

When a Passamaquoddy unstressable /ə/, That's a mora

An Optimality Theoretic approach to Passamaquoddy stress, syncope, and assimilation*

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**** PRELIMINARY VERSION—Comments Welcome****

“The point is,” she said, “that one must provide an explanation for everything. Each thing has got to be explained away satisfactorily. If you have a theory that fits every fact—well then—it must be the right one.”

—Agatha Christie, The Murder at the Vicarage

0. Introduction and background

Passamaquoddy is an Algonquian language spoken in parts of Maine and New Brunswick. Here, I present an attempt to characterize a fairly wide range of phonological phenomena cast in the framework of “Optimality Theory,” initially set forth in Prince & Smolensky (1993). The data used in this paper comes almost exclusively from LeSourd (1993),¹ who presents a rule-based account for these same phenomena in the framework of CV phonology (*e.g.*, Clements & Keyser (1983) and related work).

The purpose of this paper is severalfold. The main focus is the development of an analysis of Passamaquoddy stress, syncope, and assimilation effects, couched in terms of Optimality Theory. In the process of developing this analysis, several things of a more general theoretical interest will also be discussed. Among the theoretical claims made herein is for the allowability of a prosodic structure in which a prosodic foot directly parses a mora with no intervening syllable. Two constraints with possible crosslinguistic effects will also be proposed

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¹Further references to LeSourd and page references herein refer to LeSourd (1993).

and discussed, *PEAK(\emptyset) and MIN(μ), the latter of which is part of a family of constraints each having similar character.

Passamaquoddy has a relatively small segmental inventory, which includes five vowels [a, i, o, e, \emptyset] and twelve consonants [p, t, c, k, k^w, s, h, m, n, l, w, y].²

0.1. Optimality Theory

It is assumed that the reader is familiar with the basic literature on Optimality Theory stemming from recent work of Prince, Smolensky, and McCarthy (in particular, Prince and Smolensky (1993), McCarthy and Prince (1993a,b)). The following is a very rapid overview of Optimality Theory, and the reader is referred to the above works and references cited therein for a more complete background in the details of Optimality Theory.

The two basic components of Optimality Theory are GEN, the generator of the candidate set, and EVAL, the evaluation mechanism which sifts the candidate set to find the most optimal candidate. The candidate set is comprised of all possible variations on the input structure, including additions of prosodic structure in all of the various ways that such structure could be added. In other words, the candidate set is the set of all possible outputs for the given underlying form. The candidate set is then sifted by EVAL, which evaluates each candidate against a set of interranked constraints. The candidate which minimally violates the most important constraints is chosen as the actual output form. Due to this method of evaluation, a constraint need not be “surface true;” surface forms may in fact violate many of the constraints, particularly those constraints which are ranked relatively low. This method of evaluation is assumed not to be derivational, but rather occurring in a single step. Although there are reasons to believe that multiple evaluations may need to take place at different levels (see, *e.g.*, Kenstowicz (1994b)), these levels appear to be analogous to the levels of Lexical Phonology (*e.g.* word level, phrase level, see Kiparsky (1982, 1985)), and not isomorphic to the arbitrarily many intermediate representations which may exist in a derivation. In this respect, Optimality Theory constitutes a distinct approach from other derivational theories.

One strong claim made by Optimality Theory is that the set of constraints is universal across human languages and that only the ranking of these constraints varies from language to language. In keeping with this claim, many of the constraints involved in the upcoming

²Note that I am using the transcriptions as they appear in LeSourd. In other literature, /o/ is usually written as “u”, and / \emptyset / is usually written as “o.” Note too that, following LeSourd, I transcribe /k^w/ as “kw,” but this should be considered a single (but perhaps complex) phoneme. The sequence /k/ + /w/ does occur, but only word-initially with the second person prefix /k-/ , so there is no real ambiguity by writing the /k^w/ phoneme as “kw.” The /c/ consonant is an affricate, IPA /tʃ/, which LeSourd argues is a complex phoneme constructed of /t/ and /ʃ/. LeSourd also indicates that /ŋ/ and /t/ have marginal status, generally occurring only in loan-words.

discussion have been proposed elsewhere in other analyses for other languages. Those novel constraints introduced for language-internal reasons in the present analysis should also be investigated for crosslinguistic support, although this issue is not much considered in the present paper.

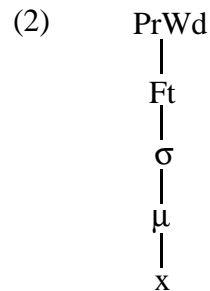
Optimality Theoretic evaluations are demonstrated by using a tableau such as that shown in (1). The candidates *a*, *b*, and *c* are being evaluated against constraints A and B, where $A \gg B$ (“A is ranked higher than B”). The winning (most optimal) candidate is indicated by the pointing finger. Notice that, while all of the candidates violate constraint A, candidate *a* violates it worse. The point at which a candidate drops out of the running is marked by an exclamation point (!). Shading indicates results which are irrelevant to the rest of the evaluation. In (1), because candidate *a* has been removed from consideration due to its excessive violation of constraint A, how well *a* satisfies constraint B is irrelevant. Because candidates *b* and *c* equally violate constraint A, constraint A makes no decision between them, allowing constraint B to make the choice in favor of candidate *c*. Notice that even *c*, the surface form, violates constraint A.

(1)

/input/	A	B
a	**!	√
b	*	*!
☞ c	*	√

0.2. The Prosodic Hierarchy

One of the main claims of general theoretical interest made herein concerns the proper treatment of feet and moras in the Prosodic Hierarchy (developed in Selkirk (1984), and many others subsequently), illustrated in (2) below. In the Prosodic Hierarchy, a prosodic word (PrWd) is constructed of feet (Ft), which are constructed of syllables (σ), constructed of moras (μ), which dominate the actual phonemic segments.



In early work on the Prosodic Hierarchy, it was believed that every category in the Prosodic Hierarchy must dominate only categories of the level immediately below, which was the content of Selkirk's (1984) "Strict Layer Hypothesis." More recent work has suggested that this hypothesis may be too strong. As discussed in Itô and Mester (1992), strict layering faces difficulty both in that it requires postulation of much unmotivated constituent structure, and also in that some empirically well-motivated structures are unrepresentable.

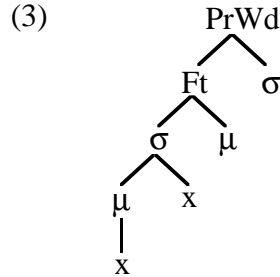
Several more recent analyses involve structures which do not conform to the Strict Layer Hypothesis. For example, both McCarthy & Prince (1993b, and much related work, see citations within) and Hayes (1989) suppose that onset consonants are parsed directly into the syllable because onsets do not have phonological weight crosslinguistically. In other analyses, use is made of "loose syllables," or syllables parsed directly into the prosodic word, in the explanation of stress patterns of languages like Garawa (McCarthy & Prince (1993b), see also fn. 6) and Indonesian (Cohn & McCarthy (1994)). Each of these structures violated the Strict Layer Hypothesis by a single level, skipping the mora and foot level, respectively.³

Generalizing the structures above leads to the conclusion that a given prosodic category can parse elements of a category either one or two levels below itself in the hierarchy.⁴ By parity of reasoning, if a syllable can parse a segment and a prosodic word can parse a syllable, we would expect that a foot can parse a mora. If this more uniform view is correct, the Prosodic Hierarchy has the structure in (3), where categories are shown connected to categories into which they may be parsed.⁵

³Of course, not everyone agrees with these views. For example, Bagemihl (1991) suggests that onsets are actually parsed into the nuclear mora, but his main motivation appears to be mainly just better satisfaction of the Strict Layer Hypothesis. With only minor modifications, however, his arguments concerning Bella Coola would hold of structures where onsets are parsed into syllables rather than into moras.

⁴It is conceivable that the "one or two levels" generalization is an effect of the STRICT-PARSE constraint discussed in section 3.2 (and also see fn. 5 below), although the final ranking of this constraint will be relatively low in the present analysis.

⁵This differs from the view taken by Hung (1994) and Itô & Mester (1992), where it is suggested that the Prosodic Hierarchy consists of two distinct domains, one above and one below the syllable level. However, the view taken here is a more uniform view, and does not require stipulating the special status of the syllable level. In Hung (1994), this division of domains was made in order to ensure that subsyllabic elements could not be adjoined to prosodic nodes higher than the syllable (note that these issues will be further explicated in section 3.2 below). Even without this domain restriction, the formulation of STRICT-PARSE adopted here and that adopted in Hung (1994) will each have the effect that the lowest adjunction possibility will be preferred. Although we cannot here enter into detailed discussion of the implications of removing from Hung's (1994) analysis the division of the Prosodic Hierarchy at the syllable level, it would appear that this division is not crucial to her analyses. Furthermore, the coherence of the analysis of Passamaquoddy under a uniform Prosodic Hierarchy contained herein suggests that such a division is not appropriate.



This is not a completely uncontroversial statement. The ability of feet to parse moras has been explicitly denied in the literature (*e.g.*, by the “Mora Confinement” constraint in Itô & Mester (1992)), but I suggest that the evidence from Passamaquoddy indicates that the Mora Confinement Condition is not a fundamental property of the Prosodic Hierarchy. As we will see, the ability of Passamaquoddy to employ this structure comes about through ranking of particular constraints with respect to each other, which, if ranked differently, would have the same effect as the “Mora Confinement” condition. What is being suggested here is not necessarily that the empirical basis for the “Mora Confinement” condition was misinterpreted, but rather that the constraint is not fundamental to the Prosodic Hierarchy and is able to be ranked low enough to lose effect in some cases.

The last background principle in connection with the Prosodic Hierarchy is the principle of Stray Erasure (Steriade (1982), Itô (1986)), stated below.

- (4) Stray Erasure: Segments not parsed into prosodic structure will be deleted at the phonetic level.

The principle of Stray Erasure will ensure removal of any unparsed segments prior to phonetic production of a phonological structure. This is the device which Optimality Theoretic analyses generally use to account for syncope; if in the optimal representation a segment is unparsed, that segment will not be pronounced in the output.

1. Basic stress patterns

When nothing complicates matters, stress in Passamaquoddy falls on alternate syllables from the right edge of the word as well as on the initial syllable, as shown in (5), below.⁶ We will not be concerned here with differentiating the main and secondary stresses.⁷

(5)	óσ	wás-is	child-DIM	‘child’ (75)
	óóσ	l-éwésto	thus-speak-(3)	‘he speaks’ (75)
	óóóσ	wík-ewésto	like-speak-(3)	‘he likes to talk’ (75)
	óóóóσ	séhtáy-ewésto	backwards-speak-(3)	‘he speaks while walking backwards’ (75)

On the assumption that stress indicates the head of a prosodic foot, we can interpret the facts in (5) as demonstrating that Passamaquoddy has left-headed, binary feet, arranged from right to left. The presence of stress clash in odd-parity words implies that the first syllable in such words constitutes its own, degenerate foot.

It is a straightforward matter to arrive at a constraint ranking that will produce this pattern, as stress patterns are among the most commonly analyzed phenomena in Optimality Theory. The pattern reflects a preference to parse syllables into feet, even at the expense of binary feet, as well as a preference to realize stress on the left element of a foot. Finally, when an option exists, feet will prefer to be closer to the left edge of the prosodic word, which will have the result of placing a degenerate foot, if present, first. Below are the constraints which govern the pattern in (5).

(6)	PARSE-SYLL	Syllables must be parsed into feet (<i>to be revised</i>).
	FTMAX	Feet can be no larger than two syllables.
	FTMIN	Feet can be no smaller than two syllables.
	FTFORM(L)	Feet are left-headed.
	ALIGN-FT-L	Feet are minimally disaligned (syllables) from the left edge of the Prosodic Word; ALIGN (Foot, L; PrWd, L).

⁶Throughout this analysis, word forms will be shown as if the underlying third person suffix /-w/ were not present, although the issue will be taken up in section 4.8. The numbers provided in parentheses after examples refer to the location of the datum in LeSourd (1993).

⁷The location of main stress is easily predictable, which is why it is of little interest at this stage of the discussion. Main stress falls on the last stressed syllable when a word is utterance-final, but shifts to the penultimate stressed syllable in cases where the word is not utterance-final. Admittedly, what is meant by an “utterance” is not explicitly stated by LeSourd, but it appears to be generally equivalent to a sentence. This could be the result of an interaction between constraints on realizing a main stress final to an utterance, nonfinal in a word, and rightmost. Alternatively, as was suggested to me by Michael Kenstowicz (p.c.), this might be a case where a sentence-final, phrase-level stress phonetically overshadows an invariant main stress on the penultimate foot. Either way, the interpretation of this case will not bear on any other issues in the present analysis.

All of the constraints in (6) have crosslinguistic support from other analyses in the Optimality Theory literature. PARSE-SYLL and FTFORM(L) were introduced in Prince & Smolensky (1993). ALIGN-FT-L is a member of a family of alignment constraints introduced in McCarthy & Prince (1993a). FTMAX and FTMIN, a replacement for Prince & Smolensky's single FTBIN constraint, were introduced in Everett (1994).⁸

By virtue of the fact that a degenerate foot is preferred for words of odd parity, we know that both PARSE-SYLL and FTMAX must outrank FTMIN, as indicated in the ranking below.

(7) PARSE-SYLL, FTMAX » FTMIN

To demonstrate how this ranking achieves the stress pattern in (5), consider the tableau below in (8). Because the word has five syllables, it is clear that it will not be possible to satisfy both the requirements that all syllables be parsed into feet and that all feet be binary. The dotted line between the PARSE-SYLL and FTMAX columns in the tableau of (8) indicates that PARSE-SYLL and FTMAX have not been ranked with respect to one other.^{9,10}

(8)

	/sehtay-ewesto/	PARSE-SYLL	FTMAX	FTMIN	ALIGN-FT-L	FTFORM(L)
a.	σ(́σ)(́σ)	*!	√	√	σσσσ	√
b.	(́σσ)(́σ)	√	*!	√	σσσ	√
c.	(́σσσσ)	√	*!	√	√	√
d.	(́σ)σσσ	***!	√	√	√	√
e.	(σ́)σσσ	***!	√	√	√	*
f.	(́σ)(́σ)(́)	√	√	*	σσσσσ!	**
g.	(́σ)(́)(́σ)	√	√	*	σσσσ!	√
h.	(́)(́σ)(́σ)	√	√	*	σσσσ	***!
i.	☞ (́)(́σ)(́σ)	√	√	*	σσσσ	√

⁸The advantage of FTMAX and FTMIN to FTBIN is that relative reranking can distinguish a ternary foot from a degenerate foot, which FTBIN was unable to do. I suggest that in Passamaquoddy, FTMAX is ranked above FTMIN, which will favor degenerate feet over ternary feet, but another language might have FTMIN ranked above FTMAX and would therefore favor ternary feet. Such a pattern is arguably found in Garawa, which has a stress pattern just like that shown in (5) for Passamaquoddy but without stress clashes; thus, in odd-parity words the second syllable is not stressed (but *cf.* McCarthy & Prince (1993), who present an analysis of Garawa which involves strictly binary feet and a loose syllable, rather than allowing a ternary foot). For the purposes of the present analysis, FTMAX could be replaced with the LAPSE constraint introduced in Green (1995) as well. See also Kager (1994) for discussion of related issues.

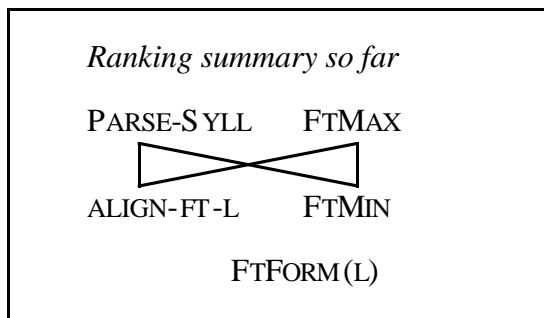
⁹Note that it is not being claimed that PARSE-SYLL and FTMAX are actually tied, or unranked, in the sense of Pesetsky (1994). The general assumption within Optimality Theory phonology analyses has been that constraints are totally ordered, although the ordering itself may not be determinable from the data. For further discussion, see Prince & Smolensky (1993).

¹⁰In order to make the metric used in the evaluation of ALIGN-FT-L clearer, violations are indicated in (8) by a sigma.

The candidate in which all feet are strictly binary, (8a), must leave one syllable unparsed, and is thus rejected immediately by the high-ranking PARSE-SYLL constraint. Similarly, candidates (8d) and (8e), each with only a single binary foot, satisfy almost all of the other constraints, but because PARSE-SYLL is ranked highest, these two candidates are removed from consideration. The remaining candidates listed in (8) all have one nonbinary foot. Candidates (8b) and (8c) are ruled out by FTMAX because they each have a foot containing more than two syllables, but candidates (8f-i) satisfy FTMAX. FTMIN, although it finds each of candidates (8f-i) in violation, makes no choice among them. Candidates (8e-f) are eliminated because their feet are further disaligned than two other candidates, (8h-i), with respect to the left edge of the word. The final decision between (8h) and (8i) is made by FTFORM(L), which removes candidate (8h) because it has feet which are not left-headed.

Notice that by looking at candidates (8c-d) above, we observe that ALIGN-FT-L can be improved both by violations of FTMAX (if a word were one large foot it could be aligned perfectly, as in (8c)), and by violations of PARSE-SYLL (leaving syllables unparsed can bring feet closer to the left edge, as in (8d)); since on the surface syllables are always parsed and FTMAX is not violated, PARSE-SYLL and FTMAX must outrank ALIGN-FT-L. FTFORM(L), however, will never conflict with any other constraints for the rest of this analysis, and its ranking with respect to the other constraints is therefore underdetermined. The ranking just described is formalized in (9), and all of the rankings discussed so far are summarized in the box at the end of this section.

(9) PARSE-SYLL, FTMAX » ALIGN-FT-L



2. Stress in words containing /ə/

2.1. The stress facts and a generalization

The unmarked stress pattern shown in (5) does not correctly describe stress in words that contain the vowel /ə/.¹¹ Schwa is special in that it does not always “count” when stress is being assigned. When /ə/ is present but not involved in stress assignment, we will call it “unstressable.” In the data given below, the unstressable segments are underlined>. Example (10) shows an instance in which /ə/ is not counted in stress assignment; the word is stressed as if it were a two-syllable word and the /ə/ were not present.

- (10) sók-əlan ‘it pours (rain)’ (81) *sók-élan
 pour-rain-(3)

However, /ə/ is not always invisible to metrical structure. The examples in (11) show normal (unmarked) stress patterns despite the presence of /ə/. This variable status of /ə/ is demonstrated dramatically in (12), where an apparently six-syllable word has only two stresses, falling three vowels apart. Notice that in the examples below /ə/ is not only capable of affecting stress assignment but also of bearing stress.

- (11) a. písk-élan ‘it rains so hard that it is dark or hard to see’ (81)
 dark-rain-(3)
- b. ác-ehl-éso ‘he changes himself’ (82)
 change-TA-REFLEX-(3)
- (12) ht-étəl-ət-əm-én-əl ‘he is eating them (inan.)’ (92)
 3-ongoing-eat-TI-3IN-33IN

The pretheoretic generalization which LeSourd gives to describe the distribution of stressable /ə/ is that shown in (13) below.¹²

¹¹It should be noted that it isn’t only /ə/ that can act in the way described in this section, but the overwhelming majority of “unstressable vowels” are /ə/. In specific circumstances, /a/, /o/, and /e/ can also be “unstressable” and even sycopate, but these situations will not be addressed here. (For discussion of the data, see LeSourd, chapter 6).

¹²The contexts in (13) don’t predict the surface stressability pattern in (12), but LeSourd attributes the behavior of the initial *ht* cluster in (12) to the fact that it is underlyingly /wt-/.

- (13) /ə/ is stressable if:
- underlyingly designated as a full vowel
 - or*
 - a) is the last vowel of a word, *or*
 - b) follows a cluster of nonsyllabics other than /hC/ (with some exceptions involving geminates), *or*
 - c) follows /hl/, *or*
 - d) stands between /s/ and /hs/, *or*
 - e) is the first /ə/ in word-initial /(C) ə [+sonorant] ə/ where second /ə/ is unstressable, *or*
 - f) is in even position, counting from left to right, in a series of /C₀ ə/ sequences in which no /ə/ is stressable by other means.

The idea which motivates most of the present analysis is that the statements above can be reduced to the generalization in (14) below, in the context of an analysis of proper syllabification.

- (14) /ə/ will participate metrically only if it is necessary for proper syllabification.

To see what is intended by (14), consider the pair below. In (15a), the /ə/ is unnecessary for proper syllabification because both *sók* and *lan* are possible syllables in Passamaquoddy. By contrast, the /ə/ in (15b) cannot be omitted because neither *písk* nor *kłan* are proper syllables in Passamaquoddy. By virtue of the necessity of /ə/ in (15b), (14) correctly predicts that it will participate metrically.

- (15) a. sók-əlan b. písk-əlan
 pour-rain-(3) dark-rain-(3)
 ‘it pours (rain)’ (81) ‘it rains so hard that it is dark or hard to see’ (81)

Assuming the generalization in (14) is correct, the problem of stress assignment is now shifted mainly to the problem of determining the principles of syllabification in Passamaquoddy, and it is with these issues that the majority of this paper will be concerned.

Before continuing with this analysis, however, we will first take a moment to consider some of the more obvious alternatives for the stressable/unstressable distinction, after which the basic proposal of this analysis will be suggested.¹³

2.2. Why epenthetic origin does not determine stressability

One possibility for a means of distinguishing the /ə/ in (15a) from that in (15b) is that one is epenthetic and one is underlying, the idea being that the stressability of a /ə/ would then be directly correlated with its underlying presence or absence. While an attractively simple idea, it

¹³Note that some elements of the arguments in the following two sections were previously made by LeSourd (1993).

is not sufficient to describe the distribution of unstressable /ə/. To see this, consider the words below, all of which involve the same morpheme, glossed ‘sit.’

- (16) a. wəl-əpo ‘he sits nicely, comfortably; he is well off’ (87)
good-sit-(3)
- b. pét-ék-əpo ‘it (an., e.g. cloth) comes to be located here’ (81)
arrive-sheetlike-sit-(3)
- c. nís-ek-əpí-si-t ‘ghost’ (90)
two-sheetlike-sit-AI-3AN

In each case above, the /ə/ is unstressable. Moreover, since in (16) we see /ə/ appearing between consonants which also occur together in clusters, as demonstrated by the examples in (17), the /ə/ in the morpheme glossed ‘sit’ is almost certainly underlying. If the /ə/ which occurs in (16) had been epenthetic, we would be left without an explanation for why whatever general process was responsible for its insertion does not also apply to the examples in (17).

- (17) a. k-ták-əm-ól-pən 2-hit-TA-2OBJ-11 ‘we hit you’ (389)
- b. tólpráyo ‘he is scared’ (59)¹⁴
- c. kprócále hoarse-(3) ‘he is hoarse’ (168)
- d. ktəmakpəket ‘it is a weak liquid’ (Sherwood, p.75)¹⁵

Recall that the hypothesis under scrutiny holds that there is a direct correlation between epenthetic origin of /ə/ and its stressability. Therefore, given that we have reason to believe that /ə/ in examples (16) is underlying, and given that it is not participating in stress assignment, the direction of the correlation must be that underlying /ə/ is unstressable while epenthetic /ə/ is stressable. Extending this correlation back to the examples in (15), we can conclude that the /ə/ in (15b), being stressable, is therefore epenthetic, while the /ə/ in (15a), being unstressable, is underlying. This is consistent with underlying forms of /sokə-lan/ for (15a) and /pisk-lan/ for (15b).

Unfortunately, this potentially simple correlation fails in light of examples like that given below.

- (18) tékk-əpi-t ‘as far away as he sits’ (82)
as.far-sit-3AN

¹⁴Morpheme breaks not provided for this example, but it is probably /ətəl-ayi-w/ (ongoing-scared[?]-3).

¹⁵The stress pattern was not provided in Sherwood (1986).

Because (18) involves the same morpheme as the examples in (16), we must suppose that the /ə/ is underlying. This predicts that the /ə/ should be unstressable, but we can see that it is not only stressable but actually bears stress in (18). In light of this failure of correlation, we cannot maintain that stressability is solely determined by the epenthetic origin of /ə/, because underlying /ə/ appears to be capable of being either stressable (18) or unstressable (16).

This brings us back to where we began, as the question of which conditions cause such /ə/ segments to be stressable is the main focus of both LeSourd (1993) and the present paper.

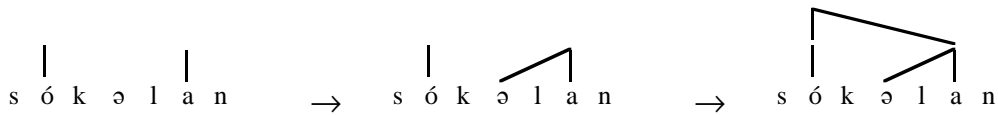
2.3 Why stressability is not strictly positional

Stowell (1979) proposed a system for Passamaquoddy stress which featured a number of underlying schwas which were systematically syncopated before obstruents in the weak position of binary feet.¹⁶ A central focus of Stowell's system is to derive the effect of clusters on following schwas (13b) from the fact that, underlyingly, the consonants of the surface cluster had a schwa between them.

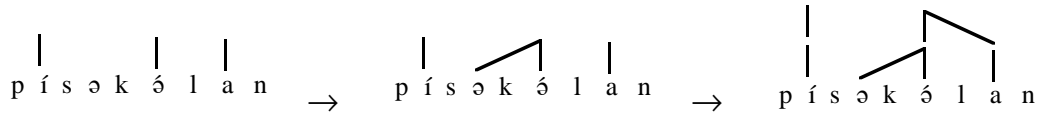
Stowell's system itself involves two layers of binary groupings, as illustrated in (19) for the two words given earlier in (15). The first step makes all full (*i.e.*, non-/ə/) vowels the head of a constituent. Thus, in both examples in (19) the first and final vowels are each assigned head status, indicated by the vertical lines. The next step is a left-to-right formation of binary constituents, where the head is the rightmost of the group. In (19a), the /ə/ can be incorporated into a constituent whose head was already established, and in (19b), the two underlying /ə/ segments will form a single constituent, the rightmost becoming the head. After these groupings have been made, a second level of binary constituent formation, this time with the heads oriented leftward, is formed from the heads of the first-level groups. This second grouping proceeds from right-to-left, as can be seen in (19b), indicated by the fact the leftmost element forms a unary constituent. The last step of the process is a syncope rule which will eliminate /ə/ when it is the weak element of a first-level binary constituent where it precedes an obstruent. Thus, in (19b), the first of the two underlying /ə/ segments will syncopate, giving the correct surface form *pískəlan*. Because the syncope rule is triggered only by obstruents, the /ə/ in (19a) will not delete because it precedes a sonorant, despite constituting the weak half of a first-level binary foot, yielding the correct surface form *sókəlan*.

¹⁶Stowell credits the basic metrical analysis to LeSourd, although in more recent work, LeSourd no longer accepts the theory presented in Stowell (1979).

(19a)



(19b)



This system has some predictive success, although it quite often has to postulate underlying schwas which never surface under any circumstances. As an example of this, note that the /ə/ in the hypothesized morpheme /pisək/ of (19b) will never fail to undergo syncope.

It is an important fact that there are no clusters in Passamaquoddy which fail to have the effect of making following /ə/ stressable.¹⁷ If we pursue this two-layered metrical approach, under the assumption that this generalization is not a purely coincidental matter of the lexicon, we must therefore assume that not only is /pisək/ the correct underlying form of the morpheme in (19b), but that an underlying form like /pisk/ would be impossible. One approach to this restriction might be to suppose that Passamaquoddy lexical items are strictly CV sequences underlyingly.

No matter how we encode the restriction, however, the existence of surfacing three-element clusters causes a fatal complication. As an example of such a cluster, consider the morpheme glossed as “round” in (20) below, which invariably surfaces as *apsk-* and invariably has the effect of causing a following /ə/ to be stressable.

- | | | | | |
|------|----|---|----|---|
| (20) | a. | étót-apsk-šla-k
extreme-round-rain-3IN
'it is raining very big drops' (245) | b. | kín-apsk-šso
large-round-AI-(3)
'he is fat' (245) |
|------|----|---|----|---|

Notice that if the underlying form were /apəsək-/, we have no explanation of why a following /ə/ would always be stressable, nor would we have an explanation for why /ə/ never surfaces morpheme-internally. Recall that the reason /ə/ becomes stressable after two-member clusters involved a medial schwa which assigns the following schwa the appropriate parity for stressability then deletes to yield the cluster. However, this predicts precisely the wrong result

¹⁷Except the predictable *h*-obstruent clusters (13b), which will be discussed in great detail in section 4. Of clusters not in the shape *h*-obstruent, the generalization holds: there are none which do not confer stressability on a following /ə/.

for the situations which surface with three-member clusters; because /apəsək-/ begins with a full vowel, a following /ə/ should instead be assigned to a weak position of a foot. The only viable solution to this problem is to assume that only a single /ə/ is present in the underlying form of this morpheme, meaning that the underlying form is either /apəsk-/ or /apsək-/.

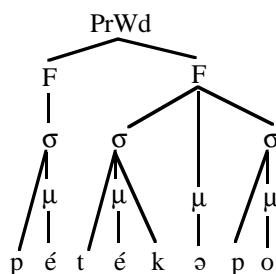
We are left with two contradictory requirements for the Passamaquoddy lexicon: we must disallow an underlying form like /pisk/, yet we must allow underlying forms like /apəsk-/ or /apsək-/. It is unclear how to accomplish such a restriction in a way sufficiently elegant to make the attribution of post-cluster stressability to strategic syncope a net simplification to the analysis. Combined with the fact that both syncope and stressability conferral occurs in a number of other environments, it seems unlikely that this approach would yield any simplification at all.

The conclusion to be drawn from this discussion is that the best theory of the cluster effects on stressability of following segments is not going to be simply one of underlying positional parity, but one which involves some further rules to indicate which /ə/ segments are stressable. Again, we have returned to the question with which we began: what causes /ə/ to be stressable?

2.4. The proposal: unstressable /ə/ as a footed mora

The suggestion made here is that unstressable /ə/ is a segment parsed into a mora which is in turn parsed directly into a foot, bypassing the syllable level. Unlike the alternatives discussed above, this system takes stressability to be directly and solely governed by principles of syllabification. The example below illustrates the proposed structure for a simple case.

(21)



That such structures are most optimal reflects a preference in Passamaquoddy to avoid realizing /ə/ in a syllable, but this preference is often at odds with the more important syllabification requirements, which can force a /ə/ to be syllabified, thus stressable. The

constraint which is responsible for the preference for unsyllabified /ə/ is *PEAK(ə), one of the family of *PEAK constraints discussed in Prince & Smolensky (1993, ch. 8).¹⁸

(22) *PEAK(ə) /ə/ must not be parsed as a syllable peak.

Assuming the formulation of the Prosodic Hierarchy outlined in §0.2 (in particular, with respect to the modification which allows a mora to be parsed by a foot), a language will have two ways for a /ə/ segment avoid a violation of *PEAK(ə):¹⁹

- (23) A language may avoid violations of *PEAK(ə) by
- a. Not parsing /ə/ (resulting in Stray Erasure).
 - b. Parsing /ə/ into a footed mora (not parsed into a syllable).

In Passamaquoddy, both options are realized in various environments. The structure in (20) shows an example of option (23b), while /ə/ syncope would be a result of taking option (23a).

Passamaquoddy holds *PEAK(ə) in high regard, but the complex distribution of stressable and unstressable /ə/ indicates that principles of proper syllabification are held in even higher regard. The basic thesis of this analysis of Passamaquoddy revolves around the idea that *PEAK(ə) will be satisfied insofar as it can be without violating higher ranked principles of proper syllabification.

Another general theoretical point relevant to this analysis with respect to stress assignment is the following:

(24) Foot-level constraints (FTMAX, FTMIN, FTFORM) are only sensitive to syllables.

Given (24), the foot in (21) satisfies both FTMAX and FTMIN; it is a binary foot in the relevant sense. In other words, moras are invisible to foot-level constraints (perhaps as a language-specific parameterization), so a mora, even if foot-initial, will not receive stress via FTFORM(L), nor will a bisyllabic foot with an additional mora violate FTMAX.

¹⁸This analysis might also be extended to the analysis of Indonesian presented in Cohn & McCarthy (1994), where *PEAK(ə) is the implementation of their NONFOOT(ə) constraint, which they declined to spell out in full detail.

¹⁹There are actually three options. The third option not mentioned in (23) is that a segment be directly parsed into a foot, skipping both the mora and the syllable levels (this possibility was brought to my attention by David Pesetsky (p.c.)). However, note that in the final ranking (*i.e.* the one listed at the end of section 4), STRICT-PARSE outranks PARSE-V, which has the effect of preferring syncope to a foot-parsed segment. Thus, this third option will always be available in the same environments as (23a), yet will always be dispreferred to option (23a). Whether or not this third option should be ruled out on independent grounds (*e.g.* whatever underlies the “1 or 2 levels” aspect of the Prosodic Hierarchy, discussed in section 0.2) is left open for future research, since the choice need not be made for the proposed analysis to proceed.

The remainder of this paper will be mainly dedicated to issues of syllabification and representation in Passamaquoddy. Although explanation of the stress pattern was our initial motivation, the analysis is actually more concerned with assimilation and syncope effects, with the stress pattern explained as a by-product.

3. Representation in Passamaquoddy

The system suggested above for the determination of stress patterns relies heavily, by design, on precisely what constitutes a proper syllable in Passamaquoddy. We will begin the task of determining the principles which underlie Passamaquoddy syllabification by examining LeSourd's contexts in which /ə/ becomes stressable, since under this theory the appearance of stressable schwa provides us with boundary conditions on proper syllabification. LeSourd's pretheoretic contexts are repeated below for convenience:

- (13) /ə/ is stressable if:
- underlyingly designated as a full vowel
 - or*
 - a) is the last vowel of a word, *or*
 - b) follows a cluster of nonsyllabics other than /hC/ (with some exceptions involving geminates), *or*
 - c) follows /hl/, *or*
 - d) stands between /s/ and /hs/, *or*
 - e) is the first /ə/ in word-initial /(C) ə [+sonorant] ə/ where second /ə/ is unstressable, *or*
 - f) is in even position, counting from left to right, in a series of /C₀ ə/ sequences in which no /ə/ is stressable by other means.

LeSourd also provides a list of pretheoretic contexts in which an unstressable /ə/ undergoes syncope, which is given below:

- (25) Unstressable /ə/ syncopates:
- a) before obstruents
 - b) before /h/
 - c) between /h/ and /m/
 - d) between identical non-syllabics
 - e) at the beginning of a word

3.1. Basic syllable shape

Beginning with the observation (13b) that /ə/ following a cluster cannot be purely moraic (unstressable), we can deduce the fact that Passamaquoddy syllables generally have simple onsets and codas: the maximal syllable is *CVC*, to a first approximation. This correlates with the fact that the overwhelming majority of Passamaquoddy clusters are limited to two consonants, presumed to occur at the boundary between two *CVC* syllables.

Passamaquoddy does have tri-consonantal clusters, but these are highly restricted. All such clusters involve /s/, and are of the shape *CsC*.²⁰ Since such clusters come about between adjacent syllables (putting aside word-peripheral clusters temporarily), these facts indicate that /s/ is allowed to form a complex margin if external. Therefore, our syllabification process must allow *sC* as an onset or *Cs* as a coda. Some examples of words containing such clusters are listed below.

- (26) a. *sísəlápskwəhtíkən* ‘frying pan’ (61)
 b. *kákskòs* ‘cedar’ (61)
 c. *nímskéhe* ‘he drops by to visit’ (61)
 d. *málskwəsítəl* ‘beans’ (61)

Interestingly, the datum below indicates that even after *Cs* clusters, a /ə/ is rendered stressable, which would be unexpected if /s/ can be freely syllabified with a preceding coda.

- (27) *áps-əkíl* ‘he is small’ (164)
 small-size-(3)

We conclude that Passamaquoddy only allows /s/ to be part of a complex margin as a last resort, in situations where both the preceding coda and the following onset are filled. Under less dire circumstances, where not being threatened with unsyllabifiability, an /s/ acts like any other consonant, taking onset position if the last element in a two-member cluster, even if doing so results in a violation of *PEAK(ə).

The constraint used in Prince & Smolensky (1993) to encourage syllables to be maximally of the shape *CVC* is *COMPLEX, which is defined below in slightly modified form:²¹

- (28) *COMPLEX A syllable may not have a margin consisting of more than one segment.

²⁰Rarely, clusters involving /h/ can be larger. I found two examples of *CCh* clusters in LeSourd (1993), where the number of known cases is described as “a handful.” LeSourd (p.c.) also mentioned that one of his (reliable) informants was able to get clusters like *kph* (*pocc əkphətəwək* ‘they (pl.) are soaking wet’) and *mskwh* (*somskwhətəwək* ‘they (pl.) spit,’ stress pattern not given). He also notes (p.c.) that for speakers who drop the first vowel in a *VhV* sequence, a cluster like *hth* (*sáhtihil* ‘blueberries,’ a variant of *sáhtihil*) becomes possible. This appears to be a special property of /h/, since all clusters larger than two consonants contain /h/ or /s/, but there will not be a specific explanation of this behavior presented in this analysis.

²¹Prince & Smolensky (1993) recognize that *COMPLEX is actually a cover term for other interacting factors, but it is sufficiently basic for the present analysis. The formulation in Prince & Smolensky (1993) is: “No more than one C or V may associate to any syllable position node” (p. 87, ch. 6). The version adopted here is slightly modified, but this is basically for presentational reasons. The only constraint with which *COMPLEX would interact (concerning the syllable nucleus) is the MIN(μ) constraint introduced below in section 4.1, and since MIN(μ) will end up outranking *COMPLEX in Passamaquoddy, the reformulation in (28) has no actual effect, but makes its function in the present analysis clearer. It may also be worth noting, however, that the interpretation given in (28) is the one adopted without comment in Zec (1994).

In a situation where a segment is left unparsed even after maximal simple syllables are created, there is a conflict. A language has three basic options it can take: it could (i) leave the segment unparsed and allow it to be erased via Stray Erasure, (ii) parse the segment into a syllable despite a violation of *COMPLEX, or (iii) add an epenthetic vowel to form the nucleus of a syllable which could then host the segment as its onset. The constraints governing this choice are *COMPLEX and the faithfulness constraints PARSE and FILL, also introduced in Prince & Smolensky (1993).

- (29) PARSE A segment must be parsed into the PrWd (*to be replaced*).²²
 FILL A segment may not be added to the representation.

Before proceeding, we take note of one puzzling fact. Why is /s/ the only segment which is permitted this grace? So long as we believe it is not a coincidence that *CsC* is the only allowed shape for tri-consonantal clusters, the analysis should reflect this restriction in some way. Crosslinguistically, /s/ has a tendency to be treated in a special way in syllabification processes. In English, for example, /s/ is able to violate otherwise inviolate restrictions on the sonority contour of onsets and place of articulation in clusters (*e.g., stripe, smell, slow*, but **ktripe, *tmell, claw, *tlow*; for discussion see Kenstowicz (1994a, §6.3)). In Finnish too, as stated in Prince (1984), “the middle *C* of *CCC* clusters must be *s*.” Although no explanation for the special nature of /s/ will be presented here, this effect may be rooted in an extrasystematic pressure for perceptual salience. While a stop consonant between consonants would be likely to lack a burst, leaving the place of articulation imperceptible, a fricative like /s/ is able to cue perception of place without a burst.²³ Whether constraints which enforce perceptual salience are actually part of the prosodic system or whether extrasystematic factors of perceptual salience simply influence the ranking of structural constraints within the prosodic system remains an open question.

For the present, the simplest solution is to suppose that there is a PARSE constraint which applies only to /s/, held to be of greater importance than the PARSE constraint for other consonants. While this may not ultimately be the best formulation of this constraint, phrasing it in this way seems the simplest and most direct way to encode the effect.

²²Note that this constraint is satisfied if a segment is parsed into any prosodic element under the PrWd level. What the PARSE constraint militates against are completely unassociated segments. See Hung (1994) for further discussion of this formulation of PARSE.

²³This possibility was suggested to me by Michael Kenstowicz (p.c.). Morris Halle (p.c.) points out that we might expect other fricatives to have this same property, making it perhaps surprising that there are no clusters of the shape *CfC* or *CšC*. However, this may also simply be attributable to the fact that neither /f/ nor /š/ are in the Passamaquoddy consonant inventory. If the suggestion in the text above is correct, we would expect /f/ and /š/ to act like /s/, if Passamaquoddy had these phonemes at its disposal. This leaves unexplained, however, why /c/ does not behave like /s/, which may be damaging to a “perceptual salience” account (also noted by Morris Halle, (p.c.)).

The constraints defined below also anticipate the fact that vowels and consonants have differing parsing requirements, as evidenced by the common phenomenon of vowel syncope as opposed to the vanishingly rare occurrences of consonant loss.

- (30) PARSE-S An /s/ segment must be parsed into the PrWd.
 PARSE-C A consonantal segment must be parsed into the PrWd.
 PARSE-V A vocalic segment must be parsed into the PrWd.

Among the constraints we have accumulated, we have several arguments for their ranking with respect to one another. We have seen that /s/ can be parsed at the expense of a violation of *COMPLEX, yet it appears that this is not the case for other consonants. This indicates the ranking below in (31).

- (31) PARSE-S » *COMPLEX » PARSE-C

We also know that /s/ will induce violations of *COMPLEX rather than induce a violation of FILL, indicating that FILL is a more highly ranked constraint than *COMPLEX. Epenthesis in Passamaquoddy is reasonably uncommon, and when it does occur, it appears to be more tied to morphological factors than to syllabifiability. Because we would expect to see more examples of epenthesis for syllabification if parsing all underlying consonants were more important than the avoidance of epenthesis, we may also suppose the ranking given in (32). It is worth mentioning that we don't have any examples of a consonant which syncopates to avoid vowel epenthesis, but turning the argument around, it is also presumably that case that the ranking in (32) would discourage a language learner from acquiring underlying forms which have too many consonants to syllabify.

- (32) FILL » *COMPLEX » PARSE-C

That vowel syncope is fairly common while consonant syncope is practically unattested, provides evidence for the ranking in (33).


- (33) PARSE-C » PARSE-V

Finally, we have also seen that the preference to avoid realizing /ə/ as the nucleus of a syllable is a secondary concern to these constraints on syllabification; avoidance of complex margins is more important (causing /ə/ to be stressable after clusters), as is the parsing of consonants (as evidence, note that the /k/ does not syncopate in *pískəlan*).


- (34) *COMPLEX, PARSE-C » *PEAK(ə)

The tableaux below show how these constraints interact to syllabify *CsC* clusters, as well as showing how the constraints would deal with a (hypothetical) underlying tri-consonantal cluster.²⁴ The /ə/ in outline indicates a moraic /ə/ parsed directly into a foot.

(35)

/apsəkil/	PARSE-S	FILL	*COMPLEX	PARSE-C	*PEAK(ə)
a. (aps.ə.kil)	√	√	*!	√	√
b. (ap<s>.ə.kil)	*!	√	√	*	√
c. (a)(pVs.ə.kil)	√	*!	√	√	√
d.  (ap)(sə.kil)	√	√	√	√	*

(36)

*/apkta/	PARSE-S	FILL	*COMPLEX	PARSE-C	*PEAK(ə)
a. (ap.kV.ta)	√	*!	√	√	√
b. (apk.ta)	√	√	*!	√	√
c.  (ap<k>.ta)	√	√	√	*	√

In (35a), we see that the candidate which satisfies *PEAK(ə) by parsing /ə/ into a foot-parsed mora violates *COMPLEX by having *ps* in a coda position. This is fatal for this candidate because there is another candidate which does not violate *COMPLEX, namely (35d). In (35b) and (35c) we see the results of dropping /s/ and epenthesis of a vowel (denoted by “V”), respectively. Each violates a high ranking constraint (PARSE-S or FILL) that is not violated in the winning candidate, (35d). The winning candidate violates only *PEAK(ə), a constraint which is ranked low enough so as not to be relevant for this word.

In (36), we see the content of the prediction that three underlying consonants falling together will cause one to syncopate. In (36a), an epenthetic vowel is inserted, and in (36b) a complex cluster is formed, but neither of these candidates fares better than (36c) where one of the consonants is dropped.²⁵

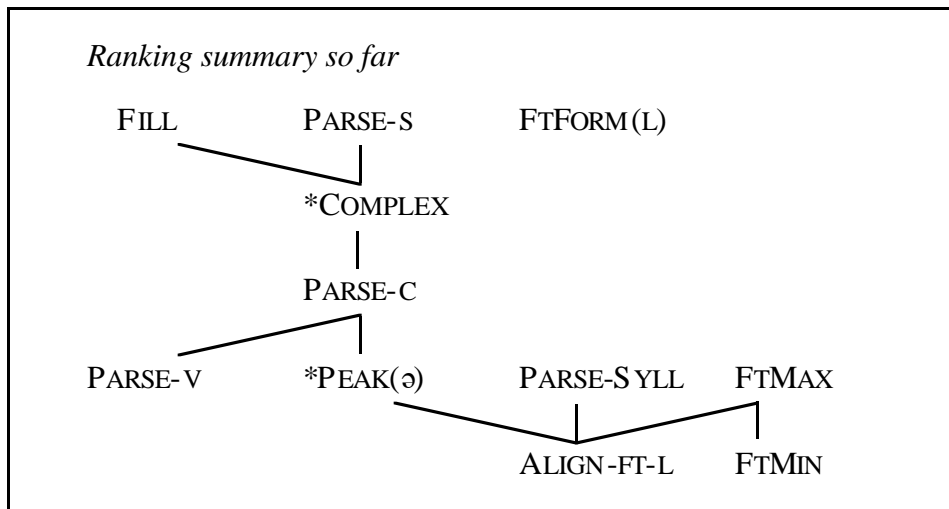
One last ranking argument in this section comes from the observation that all violations of *PEAK(ə) imply a worsening of ALIGN-FT-L, since this increases the number of syllables in the word. Because /ə/ is the only vowel which is allowed to be a foot-parsed mora, it must be

²⁴Despite a fair amount of effort, I have yet to come up with a convincing example of an underlyingly tri-consonantal cluster which surfaces with one of its consonants dropped. It seems that in most cases, the allomorphic alternations available in Passamaquoddy foil any such possibility, even though the alternation itself is not conditioned on syllabifiability (*i.e.* a vowel-initial alternate will be chosen after a consonant, even if a consonant-initial allomorph would be perfectly syllabifiable).

²⁵Note that at this point, there is no prediction as to *which* of the three consonants will drop. This is an issue for future research (see also the previous footnote).

that case that *PEAK(ə) is the controlling constraint between these two, and thus must outrank ALIGN-FT-L.

(37) *PEAK(ə) » ALIGN-FT-L



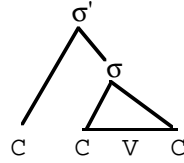
3.2. Word-peripheral clusters and extrametricality

Word-peripheral clusters require the additional mechanism of extrametricality, which we will adopt from Hung (1994). For Passamaquoddy, it is generally correct to say that any and only clusters which can occur word-internally can occur word-peripherally, including CsC clusters as shown below.

- (38)
- | | | |
|----|---------------------|--|
| a. | <u>pskw</u> ácis | ‘war club’ (61) |
| b. | <u>ksp</u> íson | ‘belt’ (61) |
| c. | <u>ksk</u> wópéhsan | ‘it rains and snows at the same time’ (61) |
| d. | pəná <u>pskw</u> | ‘rock’ (61) |
| e. | nís <u>nsk</u> | ‘twelve’ (61) |
| f. | ksé <u>wsk</u> | ‘hemlock’ (61) |

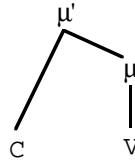
While we explained the observed patterns of the word-internal clusters in terms of constraints on abutting onsets and codas, there is no adjacent syllable in word-peripheral contexts. The traditional response to this problem is to suggest that an extrametrical (or “extraprosodic”) consonant is allowed at the edges of the word, and this is what I suggest is happening in Passamaquoddy, implemented in terms of the adjunction structure proposed in Hung (1994) and shown below.

(39) Adjunction structure (only available word-peripherally)²⁶



The adjunction possibilities in Passamaquoddy are slightly more general than in the cases considered in Hung (1994) due to the fact that, in Passamaquoddy, an unsyllabified mora can occasionally be found in word peripheral position. What we find is that not only are adjunction structures like that shown in (39) possible, but also adjunction structures like that shown in (40) below.

(40)



Notice, though, that allowing the structure in (40) is not a complication to the analysis, but in fact the null hypothesis, given that foot-parsed moras exist. That is, rather than stipulating that adjunction is not available to moras but is only available to syllables, feet, and prosodic words (all of which are used in Hung (1994)), we can simply say that adjunction is available at any word peripheral location.

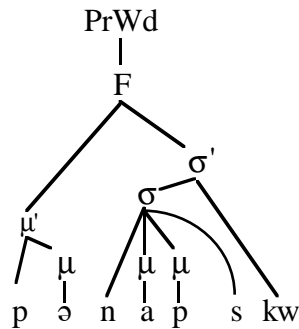
Furthermore, the examples shown in (41) provide evidence that such mora-adjunction structures exist. In these cases, the first /ə/ is unstressable despite being preceded by a consonant. That this behavior is not strictly a property of the morphological structure is shown by the identical behavior of (41d). Further support for the structure in (40) as a representation of the examples in (41) is given by (42), which shows that a second word-initial consonant forces the /ə/ to become stressable since a syllable is required to syllabify the second consonant.

²⁶This restriction to word-peripheral position is not argued for in Hung (1994) but merely stipulated. To say that an adjunction structure is only well-formed when it occurs word-peripherally implies that GEN does not produce any candidates which have word-internal adjunctions. For simplicity, I will assume this view is correct, and that a structure involving word-internal adjunction is somehow representationally incoherent. Note that the idea that extrametricality/adjunction is only allowed at edges has long been assumed and is well-supported empirically in other languages. This may be an area for future research, since even Hung (1994) admits that “it is not entirely clear why adjunction to a *syllable* should be restricted to the edge of a PrWd” (her emphasis, p. 32).

- (41) a. cən-éssón-ol stop-move-(3)-33IN ‘they (in.) stop’ (81)
 b. pəm-ásóke along-wade-(3) ‘he wades along’ (85)
 c. pəm-éhlókwe along-float-(3) ‘it floats along’ (82)
 d. pənápskw rock ‘rock’ (61)
- (42) sp-épo above-sit-(3) ‘he sits up high’ (81)

It is also noteworthy that because *CsC* clusters can occur both word-initially (*pškᵛáxis* ‘war club’) and word-finally (*pənápskw* ‘rock’), /s/ is able to be syllabified either as part of a complex onset or a complex coda if necessary. For illustration, the winning structure for *pənápskw* is shown below. Notice that there is an adjunction on each edge of the prosodic word in this case.

(43)



Following Hung (1994), I assume that the availability of word-peripheral adjunction structures is governed by the STRICT-PARSE constraint and its ranking relative to the other PARSE constraints.²⁷ The adjunction structures in (39) and (40) each violate STRICT-PARSE, since there is a closer prosodic unit into which the consonants could be parsed, but they satisfy PARSE-C because the consonants are parsed into the prosodic word.

- (44) STRICT-PARSE A parsed node must be parsed by the closest higher node.²⁸

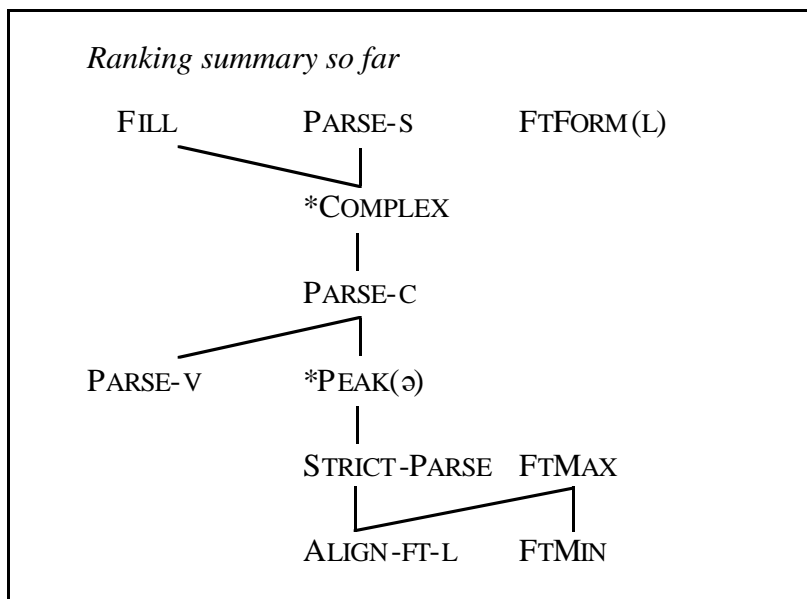
²⁷The version of STRICT-PARSE given in (44) is inspired by but rephrased from that proposed in Hung (1994). The modification introduced here does away with the explicit prohibition of a foot-parsed mora and the split of the Prosodic Hierarchy into two domains.

²⁸The “closest higher node” is a gradient notion with respect to the adjunction structures, where the higher segment of an adjunction structure is less close in these terms than the unadjoined node. This may raise minor questions having to do with where an onset segment is attached (the syllable or the nuclear mora) when both options are otherwise available, but these issues don’t play a role in the present analysis. For further discussion of these constraints, the reader is referred to Hung (1994).

For adjunction structures of this sort to be available at all requires that PARSE-C outrank STRICT-PARSE. Further, note that the central structure of this analysis, the mora parsed directly into a foot, is also a violation of STRICT-PARSE, which indicates that, for this structure to be allowed, STRICT-PARSE must be ranked below *PEAK(ə).

(45) PARSE-C » *PEAK(ə) » STRICT-PARSE

We can replace PARSE-SYLL in our rankings with the more general STRICT-PARSE without a loss of data coverage. This is true because, in our discussion of the PARSE-SYLL constraint in foot construction, the intended interpretation was that this constraint required strict parsing of syllables; a “loose syllable” parsed directly into the prosodic word would not have satisfied this constraint.



3.3. Heavy syllables

Although not playing as large a role in Passamaquoddy as in some other languages, there is some reason to believe that Passamaquoddy distinguishes open from closed syllables, which is generally taken as an indication that coda consonants are moraic.

One bit of theory-external evidence in support of this distinction between open and closed syllables in Passamaquoddy comes from its vowel lengthening phenomenon. On the surface, some vowels are realized as long in predictable contexts. In particular, the penultimate syllable is lengthened if both (a) the penultimate syllable is open, and (b) stress falls on either the final or penultimate syllable. The fact that such lengthening is sensitive to the presence of a coda

consonant implies that CV and CVC syllables are formally distinct, a distinction that is usually attributed to a moraic coda consonant.

Another sliver of external evidence comes from the surface length of these consonants. LeSourd notes that a consonant is realized as long when it is the first member of a non-initial cluster (except if that segment is /h/), or it is a word-final /s/ in a cluster. Structurally, the first member of a non-initial cluster is in the coda position of a syllable, so there is a sensible correlation between the surface length and the assignment of a coda consonant to a mora, which is traditionally a weight-bearing category. As for /h/, we will see in section 4.2 that in this position, /h/ is generally not in coda position. Finally, the segment /s/ is special in that it is able to attach to a closed syllable, which may be at the heart of this lengthening as well.²⁹

Although it is somewhat premature to discuss the theory-internal implications of moraic coda consonants, it will play a useful role in explaining why pre-obstruent, but not post-obstruent, syncope is common in Passamaquoddy. More specifically, it explains why a sonorant which follows unstressable /ə/, but not one which precedes, can save that /ə/ from syncope.

In languages where a syllable coda is assigned a mora, such as is the case in Passamaquoddy, something must motivate the addition of a mora to the representation, under the assumption that consonants come out of the lexicon without an associated mora (but see the next section with respect to sonorants in Passamaquoddy).

The constraint which appears to be responsible for moraic codas is the MIN(SYLL) constraint given below. Since any addition to the representation is a violation of faithfulness to the underlying form, we assume that there is a constraint which prohibits moras from being superfluously added to the representation, which I will call FILL- μ . Clearly MIN(SYLL) must outrank FILL- μ for any effect to surface. The MIN(SYLL) and FILL- μ constraints are defined below.

- (46) MIN(SYLL) A syllable must parse at least two moraic segments.
 FILL- μ No moras can be added to the representation.

- (47) MIN(SYLL) » FILL- μ

The reasons for choosing to interpret moraic codas in terms of MIN(SYLL) rather than in terms of a “Weight-by-position” constraint which says that coda consonants are moraic will not become clear until section 4.2, where we investigate the behavior of /h/. However, under most circumstances, MIN(SYLL) has the same effect as a “weight by position” constraint would. For

²⁹It is conceivable that the length in this context may indicate that a word final /s/, rather than adjoining to the syllable, actually becomes a second moraic coda, although the motivation for such a structure will not be discussed here (and is not predicted by the present analysis).

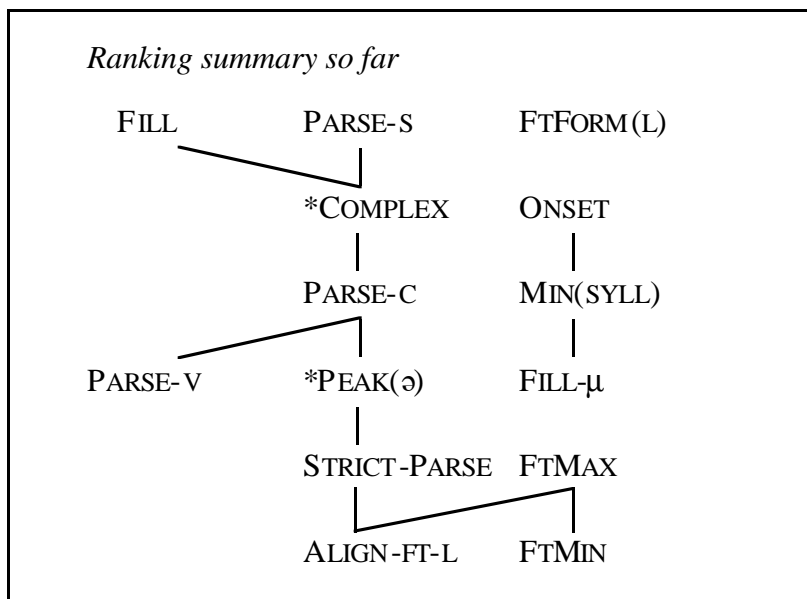
an underlying CVC sequence, FILL- μ can be violated in order to make the coda consonant moraic and thereby satisfy MIN(SYLL). If the second consonant in the CVC sequence is needed as the onset for the following syllable, however, it is not available to satisfy MIN(SYLL), which indicates that ONSET, defined below, outranks MIN(SYLL). In both this situation and a situation in which there is only an underlying CV sequence, there will not be a way to satisfy MIN(SYLL), given that onsets cannot be moraic. This restriction to nonmoraic onsets is stated below as part of the definition for the ONSET constraint, but could equally well be a universal property of GEN.

(48) ONSET A syllable must have a non-moraic consonant as an onset.

(49) ONSET » MIN(SYLL)

Finally, notice that in the definition of MIN(SYLL), it is moraic *segments* which count toward its satisfaction rather than moras *per se*. What this avoids is the prediction that open syllables would lengthen in order to satisfy MIN(SYLL). In other words, if it were simply moras that were being counted, MIN(SYLL) could be satisfied by adding a mora to the representation which either is not linked to any segmental material or is also linked to the vowel (recall that MIN(SYLL) outranks FILL- μ). Although it is true that by introducing separate constraints against bimoraic segments and/or against unassociated moras,³⁰ we could achieve this same effect, adding these constraints seems an unnecessary complication of the analysis, and it is simpler to leave this requirement as part of the definition of the MIN(SYLL) constraint unless a decomposition is later motivated on crosslinguistic grounds. It should also be noted that in most previous analyses, there would have been no difference between using moras or moraic segments as the metric; where the present analysis differs is in the suggestion that a structure in which a single mora is associated to two segments is both legitimate (an issue which is taken up in section 4.1) and, in some situations, preferred. In these cases it is useful to consider each of the two segments in the evaluation of the constraints.

³⁰Whether a mora unassociated to a segment is licensed or not may also be considered to be a rankable constraint, as is the (confusingly named) FILL constraint of Zec (1994) which requires that any mora in the representation must be associated to a segment. However, it is worth noting that, despite being a violable and rankable constraint, FILL (her constraint against unassociated moras) is not violated in the optimal forms for any of the languages discussed in Zec (1994), which suggests that it may also be a more fundamental restriction on the occurrence of moras (perhaps even a condition imposed within GEN).



3.4. Moraic sonorants in Passamaquoddy

Passamaquoddy makes a significant distinction between sonorant and obstruent consonants in a number of situations, one of which is the effect of a following consonant on the syncope of unstressable /ə/ briefly mentioned earlier and discussed in this section. Another such distinction, discussed later in section 4.2, is made in the differing effects of *hC* clusters on a following /ə/, where the behaviors of a sonorant-final cluster and an obstruent-final cluster differ (see 13b, 13c).

Generally, an unstressable /ə/ syncopates when it precedes an obstruent, but surfaces when it precedes a sonorant. In the present analysis, these behaviors exemplify the two options at the disposal of a language for satisfying the *PEAK(ə) constraint which were listed in (23), repeated below.

- (23) A language may avoid violations of *PEAK(ə) by
- a. Not parsing /ə/ (resulting in Stray Erasure).
 - b. Parsing /ə/ into a footed mora (not parsed into a syllable).

An unstressable /ə/ before a sonorant takes option (23b), while one before a nonsonorant takes option (23a).³¹ The examples below show syncope before obstruents and lack thereof before sonorants. In each, the (b) example motivates the postulation of the underlying /ə/.³²

- | | | | | |
|------|----|---|----|---|
| (50) | a. | pt-íhí-ke
hook-TA-AI-(3)
'he hooks fish' (168) | b. | n-p'ət-hì-k
1-hook-TA-AI
'I hook fish' (168) |
| (51) | a. | kp'écále
hoarse-(3)
'he is hoarse' (168) | b. | n-k'əpəcàl
1-hoarse
'I am hoarse' (168) |
| (52) | a. | kəlól-tó-w-ək
argue-RECIP-3-33PROX
'they (du.) argue with each other' (170) | b. | h-k'əlól-tí-ni-ya-l
3-argue-RECIP-PEG-33PROX-3.OBV
'he argues with the other' (169) ³³ |
| (53) | a. | pəmí-ph-â
along-carry-3PASS
'he is carried along' (170) | b. | h-p'əmí-ph-a-l
3-along-carry-DIR-3.OBV
'he carries the other along' (170) |

/ə/ syncope is, of course, not limited to the first syllable, as we can see in the data below. The (a) examples motivate the underlying presence of /ə/ (where the relevant /ə/ is underlined), and the (b) examples show situations in which the /ə/ disappears. Notice that in the cases (50-3) above and (56) below, the /ə/ syncope is occurring morpheme-internally, showing that syncope in Passamaquoddy is not restricted to morpheme boundaries as in some languages.

- | | | | | |
|------|----|------------------|-------------------------|-------------------------------|
| (54) | a. | áps-ə́kíhkʷən | small-size-(3) | 'it is small' (169) |
| | b. | kín-kíhkʷən | large-size-(3) | 'it is large' (169) |
| (55) | a. | másk-ə́sít-e | smelly-foot-AI-(3) | 'his feet stink' (169) |
| | b. | kwákw-sít-e | dirty-foot-AI-(3) | 'he has dirty feet' (169) |
| (56) | a. | h-kw'ətákən | 3-throat | 'his throat' (169) |
| | b. | píləwi-kwtákən-e | different-throat-AI-(3) | 'his voice is changing' (169) |

³¹For the purpose of this generalization, /h/ is to be considered a “non-sonorant.”

³²The examples in (50-3) also show the effects of “final vowel deletion,” which will be discussed in more detail in section 4.8. Additionally, the first /i/ which appears in (50a) is a “connective-/i/” which is inserted epenthetically. For the purposes of this section the relevant alternation in these examples is that of the /ə/ in the first syllable.

³³The penultimate vowel (/i/) in this word is the result of “E-Mutation” discussed in LeSourd (1993), chapter 8), and is therefore unstressable.

Another interesting fact about pre-obstruent syncope is that exceptions are not uncommon, making it desirable to have a natural way to represent them. One such exception is the /ə/ in /-əpi-/ ‘sit,’ shown in the example below, where the /ə/ is unstressable and precedes an obstruent, yet it does not syncope.

- (57) pét-ék-əpo ‘it (an., *e.g.* cloth) comes to be located here.’ (81)
 arrive-sheetlike-sit-(3)

Clearly some lexical marking is required to represent such exceptional /ə/ segments.³⁴ LeSourd suggests that these cases involve a lexical diacritic which marks individual segments as being outside the domain of his rule which deletes unstressable pre-obstruent /ə/. In the present analysis, a natural suggestion to make is that these exceptional segments have a lexically prespecified association to a mora. This prespecified association tips the balance toward realization (*i.e.*, 23b), while /ə/ segments which lack this association prefer to syncope (*i.e.*, 23a). If we assume that principles of faithfulness to the underlying representation discourage both adding a mora to the representation as well as leaving an underlying mora unparsed, this behavior follows.

Returning to the sonorant/obstruent distinction in the context of /ə/ syncope, note that if a /ə/, whether exceptional or not, occurs before a sonorant, realization (23b) is the preferred behavior. Drawing a parallel to the behavior of exceptional /ə/, we might suppose that a sonorant which follows a /ə/ can somehow provide it with a mora, tipping the balance toward realization.³⁵

Before discussing the mechanism for such /ə/ “support,” we will look at a possible source of independent evidence which suggests that sonorants come from the lexicon with a mora attached. Under the standard assumption that syllable onsets may not be moraic (see, *e.g.*, Hyman (1985), Hayes (1989)), for a sonorant to occur in onset position would generally mean that an underlying mora would have to remain unparsed in the output representation. Thus,

³⁴Hereafter, the term “exceptional /ə/” will be used to refer to these /ə/ segments which resist syncope.

³⁵This suggestion recalls Hyman (1985), where it was suggested that all consonants enter the computation with an associated mora and lose their mora if associated into onset position. Hayes (1989) later suggested that moras are added during the course of the derivation, rather than coming in along with the underlying form. The claim made here is something of a hybrid of these two views; sonorants enter the computation with a mora *à la* Hyman, while obstruents do not, *à la* Hayes. Zec (1994), developing a suggestion made in Zec (1988) argues that a mora is projected by a segment not followed by a more sonorous segment, but this would only be compatible with the Passamaquoddy facts if the MORAIC PROMINENCE constraint may be parameterized so as to consider sonorants like /l/, /m/, and /n/ to be as sonorous as vowels (thereby allowing a sonorant in a *VLV* sequence to nevertheless project a mora). Adopting MORAIC PROMINENCE as amended would also complicate the parts of this analysis which pertain to the KEEP constraint, defined in an upcoming section. Full consideration has not been given to this possibility, and it is possible that the KEEP results herein (mainly involved with retention of exceptional /ə/) might be reinterpretable in the context of MORAIC PROMINENCE. This remains as a topic for future research, and in the present analysis the relation between sonorants and moras is stipulated to be a lexical association.

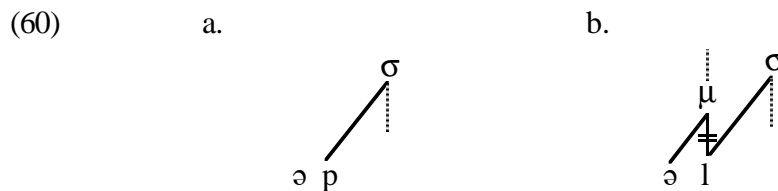
sonorants should be dispreferred to obstruents in onset position, which in turn should have a reflex in the cluster inventory: if sonorants are unlikely to be found in onset position, they will also be unlikely to be found as final elements in clusters. Indeed, Passamaquoddy has this property. Below are two tables of attested clusters. The first lists clusters which begin with a sonorant, of which there are twenty-five. The second lists clusters which end in a sonorant, of which there are only nine.³⁶

- (58) a. -mp- -mt -mk -mkw -ms -mh- -mm
 b. np- nt nc- nk nk- ns nh- nm- -nn- nw-
 c. -lp- -lt- -lc -lk -lkw -ls -lh -ll-
- (59) a. -mm- -nn- -ll- —*geminates*
 b. -hm- -hn- -hl- —*/h/ is first member*
 c. km- kn- nm- —*only with person prefix*

Moreover, notice that for each of the nine attested sonorant-final clusters, a story can be told. Three are geminates, three have /h/ as their first segment, and the final three involve morphological prefixes. We will be discussing the complex properties of /h/ and of geminates in upcoming sections, and the remaining examples, involving clusters formed from the word-initial person prefixes, could be due to a morphological alignment constraint.

If we accept the suggestion that sonorants come from the lexicon with an associated mora, we must determine by what mechanism they are capable of “supporting” a preceding unstressable /ə/.

Where a consonant follows an unstressable /ə/, that consonant is necessarily an onset (allowing the /ə/ to be unstressable). Therefore, a sonorant which follows the unstressable /ə/ must also be delinked from its underlying mora, since onsets cannot be moraic. The structures being discussed are shown below.



For underlying association to a mora to have any meaning, we must assume that there is a constraint which militates against superfluous delinking of segments, which is the KEEP constraint defined below (very similar to the OVERWRITE constraint of Kenstowicz (1994b)). However, we see that KEEP may be violated in order to satisfy ONSET, and in a situation where a

³⁶Source: Sherwood (1986), p.72.

/ə/ does not precede the sonorant, PARSE- μ may also be violated for ONSET satisfaction. These facts motivate the first ranking in (62). While the /ə/ in (60a) will be lost to Stray Erasure, the mora left delinked by the sonorant in (60b) is available for association to /ə/ in order to avoid violating PARSE-V and PARSE- μ , defined below. In (60a), we assume that the constraint forbidding the addition of moras (FILL- μ) outranks PARSE-V, since the /ə/ is forced to syncopate.

- (61) KEEP Maintain underlying segment-mora associations.
 PARSE- μ A mora must be parsed.
- (62) ONSET » KEEP, PARSE- μ
 FILL- μ » PARSE-V

As briefly alluded to earlier, the fact that coda consonants are moraic in Passamaquoddy, by virtue of MIN(SYLL), explains the asymmetrical linear relationship between sonorants and nonsyncopating /ə/ segments. Because a sonorant which precedes an unstressable /ə/ is necessarily occupying coda position, its pre-associated mora will remain associated given that coda consonants are moraic. Thus, there will not be a mora available to allow a following unstressable /ə/ to surface. The only consonant whose character will have an effect on the syncope of an unstressable /ə/ is one which follows it.

Another peripheral issue which the ranking of ONSET above KEEP and PARSE- μ explains is the fact that the penultimate syllable in *nátá:me* ‘he goes fishing’ is available for lengthening. Recall that vowel lengthening applies to penultimate syllables only if open, a fact which was taken earlier as evidence for the moraicity of coda consonants in Passamaquoddy. Here, we see that the penultimate syllable is considered to be open for purposes of vowel lengthening, despite the fact that it is followed by a sonorant. Since a sonorant comes with a pre-associated mora, we earlier concluded that, all else being equal, a sonorant would prefer being a syllable coda to being a syllable onset. However, in this situation all else is not equal, and the demand for an onset causes the sonorant to accept its role as such.³⁷

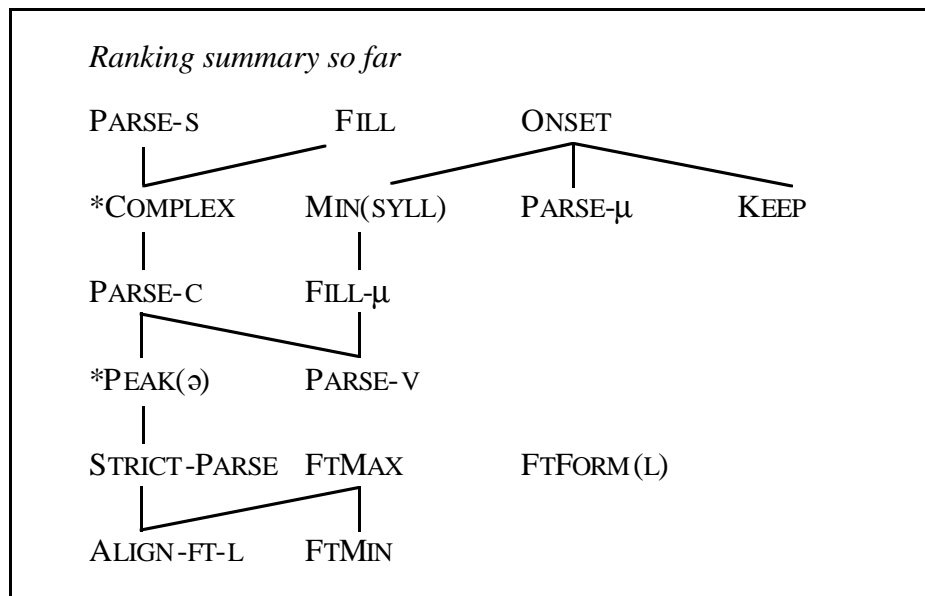
To explain why vowels other than /ə/ do not generally syncopate, I assume that most vowels come from the lexicon already pre-associated to a syllable, and that maintaining those associations is sufficiently important to always cause these vowels to surface.³⁸ There are

³⁷We might even suppose that the mora, dissociated from the sonorant, is re-associated to the vowel, producing the observed lengthening. However, note that penultimate lengthening is also available before obstruents, so this cannot be the only source of the observed lengthening. Moreover, sonorants do not generally have the effect of lengthening preceding vowels. Clearly, there must be another force at work in penultimate lengthening, but further explanation of this phenomenon will not be pursued in the present analysis.

³⁸It is for this reason that KEEP was formulated specifically in terms of segment-mora associations. In Passamaquoddy, delinking an underlying mora-to-syllable association never occurs, indicating that whatever relative of KEEP governs this behavior is an undominated constraint.

alternatives to this suggestion; for example, we might instead suppose that there is a PARSE-V constraint which is more highly ranked than a PARSE-ə constraint, but this approach runs into difficulty when faced with instances of vowels other than /ə/ which syncopate much in the same way as /ə/ does. For this reason, a constraint based on segmental content is probably not going to yield the correct results.

To summarize the assumptions about structure from the lexicon, we suppose here that /ə/, obstruents, and syncopating vowels come from the lexicon simply as segments, while exceptional /ə/ and sonorants come from the lexicon with a mora pre-associated. Full vowels and underlyingly stressable /ə/ are assumed to come pre-associated both to a mora and to a syllable. Stated this way, these assumptions do entail a fair amount of redundancy in the syllabification system, but we know that we must distinguish /ə/ (and other initially unstressable vowels) from full vowels in some way. The choice we make here is simply to gloss over the mechanism of the distinction and say the full vowels are simply “pre-associated to a syllable.” If we wished to actually implement the mechanism for such pre-association, a promising approach would be to suppose that there is a lexical diacritic that indicates whether a vowel is a full vowel or a weak vowel, in conjunction with a high-ranking constraint which requires that all vowels marked [+Full] head a syllable. If we accept this explanation of what it means to be “lexically pre-associated to a syllable,” the redundancy is removed and the distinction is reduced to the irreducible diacritic. Note too that regardless of which way full vowels are handled, we need a further distinction between normal from exceptional /ə/, which here has been said to involve “pre-association to a mora.” This too could be handled by a morafication constraint, but the underlying distinction is irreducible.



3.5. Syllable/word alignment and word-initial syncope

Although we have seen that mechanisms exist which can allow a word to begin or end with a mora, Passamaquoddy nevertheless has a preference for keeping its loose moras word-internal if possible.

We saw in a previous section that Passamaquoddy allows word-initial moras in cases like *pəməsókə*. However, it turns out extrametricality of this type occurs only at the left edge; the rightmost /ə/ of a word can not be left unstressable in this way (*cf.* (13a)).

- (63) a. *tóhsán-ək* ‘sled (loc.)’ (80) **tóhsanək*
sled-LOC
- b. *pkáhkənikən* ‘crooked knife’ (331) **pkáhkənikən*, **pkáhkənikən*

This can be taken as an indication that it is more important not to end a word in a mora (or, in other words, to end a word in a syllable) than it is to satisfy *PEAK(ə). Presumably, this is the result of the constraint in (64), ranked as in (65).

- (64) AL-R-PWS = ALIGN(PrWd, R; σ, R); the right edge of a prosodic word must be minimally disaligned from the right edge of a syllable.
- (65) AL-R-PWS » *PEAK(ə)

Interestingly, we also have evidence that Passamaquoddy also prefers not to begin a word with a mora, despite the existence of examples like *pəməsókə*.

The main evidence for this preference to begin words with a syllable comes from word-initial syncope. Unstressable /ə/ will generally syncope when it is word-initial, regardless of the nature of the following consonant. In the examples below, we see word-initial /ə/ disappearing before both obstruents and sonorants. The (b) examples motivate the presence of underlying /ə/.

- (66) a. *lámí-ptin*
inside-hand
‘palm of the hand’ (319)
- b. *ht-əlámí-ptin*
3-inside-hand
‘the palm of his hand’ (319)
- (67) a. *ílí-ne*
ongoing-die-(3)
‘he is dying’ (316)
- b. *ht-ətəlí-na-n*
3-ongoing-die-SUBORD
‘he is dying (subordinative).’ (316)

However, some (but not all) of the morphemes which are exceptions to pre-obstruent syncope are also exempt from word-initial syncope. Two examples are given below, both of

which retain their morpheme-initial /ə/ word-internally, even if in an unstressable position (*e.g.*, see (57)).

- (68) a. əpì-n sit-2 ‘sit (sg.)!’ (317)
 b. əkíso read-(3) ‘he reads’ (317)

When word-initial, for a /ə/ to surface without violating *PEAK(ə) would mean beginning the word with a mora, which appears to be disfavored by a constraint, given below, which is similar to that operative on the right edge.

- (69) AL-L-PWS = ALIGN(PrWd, L; σ, L); the left edge of a prosodic word must be minimally disaligned from the left edge of a syllable.

We see that rather than violate AL-L-PWS, even if a mora is available by virtue of a following sonorant being delinked, the /ə/ will not be associated to it. This indicates that we have the following ranking:

- (70) AL-L-PWS » PARSE-V, PARSE-μ

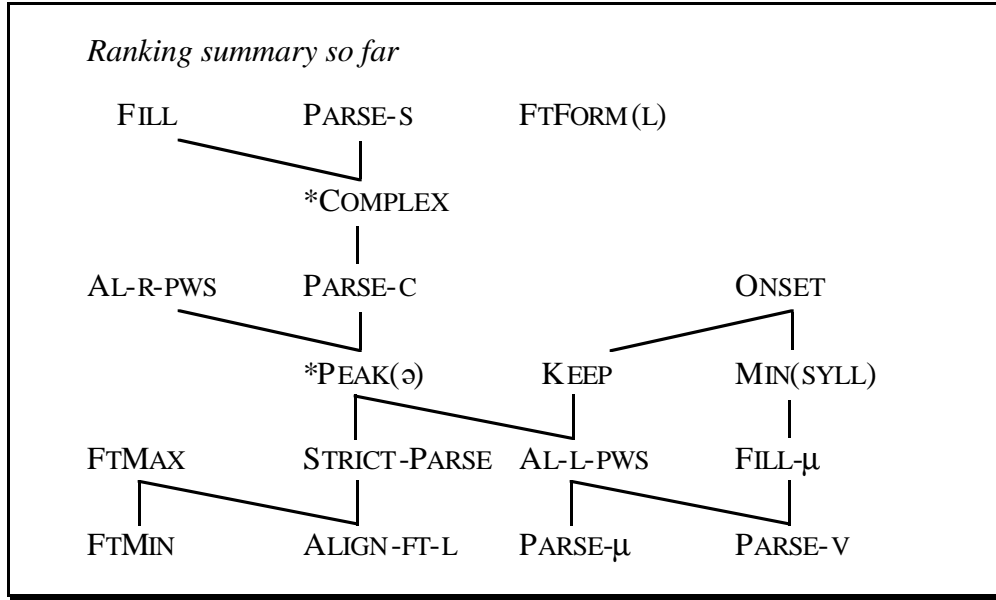
For the exceptional /ə/ segments, which come pre-associated to a mora, AL-L-PWS will generally not delink them from their underlying mora, also indicating the ranking given in (71).³⁹

- (71) KEEP » AL-L-PWS

Notice that neither syncope nor non-syncope of a word-initial /ə/ has any direct effect on the satisfaction of *PEAK(ə), since *PEAK(ə) can be satisfied whether /ə/ syncopates or not. However, we know from the existence of examples like *pəməsókə* that alignment of the left edge of a word with a syllable is not satisfied if *PEAK(ə) is at stake, so we know that the ranking in (72) must hold.

- (72) *PEAK(ə) » AL-L-PWS

³⁹This leaves us without a good explanation for why there are some /ə/ segments which, although exceptional word-medially (*i.e.* refusing to syncopate before obstruents), will nevertheless syncopate word-initially. LeSourd does not specify which behavior is the most common, although his phrasing seems to indicate that for exceptional schwas it is more unusual to syncopate word-initially than not. It is worth noting that there do not appear to be any instances of /ə/ which does not syncopate word-initially but does syncopate word-medially. Presumably there is something else going on which allows these *exceptionally* exceptional /ə/ segments to violate KEEP when word-initial, but precisely what that is will not be further investigated here.



3.6. Ambiguity and *PEAK(ə)

The constraints proposed so far still leave occasional ambiguity as to which /ə/ is made moraic in cases where there is a series of unstressable /ə/ vowels. Recall that in LeSourd’s contexts for stressability, (13f) indicated that even-numbered /ə/ segments, counting from left to right, are stressable. Although the analysis to this point does capture the alternating nature of this stressability, it does not yet capture the “left-to-right” part of the generalization.

In the example below, there are two options with respect to the syllabification of the word-medial /w/, listed as (73a) and (73b), where the outlined /ə/ represents a moraic /ə/ parsed directly into the foot. In each candidate, exactly one /ə/ violates *PEAK(ə), and with respect to the constraints discussed so far, no decision is made between the two.⁴⁰

- (73) kínəw-əso particular-AI-(3) ‘he is a certain one’ (90)
- a. (kin)(ə.wə.so) → kínəwəso
- b. (ki)(nəw.ə.so) → *kínəwəso

In cases of ambiguity such as that above, it is the form which has its unsyllabified moras closer to the left edge of the word that actually surfaces as the winning candidate, *i.e.* the “left-to-right” aspect of LeSourd’s (12f). In the example above, this means that (73a) would be

⁴⁰Notice that in (73a), the second foot has two syllables and a single mora. Because FTFORM(L) is a foot-level constraint, only sensitive to syllables (see (24) from section 2.4, above), the stress placement shown in (73a) fully satisfies FTFORM(L).

predictably the winner over (73b), because the leftmost /ə/ of the otherwise equivalent choices is moraic. Some further cases of this type are listed below.

- | | | | | |
|------|----|---------------------|-----------------------------|--|
| (74) | a. | h-péhk-ən-ám-ən | 3-completely-by.hand-TI-3IN | ‘he takes it all’ (90) |
| | b. | étəl-élohk-é-c-ik | ongoing-work-AI-3AN-33PROX | ‘they (du.) who are working’
(91) |
| | c. | íhtəl-ékehkí-m-ot | usually-teach-TA-3PASS | ‘where he goes to school’
(91) |
| | d. | h-pásk-əcək-án-a | 2-break-messy-by.hand-DIR | ‘you (sg.) break him, it (an.,
squishy) with your hand’
(92) |
| | e. | ásəw-əcək-əpo | oblique-messy-sit-(3) | ‘it (an.) is flopped over to
one side’ (92) |
| | f. | ht-ətəl-ət-əm-án-əl | 3-ongoing-eat-TI-3IN-33IN | ‘he is eating them (in.)’ (52) |

To capture this effect, we will assume that the AL-SYLL-R constraint defined in (75), below, is operative, choosing among options equivalent with respect to *PEAK(ə) just as ALIGN-L-PWS did in the previous section.

- (75) AL-SYLL-R = ALIGN(σ, R; PrWd, R) (the right edge of a syllable must be minimally disaligned from the right edge of the PrWd).

The intuition behind the operation of this constraint is very much the same as that behind Mester & Padgett’s (1993) when they derive the differing effects of “directional syllabification” in Iraqi and Cairene Arabic. Because this is an alignment constraint on syllables, it is clear that the evaluation of this constraint must be made with respect to some sub-syllabic unit of measure. As it turns out, measuring distance either in moras or in surfacing segments will produce the desired result in this situation,⁴¹ but in the upcoming section on geminates, the analysis is simplified by assuming that the metric for ALIGN-SYLL-R is commensurate with that used in the formulation of MIN(SYLL), namely moraic segments.

AL-SYLL-R encourages all syllables to be as close to the right edge of the word as possible. In the cases which are relevant in this section, there is a CəCə sequence in which either, but not both, of the /ə/ segments might be able to satisfy the *PEAK(ə) constraint. The two options have different results with respect to the satisfaction of AL-SYLL-R, however. In the

⁴¹Assuming the structures argued for in later sections, particularly assuming that coda consonants are moraic and that unstressable /ə/, when surfacing, is parsed by a single mora.

truncated tableau shown below, we see the effect of the choice on the satisfaction of AL-SYLL-R.⁴²

(76)

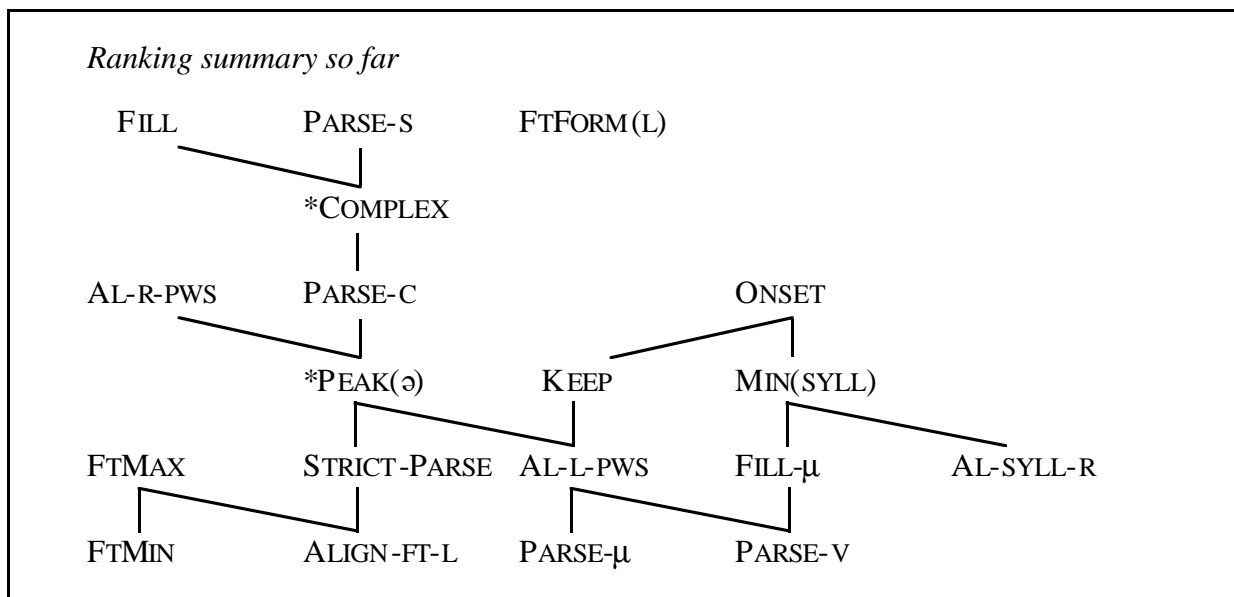
	/CVCəCəCV/	AL-SYLL-R
a.	CV.CəC.ə.CV	√+μμμμ+μμμμ!
b.	☞ CVC.ə.Cə.CV	√+μμ+μμμμ

We cannot rank AL-SYLL-R with respect to *PEAK(ə), since if *PEAK(ə) is violated, the number of syllables in the prosodic word is increased, guaranteeing a worsening of AL-SYLL-R as well; because the two constraints covary rather than conflict, there is no direct evidence for a ranking. Later, other rankings will indicate that AL-SYLL-R outranks *PEAK(ə) by transitivity, but we do not have direct evidence for such ranking at this point.

Lastly, notice that if it were possible for a coda consonant to not be moraic (violating MIN(SYLL)), syllables would be closer to the right edge, given that moras are the unit of measure for AL-SYLL-R. So, if it were the case that AL-SYLL-R outranked MIN(SYLL), the effect of MIN(SYLL) would be neutralized. Since we have some empirical reason to believe that coda consonants are generally moraic, it must be the case that MIN(SYLL) outranks AL-SYLL-R. Apart from this somewhat indirect argument, another argument for this same ranking will be presented in the next section.

(77) MIN(SYLL) » AL-SYLL-R

⁴²The notation used for evaluation of AL-SYLL-R shows the result for each of the three syllables evaluated separately, however this is only for presentation and not to be taken as a claim about how such constraints should be evaluated in general. It is more commonly supposed (see, *e.g.*, McCarthy & Prince (1993a)) that such constraints are evaluated by the total number of violations in the form and not relative to each evaluation unit.



3.7. Word-initial /*(C) ə* [+sonorant] *ə*/ sequences

LeSourd notes (see 13e) that a special situation obtains when a word begins with two schwas separated by a sonorant (with or without a word-initial consonant). So long as neither one is required to be stressable for any other reason, the first of the two becomes stressable, as can be seen in the following examples. By examining this situation carefully, we will arrive at a few additional ranking arguments for the constraints already defined.

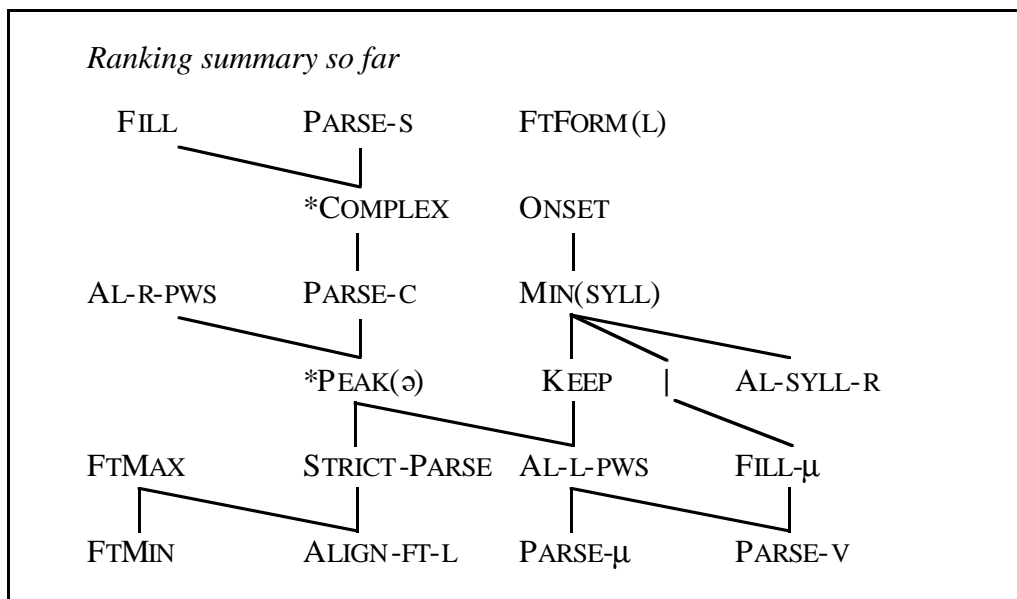
- (78) a. pám-əka 'he dances' (87)
along-dance-(3)
- b. pám-əkohóke 'he floats along (in a current)' (88)
along-float-(3)
- c. wál-əpo 'he sits nicely, comfortably; he is well off' (87)
good-sit-(3)
- d. óləkʷ-ewésto 'he speaks in that direction;
direction-speak-(3) he walks in that direction while speaking' (88)
- e. óləmoss 'dog' (87)

The examples in (78) differ from examples like *pámásóke* in that there are two /ə/ segments, only one of which will be able to satisfy the *PEAK(ə) constraint. Also notice that /ə/ does not syncopate word-initially in this situation, as can be seen in (78d-e), which indicates that AL-L-PWS is not the crucial constraint, although the examples in (78) do satisfy it. Also notice

In order to ensure MIN(SYLL) makes the decision rather than KEEP and AL-L-PWS, MIN(SYLL) must be ranked higher than both constraints. With respect to STRICT-PARSE, the ranking isn't clear, since STRICT-PARSE does not promote the wrong candidate, but merely makes no decision in most circumstances.

(80) MIN(SYLL) » KEEP, AL-L-PWS

As mentioned earlier, the winning structures in (78) violate AL-SYLL-R more than necessary, since the preferred state of affairs from the perspective of AL-SYLL-R is to have all unstressable elements as far left as possible. This is further evidence that MIN(SYLL) outranks AL-SYLL-R, a ranking which was established in the previous section in (77).



3.8. Interlude: where we are so far and where we hope to be

Before moving on to the next major section, where more involved issues of assimilation are discussed, let us take a moment to look back at what has been accomplished so far.

The underlying idea behind this entire analysis is that the stress and syncope effects in Passamaquoddy can be explained by supposing that “unstressable” /ə/ is in fact a mora directly parsed into a foot, a structure which is preferred but often made impossible by constraints of syllabification.

We have basic syllabification constraints which explain the observed “stressability after clusters” (13a) effects, based on the observation that in a cluster of consonants, Passamaquoddy considers it more important to recruit one consonant as an onset than to preserve a moraic /ə/. Based on phenomena in Passamaquoddy differentiating open from closed syllables, we

concluded that coda consonants are moraic, and we speculated that sonorants may enter from the lexicon as moraic. By accepting these possibilities, we reach a plausible explanation both for the observed distribution of clusters and for why an unstressable /ə/ would syncopate before an obstruent but not before a sonorant.

It may be particularly noteworthy that this fact (syncope before obstruents) is not explained in any other existing analysis of Passamaquoddy syllabification, but merely stipulated by a rule which deletes unstressable /ə/ before obstruents. Here, we may actually have an explanation for why it is before obstruents that syncope occurs, and why it would not be equally possible to have a “pre-sonorant syncope” rule.

In order to get the appropriate edge effects, we needed to call on a number of alignment constraints, one which aligns the feet in such a way as to put degenerate feet on the left edge, two which have the effect of containing moras to word-internal position, and one which causes loose moras to be realized in the leftmost position given a choice between positions.

In LeSourd’s list of contexts in which /ə/ is stressable, repeated below, we now have an explanation for (13a), (13e), (13f), and most of (13b).

- (13) /ə/ is stressable if:
- underlyingly designated as a full vowel
 - or*
 - a) is the last vowel of a word, *or*
 - b) follows a cluster of nonsyllabics other than /hC/ (with some exceptions involving geminates), *or*
 - c) follows /hl/, *or*
 - d) stands between /s/ and /hs/, *or*
 - e) is the first /ə/ in word-initial /(C) ə [+sonorant] ə/ where second /ə/ is unstressable, *or*
 - f) is in even position, counting from left to right, in a series of /C₀ ə/ sequences in which no /ə/ is stressable by other means.

Simultaneously, we have also explained two of the five contexts, repeated below, in which /ə/ undergoes syncope, (25a) and (25e).

- (25) Unstressable /ə/ syncopates:
- a) before obstruents
 - b) before /h/
 - c) between /h/ and /m/
 - d) between identical non-syllabics
 - e) at the beginning of a word

The next sections of the paper investigate the remaining contexts for stressability and syncope.

4. Doubly-linked structures and greedy phonemes

4.1. Geminate structures and MIN(μ)

Passamaquoddy appears to have a particular affinity for geminates, as is evidenced by the fact that an unstressable /ə/ will always syncopate between identical consonants—whether obstruents or sonorants—and regardless of whether it would normally syncopate before obstruents or not. In the examples below, (81a) shows an unstressable /ə/ syncopating between sonorants where otherwise a sonorant would save a preceding /ə/ from syncope (*cf.* *sókəlan*, ‘it pours (rain)’). (81b) shows that a /ə/ which normally does not syncopate before obstruents disappears when a geminate structure is at stake (*cf.* *w’əlapo*, ‘he sits nicely, comfortably; he is well off’). Notice that these data are directly contrary to the generalization proposed in McCarthy (1986), which suggests that where syncope would result in an OCP violation, the syncope is blocked. Here, syncope is in fact encouraged when the affected vowel is flanked by identical segments.

- (81) a. *təl-lan* ‘it is pouring (rain)’ (277)
 ongoing-rain-(3) /təl-ələn/
 b. *éwép-po* ‘he sits up, he is located at a height’ (283)
 up-sit-(3) /ewep-əpo/

In these cases, the geminate structure is not a result of a compensatory lengthening process, but is constructed of segments which are underlying. Thus, if we suppose that these segments are parsed in the output representation (which we would expect out of a general concern for faithfulness to the underlying form), these geminates are probably structures in which the two identical segments are parsed into a coda mora, and in which the second segment also constitutes the onset of the following syllable. The three basic cases are those diagrammed below. In (82a), we see an unstressable /ə/ syncopate between identical obstruents. In (82b), we see an exceptional /ə/ syncopate between identical consonants, which is the case in (81b). Finally, (82c) shows the case in (81a), where a /ə/ syncopates between identical sonorants.

- (82) a. b. c.
-
- σ σ σ σ
 | | | |
 \ / \ / \ / /
 μ μ μ μ
 / \ / \ / \ / /
 p <ə> p p <ə> p l <ə> l l <ə> l

In this framework, such structures must come about due to some harmonic result they achieve. Optimality Theory is not generally assumed to have “positive constraints” of the sort

that would give a positive mark assigned to every structure which satisfies a constraint like “encourage geminates.” Thus, to avoid making a fundamental change to the theoretical assumptions, we must phrase the constraint which has the effect of encouraging geminates in negative terms, *i.e.* “discourage nongeminates.”

What we are after is an interaction between constraints with the result that, so long as the two segments are (relevantly) identical, a mora must parse two segments. The constraint which has this effect is $\text{MIN}(\mu)$, defined below.⁴³

(83) $\text{MIN}(\mu)$ A mora must parse two (Place-)identical segments.⁴⁴

Looking at the three cases illustrated above in (82), we see that an unstressable /ə/ is syncopated in favor of geminates, indicating that PARSE-V is ranked lower than $\text{MIN}(\mu)$. Since even an exceptional /ə/, which comes in pre-associated to a mora, will syncopate in these environments (as in (82b)), we see that $\text{MIN}(\mu)$ must also outrank KEEP , a result which is reinforced by the winning structure in (82c).

(84) $\text{MIN}(\mu) \gg \text{PARSE-V}, \text{KEEP}, \text{PARSE-}\mu$

There is some evidence which suggests that if the identity requirement of $\text{MIN}(\mu)$ is not fully satisfied in underlying form, some features can be spread (or sometimes be omitted) in order to achieve identity. In the formulation of the $\text{MIN}(\mu)$ constraint, it was suggested that the relevant measure of identity was the Place node.⁴⁵ To give one example, let us (plausibly) suppose that the /kw/ phoneme in Passamaquoddy differs from /k/ only in the labial feature [+round] (which is under the Labial node under the Place node in the geometry assumed here, see Halle (1995)). Observe that in the cases below, we see instances of the distinct phonemes /k/ and /kw/ surrounding an unstressable /ə/ in the underlying form, but which induce syncope as geminates just like in the cases discussed above. Interestingly, they both surface as /kw/

⁴³Alternatively, this might be considered to be an interaction between two constraints, one which requires coparsing of two segments and another which requires coparsed segments to be identical. One reason for not adopting this approach is that these two constraints, if separate, would have to be universally ranked $\text{IDENTITY} \gg \text{COPARSE}(\mu)$, since there is no known case in which we might be led to suppose a reversed ranking. Moreover, since there is no language-internal reason to separate these constraints, such a separation would simply complicate the present analysis.

⁴⁴By Place-identical is meant that the Place node must either absent for both segments or be identical for both segments. For recent discussion of phonological feature geometries, see Halle (1995) and references cited therein.

⁴⁵It is probably slightly more complicated that this, since /s/, /t/, and /n/ do not appear to induce geminate formation indiscriminantly with any other coronal, although they match below the Place node. The exact conditions have not been investigated here, but (speculatively) it may be that the Place node and the nodes immediately below the root node must be identical to satisfy $\text{MIN}(\mu)$. In the text, we will still refer to the assimilation phenomenon as if it were only Place features that count toward identity.

segments. This suggests that at least spreading of the Labial node is permitted in order to achieve satisfaction of MIN(μ), although we will not pursue this issue further to determine where the constraint relevant to this spreading phenomenon is ranked.

- (85) a. n-sákwwì-pən /n-səkəkwi-.../ ‘we (du. exc.) vomit’ (292)
1-vomit-11
- b. sékwwi-yàn /səkəkwi-.../ ‘when I vomited’ (292)⁴⁶
vomit-1-(PERF)
- c. ékw-kwehkí-ti-n /ehkw-əkəhki-ti-n/ ‘school is out’ (289)
stop-teach-RECIP-UNSPEC
- d. ékw-kwíso /ehkw-əkisi-w/ ‘he stops reading’ (289)
stop-read-(3)

The example supports the idea that Passamaquoddy favors geminate structures when available, but the main discussion of the spreading processes such as those exemplified above is deferred until the later section on *VhV* assimilation (section 4.5), where we will discuss feature assimilation phenomena involving vowels.⁴⁷

One fact about geminate formation remains to be explained. Although unstressable /ə/ may syncope in favor of geminates, stressable /ə/ will not. One example of the unexplained phenomenon is shown below. Notice that, although the second /ə/ is between two identical consonants, it is stressable by the left-to-right count of (13e).

- (86) étəl-əlohk-é-c-ik ‘they (du.) who are working’ (91)
ongoing-work- AI-3AN-33PROX

⁴⁶The fact that the underlying /ə/ which occurs in the first syllable of this example is realized as /e/ is a result of the particular verb mode, a process called “Initial Change” by LeSourd. This change is a reasonably regular one, although there are significant complications involved that cannot be addressed here (but are addressed at some length in LeSourd, chapter 9). One analytic benefit of this mutation is that it allows us to see, in some cases, where an underlying /ə/ must be. For example, the underlying /ə/ we established in the morpheme /əpi/ ‘sit’ (section 2.2), is corroborated by the Initial Change in the form *épi-t* (sit-3an) ‘when he sits’ (433).

⁴⁷There are further complications in the spreading of consonants which we will not be able to address here. For instance, there are examples like *sákko* (vomit-(3), /səkəkwi-w/, ‘he vomits’) in which the [+round] feature of /kw/ appears to be dropped rather than spread, perhaps due to the [+round] in the following vowel (perhaps relevant to this is the fact that the entry for this word in the Passamaquoddy dictionary (LeSourd (1986)) states that “qq changes to kk before u” in the spirit of a general rule). With respect to another potentially complex consonant, /c/, both *c-c* and *t-c* sequences become *c-c* geminates (e.g. *tóc-c əsso*, extreme-color-(3), /tot-əcəssi-w/, ‘he is dark’), while *c-t* sequences do not form geminates at all (e.g., *míxc-əémo*, bad-cry-(3), /məc-ətəmi-w/, ‘he (e.g., an actor) cries badly’). LeSourd analyzes this as evidence for the complex nature of /c/ as /t+š/. To go into the implications of such a structure would take us too far afield in the present context, however.

In LeSourd’s rule-based framework, geminate formation is a fairly late rule which has access to stressability information assigned in the contexts of (13), thus able to predict (86). In the present analysis, this must be a result of AL-SYLL-R, the constraint behind the “left-to-right” orientation of alternating stressability, being ranked higher than MIN(μ).

(87) AL-SYLL-R » MIN(μ)

To see how this achieves the desired effect, consider the tableau below. The outlined /ə/ segments are to be interpreted as foot-parsed moras, and the underlined /l/ segments in candidate (88b) are to be interpreted as being in the configuration shown in (82c). What is shown is that when a /ə/ is stressable by virtue of being in a sequence of /ə/ segments, it is immune to the preference for geminates that MIN(μ) provides, replicating the result in LeSourd (1993) which was achieved by ordering geminate formation after stressability assignment.

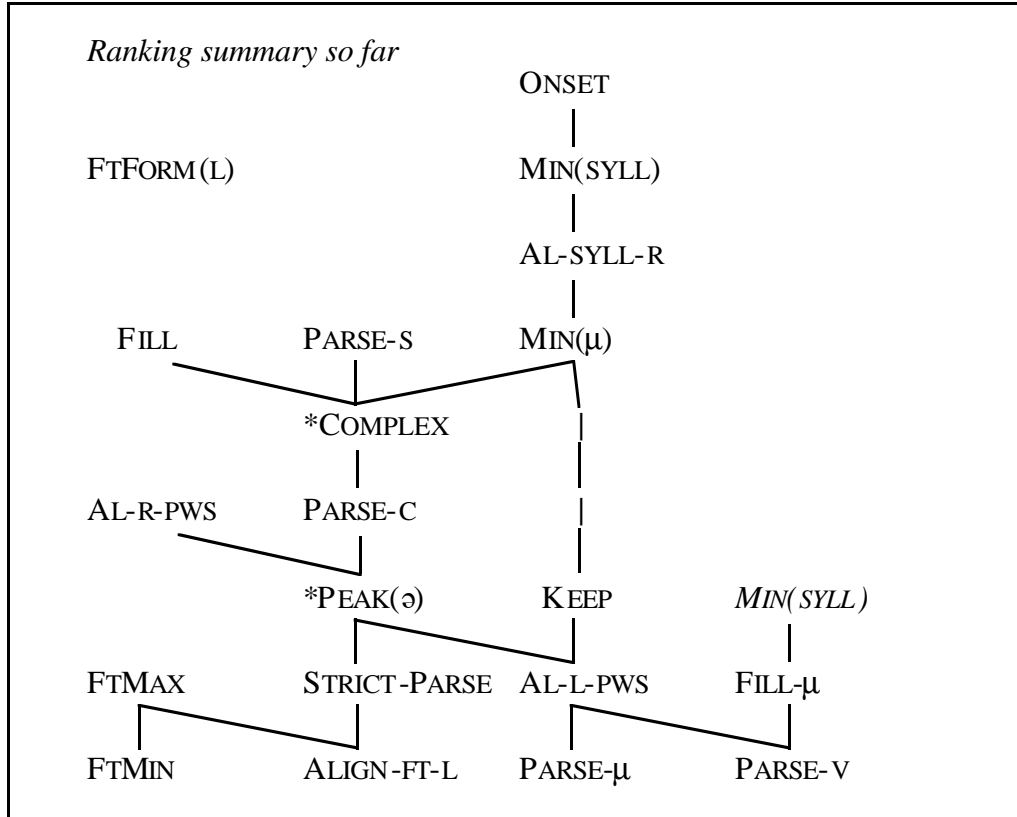
(88)

	/etələlohkecik/	AL-SYLL-R	MIN(μ)
a.	(é)(təl.ə.loh)(ke.cik)	...+ $\mu\mu\mu\mu\mu\mu\mu\mu$ + $\mu\mu\mu\mu\mu\mu\mu\mu$!	... * ...
b.	(é)(təl.l ^o h)(ke.cik)	...+ $\mu\mu\mu\mu\mu\mu\mu\mu$ + $\mu\mu\mu\mu\mu\mu\mu\mu$!	...√...
c.	☞ (ét)ə(l ^o .loh)(ké.cik)	...+ $\mu\mu\mu\mu\mu\mu$ + $\mu\mu\mu\mu\mu\mu\mu\mu$... * ...

The tableau above brings out a couple of points about the evaluation of constraints with respect to geminate structures. Recall that when AL-SYLL-R was introduced, it was indicated that we would wish to use moraic segments for the measure of misalignment. We can see from the example given above in (88) that for the ranking in (87) to have the correct effect, it must not be possible for geminate structures to increase the harmony of AL-SYLL-R. If we were measuring simply moras, the geminate structures which drop a medial /ə/ would conserve a mora and thereby improve the representation with respect to AL-SYLL-R. In that case, (88b) would tie with (88c) under the assumption that violations of AL-SYLL-R are pooled rather than evaluated syllable-by-syllable. However, by accepting that the unit of measure is moraic segments, (88c) becomes the most optimal candidate because both /l/ segments in candidate (88b) are moraic segments.

One further thing to consider is the treatment of these geminate structures with respect to *COMPLEX. Recall that the definition of *COMPLEX in (29) required that syllable margins consist of no more than one segment, yet we also must allow the structures in (82) to surface. Thus, it must be the case that MIN(μ) outranks *COMPLEX.

(89) MIN(μ) » *COMPLEX



4.2. Clusters with /h/ and *PEAK(ə)

The phoneme /h/ has a number of complex properties. With the analyses up to the previous section, we have accounted for all of the contexts in which /ə/ will be unstressable as well as those in which it will syncopate except those contexts which involve /h/.

The examples below demonstrate the divergent behavior of *hC* and *hL* clusters with respect to the stressability of a following /ə/ (contexts (13b-c)). When /ə/ follows a cluster of the shape *hC*, the /ə/ may remain unstressable, as shown in (90a), but when /ə/ follows a cluster of the shape *hL* (where *L* indicates a sonorant), the /ə/ must be stressable just as if it followed any other cluster, as shown in (90b).

- (90) a. téhkəneps ‘monkey’ (82)
 b. ác-ehl-əso change-TA-REFLEX-(3) ‘he changes himself’ (82)

Also, the presence of a preceding /h/ can induce syncope of an unstressable /ə/ before a sonorant (context (25c)). Note that this is one of the few instances in which a following sonorant

cannot “save” a /ə/ from syncope. This behavior is shown below, where the (a) example motivates the presence of underlying /ə/ and the (b) example shows the syncope.⁴⁸

- (91) a. íkətəhəm yawn-(3) ‘he yawns’ (264)
 b. íkətáhm-ok yawn-(3)-33PROX ‘they (du.) yawn’ (264)

Before moving on to discuss the proposal to account for these cases, it is worth mentioning a possible alternative approach which would hold that a *hL* sequence simply cannot be a coda in Passamaquoddy because /h/ and sonorants are too close in sonority. That is to say, while there is enough of a sonority difference between /h/ and obstruents to permit a complex coda in such cases, this is not the case for *hL*. Although this will handle the phenomenon of (90) without difficulty, it does not account for (91), unlike the account we give below.^{49,50}

The intuition behind the approach taken here is that /h/ in some sense “steals” a following mora. In examples like (91b), the /h/ “steals” the mora which is underlyingly associated to the /m/, making it unavailable to the intervening /ə/. In examples like (90b), the /h/ “steals” the mora underlyingly associated with the sonorant, forcing the sonorant to be an onset in order to be parsed at all. In short, the /h/ phoneme in Passamaquoddy is “greedy.” This intuition is formalized in the constraint given below in (92).⁵¹

- (92) GREED A greedy phoneme (*e.g.* /h/) must be associated to two moras.

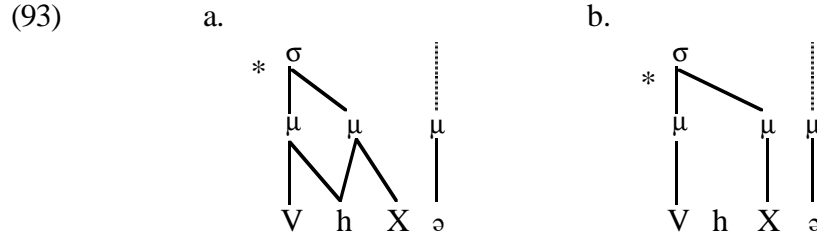
To begin our discussion of how GREED plays a role in syllabification, let us first turn to the *hC/hL* cluster distinction with respect to the stressability of a following /ə/. There are several potential configurations available for underlyingly *VhCə* and *VhLə* sequences. To begin, two are shown below which will be nonoptimal whether either a sonorant or an obstruent is involved.

⁴⁸The vowel change from /ə/ to /a/ shown in (91b) will not be discussed, but is the result of a general assimilation process that occurs before *hm* clusters.

⁴⁹There are also several related phenomena concerning /h/ and syllabification which at present have no explanation under either account, such as the fact that /h/ will drop out if either a *hCC* cluster or a *hCəC* sequence (with an unstressable but exceptional /ə/) threatens to surface. The strange behavior of /h/ does not appear in these cases to be sonority-driven, although it is not clear what the account will be under the “Greed” story discussed below either.

⁵⁰Since the “Greed” story given below is an unusual innovation, it is worth mentioning that not much of the rest of the analysis turns upon this. If we take a different view which just stipulates that *hL* is disallowed in codas, we lose the data in (91), but not much else (since the upcoming section of *VhV* assimilation, although also involving /h/, does not involve its “greediness”).

⁵¹I leave entirely open what the nature of the marking of /h/ as “greedy” is. The constraint was formulated in such a way as to allow other phonemes to be marked as “greedy” in other languages, although /h/ appears to be the only phoneme in Passamaquoddy which is of this type.

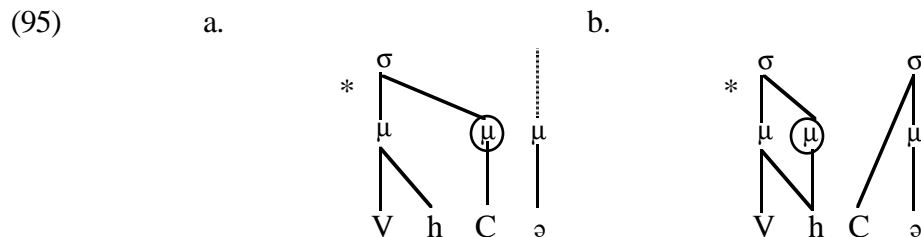


The structure in (93a) is an example of a structure which satisfies GREED, since the /h/ segment is parsed by two moras. However, it fatally violates the more highly ranked MIN(μ) because it faces contradictory requirements; it is not possible for the /h/ to be simultaneously identical to the vowel and to the consonant denoted “X” in (93a). The structure in (93b) is also ruled out because MIN(μ) is not satisfied, given that there are other candidates which do satisfy MIN(μ), as we will see.

In Passamaquoddy, it seems that it is not possible to add a mora to the representation only for the purpose of satisfying GREED. In other words, we know that FILL- μ must outrank GREED.

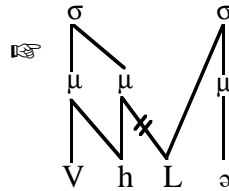
(94) FILL- μ » GREED

This causes an interesting asymmetry between *VhCə* and *VhLə* sequences, since the sonorants come into the computation with a mora already attached, and will always be spared from any need to violate FILL- μ . We see that the following two structures for *VhCə* sequences will be ruled out by FILL- μ , in light of the fact that candidates are available which do not violate FILL- μ . In (95b), notice that GREED is satisfied. The circled moras in (95) are epenthetic, violating FILL- μ .



The structures analogous to the two above, which for obstruents are ruled out by violations of FILL- μ , are not impossible for sonorants because sonorants need not violate FILL- μ in order to achieve the same structures. Since GREED is satisfied in (95b), its analog for a sonorant, shown in (96), will be the victor, despite the violation of *PEAK(\emptyset) and of KEEP.

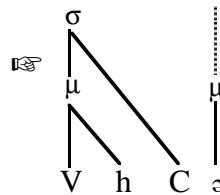
(96)



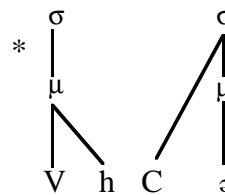
For obstruents, however, the only two remaining candidate structures are both in violation of GREED, and thus GREED does not make a determination between them. The final decision, in favor of (97a) against (97b) is made by the violation of *PEAK(ə) in (97b).

(97)

a.



b.



The ranking which has these effects is given below in (98).

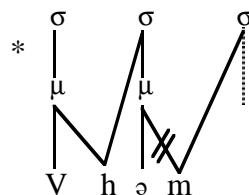
(98) MIN(μ) » FILL- μ » GREED » *PEAK(ə), KEEP

Recall that the formulation of MIN(SYLL) in section 3.3 required that a syllable dominate two moraic segments. Notice that, given this formulation, both of the structures in (97) are satisfactory with respect to MIN(SYLL). For the structures discussed in this section, this means that MIN(SYLL) has no influence on the result, since in every case where MIN(μ) is satisfied, MIN(SYLL) is also satisfied.

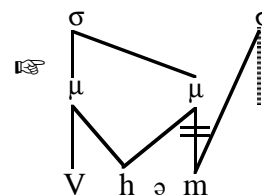
Now let us turn to the last case discussed in this section, an underlying *həm* sequence, which is a somewhat more graphic example of the greediness of /h/. There are several structures in possible competition, but we will discuss only the two which are relevant. The structures shown below satisfy MIN(μ), MIN(SYLL), FILL- μ , and ONSET. They differ, however, with respect to their satisfaction of GREED. Given that (99b) is an option, (99a) is ruled out in favor of (99b) despite a violation of the low-ranked PARSE-V which is thereby incurred.

(99)

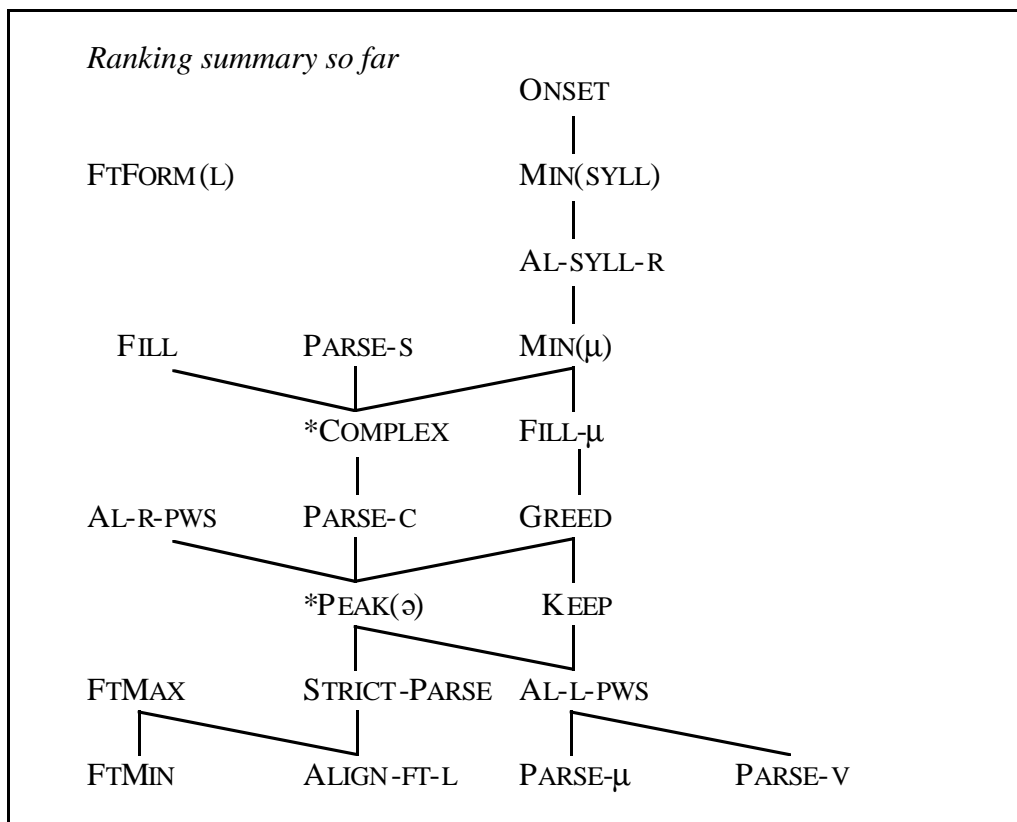
a.



b.



If the *Vhəm* sequence is word-final, such as in (91a), the structure analogous to (99b) is ruled out by PARSE-C because the word-final /m/ cannot serve as an onset to a following syllable. In this situation, a structure like (99a), except with /m/ as a coda consonant, would be most optimal.



4.3. Remaining contexts: *s-hs* epenthesis and pre-/h/ syncope

There are two contexts in (13) and (25) which remain to be explained. They are (13d), which indicates that /ə/ becomes stressable when preceded by /s/ and followed by /hs/, and (25b), which indicates that unstressable /ə/ will undergo syncope before /h/.

The explanation for (25b) is straightforward, since it is nothing more than pre-obstruent syncope. /h/ does not come into the system with its own mora attached, thus what causes /ə/ to syncope before obstruents and /h/ alike is the fact that neither obstruents nor /h/ can provide a mora. Moreover, because FILL-μ outranks it, GREED will have no voice in the matter, making /h/ even more like an obstruent in this context.

Unfortunately, a full explanation for (13d) lies outside the scope of this analysis, due to the fact that it is tightly interwoven with a process of morphologically governed epenthesis and an assimilation which has the net result of rendering underlying *s/hs* sequences as *sæss* and other

underlying *Chs* sequences either as *Cəss* or *Cs*, depending on the independently determined stressability of the epenthetic /ə/. Since satisfactory accounts of neither the epenthesis nor assimilation processes has so far been proposed in the present framework, discussion of the phenomenon of “*s-hs* epenthesis” (13d) would be premature. Because none of these three phenomena will be discussed again in this paper, these phenomena present a clear topic for future research.⁵²

4.4. H-Assimilation

Another place where the effects of $\text{MIN}(\mu)$ are visible is in the vowel assimilation phenomena. In this section we will look at a set of assimilations involving the vowel /o/, and in the next section we will look at assimilation behavior for other vowels as well.

To begin the discussion, let us consider how LeSourd describes the phonetics of the /h/ phoneme. He states that

h is pronounced with glottal friction when it precedes a vowel, but this friction is frequently omitted where *h* follows a vowel before another non-syllabic. In this position, *h* is often realized as a voiceless continuation of the preceding vowel, but it may instead be reflected by the pronunciation of this vowel with creaky voice, or only by the relatively greater length which is characteristic of vowels before *hC*.⁵³

/h/ appears to have two realizations, one as /h/ and one as a sort of augmentation of a preceding vowel. If we assume that /h/ has its articulatory features under the Gutural and Larynx nodes, but no Place features, we have the following plausible scenario: In a context where /h/ follows an /o/ and precedes a consonant it may coparse with the mora of the preceding vowel, satisfying $\text{MIN}(\mu)$ by assimilating that vowel’s Place features, in structures similar to those discussed in section 4.2. The result is that the /h/ segment would have identical Place features (satisfying the identity requirements of $\text{Min}(\mu)$), but would retain its laryngeal features, which quite possibly is the cause of the phonetic realization LeSourd indicated, as quoted above. On the other hand, when /h/ precedes a vowel, /h/ will be recruited as a consonant to satisfy the

⁵²Speculating prematurely, it would appear that the assimilation from *əhs* to *əss* indicates that the /h/ and /s/ segments are able to be coparsed by $\text{MIN}(\mu)$. This means that /h/ is not only capable of assimilating the quality of vowels, but also able to assimilate the quality of /s/. The particular behavior of /s/ with respect to stressability might be linked to its special behavior with respect to syllabification (*e.g.*, via the PARSE-S constraint or some replacement) as well as to the fact that it is segmentally identical to the material which surfaces at the other side of the /ə/. An explanation must be given as to why syncope isn’t favored to further satisfy $\text{MIN}(\mu)$, but this might also be evidence of the presumably existing $\text{MAX}(\mu)$ which would prevent a single mora from parsing all three segments. Theories in each of these areas have been tentatively explored, but none is complete enough for presentation beyond these speculations in a footnote.

⁵³LeSourd, p. 37.

ONSET constraint. Because /h/ can be both an onset and coparsed with a nuclear mora, we will think of it as initially unspecified for the feature $[\pm\text{Cons}]$. The implications of this status will become clearer in the discussion of the /o/ assimilations discussed below, where we will conclude that /o/ too is unspecified for $[\pm\text{Cons}]$.

To begin, let us consider two assimilation rules proposed by LeSourd, which are listed below.⁵⁴

- (100) a. $\begin{array}{ccc} \text{V} & \text{C} & \text{V} \\ | & | & \\ \text{o} & \text{h} & \end{array} \rightarrow \begin{array}{ccc} \text{V} & \text{C} & \text{V} \\ & \swarrow \searrow & \\ & \text{o} \ \emptyset & \end{array} \quad \begin{array}{l} (\text{ohV} \rightarrow \text{owV}) \\ \text{(p. 52)} \\ \text{“H-Assimilation”} \end{array}$
- b. $\begin{array}{ccc} \text{V} & \text{C} & \text{C} \\ | & | & | \\ \text{o} & \text{w} & [-\text{son}] \end{array} \rightarrow \begin{array}{ccc} \text{V} & \text{C} & \text{C} \\ | & | & | \\ \text{o} & \text{h} & [-\text{son}] \end{array} \quad \begin{array}{l} (\text{owC} \rightarrow \text{ohC}) \\ \text{(p. 58)} \\ \text{“untitled”}^{55} \end{array}$

The sum result of these rules is that underlying sequences *oh* and *ow* will always surface identically, in a shape which is predictable by the status of the following segment. Prevocally, a /w/ will surface for both of these underlying sequences, but preconsonantly, the /o/ vowel will be pronounced as long, continued as devoiced, or in creaky voice—*i.e.*, realized as *oh*.

LeSourd notes in his discussion of the lack of vowel hiatus (a topic explored later in section 4.7) that in general, when two full vowels fall together in the underlying form, a /y/ is inserted between them. However, he also notes that “there are no clear examples of glide insertion after /o/.”⁵⁶ In light of this and the effect that the rules in (100) describe, we might suppose that there is not actually an underlying distinction between /o/ and /w/, but that the two are in fact the same phoneme, unspecified for the feature $[\pm\text{Cons}]$.⁵⁷ We assume that GEN can

⁵⁴(100a-b) do not address the case of *owL*, where *L* is a sonorant. However, there are no instances of *wL* clusters attested in Passamaquoddy, so certainly if *owL* were underlying, it must either surface as *oL* or as *ohL*. Because (100b) was not explicitly stated and argued for in LeSourd (see the following footnote), the evidence which led him to specify obstruents in his informal statement of the rule is not clear. It may be the case that no such underlying clusters occur, in which case the point is moot and the restriction to obstruents need not be made, but no further discussion on this point will be indulged in here.

⁵⁵To the best of my knowledge, this rule was not explicitly formulated in LeSourd, but LeSourd, p.58, notes that: “The sequence *ow* does not occur before obstruents, since /ow/ surfaces as *oh* in this environment: compare *cków-ápən* (hither-dawn-(3)) ‘it is dawn,’ *ckóh-pé-he* (hither-liquid-go-(3)) ‘the tide is coming in.’”

⁵⁶LeSourd, p. 400.

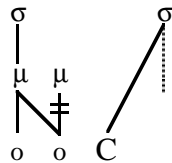
⁵⁷Although LeSourd does not appear to comment on this possibility, Teeter (1971) notes that “the semivocalic nature of *y* and *w* is exhibited in their respective interchange with *i* and *o*,” and gives as examples *pəməhse* ‘he ...continues’

add features including [+Cons] to the phonemes in the candidate set, and when underlying /o/ surfaces with the feature [+Cons] it is realized as /w/, otherwise being realized as /o/.⁵⁸ Although there is presumably a constraint against adding such features to the representations, it is ranked low and does not figure in the remainder of the analysis. What might cause the addition of the [+Cons] feature to improve the optimality of a candidate? Recall that in the definition of the ONSET constraint, it was a prerequisite of onsets that they be a nonmoraic consonant. Thus, when /o/ occurs before another vowel, the most optimal candidate will be one in which it actually functions as a /w/ onset. This explains LeSourd’s observation that glide insertion does not appear to occur after /o/.

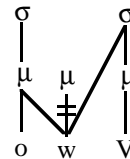
This also explains the behavior described in the rule (100b), since /o/ and /w/ are nondistinct segments, and when /w/ is not recruited as the onset of a following vowel, the MIN(μ) constraint, encouraging moras to doubly-link to identical segments, causes the two segments to be coparsed by a single mora. We assume that /o/, in its role as a full vowel, comes into the computation with a mora already attached, so that in the process of satisfying MIN(μ), KEEP must be violated once (which is not a problem, since we have previously established that MIN(μ) outranks KEEP). The resulting structure is that illustrated in (101a). If underlying *ow* were followed by a vowel (the case not explicitly covered by (100b)), the most optimal candidate would have a [+Cons] feature added to the underlying /o/ in order for it to function as the onset of the following syllable, as shown in (101b). Notice that in (101b), the demands of MIN(μ) and ONSET are simultaneously satisfied by doubly-associating the /w/ segment to the preceding mora and the following syllable. That this is the correct structure is suggested results in the next section on *VhV* assimilation, but the implication here is that MIN(μ) is satisfied by two coparsed segments even if they vary with respect to the value of [+Cons].

(101)

a.



b.



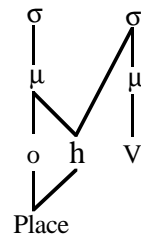
walks along’ and *macewse* ‘he walks off’ both of which, he suggests, contain the stem *-ohs-* ‘walk.’ This brings up a question of whether /i/ and /y/ are also, like /o/ and /w/, underlyingly nondistinct, but this possibility does not have any real implications in the scope of the present analysis.

⁵⁸Morris Halle (p.c.) suggests that this picture might be simplified if we do not involve the feature [\pm Cons] in this way, but simply say that /o/ is a vowel but is pronounced as /w/ when in onset position. This would allow the removal of the “consonantal” specification in the ONSET constraint. This idea will probably simplify some of the present discussion and is scheduled for further consideration.

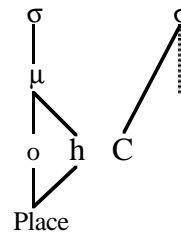
The rule in (100a) makes reference to an underlying *oh* sequence. Although $\text{MIN}(\mu)$ cannot be satisfied by the segments as they appear underlyingly, the behavior of /h/ suggests that it is a relatively unspecified segment and is capable of assimilating the Place features of a neighboring vowel in order to achieve satisfaction of $\text{MIN}(\mu)$. As was suggested with respect to /o/, we will suppose that /h/ is not specified for $[\pm\text{Cons}]$ and it therefore consonantal when needed as an onset, and is vocalic otherwise. Moreover, because the /h/ lacks Place features, it can be coparsed with a preceding vowel in satisfaction of $\text{MIN}(\mu)$ if the Place features can be spread to it. An /h/ will therefore surface as /w/ before a vowel when following an /o/ (as suggested by the rule in (100a), with the structure as shown in (102a)) and as /h/ before a consonant (shown in (102b), which, we recall from LeSourd’s description, is generally a voiceless extension of the vowel and not the glottal friction associated with /h/ in onset position).

(102)

a.



b.



One other comment should be made with respect to the structures in (102). Notice that although these structures involve /h/, in neither of these structures is GREED an issue since there are no available moras in the local vicinity that can be appropriated without causing a violation of higher ranking constraints like ONSET .

4.5. *VhV* Assimilation

Generally in Passamaquoddy, where two vowels are separated by /h/, the first vowel takes on the quality of the second, which will provide us with yet another example of the influence of $\text{MIN}(\mu)$ on Passamaquoddy syllabification, extending the discussion of the previous section. An example of the “*VhV* assimilation” phenomenon is shown below, for the stem /pət-əh/ (hook-TA) ‘hook (a fish).’ The examples in (103) show syncope of the second vowel of this stem, which implies that the underlying vowel is probably /ə/.⁵⁹ In (104), we see that when this vowel is not subject to syncope, it always takes on the quality of the vowel which follows the stem-final /h/. Notice that in morphemes of this sort with underlying vowels other than /ə/, there

⁵⁹Although, given that there are instances of syncope of /i/, /o/, and /a/ (albeit rare), even the identification of an underlying /ə/ based solely on its syncope behavior is not altogether conclusive.

is often no basis for determining the identity of the underlying vowel because it will always appear on the surface with an assimilated quality.

- (103) a. h-pát-h-a-l 3-hook-TA-DIR-3.OBV ‘he hooks the other’ (259)
 b. pét-h-à-t hook-TA-DIR-3 AN-(PERF) ‘when he hooked the other’ (259)⁶⁰
- (104) a. pt-áh-à-t hook-TA-DIR-3 AN-(SUBJ) ‘if he hooks the other’ (259)
 b. pt-éh-èk hook-TA-1 I-(SUBJ) ‘if we (exc.) hook him’ (259)
 c. pt-íh-i-hìn hook-TA-1.OBJ-2-(SUBJ) ‘if you (sg.) hook me’ (259)
 d. pt-óh-òk hook-TA-1/3(3)-(SUBJ) ‘if I hook him/them’ (259)
 e. pt-éh-èt hook-TA-2/3(3)-(SUBJ) ‘if you (sg.) hook him/them’ (259)

Another example is the following, where the form in (105) suggests that the underlying vowel is /a/, and in (106), we see the assimilation. This example indicates that *VhV* assimilation is not simply a property of an underlying /ə/.

- (105) néhpá-hto-n (3)-kill-TI-3 IN ‘he kills it (e.g. a plant)’ (260)
- (106) a. k-néhpá-h-a-l 2-kill-TA-DIR-3.OBV ‘you (sg.) kill him’ (260)
 b. k-néhpí-h-i 2-kill-TA-1.OBJ ‘you (sg.) kill me’ (260)
 c. k-néhpó-h-ol 2-kill-TA-2.OBJ ‘I kill you (sg.)’ (260)

VhV assimilation generally only applies to sequences in which the first vowel is /a/, /e/, or /ə/ (although any vowel may be the second, as can be seen in (104)). We have observed in the preceding section that a sequence of *ohV* does not undergo *VhV* assimilation but rather surfaces as *owV*. An underlying *ihV* sequence resists *VhV* assimilation and the /i/ surfaces, as shown below.

- (107) a. pəm-ákəmí-həm along-snowshoe-AI-(3) ‘he goes along on snowshoes’ (260)
 b. ési-h-èk give.drink-TI-TI-3 AN-(PERF) ‘when he watered it’ (260)

Note that an underlying sequence of *əhV* will always surface either as *hV* (syncope) or as *VhV* (if the /ə/ was in a position to be stressable), which was demonstrated above the examples in (103-4).

Here, it is suggested that this phenomenon is attributable to the same cause as that underlying the /o/ assimilations in the previous section, except that instead of /h/ assimilating the quality of its coparsed vowel, in *ahV* and *ehV* sequences the vowel assimilates to the /h/. More specifically, these vowels lose their Place features to match the Place-lessness of /h/ in order to satisfy the identity requirements of MIN(μ). In this situation, I suggest that the empty vowel is

⁶⁰As mentioned in a previous footnote, the change in the first vowel from /ə/ to /e/ is a result of the particular conjugation and is not relevant to the discussion here. (See also fn. 46).

interpreted phonetically by anticipating the Place of the upcoming vowel.⁶¹ As support for the deficient nature of these first vowels in the *VhV* sequences, consider the following statement by LeSourd, who writes that

the *VhV* sequences which result from assimilation have special phonetic properties. The first vowel in such a sequence is usually quite short and is often weakly articulated. In fact, it seems that stress is often phonetically realized on the second vowel in the sequence even when it is phonologically assigned to the first.⁶²

This first vowel in a *VhV* is also not subject to penultimate lengthening,⁶³ and LeSourd (p.c.) indicates that for some speakers a *VhV* sequence can be reduced to *hV* by dropping the first vowel entirely.

For *ihV* sequences, since we see no spreading, we suppose that the coparsed structure is non-optimal, for reasons which we will explore below.

To begin differentiating the behaviors of the different vowels, we first must decide how they are distinguished from one another. The descriptions of Passamaquoddy's vowels given by LeSourd are the following:

i is a high, front, unrounded vowel..., *e* is a non-high front unrounded vowel..., *ə* is a central vowel..., *o* is a non-low back round vowel...probably best interpreted as a phonologically high vowel, *a* is usually a low central to back vowel, but it varies considerably in height.⁶⁴

Thus, we might contrast the vowels along [High] and [Back] dimensions. The behavior of /ə/ most closely matches the behavior of the other [-High] vowels, but the data from section 4.6 suggests that it is unspecified for these dorsal features, so we will assume here that /ə/ has a Dorsal node with no features specified below it.

(108)

	+High	-High
+Back	o	a
-Back	i	e

⁶¹Note that this phonetic process may also be the same one that confers the quality on vowels which come about via Dorsey's Law in Winnebago.

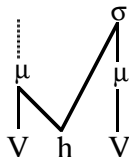
⁶²LeSourd, p. 55.

⁶³LeSourd, p. 47.

⁶⁴LeSourd, pp. 35-6.

The structure which is involved for *VhV* sequences (other than *ihV*) is the following, where the first vowel and the medial /h/ are coparsed by the same mora, satisfying MIN(μ) if the identity requirement is met, while the /h/ also serves as the consonantal onset for the syllable involved in the second vowel, satisfying ONSET.

(109)



Note that the /h/ will be [+Cons] by virtue of its role as an onset. Recall that when the first vowel is /o/, the features spread from the vowel to the /h/ to achieve satisfaction of the identity requirement of MIN(μ), but we have seen that when the first vowel is /a/ or /e/, the Place features of the vowel do not spread to the /h/ but instead seem to delete. There appears to be a behavioral split down the [\pm High] division line.

First, let us consider the [-High] vowels. In a structure like (109), there are two possibilities available to satisfy MIN(μ)'s identity requirement: either spread the vocalic Place features to the /h/, or delink the Place features from the vowel. The first option is made difficult in Passamaquoddy, however, because there are no phonemes which can be pronounced in the medial position if the Place features including the [-High] dorsal feature are spread because there are no [-High] glides in the phonemic inventory of Passamaquoddy. Accordingly, the Place features cannot spread to /h/, either due to a constraint requiring surfacing phonemes to be in the phonemic inventory of the language, or due to a specific constraint which forbids [-High] consonants (the *NONHIGLIDE constraint defined below). In the present analysis, we will suppose that this behavior is due to the latter.⁶⁵ The only other way in which the identity requirement of Min(μ) can be satisfied is by delinking the Place features from the vowel, to match the lack of Place features on /h/.

Also note that it is not an option to avoid violations of *NONHIGLIDE by not parsing the /h/ into onset position, indicating that ONSET » *NONHIGLIDE.

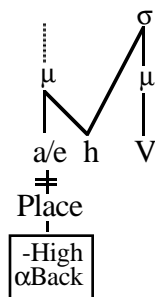
(110) *NONHIGLIDE *[-High, +Cons]
 PARSE-[-HIGH] A [-High] feature must be parsed

(111) ONSET » *NONHIGLIDE » MIN(μ) » PARSE-[-HIGH]

⁶⁵It should be noted that a constraint which requires surfacing segments to be in the language's phonemic inventory might end up being a preferable choice, but adopting such a constraint will not change the present analysis much.

The resulting structures after the removal of the Place nodes would be like that shown below in (112).⁶⁶ Recall that the idea here is that the phonetic interpretation of the first vowel in such structures is that it will anticipate the Place features from the upcoming vowel, so the first vowel is indeed left Place-less in the output of the Optimality Theoretic computation.

(112)



Turning to the [+High] vowels, we have two behaviors to consider. In neither case is delinking the dorsal features of the vowel an option, but even spreading is prohibited when the vowel is [-Back], *i.e.* /i/. The simplest approach is just to suppose that there is another constraint like *NONHIGLIDE which prohibits [-Back] glides as well. By ranking these constraints above MIN(μ), it becomes better not to coparse if the coparsed segments cannot be made identical without violating the glide constraints. As before, it also appears that the ONSET constraint cannot be violated in order to avoid a *FRONTGLIDE violation.

(113) *FRONTGLIDE *[-Back, +Cons]
 PARSE-[+HIGH] A [+High] feature must be parsed

(114) PARSE-[+HIGH], *FRONTGLIDE » MIN(μ)
 ONSET » *FRONTGLIDE

*FRONTGLIDE is a counterintuitive constraint given that Passamaquoddy indeed has a front glide, namely /y/. However, by virtue of also being [+High], *FRONTGLIDE will never cause delinking of an underlying /y/'s Place node, provided we assume the following ranking.

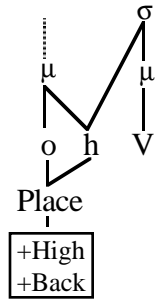
(115) PARSE-[+HIGH] » *FRONTGLIDE

The resulting structures for the [+High] vowels would be as shown in (116).

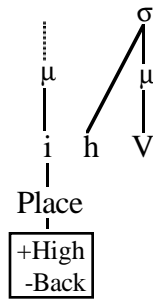
⁶⁶Note that although the box containing the [±High] and [±Back] features appear under the Place node in this diagram and in the diagrams to come, it is not suggested that these features are directly dominated by the Place node. Rather, they are probably under the Dorsal node which is itself under the Place node. The diagrams have been simplified for readability, however.

(116)

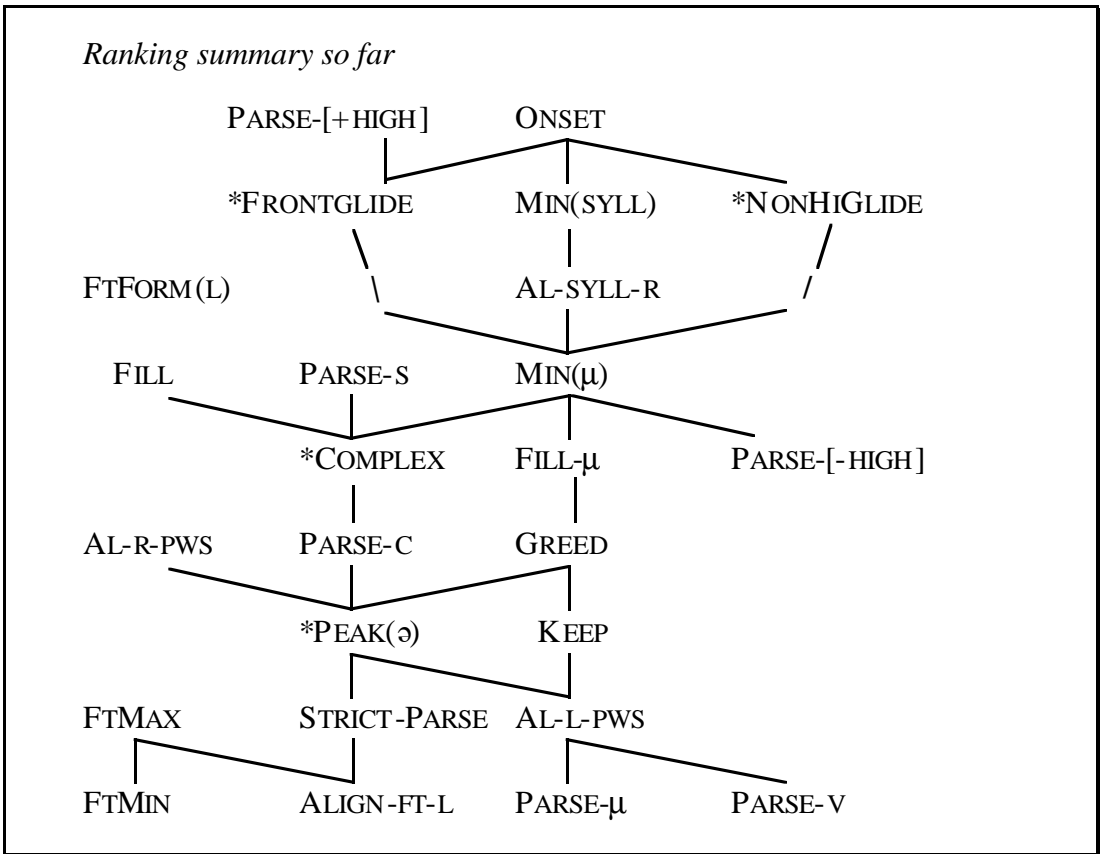
a.



b.



Finally, notice that we have not changed the dynamics of assimilation in a *VhC* context, since *FRONTGLIDE and *NONHIGHLIDE only apply to consonants and /h/, being unspecified for [±Cons], is only [+Cons] when it is in onset position.



4.6. Schwa rounding and contraction

The next two assimilation facts barely warrant their own section, now that the preceding discussion has done all of the groundwork. LeSound proposes two rules for the assimilations discussed in this section, which are listed below.

- (117) a.
$$\begin{array}{ccc} \text{V} & \text{C} & \rightarrow & \text{V} & \text{C} \\ | & | & & \swarrow & \searrow \\ \text{ə} & \text{w} & & & \text{o} \end{array} \quad \begin{array}{l} (\text{əw} \rightarrow \text{ow}) \\ \text{(p. 51)} \\ \text{“Schwa Rounding”} \end{array}$$
- b.
$$\begin{array}{ccc} \#C & \text{C} & \text{V} & \rightarrow & \#C & \text{V} \\ | & | & & & | \\ \text{w} & \text{ə} & & & \text{o} \end{array} \quad \begin{array}{l} (\#Cwə \rightarrow \#Co) \\ \text{(p. 226)} \\ \text{“Contraction”} \end{array}$$

As mentioned earlier, we assume here that /ə/ is unspecified for features below the Dorsal node. Under this assumption, the effect described by the rules above is a clear consequence of the attempt to satisfy MIN(μ) in the output representations.

When /o/ and /ə/ occur next to each other, /ə/ can become Place-identical to /o/ by assimilating its Dorsal features, and then both segments can be coparsed by a single mora, satisfying Min(μ). Also notice that the structures described in (117) will surface as either *oh* or *ow* depending on the nature of the following segment, as previously discussed in §4.4.⁶⁷

As an interesting corollary to this answer to the rules in (117), note that /ə/ will generally assimilate to any vowel it is underlyingly adjacent to, a fact which we discuss in the next section.

4.7. The lack of vowel hiatus and evaluation of ALIGN

Passamaquoddy allows no surface vowel hiatus. When vowel hiatus threatens to surface, it is resolved in one of two ways. If the second of the two vowels is an unstressable /ə/, it will delete. Otherwise, an epenthetic /y/ is inserted between them. The most common case is easily explained by a ranking of ONSET above FILL, making epenthesis of /y/ allowable if otherwise threatened with an onsetless syllable (also suggested to account for the same phenomenon in Lardil by McCarthy & Prince (1993a,b)).

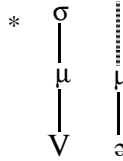
(118) ONSET » FILL

The other strategy of hiatus avoidance, syncope where the second /ə/ is unstressable, is almost as straightforward given the maturity of the analysis at this point. First, notice that if unstressable /ə/ is the second vowel in a sequence, a mora not a syllable is involved, thus exempting it from any requirements ONSET might have. What this means is that an explanation

⁶⁷Note that, by the way the rule is formulated, “Schwa Rounding” only occurs for stressable /ə/ segments. This seems to imply that a foot-parsed mora cannot parse two segments (satisfying MIN(μ)), although this is just speculation, and no reason for this restriction is clear. I ignore this for the moment, leaving it for future research.

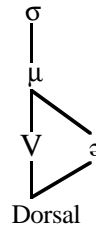
of the lack of vowel hiatus between full vowels which relies on ONSET, cannot be used for hiatus involving unstressable /ə/. The structure which must be disallowed by some other means is that shown below.

(119)



However, given the assumption that /ə/ has no dorsal features specified, this structure is already disallowed because it would more optimal with respect to MIN(μ) to assimilate the Dorsal node of the two vowel segments together, in a structure like that in (120) below. That is to say, it is not exactly true that the /ə/ syncopates to avoid hiatus; rather, it is simply camouflaged by the adjacent vowel in such cases.⁶⁸

(120)



There is still another crucial point to consider in this connection, however. As we have seen several times even in the data presented here, Passamaquoddy allows vowel-initial words quite freely. This is clearly in conflict with a high-ranking of the ONSET constraint, indicating that there is some constraint which is higher-ranked than ONSET and which discourages word-initial epenthesis.

Facing a similar situation in Axininca Campa, McCarthy & Prince (1993a, b) suggest that this phenomenon is the result of an alignment constraint, ALIGN-L = ALIGN(Stem, L; PrWd, L), which outranks ONSET. This constraint insists that the left edge of the morphological stem be

⁶⁸There is an inconsistency with respect to the phonetic interpretation of syllable nuclei which parse two segments, which we must leave as a project for future research. In the situation where an underlying /ə/ shares a mora with a full vowel, as in this section, the assumption is that the full vowel is not lengthened. However, earlier, we supposed that the fact that vowels generally lengthen before /h/ was due to the same structure, two segments coparsed into a single mora. As pure speculation, we might attribute this to the fact that the two segments are *actually* fully identical in the “hiatus” case discussed above, whereas in the case involving /h/, the second segment has additional (laryngeal) features. The idea here would be that coparsed identical segments are not realized as double-length, but nonidentical segments must be realized as long because the articulators have two distinct phonemes to realize.

aligned with the left edge of the prosodic word. By ranking this constraint above ONSET, no word-initial onsets will be epenthesized, since their presence would serve to disalign the stem and the prosodic word. McCarthy & Prince also argue that underparsing the word-initial vowel, satisfying ONSET, will result in a violation of ALIGN-L.

What makes the situation in Passamaquoddy intriguing is that, on top of the fact that vowel-initial words are allowed, we also have evidence that a word-initial /ə/ undergoes syncope. The juxtaposition of these two facts, along with the already established rankings which have placed ONSET far up in the rankings for Passamaquoddy, indicate that the ALIGN-L solution as suggested in McCarthy & Prince (1993a, b) will not be sufficient for Passamaquoddy. What is needed for Passamaquoddy is a constraint which is violated by epenthesis of a /y/ to form a word-initial onset, yet is not violated by the syncope of a word-initial vowel. Note that both of these situations which would both violate ALIGN-L as defined in McCarthy & Prince (1993a,b).

There is an aspect of the ALIGN family of constraints which has not been investigated in great detail (although considered in Mester & Padgett (1993) and Kenstowicz (1994c)), namely the metric which is to be used to determine the magnitude of an ALIGN violation. In McCarthy & Prince (1993a,b) and Kenstowicz (1994c), the violations of ALIGN-L were measured over distances in terms of *underlying* phonemes. In the present analysis, using ALIGN constraints which are of a fairly standard nature in the literature, violations of ALIGN-SYLL-R, AL-R-PWS, and AL-L-PWS are measured in terms of *surfacing* moras or segments, and violations of ALIGN-FT-L are measured in terms of *surfacing* syllables.

In light of these observations, ALIGN-L can be considered to be a “morphology oriented” constraint, taking the *underlying* morphological form as basic, while the other constraints are “prosody oriented” constraints, taking elements of the *prosodic* structure as basic. Recall that ALIGN-L is ALIGN(Stem, L; PrWd, L), which is taken to mean that for every morphological stem, there exists a prosodic word such that their left edges coincide. If the edges do not coincide, a gradient violation is incurred, proportional to the number of *underlying* stem segments which intervene. Recall also that AL-L-PWS = ALIGN(PrWd, L; σ, L), meaning that for every prosodic word, there exists a syllable such that their left edges coincide. Here, a violation is proportional to the *surfacing prosodic* segments which intervene, which is supported by the fact that syncope of a word-initial /ə/ will satisfy this constraint.

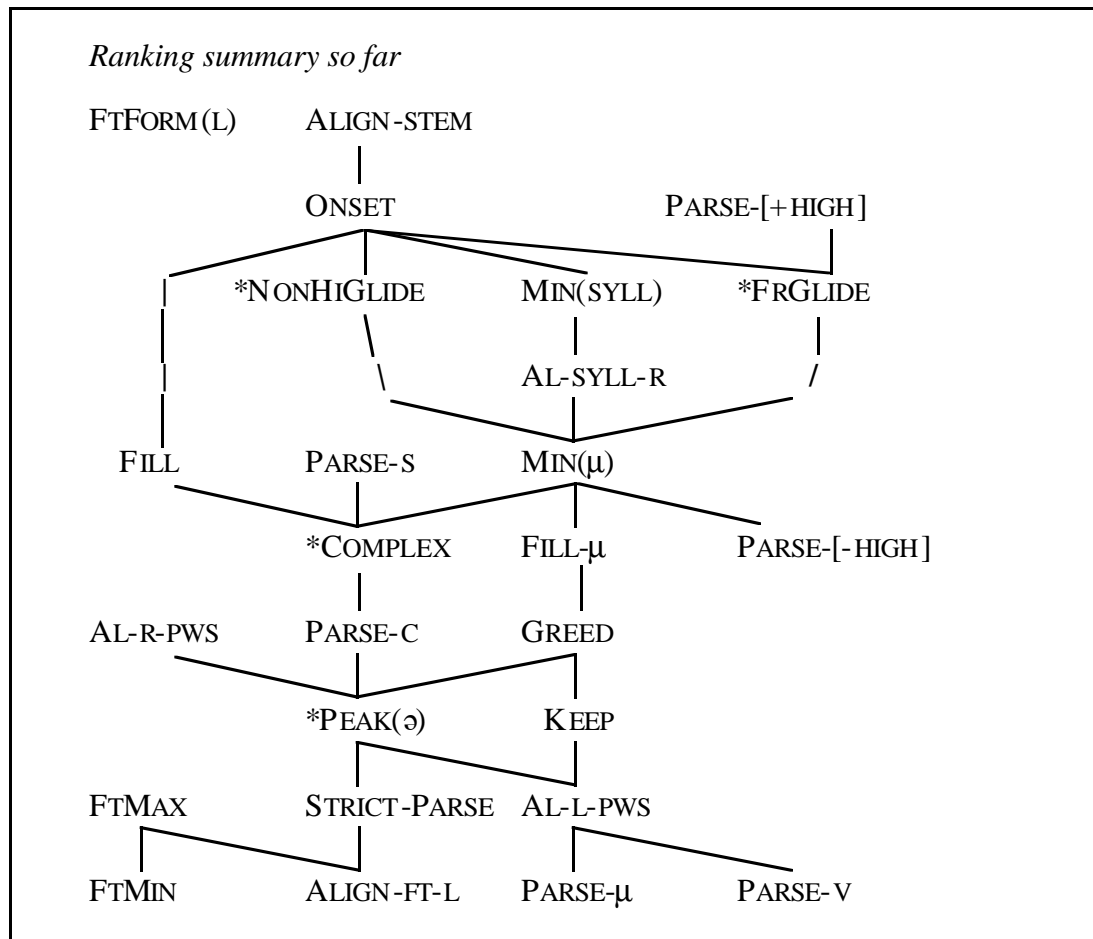
Perhaps, then, what is at work in Passamaquoddy is a “prosody oriented” analog of ALIGN-L, where only *surfacing* prosodic segments are considered in its evaluation. In other words, perhaps the constraint in Passamaquoddy is that given below.

- (121) ALIGN-STEM =ALIGN(PrWd, L; Stem, L); the left edge of a prosodic word must be minimally disaligned from the left edge of a morphological stem.

We see that if an epenthetic /y/ were added word-initially to satisfy ONSET, it will violate ALIGN-STEM, since the surfacing /y/ segment intervenes between the stem's left boundary and the prosodic word's left boundary. However, when a word-initial /ə/ is syncopated, there is crucially no violation of ALIGN-STEM, since no surfacing segments intervene between the left edge of the prosodic word and the left edge of the stem. Because of the now-familiar nature of the facts involved, we know that we have the ranking in (122)

(122) ALIGN-STEM » ONSET

More generally, we might speculate that the metric by which violations of ALIGN constraints are measured is correlated with the universal argument, meaning that if a *prosodic* element constitutes the universal argument, only *surfacing* elements will be counted when determining the magnitude of an alignment violation. Exploration of this possibility will constitute an interesting area for future research.



4.8. Final Vowel Deletion and final-/w/ deletion

4.8.1. Word final deletion

A large class of Passamaquoddy words surface with a rising pitch contour, which has been transcribed with a grave accent. Comparing words of this class in contexts which show this accent and contexts which do not reveals that the source of this accent is correlated with the deletion of a word final vowel. This is demonstrated below, where the (a) examples show the pitch contour, and the (b) examples motivate the underlying presence of the vowel.

- | | | | | |
|-------|----|--|----|---|
| (123) | a. | ótèn
'town' (453) | b. | óténɛk
town-LOC
'town (loc.)' (453) |
| (124) | a. | k-pòs
2-embark
'you (sg.) leave by boat' (453) | b. | k-pósíhpən
2-embark-PRET
'you (sg.) left by boat' (453) |
| (125) | a. | k-ótəm
2-smoke
'you smoke (sg.)' (454) | b. | k-ótəmápa
2-smoke-22
'you (du.) smoke' (454) |

Also notice that the vowel which hosts the pitch contour acts as the head of a full foot. Put another way, the deleted vowel was counted for stress placement. The generalization appears to be that the rising stress contour (indicated by the grave accent) is realized on the stressed vowel of a foot in which a syllable nucleus was deleted. This generalization is strengthened by the fact that in some uncommon cases, the final foot may have an unstressable vowel between its two syllables, causing the accent to appear on the penultimate surfacing vowel. Some examples are in (126).⁶⁹

- | | | | |
|-------|----|---|--|
| (126) | a. | nt-ótəl-əskwè-pən
1-ongoing-check.traps-11 | 'we (du. exc.) are checking traps' (177) |
| | b. | n-sákh-ótkwihì-pən
1-into.view-jump-11 | 'we (du. exc.) jump into view' (455) |
| | c. | k-nápískwahmà-pən
2-trip-11 | 'we (du. inc.) trip' (276) |
| | d. | n-sókwwì-pən
1-vomit-11 | 'we (du. exc.) vomit' (292) |

⁶⁹These examples are scattered throughout LeSourd (1993), so I have collected a number of them here.

- e. má te k-nəmi-y-ì-n-pən ‘you (sg./pl.) do not see us (exc.)’ (29)
not EMPH 2-see-TA-1.OBJ-NEG-11
- f. n-mós-okè-pən ‘we (exc.) get our hair cut’ (389)
1-cut.hair-PASS-11
- g. n-táhk-w-ən-ahkè-pən ‘we (du. inc.) arrest’ (439)
1-arrest-by.hand-AI-11

LeSourd suggests that this behavior is caused by a general rule of final vowel deletion, which will always delete a word-final vowel.⁷⁰ As for the numerous words which surface with a final vowel, these are generally words which underlyingly have a word final /-w/ suffix. An example of this situation is shown below in (127).

- (127) a. pəm-ásóke /pəm-asoke-w/ ‘he wades along’ (85)
along-wade-(3)

The existence of a process which deletes a word-final /w/ is independently supported by words such as the following recent borrowings, which have /w/ underlyingly but which lose it word-finally. Note that in these cases, the word-final /w/ does not underlyingly originate in the third person suffix, which indicates the existence of a more general phonological rule rather than a special morphologically-governed condition.

- (128) a. ópəsénta ‘sundog’ (455)
b. ópəséntáw-ək (sundog-33PROX) ‘sundogs’ (455)
- (129) a. káhpe ‘coffee’ (455)
b. káhpéw-əl (coffee-33IN) ‘cups, jars, etc. of coffee’ (455)

The explanation for the two word-final phenomena of final vowel and final-/w/ deletion will be unified by supposing that the word-final /w/ is “vowel-like” enough to delete by the same process that would otherwise delete a word-final vowel. In this respect, the analysis presented here is similar to that suggested by Hung (1994) for a similar phenomenon in Ojibwe, another Algonquian language. However, the implementation of the process she suggests will not be adequate to describe final vowel deletion in Passamaquoddy. Hung suggests that the process simply involves a high-ranking constraint which leaves a word-final mora unparsed, thus causing it to be Stray Erased. However, in Passamaquoddy, all coda consonants are moraic and this solution would predict the loss of word-final consonants as well. Moreover, we have evidence

⁷⁰At least for nouns and verbs. LeSourd also indicates that Final Vowel Deletion does not apply to particles and other grammatical words.

from the stress patterns that the mora was indeed parsed into a syllable and a foot, since the nonsurfacing vowel nevertheless “counts” for stress placement.

The analysis which will be pursued here is one in which, rather than being unparsed, a word-final vocalic segment will be deprived of its phonetic features. Phonetically, the stress on a foot which contains a syllable whose nucleus lacks phonetic features ends will be realized as having rising stress on the head of the foot. If the segment which lacks phonetic features is not the nucleus of a syllable, there will be no phonetic reflex. The constraint which accomplishes this is that given below in (130).

(130) FVD A surfacing word-final vocalic segment may not have phonetic features.

The FVD constraint has the effect of delinking the phonetic features from a word-final vowel or /w/, while leaving the rest of the structure intact. As noted by Hung (1994) when discussing Ojibwe, the dropping of a final vocalic segment is a very common phenomenon crosslinguistically, and the investigation of the properties of the FVD constraint should clearly be driven by crosslinguistic considerations.

4.8.2. The interaction between /h/ and Final Vowel Deletion

One item which lends indirect support to the interpretation given above is that Final Vowel Deletion does not occur after /h/, as can be seen in the following examples. The (a) examples show the vowel appearing word-finally after /h/, and the (b) examples indicate that the vowel underlyingly ends the word.

- (131) a. n-sákh-ətkwíhi ‘he jumps into view’ (455)
1-into.view-jump
- b. n-sákh-étkwihì-pən ‘we (du. exc.) jump into view’ (455)
1-into.view-jump-11
- (132) a. k-máca-ha ‘you (sg.) leave’ (455)
2-start-go
- b. k-máca-há-pa ‘you (du.) leave’ (455)
2-start-go-22

Recall that under the present analysis *VhV* assimilation involves the delinking of the first vowel’s Place features in order to meet the identity requirements of MIN(μ) with /h/. In that case, the first of the two vowels is phonetically interpreted (weakly) with the Place of the following vowel.

The cases in (131-2) are examples where both *VhV* assimilation and final vowel deletion might apply, but what we see is that *VhV* assimilation takes effect at the expense of final vowel deletion. Although still a speculative possibility, this might be due to the fact that if the final vowel lost its phonetic features (satisfying FVD), no Place feature is available from the following segment for the realization of the vowel which lost its Place features to satisfy MIN(μ). This requirement is stated in the NoGAP constraint defined below, although at this point, of course, NOGAP really does little more than restate the phenomenon in a concise way.

- (133) NOGAP A (vocalic) segment lacking a Place node must precede a vocalic segment which can provide Place features (in phonetic interpretation).

Because we don't see final vowel deletion taking precedence over *VhV* assimilation, we can assume that MIN(μ), the driving constraint behind *VhV* assimilation, is outranked by NOGAP.

- (134) NOGAP » MIN(μ)

And, of course, since final vowel deletion is blocked when NOGAP is at stake, we also know that NOGAP outranks FVD.

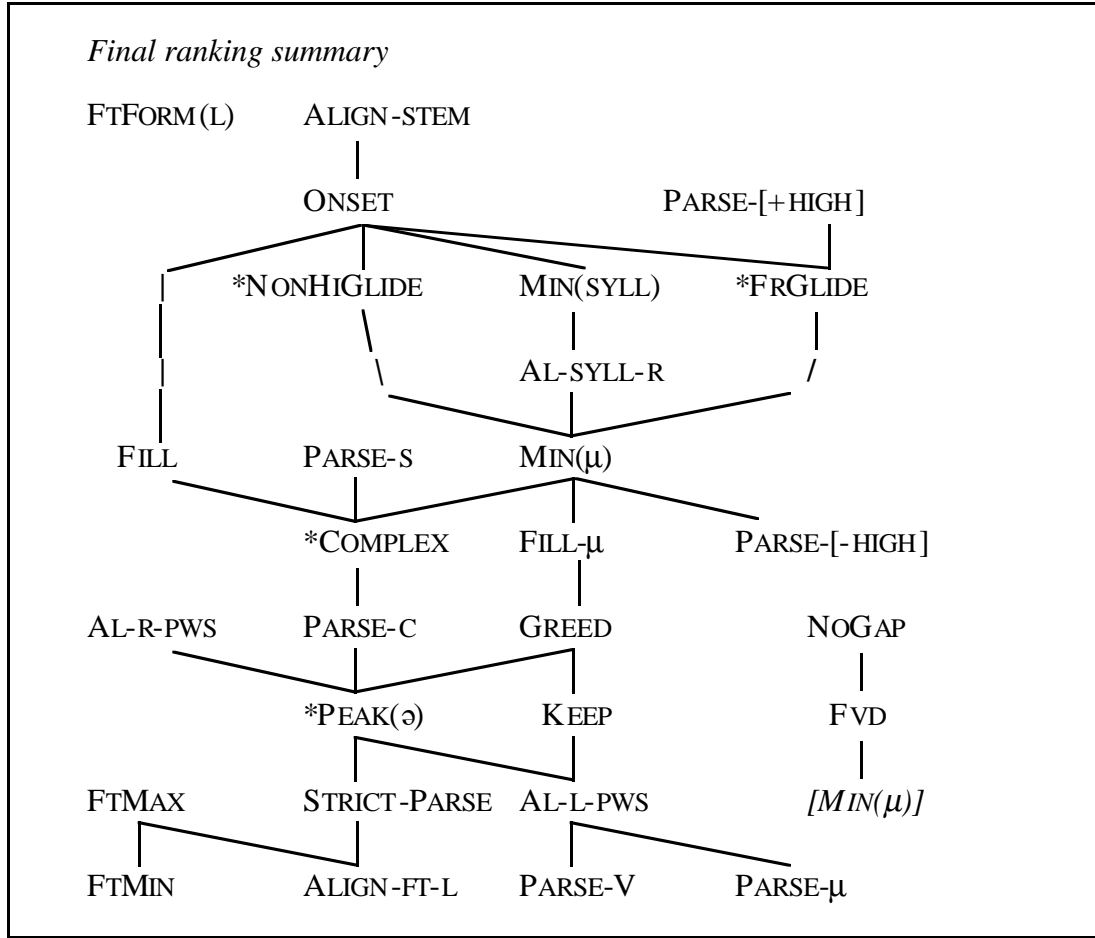
- (135) NOGAP » FVD

4.8.3. Final /w/ deletion for consonant-final stems

Another fact concerning final vowel and final-/w/ deletion which is worthy of mention is the fact that for stems which end in a consonant do not show any overt evidence of the presence of a word-final /-w/ suffix in the stress assignment. For example, consider (136).

- (136) sók-ələn /sok-ələn-w/ 'it pours (rain)' (81)
pour-rain-(3)

Clearly, this suffix does not induce epenthesis, although most vowel epenthesis in Passamaquoddy appears to be a morphologically governed process and not generally driven by considerations of syllabification. However, neither can the /w/ be parsed without violation *COMPLEX. Recalling that /w/ and /o/ are nondistinct, it is reasonable to assume that this suffix is subject to PARSE-V and not to PARSE-C, which means that leaving it unparsed is not a crucial violation, and it can simply be Stray Erased.



5. Discussion of the constraints, rankings, and assumptions

5.1. Recapitulation

We have covered a tremendous amount of territory in this analysis, and so we will once again pause to recap the accomplishments, the assumptions, and the evidence which has been examined in the course of this investigation.

We began with the suggestion that the /ə/ in Passamaquoddy is “unstressable” in those situations where it is structurally a moraic segment parsed directly into a foot. The availability of this structure is governed by a wide variety of independently motivated syllabification constraints, exploration of which constituted the bulk of this analysis.

Among the assumptions which have been made are that the prosodic hierarchy allows structures such as that described, where a mora may be parsed into a foot without an intervening syllable, and that adjunction structures such as those proposed in Hung (1994) are permissible word-peripherally. Acceptance of this structure also entailed considering foot-level constraints,

such as FTMAX, to be sensitive only to syllables. However, allowing foot-parsed moras was central in the reduction of the stress facts to properties of syllabification.

Several language-internal representational assumptions were made as well, including a heavy/light syllable distinction encoded by moraic coda consonants and the assumption that segments entering the computational system frequently come from the lexicon with some prosodic structure already associated. In particular, full vowels are assumed to already be attached to a syllable, and “exceptional” (syncope-resistant) /ə/ segments and sonorants are assumed to be attached to a mora (but see section 3.4 for a discussion of how this may be interpreted in terms of diacritics and constraints). We also have reason to believe, from assimilation phenomena, that /w/ and /o/ are not underlyingly distinct. Evidence for moraic coda consonants came mainly from sensitivity of vowel lengthening phenomena to open and closed syllables and from the fact that a preceding sonorant cannot affect the syncope behavior of an unstressable /ə/. Evidence for moraic sonorants came from the fact that unstressable /ə/ will not syncopate before sonorants, from the differing effects of *hC* and *hL* clusters on a following /ə/, and from /ə/ syncope between /h/ and /m/.

Based on several phenomena like geminate formation and vowel assimilations, the constraint MIN(μ) was suggested, which encourages a mora to parse two segments provided they are, or can be made to be, (Place-)identical. Once particular consideration of the special properties of /h/ in Passamaquoddy was made, further evidence for MIN(μ) was accumulated from the effect of clusters involving /h/ on the stressability of a following /ə/ and from further vowel assimilation phenomena. The special property of /h/ which yields these results appears to be that it must be associated with two moras simultaneously whenever possible, implemented by the GREED constraint.

Finally, our explanations of *VhV* assimilation, final vowel deletion, and final-/w/ deletion centered on some assumptions about the phonetic interpretation of a vocalic segment either lacking Place features or lacking all phonetic features. In particular, when a Place-less vocalic segment precedes a non-deficient vowel, the Place of the following vowel is used for the phonetic interpretation of the Placeless one, and if a segment with no phonetic content is the nucleus of a syllable in the word-final foot, the stress on the foot which contained that empty segment will be realized as a rising pitch contour. Aside from this specific situation, lack of phonetic content will mean simply nonpronunciation.

5.1. The nature of the constraints

Theory-internally, some constraints previously suggested in the Optimality Theory literature were clarified or slightly modified, and these modifications will be summarized below.

One modification which was made to the foot-level constraints FTMAX, FTMIN, and FTFORM is the specification that they are sensitive only to syllables under evaluation. This allows a foot with two syllables and a mora to be considered binary, and avoids any reason to suppose that a mora might be assigned stress in a foot. These assumptions are fairly central to this analysis, but they do not generally conflict with assumptions previously made about these constraints specifically because previous literature has generally supposed that a foot which parses a heterogeneous set of syllables and moras was not a possible structure.

The PARSE and STRICT-PARSE constraints were adopted from Hung (1994), but modified so as not to explicitly exclude feet which parse moras, the central structure in the present analysis. PARSE was split into several subconstraints: PARSE-V, PARSE-C, PARSE-S, PARSE-[+HIGH], AND PARSE-[-HIGH]. Of these, the division between parsing requirements on vowels and on consonants is commonly forced on Optimality Theory analyses, and the need for such a division in Passamaquoddy seems inescapable, given the differing behavior of vowels and consonants with respect to syncope effects. The PARSE-S constraint, however, is on much shakier ground, solely involved in syllabification in order to allow clusters of the shape CsC. Perhaps, however, when the *COMPLEX constraint is fully unpacked, this special behavior of /s/ will fall under the domain of those constraints, since this ability of /s/ to stretch the bounds of syllabification is not uncommon crosslinguistically, as briefly discussed in section 3.1.

Another modification made to a previously proposed constraint was to ONSET, by wording it such that only a non-moraic consonantal segment would be capable of satisfying the ONSET constraint. As discussed elsewhere, however, this might also be a property of the structures generated by GEN and not an aspect of a violable constraint. Because ONSET is so highly ranked in Passamaquoddy, however, we don't have language-internal evidence bearing on this issue.

Lastly, there was some brief discussion of the nature of the unit of measure when calculating violations of ALIGN constraints in section 4.7. Speculatively, the proposal was made that the universal argument determines the domain over which violations are counted; if the universal argument is prosodic, only surfacing elements will count, while if it is morphological, all underlying segments will count.

5.2. MAX and MIN constraints

Several constraints were introduced which all have a very similar binary maximal or binary minimal basis.

The first example of these properties are the FTMAX and FTMIN constraints adopted from Everett (1994), which respectively demand that a foot have no more than two syllables and that a foot have no fewer than two syllables.

Generalizing this idea to the moraic level, with the MIN(μ) constraint requiring that a mora parse at least two identical segments, seems to have covered a fair amount of empirical ground in the analysis of Passamaquoddy. Recall that MIN(μ) was the driving constraint behind geminate formation, *VhV* assimilation, and other assimilations. It also played a role in explaining the lack of vowel hiatus and the behavior of *hL* and *hC* clusters before / \emptyset /. There was mention in a speculative footnote of a possible place for the companion MAX(μ) constraint in the analysis once investigation of *s-hs* epenthesis is more complete (see fn. 52).

MIN(SYLL) is another example of this family of constraints, requiring of syllables that they parse at least two moraic segments. The reason for this interpretation of the constraint was to explain some of the behavior of clusters involving /h/ on stressability and syncope, as well as participating in the explanation of why geminate formation will preserve a / \emptyset / made stressable by left-to-right position. GREED, too, might be considered to be an inverted MIN constraint, requiring that a segment of a particular class (labeled “greedy”), be associated with at least two moras.

Given the number of similar constraints which appear to underlie Passamaquoddy syllabification, it seems entirely possible that MIN (and MAX) might be better considered to be schematic constraints like ALIGN of McCarthy & Prince (1993a). Although this possibility is left as a speculative comment, it might be a fruitful topic for future research within the Optimality Theory framework. In other words, FTMIN might be MIN(FT, SYLL), MIN(μ) might be MIN(μ , x), MIN(SYLL) might be MIN(SYLL, x), and GREED might be MIN(x, μ).

In this connection, note that there are also constraints in other analyses which can be easily rephrased as MAX or MIN constraints. For example, the *SUPERHEAVY constraint introduced in Zec (1994) as part of an explanation of consonant loss and gemination in Pali insists that a syllable have at most two moras, which in these terms is MAX(SYLL, μ).

5.3. Other constraints

Two other constraints which are introduced in this analysis are the phoneme restrictions *NONHIGLIDE and *FRONTGLIDE, which are fairly central to the analysis of *VhV* assimilation presented above. One clear disadvantage of these constraints, which at this point are simply filters on phonological features, is that the family which they belong to is not well constrained. That is, we are led to wonder if there are similar constraints for every possible feature combination, which, if true, would be a frighteningly large number of constraints.

Having pointed that out, however, the issue will be left for future research.

5.4. But isn't that a lot of constraints?

Of course, the answer to the question posed in the subsection title is “yes and no.” There are quite a number of interacting constraints which appear to play a role in the description of these phonological phenomena in Passamaquoddy. As the number of constraints increases, there is clearly a risk of losing explanatory force, since if every fact requires a constraint, the content of the constraints and their interactions will still be only a restatement of the facts, and quite possibly a more confusing one at that.

In the present case, however, the moderately large number of constraints discussed is offset by the extremely wide range of data and phenomena which were captured. For comparison, the system proposed in LeSourd (1993) covers the same phenomena with around thirty different rules, with around twenty additional rules to cover phenomena which were not discussed here. Moreover, a number of these rules, such as the assimilation rules, did not involve themselves with spreading of phonological features, but simply indicated that where two segments underlying fell together, they would surface in a particular way. By contrast, the Optimality analysis was directly concerned with the mechanisms of such spreading.

As a last point, note that the rules have much more power than the constraints proposed here. For example, a number of the contexts in LeSourd's rules contained reference to the edge of the word or to a morpheme boundary when determining the applicability of the rule, which would then make the appropriate change to the representation to describe the facts. In a constraint-based system, however, references to the edge of the word can only be captured by alignment constraints which interact with the constraints which cause the representational change such that they do end up applying at the edge of a word, requiring at least two constraints to capture the effect of a single rule. This disparity of power makes any direct comparison of the number of rules *vs.* the number of constraints in two theories of the same phenomena a sorely inaccurate one.

Nevertheless, if it indicates anything at all, it is true that there are actually fewer constraints involved in the explanations given here than there are rules involved in the explanations given in LeSourd (1993). But, more to the point, it is not the case that there are an outrageous number of constraints, since the only analysis with which any comparison can even be meaningfully made needs as least as many rules to account for the phenomena.⁷¹

⁷¹By saying this, I merely indicate that there are only two analyses of these phenomena in Passamaquoddy (to my knowledge), the one in LeSourd (1993) and the one presented here. Another possible alternative is the analysis based on the metrical grid, discussed below in section 6.2; however, the details of such a theory with respect to

5.5. How crucial is Optimality Theory?

Although the analysis presented above was entirely cast in terms of Optimality Theory (Prince & Smolensky (1993)), it is worth considering how much this analysis relies on this framework. Of course, there is no issue as to whether or not it is possible to construct a rule system which can accomplish what has been discussed above; for one thing, such a system already exists in LeSourd (1993).

Probably half of the arguments made so far are more concerned with the actual linguistic representation of the structures involved in Passamaquoddy than they are with the implementation within the Optimality Theory framework. Again, even assuming the representational proposals made herein, a rule-based system could certainly be constructed to accomplish the same results we achieved within Optimality Theory. Instead, we should consider which analysis best captures the underlying motivations behind the operations, as well as which analysis has more crosslinguistic applicability.

As to the crosslinguistic question, the Optimality analysis is, by hypothesis, making a claim about all human languages, as one of the leading ideas behind Optimality Theory is that languages differ not in the constraints involved in language competence, but only in the relative rankings between these constraints. So, by postulating constraints like $\text{MIN}(\mu)$ in Passamaquoddy, the implicit assumption is that these constraints are present in all languages. Of course, this hypothesis remains to be tested, which is unfortunately beyond the scope of the present discussion. The next step in this process is to examine other languages for evidence of $\text{MIN}(\mu)$ in operation, even if its effects are different from its effects in Passamaquoddy due to a different ranking in these other languages. In this respect, the Optimality Theory analysis presented here still has an “I.O.U.” outstanding which needs to be repaid in future.

However, it is not clear that a rule-system comes out with any advantage on this question, since it seems at least as unlikely to find crosslinguistic evidence for a rule like LeSourd’s “Initial Syllable Epenthesis,” the means by which the stressability of the first /ə/ in a word-initial /(C) ə [+sonorant] ə/ sequence was ensured,⁷² as it does to find effects of $\text{MIN}(\mu)$ in other

assimilation and syncope have not been worked out, and so it seems premature to make any comparisons between that theory and this one. Further discussion of this point is below, in section 6.2.

⁷²The Initial Syllable Epenthesis rule took the form given below (LeSourd, p. 144), where [ə] indicates a schwa which is not associated with a timing slot on the CV tier and C' indicates a consonantal timing slot which has not yet been associated to a syllable:

$$(i) \quad \text{Initial Syllable Epenthesis:} \quad [ə] \quad \rightarrow \quad \begin{array}{c} \text{V} \quad \quad \text{C}' \\ | / \# \quad _ | \\ \text{ə} \quad \quad [+son] \end{array}$$

Of course, this rule was chosen from among the rules presented in LeSourd’s analysis in order to make a point. It is probably not the most representative example, but it is not much more specific than many other rules; it only appears to be one of the most clearly language-specific of the rules.

languages. Of course, in a rule-based framework we do not necessarily expect to find *this* rule in other languages, we do expect to find rules like it. What remains to be explained is why this rule takes the form it does, and not something slightly different. What is it which constrains the form of these rules? This ties in with the question of the explanatory adequacy of such a system in terms of acquirability by first language learners, since in general, the less constrained a system is, the more unlikely it is to be explanatorily adequate. While the problem of language acquisition under the Optimality Theory approach is a matter of determining appropriate rankings among (perhaps a fairly large number of) constraints, the problem of determining phonological rules (even if a template is available to the language learner) at least *prima facie* appears to be a more difficult task.⁷³ While (clearly) none of the discussion in this paragraph is any sort of an argument one way or another, it should be evident that neither theory can really lay claim to superiority in terms of crosslinguistic generality without more argumentation.

The question of which analysis better captures “what is really going on” is similarly elusive. It is worth recalling what it is in the Passamaquoddy data that has an “optimality flavor” to it. The clearest example is in the behaviors captured by MIN(μ), where two adjacent surfacing segments are in some sense “unified” whenever possible, even at the expense of dropping an intermediate unstressable /ə/ to form a geminate.

What is interesting from this perspective is that the MIN(μ) constraint is so rarely satisfied because it requires that the two segments involved be relevantly identical. It is also interesting that it appears to be an effect that is conditioned by the final output form rather than by a particular underlying configuration. In other words, two segments which are identical but not adjacent will nevertheless be “unified” in this way if the element which separates them is dispensable (geminate formation), and two segments which are consecutive but not quite identical can be made identical in order to satisfy the output condition (assimilation effects of /k/-/kw/ and of the vowels, coparsing of /h/ with vowels). Yet none of these operations (syncope, assimilation) occur when this “unification” process captured by MIN(μ) is not at stake, meaning that in a rule-based framework, the rules which condition these operations need to take into account whether or not the analog to MIN(μ), a separate rule, is going to apply. In this respect, with its orientation toward the output representation rather than toward intermediate operations

⁷³The constrainedness of Optimality Theory is quite different from the constrainedness of general rule-based theories such as LeSourd’s. In terms of explanatory adequacy, Optimality Theory is completely constrained, as the language learner by hypothesis is not formulating any constraints but merely ranking constraints already available. What is not well constrained in Optimality Theory is the postulation and formulation of such constraints from an analysis-building point of view, but this does not bear on the question of explanatory adequacy. The rule-based systems (such as LeSourd’s) suffer on both counts from unconstrainedness, however, because the child is expected to learn the rule as formulated in the analysis based on only a knowledge of how rules are built in general.

on the underlying form, this phenomenon seems much more naturally captured in the Optimality Theory framework.

Another example of the Passamaquoddy's "optimality flavor" is the determination of whether a /ə/ is stressable. The suggestion of this analysis is that it is unstressable whenever it can be, in keeping with the idea of "minimal violation" around which Optimality Theory is built. What keeps a /ə/ from being able to satisfy the constraint against stressability are considerations of syllabification, which are ranked higher. It is quite possible that a parallel situation exists in Indonesian, where a /ə/ never counts for stress under any circumstances (Cohn & McCarthy (1994), Halle & Idsardi (1993)). Here, we could suggest that in Indonesian *PEAK(ə) outranks the constraints which foil it in Passamaquoddy.⁷⁴ In Chukchee (Kenstowicz 1994c), /ə/ avoids being stressed when more sonorous vowels are available to receive stress, but will take stress if there is no alternative. This could be taken to indicate that /ə/ is avoiding syllabic status except where it is needed to realize stress, meaning that in Chukchee, *PEAK(ə) is ranked farther down in the hierarchy than in Passamaquoddy.⁷⁵ What we are trying to establish here is the fact that *PEAK(ə) does appear to (at least arguably) have crosslinguistic effects and moreover seems to be ranked differently between languages.

To reiterate, it is not a question whether or not a rule system can be constructed to account for the phonological phenomena of Passamaquoddy which have been discussed here. What is at issue is which approach gives us a more accurate insight into the nature of the language itself. Although there have not yet been conclusive arguments on either side of the debate between Optimality Theoretic and rule-based accounts, it has been suggested here that the constraints-based approach provides a more perspicuous view of at least some of the phenomena which have been discussed in the preceding sections, such as the fact that considering the output form as the motivation for a process allows the cause to be reduced to a single constraint.

⁷⁴For this to work, of course, requires much discussion of Indonesian, even beyond what is done in Cohn & McCarthy (1994), since they do not discuss the implementation of their constraints NON-HEAD(ə) and NON-FOOT(ə). One fairly significant problem which needs explanation is the existence of words with *C əC ə* sequences, where presumably neither /ə/ counts for stress but the medial *C* still surfaces.

⁷⁵Again, for this to be accepted as an explanation for Chukchee, more work needs to be done. This is not quite the same as the analysis proposed by Kenstowicz (1994c), who suggested that the stress patterns were due to a sonority interaction one level higher on the prosodic hierarchy: the most sonorous syllables (judged by their nuclear vowel) are most preferred as heads of feet.

6. Brief comparisons to other analyses of Passamaquoddy

6.1. LeSourd's (1993) analysis

Although we have not covered all of the phenomena discussed in LeSourd (1993), a respectably large amount of it has been discussed here. Although in a very different framework from LeSourd's analysis, this analysis nevertheless adopts a great many of the basic insights of LeSourd (1993), but implements them in a different way. Like this analysis, LeSourd took syllabification to be a major driving force in the assignment of stressability, although there were also several other "epenthesis" rules granting stressability to underlyingly unstressable vowels as well.

Where this analysis goes beyond LeSourd's analysis, at least to the extent that it is correct, is in its explanatory force. Partly as a product of the framework within which LeSourd's analysis was cast, much reliance was made on a large number of basically arbitrary rules. Although each rule was well-motivated language-internally, no real explanation was available for why a rule was of a particular form.

We have seen several of LeSourd's proposed assimilation rules in the course of this analysis, and most of the contexts in (13) and (25) are each handled by mutually independent rules for assignment of stressability or syncope of segments. More or less, there is a different and basically independent rule in LeSourd's analysis for each of the phenomena which have been discussed above.

By contrast, the present analysis has been a serious attempt to unify these phenomena into a smaller group of "tendencies" exhibited by Passamaquoddy and, hopefully, crosslinguistically to varying extents. The tendencies which played a major role in the Optimality analysis are relatively few in number, such as /ə/ tending to avoid being realized as the nucleus of a syllable, and moras tending to parse two identical segments whenever the opportunity arises. While such tendencies may also be called arbitrary, many of the constraints which have been used in this analysis have crosslinguistic support, and even the innovations presented here can at least be said to present a smaller amount of arbitrariness than that found in the list of rules given in LeSourd (1993).

Moreover, even if the analysis presented above does not itself prove to be ultimately correct, many of the generalizations may still have some explanatory power in future theories. At present, the framework of Optimality Theory seems best able to capture the interactions of these tendencies and constraints.

c.	line 3: x	d.	line 3: x
	line 2: x x)		line 2: x x)
	line 1: x x] x x]		line 1: x] x x]
	line 0: {x{x {x(x		line 0: {x {x(x
	acehl@so ác-ehl-áso		tohsan@k tóhsánək
e.	line 3: x	f.	line 3: x
	line 2: x)		line 2: x x)
	line 1: x x]		line 1: x]x x]
	line 0: [x x(x		line 0: x{x{x x(x
	p@m@ka póm-əka		p@mas oke pəm-ásóke

One of the strongest advantages of the metrical grid analysis presented above is that it is able to dodge some of the complexities which ran throughout the Optimality Theory analysis, such as the need for discussion of extrametricality in cases like *pəmásóke*, alignment of the prosodic word with a syllable in order to get cases like *tóhsánək*, and favoring bimoraic syllables to get cases like *póməka*.

However, it is also clear that the system as stated above is unable to differentiate between the *hC* and *hL* clusters in *téhkəneps* and *ácehláso*, nor can it account for the fact that syncope also occurs before /h/, between /h/ and /m/, before identical non-syllabics, and word-initially. Of course, it can be made to do so; we could simply incorporate the contexts of (13) into the first operation in line 0, projecting a bracket before every full vowel and after every cluster except *hC* where *C* is an obstruent. Similarly, we could augment Vowel Elision to incorporate the contexts in (25) so that weak members of line 0 feet would not only syncope before obstruents, but also before /h/, between /h/ and /m/, between identical non-syllabics, and word-initially.

It is here that the fundamental difference between the metrical grid analysis and the Optimality Theory analysis is most clearly evident: The metrical grid analysis supposes no direct influence or interaction between the stress assignment and syllable structure, directly contrasting with the Optimality Theory analysis, which is based entirely on syllabification, with stress being assigned as a more secondary concern. The metrical grid framework simply is not designed to explain processes of syllabification, but rather is designed explicitly and solely to describe stress phenomena.

What gives the Optimality approach the upper hand here (perhaps temporarily) is that we have a unified analysis of stress, syllabification, syncope, and assimilation, while the metrical grid analysis simply predicts stress, relying on a more-or-less arbitrary list of contexts in which a bracket is projected onto line 0 and in which an unstressable /ə/ is syncopated. While it is true that future research will probably simplify and better motivate this set of contexts in terms of syllable structure or morphological composition, there is still no direct connection between stress

and the syncope and assimilation effects that have been the topic of most of the preceding discussion. In a metrical grid framework, the connection is more roundabout: metrical structure is determined by brackets conditioned by syllabic or segmental structure (e.g. “left bracket before CC”), while syncope and assimilation occurs conditioned by metrical structure (e.g. Vowel Elision). By contrast, in the Optimality analysis presented here, much effort has gone into explaining why the contexts for stressability and syncope are expected from general considerations of syllabifiability. One example is the explanation of pre-obstruent syncope, which the Optimality analysis of the preceding sections suggests comes about due to a specific deficiency of obstruents, a deficiency which has effects elsewhere in the syllabification processes as well. In other words, the Optimality analysis explains why there could not be another language exactly like Passamaquoddy except with a pre-sonorant syncope rule rather than the pre-obstruent syncope rule, while the metrical grid system allows equally both options.

The metrical grid analysis could certainly be used in conjunction with a secondary and separate analysis of syllabification which explain the contexts for syncope and stressability projection, but the fact that the Optimality analysis presents a single analysis of both stressability and syllabification suggests that with such a division of labor would also come considerable redundancy.

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