually treated as 'excrescent' and ignored in phonemic transcription.

[3] Prothesis does, for instance, occur in [ítenehreʔ] /t-n-ehr-ʔ/ 'you and I want'.

[4] All Upper Chehalis data come from the work of M. Dale Kinkade (1963-4, 1991, 1998). Some of the phonetic transcriptions (from Kinkade 1963) have been corrected in consultation with the author.

(3) UPPER CHEHALIS - INVISIBLE SCHWA

[q^{w}ʔóɬə̲weʔ]	√q^{w}ʔułwiʔ	'maple'
[čʔóp^{ʔ}waχə̲nstwə̲n]	√čʔúp^{ʔ}w=aχn-stw-n	'squeeze with the arm' *caus.*
[sqə̲ʔóq^{w}ə̲ls]	s√qəʔúq^{w}ls	'skull'
[χə́ɬə̲lp]	√χə́ɬlp	'open-weave basket'

'√'	precedes root
'='	precedes lexical suffix
'•'	separates reduplicant and base
'[ ]'	encloses infix
'-'	separates other morphemes

Evidence for the invisibility of the schwa vowels underlined in the above examples comes from the behaviour of visible schwa.

Visible schwa appears only under primary stress in closed syllables, as shown in (4aI), (4bI) and (4cI). When schwa which must bear (morphologically determined) stress [5] ends up in an open syllable, e.g. due to the plural affixation, it must change into another vowel, as shown in (4aII), (4bII) and (4cII). The plural marker /-a(ʔ)-/ (which may trigger sonorant glottalisation in the preceding root; cf. (4bII)) is suffixed or infixed after the second consonant of the root. However, the last example in (3) above, [χə́ɬə̲lp], indicates that an invisible schwa does not make the preceding syllable *count* as open, because the stressed schwa in what *looks* like an open syllable does not change into another vowel. When stress is placed somewhere else, schwa in a closed syllable disappears altogether, as shown in (4aIII), (4bIII) and (4cIII). Only invisible schwa can appear unstressed.[6]

(4) ə́ ~ í ~ Ø ALTERNATIONS

a.	I.	√cʔə́χ^{w}-mɬ	'wash for others'
	II.	√cʔíχ^{w}-a-ɬ	'be clean' *intr. pl.*
	III.	√cʔχ^{w}=šə́n-m	'wash one's feet'
b.	I.	√tə́mš	'earth, ground'
	II.	√tím^{ʔ}[a]š	'earth, ground' *pl.*
	III.	ʔác-√tmš	'ground'
c.	I.	s√q^{ʔw}ə́χ^{w}-t-n	'cut' *tr.*
	II.	s√q^{ʔw}íχ^{w}-a-t-n	'cut' *tr. pl.*
	III.	s√q^{ʔw}ə́χ^{w}•q^{ʔw}χ^{w}-t-n	'cut up' *tr.*

1.3 Epenthesis vs. excrescence?

Vowels that are ignored by prosodic processes, such as the Salish schwa accompanying sonorants, are often referred to as *excrescent*. In derivational approaches they are assumed to result from late insertion rules. On the other hand, (visible) *epenthetic* vowels are inserted earlier and may therefore interact with other phonological processes, such as stress (cf. Levin 1987). This predicts certain differences between the visible and the invisible vowels. The phonetic value of (visible) epenthetic vowels is the product of redundancy rules and therefore should be identical to one of the underlying vowels of the language. Excrescent vowels do not need to obey this restriction, often have a schwa-like quality and can be subject to feature spreading from adjacent segments.

However, these predictions are confirmed neither in Mohawk nor in Upper Chehalis. In neither language is there a phonetic difference between the two kinds of epenthetic vowels. In Upper Chehalis, both types of vowels are pronounced as schwa (and the exact phonetic quality of both is strongly influenced by the surrounding consonants), while schwa is argued not to be part of the underlying inventory (cf. Kinkade 1993). Both types tend to be ignored in writing by native speakers (cf. Kinkade 1998). On the other hand, invisible [e] vowels in Mohawk do not sound any more 'excrescent' than visible

[5] For analyses of stress in a few Salish languages, see Czaykowska-Higgins (1993) and Revithiadou (1999).

[6] This article does not deal with all types of alternations involving schwa in Upper Chehalis. For a more exhaustive treatment, see Rowicka (to appear).

ones, are not any more susceptible to the influence from the surrounding consonants as far as their phonetic quality goes and are not ignored in writing or singing by the native speakers (Michelson, p.c.).

For this reason it seems more adequate to refer to the differences between the two types of vowels as involving prosodic (in)visibility, rather than a distinction between excrescence and epenthesis.

2 Previous analyses

Earlier analyses of the facts of Mohawk by Karin Michelson and of Upper Chehalis by Dale Kinkade appeal to the ordering of phonological processes to express the complex interaction between epenthesis and stress assignment. Mohawk has also attracted the attention of many other linguists. Recently, Alderete (1995) and Hagstrom (1997) have put forward two different analyses within the framework of OT.

Alderete argues that stress on epenthetic vowels is cross-linguistically prohibited due to HEAD-DEP(ENDENCE) constraints. He assumes the formation of discontinuous stress feet in Mohawk that generally skip epenthetic vowels. Closed syllables, however, attract stress. Alderete must appeal to an implausibly complex parsing mechanism to get stress right in words with sequences of epenthetic vowels that cannot be skipped. Epenthetic vowels are left unfooted in between syllables with non-epenthetic vowels, but not when adjacent to another epenthetic vowel. Their visibility is viewed as result of a high ranked ALIGN-RIGHT constraint that prohibits stress placement too far away from the word end. This analysis implies that epenthetic vowel visibility is exclusively a word-edge phenomenon. This prediction cannot be verified in Mohawk. All evidence concerning prosodic visibility comes from fixed penultimate stress. The (in)visibility of epenthetic vowel sequences further from the word end cannot be established.

Hagstrom's analysis is based on the idea that invisible vowels in Mohawk are not at all syllable heads. They lack a dominating syllable node in the input and adding one in the output is prohibited, hence avoided. An intervocalic consonant preceding an invisible vowel is then argued to be the coda of the preceding syllable, and not the onset of the following. This is a cross-linguistically controversial proposal for which Mohawk provides no independent evidence. According to Michelson (p.c.), native speakers' intuitions about syllable breaks fail to show that invisible vowels are not syllable heads.

The central analytical problem involved in the facts presented above is how to express the prosodic deficiency of vowels that are inserted between specific consonants irrespective of the prosodic structure of the whole word and how to distinguish their status from that of vowels epenthesised for reasons of stress or to break up complex clusters. I argue that it can only be done straightforwardly within a framework that recognises separate phonotactic relations between vowels and relations between consonants, such as the Strict CV approach.

3 Analysis

3.1 The Strict CV approach

I adopt a version of Government Phonology (cf. Kaye, Lowenstamm & Vergnaud 1990) known as the Strict CV (or CVCV) approach (cf. Lowenstamm 1996), with several crucial revisions argued for in van der Hulst & Rowicka (1997) and Rowicka (1999). It incorporates some insights from Optimality Theory (cf. Prince & Smolensky 1993, McCarthy & Prince 1993). The main assumption is that in phonological representation, every consonant is followed by a nuclear position, either filled by a vowel, e.g. /a/ or /u/, or empty. Empty nuclei represent either phonetic zero or epenthetic vowels, such as Mohawk [e] or Salish schwa. Their behaviour, audibility or silence, follows from violable well-formedness constraints on phonotactic structure.

Phonotactic structure consists of two types of relations: inter-nuclear relations and inter-consonantal relations. Relations of the former type, called Proper Government (PG) feet, involve syllabic nuclei, both empty and contentful, and resemble trochaic metrical feet. They are left-headed, preferably branching and maximally binary. Non-empty vowels are always heads in PG feet. Empty nuclei are preferred as dependents. This follows from the COMPLEXITY CONDITION (cf. Harris 1994), which favours contentful, complex segments in the head position and empty segments in dependent positions in phonotactic relations. Sometimes, however, an empty nucleus ends up as a PG head to avoid a lapse, i.e. a sequence of weak (i.e. non-head) positions. Constraints on HEAD AUDIBILITY require prosodic heads, i.e. PG heads and prosodic word heads, to be pronounced. If an empty nucleus ends up in a head position, HEAD AUDIBILITY constraints come to stand in conflict with the constraint IDENTITY (Ø), which requires empty nuclear positions to have null phonetic realisation.

Inter-consonantal relations hold between consonants that are adjacent on the melodic plane, i.e. not separated by a contentful vowel. Language-specific conditions on such relations, called Inter-Onset (IO), prohibit the adjacency of certain consonants. For instance, in the languages discussed in this paper, clusters of a consonant and a sonorant are prohibited and must be split up. To achieve this, the intervening empty nucleus is made audible, i.e. pronounced as a vowel. However, this audibility does not affect its head or non-head status in PG structure. In other words, prosodic head status requires audibility, but audibility does not necessarily imply that a nucleus has the status of a prosodic head.

Moreover, in some languages certain consonants may have special clustering properties. For instance, /s/ is well known for such properties in English and many other Indo-European languages. In Mohawk, not only /s/, but also /h/ and /ʔ/ behave like this. They are omnipresent in clusters of more than two consonants. The interpretation of this fact within the Strict CV suggested in Rowicka (1999) is that these consonants can spread to the following empty nuclear position so that it no longer counts as empty. This property of consonants is not discussed in this paper, but it is indicated in representations by the symbol '☺'.

The relevant constraints are given in (5). Following OT, it is assumed that structure is not built directionally (starting at the beginning of the word or at its end), but the form is selected that maximally satisfies a set of universal constraints. The constraints are ranked with respect to each other on a language-specific basis. They may impose conflicting requirements. In that case, lower ranked constraints may be violated in order to satisfy the higher ranked ones. Different constraint rankings result in cross-linguistic variation. In the following sections, the approach outlined above is applied to the analysis of Mohawk and Upper Chehalis epenthesis.

(5) TROCHEE
PG feet are left-headed.
BINARITY
PG relations are binary.
NO LAPSE
Sequences of weak positions are ill formed.
COMPLEXITY CONDITION
In a (prosodic) relation, the dependent cannot be more complex than the head.
IDENTITY (Ø)
Empty nuclei have null phonetic realisation.
PG HEAD AUDIBILITY
Heads of PG relations must be audible.
PW HEAD AUDIBILITY
Heads of prosodic words must be audible.
INTER-ONSET
Clusters of a consonant and a sonorant or /ʔ/ are prohibited.

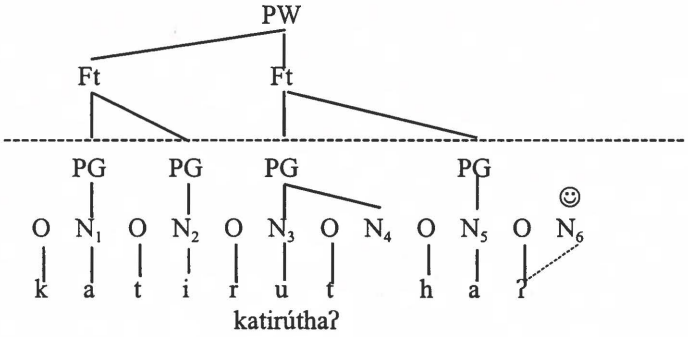
3.2 Mohawk

In the Strict CV approach, all epenthetic vowels in Mohawk are interpreted as empty syllabic nuclei in phonological representation. Empty nuclei are also assumed to intervene in between all consonantal clusters and follow every final consonant within a phonological domain.

The representation in (6) below shows a word with two empty nuclei.

(6) PG RELATIONS IN MOHAWK

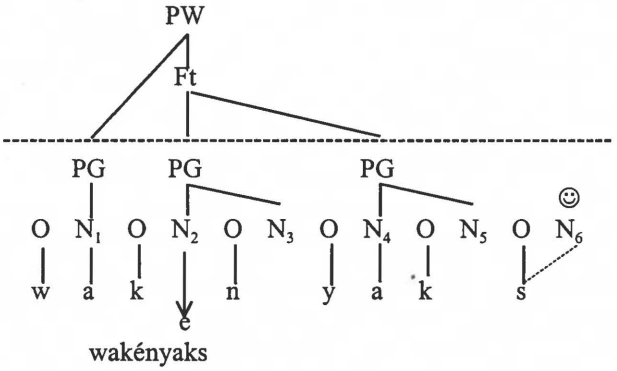
/k-atirut-ha?/ 'I pull it'



N_4 is parsed into a PG foot as a dependent of the vowel /u/ in N_3. On the other hand, N_6 is preceded by the consonant /?/ (which has special phonotactic properties) and gets a '☺'. It does not count as an empty nucleus and does not get parsed as a dependent of N_5.[7] As shown in (6), PG feet and stress feet are similar in form in Mohawk, but they form different structural levels, with PG feet constituting a representational layer below stress feet.

What happens when a representation contains a sequence of empty syllabic nuclei is shown in (7). At the end of the word, empty N_6 is left unparsed into a PG foot since it is filled by the preceding /s/. Empty N_5 is parsed together with contentful N_4 into one PG foot. Towards the left edge of the word, empty N_2 could be parsed together with contentful N_1, but that would leave the following empty N_3 on its own, unparsed and unaccounted for. Therefore, the form is selected where N_2 and N_3 are parsed together instead, with N_2 as the head of the PG foot. Since prosodic heads must be audible, N_2 is pronounced as the vowel [e]. This is what the epenthesis of prosodically visible vowels consists in, according to the present framework.

(7) /wak-nyak-s/ 'I get married'

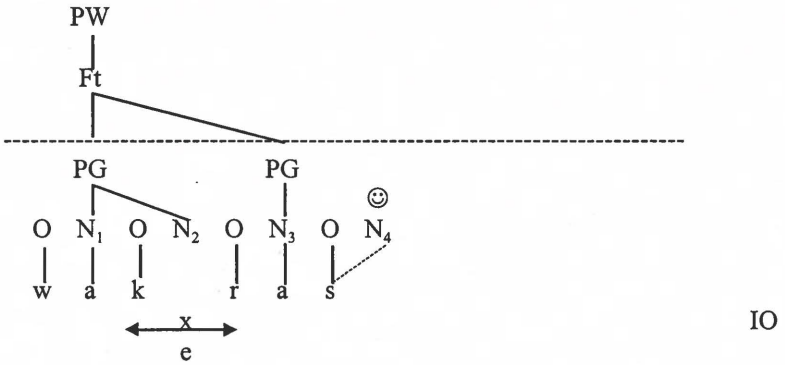


Independently of the relations between vowels, there are relations between consonants, which check whether melodically adjacent consonants are 'compatible', or their adjacency is prohibited in the language. In the latter case, a vowel appears in between the 'incompatible' consonants. This is shown in (8).

[7] The status of empty nuclei with '☺' is in between that of contentful vowels, which are PG heads and get projected into metrical structure, and that of empty nuclei, which are PG dependents and are ignored by metrical structure in Mohawk. They are not quite empty, but not vocalic enough to be treated like contentful vowels. The occurrence of such nuclei (hence of clusters with /s, h, ?/) is not restricted to the word end, as the examples in this paper may suggest, hence their behaviour cannot be accounted for by extrametricality.

(8) IO RELATIONS IN MOHAWK

/w-akra-s/ 'it smells'

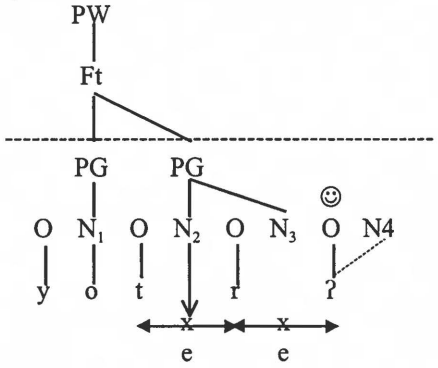


wákeras
*wákras

The consonants surrounding empty N_2 in the above representation are incompatible because their adjacency violates the INTER-ONSET constraint for Mohawk (cf. (5) above). In order to satisfy INTER-ONSET, the intervening nucleus N_2 is made audible (as [e]). However, the fact that N_2 is pronounced does not change its status as a weak position (i.e. dependent) in a PG foot. As a PG dependent it is ignored by the higher-level prosodic structure, i.e. by stress feet.

The glottal stop patterns with sonorants in that it must be separated from the preceding consonant by a vowel, as shown in (9).[8] There are two vowels in the representation below whose audibility is required by INTER-ONSET, N_2 and N_3. On the other hand, inter-nuclear relations require only one of them, N_2, to be pronounced because only N_2 is a PG foot head. This is exactly the epenthetic vowel that is visible to stress.

(9) /yo-t-r-ʔ/ 'it's in the dish/glass'



yó:tereʔ
*yótreʔ
*yóterʔ
*yotéreʔ

All and only those empty nuclei that are heads in PG relations are visible to stress. This is not surprising, given that both PG feet and stress feet involve the same type of structure, i.e. relations between syllabic nuclei, while inter-consonantal relations do not. The recognition of the two distinct types of phonotactic relations accounts for the difference between visible and invisible epenthetic vowels.

To sum up, in Mohawk every PW head (i.e. nucleus bearing word stress) and every PG head is audible. This type of PG structure parallels a rhythmic stress system, in which every PW head as well as every stress foot head bear some prominence. All complex clusters in Mohawk where epenthesis fails to take place involve the consonants /s, h, ʔ/ which have special clustering properties (not discussed here).

[8] Many Salishanists consider this similarity of phonotactic behaviour an argument in favour of classifying the glottal stop as a sonorant in Salish. This issue is not taken up here.

Apart from that, every nucleus enclosed by 'incompatible' consonants is pronounced, as required by INTER-ONSET. This situation indicates the following constraint ranking for Mohawk:

PW HEAD AUDIBILITY, PG HEAD AUDIBILITY, INTER-ONSET >> IDENTITY (∅)

In the following section, I will argue that the situation in Upper Chehalis differs in terms of a lower ranking of PG HEAD AUDIBILITY.

3.3 Upper Chehalis

Given the assumptions of Strict CV, all epenthetic vowels in Upper Chehalis are interpreted as empty syllabic nuclei in phonological representation. Empty nuclei are also postulated in between all consonantal clusters and after final consonants.

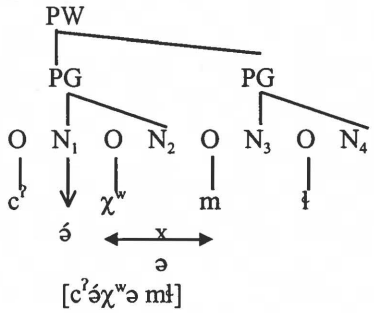
Consider the phonological representations of a few words below. In the output, some of the empty nuclei in the words in (10) are audible and others remain silent, depending on the constraint ranking in Upper Chehalis.

(10) EMPTY NUCLEI IN UPPER CHEHALIS

a.	√χə́ɬlp	/χ∅ɬ∅l∅p∅/	'open-weave basket'
b.	√čə́wɬ	/č∅w∅ɬ∅/	'wife'
c.	√máqʷm	/maqʷ∅m∅/	'prairie'

Consider now the phonotactic structure of the word in (11) below. The nucleus that is the head of the leftmost PG foot, N_1, is realized phonetically as (stressed) schwa. Every Upper Chehalis word must have an audible vowel to bear word stress. This provides evidence for the undominated status of the PW HEAD AUDIBILITY constraint. However, N_3, which is the head of the rightmost PG foot, is not audible. This results in a final consonant cluster. In general, complex (obstruent) clusters are tolerated in Upper Chehalis. They are not restricted to two segments or to specific consonants, like Mohawk clusters. I conclude that this is because the audibility of all PG heads is not required, i.e. PG HEAD AUDIBILITY is ranked below IDENTITY(∅).

(11) /cʔχʷ-mɬ/ 'wash for others'



On the other hand, clusters containing sonorants and the glottal stop are always broken up, which provides evidence for the high ranking of the INTER-ONSET constraint. Due to the latter constraint, N_2 in (11) is pronounced, although it is not in a prosodic head position. The fact that the audibility of N_2 has no influence on the quality of the preceding stressed schwa (which does not change to [i]) supports the view that it is not due to a HEAD AUDIBILITY constraint.

I conclude that the ranking of the relevant constraints in Upper Chehalis is:

PW HEAD AUDIBILITY, INTER-ONSET >> IDENTITY (∅) >> PG HEAD AUDIBILITY

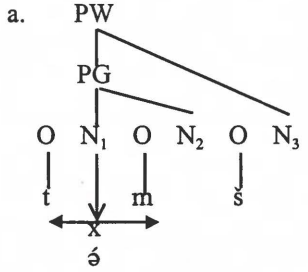
In other words, the structure of PG relations in Upper Chehalis can be compared to the metrical structure of a language with recursive footing, but where only primary stress is manifested. Such a situation is familiar from many languages with lexical accent systems, such as Russian, Greek and some Salish languages. Since only one prominence per word is realised, it has often been assumed that words in such

languages contain only one (main stress) foot. I argue, however, that the lack of secondary stresses does not constitute counterevidence to exhaustive footing. It only involves relatively low prosodic prominence of foot heads that are not PW heads.[9] In Upper Chehalis, the fact that only the PW head must be pronounced does not constitute evidence against postulating binary phonotactic relations below that level, i.e. PG feet.

Words with an odd number of empty nuclei indicate the relevance of one more constraint in Upper Chehalis. There are two plausible ways to parse three empty nuclear positions into binary relations, which are represented in (12a,b) below. Exhaustive parsing is not possible (unless high ranked BINARITY is violated). However, the representation in (12b) satisfies the constraint against lapses since a PG head in N_2 separates the two weak positions in N_1 and N_3. On the other hand, the representation in (12a) violates NO LAPSE since it contains a sequence of weak positions (N_2 and N_3). Still, (12a) corresponds to the actual word for 'earth, ground', and not (12b).

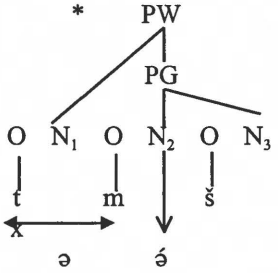
(12) /tmš/ 'earth, ground'

a.



[tə̲mš]

b.



*[tə̲mə̲́š]

This can be attributed to the well-formedness constraint familiar from the study of prosodic morphology, which requires alignment between the left edge of every PW word and a foot:

(13) ALIGN-LEFT
The left edge of every prosodic word must coincide with the left edge of a foot.

It favours the structure in (12a), where a foot begins at the left edge of the word, above (12b), where it does not. I conclude that ALIGN-LEFT outranks NO LAPSE in Upper Chehalis.[10]

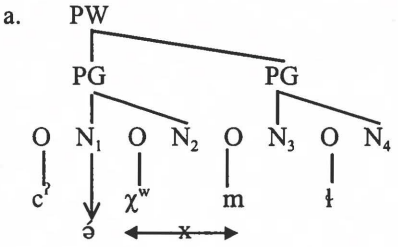
In the case of Upper Chehalis, ALIGN-LEFT requires left alignment between the PW and a PG foot, i.e. a foot including contentful as well as empty nuclei. There is no evidence in this language for stress feet distinct from PG feet. I claim that PG feet constitute both phonotactic and metrical structure in Upper Chehalis. This situation contrasts with Mohawk, where stress feet and PG feet constitute separate prosodic levels. As argued in van der Hulst & Rowicka (1997), such duality of structure can be due to the lexicalisation of earlier prosodic structure (in the form of PG feet) and the formation of new metrical structure 'on top' of it.

The above interpretation of the phonotactic and prosodic structure of Upper Chehalis straightforwardly accounts for the ə̲́ ~ í ~ Ø alternations, exemplified in (4) above. The representations in (14) below illustrate the alternation between a stressed schwa and phonetic zero in *√c'ə̲́χʷ-mɬ* 'wash for others' vs. *√c'χʷ=šə̲́n-m* 'wash one's feet'.

[9] See Revitiadou (1999) for evidence in favour of exhaustive footing in Russian.
[10] Observe that NO LAPSE is not violated in (11) above. N_3 is a strong PG position, although it is inaudible.

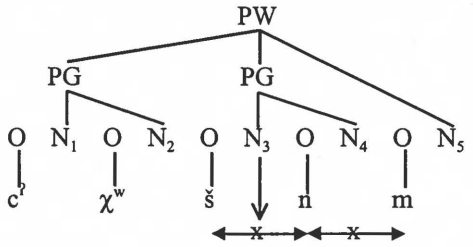
(14) SCHWA-ZERO ALTERNATIONS

a.



cf. (4aI) ə

b.



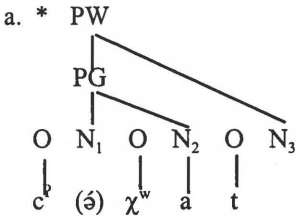
cf. (4aIII) ə́ ə

In both forms above, the empty nucleus within the root, N_1, is a PG head, but only in (14a) it is at the same time the PW head. Therefore a schwa vowel is pronounced in the root *ʔc'χʷ-* when it bears stress in (14a), but not when stress is assigned to the following lexical suffix *=šə́n* in (14b).

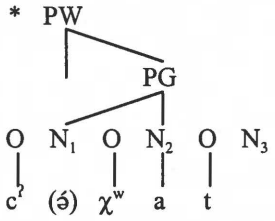
The vowel in the same root appears as [i] when it must bear stress, but ends up in an open syllable. The reason for this alternation is clear from the representations in (15) below. Stress assignment algorithm places the PW head within the root *ʔc'χʷ-*, i.e. on N_1. The PW head status implies PG headedness: a nucleus that is a dependent on one prosodic level cannot be the head on a higher level (cf. ill-formed (15b)). This, however, leads to an ill-formed structure in (15a). A PG foot with an empty head and a contentful vowel /a/ in the dependent position violates the COMPLEXITY CONDITION. It does not help to pronounce N_1 as schwa. Even though audible, schwa has no phonological content, i.e. no representational elements, while /a/ does (in a Government Phonology type of representation, it contains the element 'A'). Schwa is therefore less complex than a contentful vowel and cannot be the head if /a/ is in the dependent position. The only way to satisfy the COMPLEXITY CONDITION is to provide another contentful vowel in the N_1 position, as it is the case in (15c).

(15) SCHWA-[í] ALTERNATION

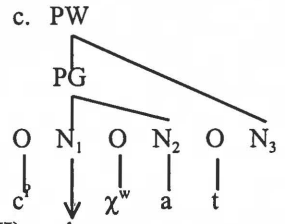
a. *



b. *



c.



cf. (4aII) í

The COMPLEXITY CONDITION explains why schwa can only appear in a closed syllable (or followed by invisible schwa) in Upper Chehalis. Within the present framework, a closed syllable is represented as a PG foot where the dependent position is empty and silent. An empty dependent allows for an empty PG head, but a contentful dependent requires a contentful head in order to meet the COMPLEXITY CONDITION.

4 Conclusion

The present paper has been devoted to the difference in the prosodic behaviour of two types of epenthetic vowels in Mohawk and Upper Chehalis Salish. One type of vowels is inserted to break up complex consonantal clusters in Mohawk and to bear stress in Upper Chehalis. They are incorporated into prosodic structure just like non-epenthetic vowels. The other kind of epenthetic vowels appear in order to separate a sonorant or the glottal stop from the preceding consonant in both languages. Those are prosodically invisible. In Mohawk, stress and stress-related phenomena ignore them. In Upper Chehalis, they involve the only instances of unstressed schwa. In both languages, an epenthetic vowel in an open syllable followed by an invisible vowel patterns with vowels in closed syllables. However, neither language fully confirms the predictions following from the epenthesis vs. excrescence distinction made in the literature.

The analysis proposed in this paper views phonotactic structure of every language as a consisting of a network of two types of binary head/dependent relations: ones between vocalic positions (inter-nuclear; called 'PG feet') and ones between consonantal positions (inter-consonantal; called IO). It is assumed that

every consonantal position is followed by a vocalic position, either filled by a (non-epenthetic) vowel or empty. Empty positions represent phonetic zero or epenthetic vowels. Well-formedness conditions on either type of relations can trigger the phonetic realisation of an empty vocalic position as an epenthetic vowel.

Prosodically visible epenthetic vowels are the ones whose audibility is required by PG relations since they occupy head positions. It is fairly straightforward that heads of one kind of prosodic relations (i.e. involving vowels), namely, phonotactic inter-nuclear relations, are relevant at another level of prosodic relations, i.e. stress feet. On the other hand, epenthetic vowels due to IO relations do not have the status of heads and are therefore treated by stress feet on a par with phonetic zero.

Mohawk and Upper Chehalis differ like a language with rhythmic stress from a language with primary stress only. In Mohawk, every nucleus in the head position in PG feet must be audible. This parallels some degree of stress on every stress foot head in a rhythmic language, like Polish. On the other hand, in Upper Chehalis, a (visible) epenthetic vowel is required only in the PW head positions, while heads of other PG feet can remain silent. This resembles the situation e.g. in Russian, where only primary stress is manifested and other foot heads bear no prominence. The approach to phonotactic structure presented in this paper suggests insightful accounts of the variation in syllable structure found cross-linguistically, in particular of languages with complex consonantal clusters.

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