Introduction

Potawatomi, an Algonquian language, demonstrates an interesting form of vowel variation in many words across the language. As can be seen below in (1), there is a vowel/zero alternation with the vowel [ə] and some instances of [o] in morphologically related forms[1]. In the third column below related forms are aligned based on their corresponding segments, making it easy to see that schwa does not appear in the same location in each word.

(1)

Word	Gloss	
nkətʃəwe	"he wins"	n k ə t ʃ ə we
nnəktəʃwe	"I win"	n-n ə k t ə ʃ we
bmose	"he walks"	b m o s e
nbəmse	"I walk"	n-b ə m s e
bk^wežgən	"bread"	b k^w e ž g ə n
nbək^wežgənəm	"my bread"	n-b ə k^w e ž g ə n - ə m

Previous analyses of the language, principally by Hockett (1948), have made certain assumptions and used a rule based account to describe this variation as the result of vowel deletion. However, a re-examination of this data using Optimality Theory (OT), and particularly the concept of richness of the base, suggests that this vowel variation may be better described as a result of epenthesis.

Richness of the base is the idea that there are no language specific constraints on input, and that the forbidden segments and sequences of a language must be proscribed through constraints on the output. With this in mind, examination of the attested patterns of Potawatomi syllable structure, show that some mechanism must be in effect

[1] Unless otherwise noted, all data is from the website maintained by Buszard-Welcher, http://www.potawatomilang.org/Reference/Grammar/grammartopics.html.

that limits the size of medial and final consonant clusters. Further examination of the consonant patterns of the language show that, independent of the vowel variation seen above, Potawatomi must allow some epenthesis as a preventative for illicit structures.

Because epenthesis is already motivated as a necessary mechanism of the language I expand on the basic ranking accounting for consonant distribution and account for the vowel/zero alternation of [ə] as an epenthetic vowel. To explain the location of epenthesis in the initial syllable, I propose a new positional maximization constraint. The ranking I propose in this paper accurately predicts when and where the vowel variation will occur, using epenthesis instead of deletion.

One result of reanalyzing the vowel/zero alternation as epenthesis is that certain forms which had previously been exceptional to a deletion account (Hockett 1948), are now readily explained. Because the instances of invariant [ə] have no clear conditioning environment either phonologically or historically, Hockett was forced to mark these as exceptional to his rules. Under an epenthetic account these forms are not only non-exceptional, but are in fact expected under richness of the base.

Finally, although the presence of a second alternating vowel [o] seems to be a difficulty for the epenthetic approach, this second vowel may be incorporated into an epenthetic account. I explain varying [o] by suggesting the presence, in Potawatomi, of a ghost segment along the lines of those discussed by Zoll (1996).

In the following paper I show that by using richness of the base and an OT analysis we are able to completely reanalyze the Potawatomi vowel variation. Many of the observations which are here crucially employed have previously been ignored, but are brought to the forefront by the concept of richness of the base. In section 1 the relevant data from the language is presented. In section 2, I use the concept of richness of the base to show that vowel epenthesis is required to account for the consonant patterns of the language. Section 3 contains my account of Potawatomi vowel variation in terms of epenthesis. Cases of invariant schwa, and their implications for both deletion and epenthesis analyses of the language are discussed in section 4. Last, in section 5, I will illustrate that varying [o] poses no problem for my analysis.

1. The Language

In order to examine the possible solutions to the vowel variation, some familiarity with the phonological patterns of the language is needed. In 1.1 I describe the stress system of Potawatomi. The attested patterns of consonant clusters are discussed in 1.2. In 1.3 I present the vowel variation itself, along with a brief description of the possible analyses of this pattern.

1.1. Stress Placement

Although not particularly relevant to previous accounts of the vowel variation, the epenthesis analysis I describe in section 3 uses stress placement to help determine the placement of the epenthetic vowel (3.2.1.). The stress pattern of Potawatomi is extremely regular, and mainly depends on the length of the word (Buszard-Welcher) [2]. In words with a single syllable, that syllable bears stress. In words of three or more syllables, main stress falls on the antepenultimate syllable, while secondary stress falls on all other odd numbered syllables (counting from right to left).

[2] Gathercole(1978) had a significantly different description of stress for the Kansas dialect of Potawatomi. Hockett, however, focuses on the more Northern dialects, as does Buszard-Welcher, whose description of stress is presented here.

(2) 3 syllables: 'σ σ σ̩

'wis.nəs̩i	"he doesn't eat"
'wa.boz̩o	"rabbit"
'wgəʃ.kət̩on	"he is able"
'nəʃ.nab̩e	"person"
'mə.ʃəgən	"Michigan"
'gnə.wanw̩e	"he has a long tail"

4 or more: (σ σ̩ σ σ̩) σ 'σ σ σ̩

mik.'če.wiw̩ən	"work"
de.'ban.dəd̩žig	"the ones that love each other"
gnə.'wan.wed̩əg	"he supposedly has a short tail"
ʃkə.'dži.mej̩əg	"later on"
gag.ta.'na.goj̩en	"crocodile, obviative"
ž̩ən.ka.'da.nad̩əg	"it is supposedly called"

In shorter words of two syllables, main stress falls on the final syllable, except where the final syllable contains a schwa, in which case the stress is on the initial syllable. This is not simply stressed schwa avoidance, as the stress shifts to the initial syllable even when that syllable contains a schwa as well: ['nə.nə], "man". Schwa frequently bears main stress in the language in longer words as well (this will always be in the antepenultimate syllable), and in final position has secondary stress in these words. The rule here seems to be avoidance of main stressed final schwa, not just any stressed schwa.

(3) 2 syllables: σ'σ

bmo'sed	"if he walks"
dža'jeg	"everyone"
nə'ko	"used to"
kə'dod	"if he says"
kəd'wig	"they say"
mtə'gos[3]	"stick"

w/ final [ə]: 'σ σ

'dat.bəg	"leaf"
'mi.džəm	"food"
'bk^{w}ež.gən	"bread"
'an.wə	"okay"
'nə.nə	"man"

Stressed syllables may be open or closed. Assuming that closed syllables are heavy, as I do throughout my analysis, then stressed syllables are both light and heavy. Both light and heavy syllables may remain unstressed as well. Stress is not correlated with syllable weight in this language.

1.2. Consonant Clusters

In Potawatomi initial consonant clusters of two and three consonants are permitted. When an initial cluster contains two consonants, the first may be any segment permissible as a first consonant (see 4), and the second any segment permissible as a

[3] Buszard-Welcher describes nasals which appear as the first consonant of an initial cluster as being syllabic (i.e. n.kə.ʃa.təs, m.tə.gos). She does not however suggest that they shift the stress pattern, or that they receive stress themselves, even when we would expect this to occur. In addition she has expressed some doubt as to the exact nature of these nasals (Buszard-Welcher, personal communication). For these reasons (i.e. because clusters containing these nasals seem to behave no differently than any other onset cluster), I treat them here as part of the onset.

second consonant, every combination of first segment and second segment is possible. So if your initial consonant is a nasal, the second can be a stop ([nbəmse], “I walk”), a fricative ([nʃəke], “alone”), a nasal ([nmet], “I wonder”), or a glide ([nwas:o], “I shine”).

(4)

Position in the cluster (CC)	Permissible consonants
1st consonant	nasals, voiced stops, palato-alveolar fricatives, [w]
2nd	stops, fricatives, nasals, glides

In clusters with three consonants the first consonant may still be any of the possibilities in (4), but the second consonant is more restricted. In (5) we can see that only oral stops and fricatives may be followed by a third consonant, which must be a glide.

(5)

Position in the cluster (CCC)	Permissible consonants
1st consonant	Nasals, voiced stops, palato-alveolar fricatives, [w]
2nd	stops, fricatives,
(3rd)	glides

Examples of some permissible three segment onsets appear below in (6).

(6)

Word	Gloss
wpwagən	"pipe"
mbwakawən	"knowledge"
nswə	"three"
ngjebən	"my late mother"

Word medially we also see consonant clusters, but in this case there are none longer than CC. So, although the sequence VCCV occurs frequently, there are no instances of VCCCV. Buszard-Welcher describes the syllabification of the VCCV pattern as being a coda and simple onset, VC.CV[4]. There appears to be no restriction on which consonants may appear in these medial clusters.

In final position we do not find any consonant clusters. Single consonants are allowed, without restriction on type. This distribution of consonant clusters proves to have interesting implications for the vowel variation seen in the language (see section 2).

1.3. Vowel Variation

Many Potawatomi words contain variation in the appearance of schwa and certain instances of [o]. Below in (7) we can see that closely related forms contain the same consonants but the vowels [ə] and [o] may appear in different locations within the word. This alternation appears in both the root and affixes and is not limited to any particular portion of the word. Other vowels of the language [e, a, i] and most instances of [o] do not vary.

[4] In 2.1 I present a pattern in the language which suggests that this syllabification is correct.

(7)

Word	Gloss	
nkətʃəwe	“he wins”	n kət ʃ əwe
nnəktəʃwe	“I win”	n-nək tə ʃ we
bmose	“he walks”	b m ose
nbəmse	“I walk”	n-bəm se
gbəmse	“you walk”	g-bəm se
bk^{w}ežgən	“bread”	b k^{w} ežgən
nbək^{w}ežgənəm	“my bread”	n-bək^{w} ežgən- əm
mdamən	“corn”	mdamən
mdamnək	“corn ears”	mdam n-ək
nbob	“soup”	n bob
nnəbobim	“my soup”	n-nəbob-im
nbəmadəs	“I’m alive”	n-bəmadəs
bmadsə	“He’s alive”	b mad sə
dabjan	“spoon”	dabjan
wdodabjanən	“her spoon”	wd-o dabjan -ən

Although the alternation is difficult to describe in a-theoretic terms, certain generalizations can be made about locations in which the varying vowels occur. Varying vowels always follow a consonant, they never appear word initially. When the first vowel of the word is a variant vowel then there will be at least two consonants preceding it. In a string of varying vowels there are two consonants between each except where one is the final vowel of the word

In cases of vowel/zero alternation there are two possible explanations: vowel epenthesis and vowel deletion. Although I will favor an analysis utilizing epenthesis, previous work on the phonology of Potawatomi has taken a different approach.

1.3.1. Variation as Deletion

One way to analyze this data is to say that varying vowels, which Hockett (1948) calls weak, are underlyingly present, but that they undergo a process of deletion. Buszard-Welcher, Gathercole (1978), and Anderson (1992) have all addressed the phonology of Potawatomi to some degree, but their analyses largely agree with Hockett's (1948) original description of the language.

Based on related languages like Ojibwe and Fox, and his knowledge of Proto-Algonquian, Hockett makes certain assumptions about Potawatomi. Principal among these is that underlying forms have remained largely the same as those seen in Proto-Algonquian. In Proto-Algonquian there was a system of contrastive long (i:, e:, a:, o:) and short vowels (i, e, a, o) (Bloomfield 1946). Hockett concludes that there are in fact still two classes of Potawatomi vowels, a strong class which corresponded to the long vowels of Proto-Algonquian, and a weak class corresponding to the short vowels. The modern strong vowels are no longer phonetically long, strong and weak [o] are described as being different only in their behavior, and three of the historically short vowels have collapsed into the weak vowel [ə]. The modern vowel inventory is shown below in (8), along with the corresponding Proto-Algonquian vowels.

(8)

	Potawatomi	Corresponds to Proto-A
Strong	a	a:
	e	e:
	i	i:
	o	o:
Weak	o	o
	ə	a, i, e

Gathercole (1978) examines the segmental inventory and prosodic structure of Potawatomi with the intent of using phonetic analysis to "properly classify the units and rearrange the [phonemic] system to reflect the objective articulatory and acoustic facts (Gathercole 1978: 20)." The phonemic system tested for accuracy is Hockett's analysis, chosen by default as it was the only one available at the time. Gathercole appears to have tested all of the vowels except weak [o], though he gives no explanation for this exception. Gathercole finds that the strong vowels average slightly more than twice the length of the vowel [ə]. From this he concludes that Hockett's division of vowels into weak and strong classes corresponding to length was justified.

Those vowels that vary are [ə] and some [o]'s, the very ones classified as weak for historical reasons. Hockett describes the alternation as the result of a series of rules applied to the word, including deletion rules which target only the weak vowels. If this is the case, then any weak vowel appearing in a surface form is underlyingly present, making the bolded form below in (9) the underlying form of the root and prefix[5].

(9)

Word	Gloss		
nkətʃəwe	"he wins"	n	k ə t ʃ ə we
		(n ə)	**n ə k ə t ə ʃ ə we**
nnəktəʃwe	"I win"	n -	n ə k t ə ʃ we

If this is the underlying form, then there is a clear pattern to the deletion: every odd numbered schwa deletes, beginning with the leftmost in the word (see 10 and 11)[6]. In

[5] Note that the prefix may be proposed to be either [n-] or [nə-], Buszard-Welcher uses the latter, while Hockett uses the former. In either case there must be a schwa preceding the root in order to feed the proper pattern of deletion, Hockett uses an epenthesis rule to accomplish this (C+C→ CəC).

[6] The fact that every other vowel is affected is striking and could indicate a metrical analysis, something first suggested by Anderson (1992). Buszard-Welcher uses such an approach in unpublished work, though

the following tables Hockett's underlying form is presented on the left, in the middle the weak vowels are numbered and odd numbered vowels (indicated by the parentheses) are targeted for deletion. The final column presents the derived surface form after deletion. Here we can see the contrasting distribution of the vowels is created because, with the addition of the prefix containing [ə] (in 11), different vowels will be counted as odd in the two words. The vowels which are odd numbered and deleted in (10), are even numbered in (11), and thus aren't targeted for deletion in that word.

(10)

3rd sing.+ to win	Deletion	"He wins"
nəkətəʃəwe	n(ə)kət(ə)ʃəwe 1 2 3 4	nkətʃəwe

(11)

1st sing.+ to win	Deletion	"I win"
nə-nəkətəʃəwe	n(ə)nək(ə)təʃ(ə)we 1 2 3 4 5	nnəktəʃwe

Although the deletion of odd numbered [ə] generally holds, Hockett (1948) points out two additional stipulations that are necessary to describe the variation.

When an invariant vowel [a, i, e, o] occurs then the count is 'reset', and the first schwa following this invariant vowel is counted as odd. This can be seen in (12a), where, to predict the correct form, the underlined [ə] in the word must be numbered odd following the [e] so as to cause deletion of that schwa. If the count did not begin again following an invariant vowel, then, as the second weak vowel of the word, the underlined

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it does not appear to have any significantly different entailments from the deletion analysis presented here (Buszard-Welcher, personal communication).

[ə] would be counted as even and would be expected to remain in the surface representation. In addition, in final closed syllables, deletion is blocked and the schwa remains, even if it is counted as odd. The underlined schwa in (12b) is odd numbered but not deleted because it is followed by a word final consonant.

(12)

(my+)bread(+my)	Deletion	"(my) bread"
a. bək^{w}ežəgən	b(ə)k^{w}ež(ə)gən 1 1 2	bk^{w}ežgən
b. nə-bək^{w}ežəgən-əm	n(ə)bək^{w}ež(ə)gənəm 1 2 1 2 3	nbək^{w}ežgənəm

Minor alterations to Hockett's analysis have since been proposed, like incorporating a metrical motivation for the deletion rules (Anderson 1992, Buszard-Welcher p.c.), but the central tenets of the analysis remain unchanged. This analysis draws a clear connection between modern forms and their ancestors, and accurately accounts for a large subset of the language's forms. Hockett (1948) acknowledges, however, that there are forms which this analysis can not account for, which contain a schwa yet never show any alternation. Though Hockett notes that these forms can be manipulated to fit the pattern, it would involve adding extra, un-motivated, and phonetically unrealized consonants and even syllables. In order to incorporate such forms, Hockett would have to radically depart from the known history of words, creating inelegant and historically unlikely underlying representations. Hockett concludes that rather than manipulate the language in such a way, he prefers to simply accept a few anomalies to the pattern.

Notice that the underlying representations proposed by Hockett largely follow a CVCV pattern, alternating consonants and vowels. In those cases where this pattern is broken by the addition of a consonant final affix, it is necessary to feed the deletion by epenthesis between root and affix. Within the word however the assumption made under this rule-based analysis was that the CVCV structure was provided by the underlying representations of the language. Richness of the base prompts us to look deeper into this pattern, making it clear that epenthesis must play a crucial role in the language.

1.3.2. Variation as Epenthesis

The alternative to a deletion analysis is to suggest that none of the alternating vowels of Potawatomi are underlyingly present, appearing instead as the result of epenthesis. In this case, in order to derive underlying representations for these words, we need merely 'subtract' all of the alternating vowels as in (13).

(13)

Word	Gloss											
nkətʃəwe	"he wins"		n		k	ə	t		ʃ	ə	w	e
		(n)	**n**		**k**		**t**		**ʃ**		**w**	**e**
nnəktəʃwe	"I win"	n-	n	ə	k		t	ə	ʃ		w	e

Underlying representations like the bolded one above are prime candidates for epenthesis, strings of consonants with relatively few vowels. Epenthesis must occur, as the sequences here are not licit syllables or sequences. In (14) we can see that the attested forms can be explained as schwa inserted to prevent clusters longer than two consonants.

(14)

$(1^{st}sg+)$to win	Epenthesis	Surface
nktʃwe	nk_tʃ_we	nkətʃəwe
n-nktʃwe	nn_kt_ʃwe	nnəktəʃwe

In section 2 I use the distribution of consonant clusters to show that vowel epenthesis must play a role in Potawatomi. Knowing that epenthesis is active in the language already, I develop an account of the vowel variation using this mechanism instead of deletion. While previous work may have shied from this approach due to the presence of two alternating vowels, I use work by Zoll (1996) to extend my epenthesis account to include weak [o]. Finally, while previous approaches accounted for only a subset of the language's forms, an epenthesis analysis covers more, using richness of the base, it predicts that the invariant, "exceptional" vowels should exist as well.

2. Forbidden Clusters and Richness of the Base

In section 2.1 I briefly define richness of the base. There is an examination of the language's medial and final consonant cluster patterns in section 2.2, with the conclusion that epenthesis is a required feature of the language.

2.1 Richness of the Base

One of the unusual features of Optimality Theory, compared to many other frameworks for analysis, is that restrictions on the surface inventory of the language are not thought to originate with restrictions on underlying representations (McCarthy 2002). Instead, an important part of OT is the concept of richness of the base (Prince and Smolensky 1993). This idea entails that all varieties of input are possible in every language and that the fact that an individual language does not have all possible outputs must be explained as the result of restrictions on possible outputs. That is, every language has the potential to contain any word or pattern; that there are illicit patterns in a language must be explained by the active constraints of that language. If a language forbids a pattern, like a sequence [.tsl] or a syllable CCVV, rather than suggesting that there are no such inputs to the language, some rule or constraint of the language must be preventing that pattern in the output.

2.2. Medial and Final Clusters

The concept of richness of the base is significant here because of the lack of medial and final consonant clusters in Potawatomi of the type VCCCV and VCC#. Richness of the base tells us that these are possible inputs to the language, and so the absence of these sequences must be a result of constraints on the output. Any analysis must explain why these sequences are impermissible, regardless of whether it suggests that vowel variation is caused by epenthesis or deletion. Both VCCCV and VCC#, were they to appear faithfully in the output, would require the appearance of syllables with complex codas or onsets. In a deletion analysis we would expect blocking of deletion where it might create such marked syllables. In fact this can be said to be the motivation behind the blocked vowel deletion in the final syllable seen earlier (12b), an illicit coda might have been formed. But considering the principle that the input is unlimited, we must be able to explain not only why VCVC# does not become VCC#, but also why the input VCC# is not faithfully represented in the language.

There are two repair strategies for an illicit VCCCV or VCC#: vowel epenthesis or consonant deletion[7]. These repair strategies are governed by the faithfulness constraints DEP(V) and MAX(C) (McCarthy and Prince 1995).

DEP(V): a violation is incurred for every vowel segment in the output which does not have a correspondent in the input

MAX(C): a violation is incurred for every consonant segment in the input which does not have a correspondent in the output

Markedness constraints that are violated by a faithful appearance of VCCCV or VCC#, such as the constraint *COMPLEX:MARGINS (Prince and Smolensky 1993), must rank above at least one of these two faithfulness constraints.

*COMPLEX:MARGINS: a violation is incurred for each syllable coda and each syllable onset which contain multiple segments.

In (13) below, we can see that by ranking either MAX(C) or DEP(V) below *COMPLEX:MARGINS, the unattested VCC# in (15a) is ruled out. Depending on which of the two faithfulness constraints is ranked lower, either (15b) with epenthesis[8], or (15c) a form with deletion, will be chosen as optimal.

[7] In truth some such sequences would also be repairable through metathesis, but as this would repair only to a subset of VCCCV and VCC# sequences, is clearly not at work in Potawatomi. Other possible repair strategies are also clearly not at work in Potawatomi and will thus be ignored for the present discussion.
[8] The placement of the vowel in epenthesis will be discussed later.

(15)

/VCC#/	*COMPLEX:MARGINS	DEP(V)	MAX(C)
a. VCC	*!		
b. VC.Cə		*	
c. VC			*

In Potawatomi although there is frequently an alternation in the presence and absence of vowels, there is no consonant/zero alternation either medially or word-finally[9]. If DEP(V)>> MAX(C), then we would expect to sometimes see such alternations in consonants, as can be seen in the tableaux below (16 and 17). Here, a final CC sequence in the input would give us a zero/consonant alternation between basic forms and those with a VC suffix like [-əm]. The candidate selected as optimal by the current ranking, indicated by an arrow, is in the one case the candidate featuring deletion, but in the other is the more faithful candidate where both consonants are preserved.

(16)

/VCC/	*COMPLEX:MARGINS	MAX(C)
VCC	*!	
→ VC		*

[9] Although word initially there are a few examples of consonant/zero alternation, these do not seem to be cases of deletion. Rather the appearance of these consonants seems to be epenthesis to prevent word initial vowels, they do not appear within the word and often do not even appear within the utterance:

Isolated: [ʔotan] "town"
Utterance: [ktəʃjamən otan] or [ktəʃjamən ʔotan] "we go to town"

Notice that the consonant in question is a glottal stop, a segment frequently found in cases of consonant epenthesis (Lombardi, 1997).

(17)

/VCC-əm/	*COMPLEX:MARGINS	MAX(C)
→ VC.Cəm		
V.Cəm		*!

The alternation created by this ranking is not actually seen in the language, forms like [dabjan] “spoon” are clearly not produced from underlying /dabjank/ as related forms, like “her spoon” [wdodabjanən], do not contain extra consonants [*wdodabjankən]. Because we do not see consonant alternations of this sort in the language, violation of MAX(C) is an unlikely explanation for the repair of underlying VCC#.

If DEP(V) ranks below MAX(C), on the other hand, we would not expect any consonant alternation. The prediction instead would be that vowels would be epenthesized to create a licit sequence out of VCC#. When a suffix is added, the same consonants would appear in both optimal forms (18b and 19a), so there would be no consonant/zero alternation.

(18)

/VCC/	*COMPLEX:MARGINS	DEP(V)
a. VCC	*!	
b. → VC.Cə		*

(19)

/VCC-əm/	*Complex:Margins	Dep(V)
a. → VC.Cəm		
b. V.CCəm	*!	
c. V.Cə.Cəm		*!

The forms seen above in (18b) and (19a), VC.Cə(m), are attested in the language as is the other probable sequence with epenthesis, V.CəC. Contrasting this prediction with the unattested consonant alternation predicted by ranking Max(C) below Dep(V), and the unattested VCCCV sequence if Dep(V) and Max(C) dominated *Complex:Margins, we can see that (20) is the ranking of constraints in Potawatomi.

(20) Max(C) *Complex:Margins

Dep(V)

Note that this ranking predicts that VCCV sequences will be syllabified VC.CV, which is, in fact, the syllabification described by Buszard-Welcher. The presence of VCCV sequences in a language where {Max(C), *Complex:Margins }>>Dep(V) indicates that *Coda must rank below Dep(V), and therefore candidate (21a) below is the optimal form. If *Coda were to dominate Dep(V), this would lead to the absence of VCCV altogether, and an optimal candidate (c), rather than to the creation of medial complex onsets.

(21)

/VCCV/	*COMPLEX:MARGINS	DEP(V)	*CODA
a. →VC.CV			*
b. V.CCV	*!		
c. V.Cə.CV		*!	

In examining the medial and final consonants of Potawatomi we have seen that epenthesis must be active in the language. In order to accurately predict the attested patterns of consonant clusters in these locations, *COMPLEX:MARGINS must dominate DEP(V), any analysis of the language must include at least this much epenthesis. Although the constraint ranking in (20) has no obvious effect on an analysis of vowel variation, as it does not rule out either deletion or epenthesis, it does suggest that an epenthesis analysis may be worth investigation. Where two analyses can both adequately describe a pattern the simpler or more uniform one is generally preferred; and while a deletion analysis must include epenthesis, an account using epenthesis need not include deletion. In section 3, below, I show that the appearance and location of the weak vowels can indeed be a result of epenthesis.

3. An Epenthesis Account

We have now established that any description of the language must involve at least some epenthesis, which raises the possibility of attributing the vowel variation to epenthesis as well. Here I use an Optimality Theoretic analysis to show the feasibility of epenthesis as an explanation of the vowel variation of Potawatomi. In 3.1 the causes of epenthesis are discussed: in 3.1.1 the type of complexity causing epenthesis is questioned and in 3.1.2 I address the initial consonant cluster. Here I introduce a new positional maximization constraint necessary to account for the behavior of the initial onset in Potawatomi and variant vowels within the first syllable. Section 3.2 expands on the constraint ranking to account for the location of epenthesis in non-initial syllables. The result is a constraint ranking which predicts the attested alternation of Potawatomi weak vowels.

3.1. Causes of Epenthesis

3.1.1. Cause of Epenthesis: Complexity

In section 2 we saw that the language will epenthesize a vowel rather than have consonant clusters which force complex syllable structure in medial and final consonants. These same syllable well-formedness conditions seem a likely motivation for vowel variation as well. Another suggestion that could be made is that epenthesis occurs not based on syllable composition but rather on constraints governing which segments are allowed to be adjacent to one another. Conditions on adjacent consonants cannot be the only motivation, however, else we would expect the same sequences of segments to be permissible everywhere in the word. This is not the case here, [wbənakwa**nm**ewa] is acceptable while [*nbək^{w}ežgə**nm**] is not. Syllable structure constraints are responsible for the acceptability of one and the unacceptability of the other, some sequences are ruled out not because of the segments involved, but by the placement of those segments in the syllable.

This is not to say that limitations on consonant sequencing don't play any role in causing epenthesis. As mentioned previously there are restrictions on what consonants may appear in the positions of the initial cluster. The explanation for why (22a) has an initial cluster of [mb] instead of [mbs], while in (22b) no [ə] is epenthesized in [mbw] to make [mbəw] is a constraint on sequences, but one that is restricted to working within the syllable structure constraints. Presumably this constraint chooses between these two forms, a violation occurring for [mbs] while [mbw] receives none.

(22)

Underlying	Surface
a. mbs	mbəs
b. mbwakawn	mbwakawən

Potawatomi initial clusters are unusual in that it does not appear that the entirety of the cluster is constrained by a sonority curve as onsets generally are. In other languages, initial and final clusters which do not fit the curve are sometimes analyzed as being made up of an onset and an initial or final extra-metrical 'appendix' (Lamontagne 1993). Two things suggest that this is not the case with Potawatomi, the three consonant cluster and a comparison of initial and medial clusters.

As discussed previously, in Potawatomi the composition of initial clusters differs from that seen in medial clusters. Initial clusters appear with the structure indicated in the table below (23), while medial clusters appear to have any possible combination of two consonants, but an absolute prohibition on a third consonant.

(23)

Position in the cluster	Permissible consonants	
1st consonant	nasals, voiced stops, palato-alveolar fricatives, [w]	
2nd	stops, fricatives, nasals, glides	stops, fricatives
3rd		glides[10]

There are many clusters which appear medially but are not found initially (i.e. [j.m], [s.n], [t.b], [k.tʃ], [tʃ.g]). The lack of restriction on medial clusters indicates that there is little, if any, constraint on tautosyllabic consonant contact. If in fact the initial consonant is an appendix and is not truly a part of the initial onset, then we would expect there to be no more constraints on which consonants may have contact there than we see in medial clusters. However we do see greater restriction, both in the initial consonant and in the second member of the cluster.

Although medial clusters contain a wider variety of consonant combinations, they do not allow a third member of the cluster under any circumstances, while initial clusters allow glides as a third member. Even if we assumed that the initial consonant in a cluster was extrametrical we would still need to explain why initial onsets are permitted to be complex (i.e. second consonant of cluster and glide), while medial syllables are allowed only a simple onset.

Rather than attempting to explain why the initial cluster contains both an extrametrical appendix to the word and a more complex onset than is found in the rest of

[10] Remember that a third consonant appears in the initial cluster only if the second consonant was an obstruent. Words with a nasal or glide in the second consonant position are not followed by a third consonant. Note also that while the move from second to third consonant does demonstrate a normal sonority curve, no other portion of the cluster is obligated to do so.

the word, why not simply explain a more complex onset? This is especially attractive given that every position of this cluster exists under greater segmental restrictions than those found in the rest of word. This may be an indication that different rules are in effect for these two locations, something we expect in a contrast between a cluster appearing as an onset and one appearing across syllable boundaries. The requirements shown above in (23) are produced by constraints on the onset, which in this case we are calling ONSET-COND, and describe below.

ONSET-COND: a violation is incurred for every complex onset which does not fit the template shown in (23)[11]

This constraint must work in conjunction with the syllable structure constraints to motivate and govern epenthesis. In (24), ONSET-COND must dominate DEP(V), else the unattested but more faithful candidate in (24a) would be selected for containing fewer epenthetic vowels. In this tableau, and others throughout my paper, I use a bullet (•) to indicate the attested candidate and an arrow to indicate the candidate selected by the current ranking.

(24)

/nktʃwe/ "he's glad"	ONSET-COND	DEP(V)
a. nktəʃ.we	*!	*
b. →• nkət.ʃə.we		**

[11] I use this somewhat circular definition as a time-saving measure, due to considerations of length and relevance I will go no deeper into this constraint here.

Previous discussion indicates that *COMPLEX:MARGINS must also dominate DEP(V), which will prohibit VCCCV sequences and cause epenthesis in forms like that in (25):

(25)

/məʃəgn/ "Michigan"	*COMPLEX:MARGINS	DEP(V)
a. məʃəgn	*!	
b. → • məʃəgən		*

The constraint ranking thus far discussed is shown in (26).

(26)

MAX(C)   ONSET-COND   *COMPLEX:MARGINS

DEP(V)

In addition to the rankings from (20) in (24) we saw that DEP(V) must be subordinate to ONSET-COND, so as to allow epenthesis to prevent illicit onsets.

3.1.2. Complexity of the Onset

In section 2 we determined that epenthesis was a necessary part of Potawatomi and that *COMPLEX:MARGINS>> DEP(V). By ranking *COMPLEX:MARGINS above DEP(V), the prediction is made that all complex onsets should be prevented through epenthesis, but the large number of initial clusters seem to suggest that this is not true of Potawatomi.

By examining the medial sequences permitted by the language, we can see that epenthesis does occur to prevent complex onsets, but that this epenthesis is blocked in initial position.

As discussed previously, richness of the base means that the prohibition on VCCCV sequences medially cannot result from constraints on the input, but must be a function of markedness constraints on the output. Earlier I used the constraint *COMPLEX:MARGINS, this is because *COMPLEX:CODA alone is insufficient to prohibit this sequence (27). The candidate in (27b) loses here because it is less faithful than (27a) which is acceptable because it has no complex coda, only a complex onset.

(27)

/VCCCV/	*COMPLEX:CODA	DEP(V)
a. → VC.CCV		
b. • VC.Cə.CV		*!

In order to prohibit a candidate like (27a) from winning, *COMPLEX:MARGINS [12], not *COMPLEX:CODA, must be used. As the constraint *COMPLEX:MARGINS is necessary, the appearance of initial onsets must be the result of a more dominant constraint which allows violation of the markedness constraint.

Where the first syllable contains a complex onset and a strong vowel (i.e. [bk^{w}ež.gen] "bread") this new constraint will only have to block epenthesis, but when the

[12] A combination of *COMPLEX:CODA and *COMPLEX:ONSET could be used instead of *COMPLEX:MARGINS. Note however, that use of these two separate constraints does not prevent the need for some additional constraint which actively prefers a complex onset. Without this preference for the initial complex onset, any demotion of *COMPLEX:ONSET sufficient to allow an initial complex onset will also allow an illicit VC.CCV to surface.

first vowel is weak it seems it must prefer a complex onset. Whatever constraint allows the complex initial onset will have to generate several specific properties in cases with epenthesis:

-Complex onsets are preferred over simple, CCə is always generated, never CəC.

-These complex onsets occur in both closed and open syllables (CCə and CCəC).

-Onset complexity is allowed only initially (epenthesis is blocked only locally).

Two different mechanisms have been proposed which create complexity only on a word edge, directional syllabification and positional maximization.

3.1.2.1 Directional Syllabification

It has been suggested that some languages generate word edge complex margins through directional syllabification caused by an alignment constraint. Rose (2000) uses such a constraint in her analysis of Chaha, following Farwaneh (1995) where Arabic coda (complex onsets only) and onset (complex codas only) dialects are instantiations of different directional syllabifications. In this case syllable construction proceeds directionally through a word, with the intent of aligning the far edge of the word with the edge of the last syllable constructed. In languages where the constraint governing this construction outranks the constraints prohibiting complex margins then the result is a complex onset or coda. Applying this to Potawatomi in (28), we can see that it does predict some of the attested forms[13].

[13] Interestingly, the left aligned version of this constraint might seem to be a viable explanation of the Potawatomi pattern. However, a distinction between initial and non-initial syllables must still be encoded in the constraints as CCC may appear initially but never medially, which ALIGN-L alone would not predict.

ALIGN-R (C-Edge, PrWd-Edge): Every consonant must be aligned with the right edge of some prosodic word (from Rose 2000, pg 408).

(28)

/nbmse/ "I'm alive"	ALIGN-R	*COMPLEX:MARGINS
a. →•nbəm.se	12	*
b. nəb.mə.se	13!	

However, this ranking would still prefer to satisfy complex margins whenever possible, predicting that in a word with fewer underlying consonants (i.e. CCCV) the preferred form will be CəC.CV. In Potawatomi however we see a preference for CCə syllables not CəC, which (29) shows is not predicted when using directional syllabification[14].

(29)

/nbmads/ "I'm alive"	ALIGN-R	*COMPLEX:MARGINS
a. • nbə.ma.dəs	19!	*
b. → nəb.ma.dəs	18	

Although employed successfully to explain word initial complex onsets in other languages which generally forbid complex segments, directional syllabification does not predict the pattern of Potawatomi initial complex segments.

[14] Rose (2000) proposes a syllable contact constraint in Chaha which results in some syllables surfacing as CCə and others as CəC. The addition of this constraint will not help directional syllabification account for Potawatomi; alternation between the two possibilities would be predicted rather than the consistent preference for CCə.

3.1.2.2. Positional Maximization

Initial complexity has been accounted for in other analyses by noting that these marked onsets occur only in the initial syllable. As discussed by Beckman (1998), initial syllables, onsets, and several other key positions within the word seem to have tendencies to operate semi-independently of the rules applied to other portions of the word. In such cases, these positions may demonstrate a greater degree of faithfulness to the input than other positions do, a phenomenon Beckman calls positional faithfulness. Another theory put forth by Beckman is positional maximization, where certain positions, like the first syllable, seek greater prominence within the word through marked behaviors. One example of this prominence maximization is Tamil, where complex codas are permitted in initial syllables but are illicit elsewhere within the word. This is permitted because a constraint requiring the initial syllable to be maximally prominent (and thus contain as much of the word as possible) outranks the constraint that prohibits complex codas elsewhere in the word (Beckman 1998: Ch. 5).

Unfortunately, Beckman's constraint cannot be used to here, as Potawatomi, does not seem to be interested in 'packing' or maximizing the first syllable, but rather only the initial onset. With the constraint MAXσ^1, epenthesis should occur where it will allow the most input segments into the initial syllable.

MAXσ^1: a violation is incurred for every segment in the input that is not in the initial syllable of the output.

Although in some cases this will allow an initial complex onset, where more segments may be included in the initial syllable, in other cases it will not. Beckman's MAXσ^1 constraint does not make the correct selection in (30), as it is satisfied equally by the forms (a) and (b)[15] regardless of the complexity of the onset. Where the same number of segments may be included in the syllable, as is the case here, the vowel should appear in the least marked location, the one preventing a complex onset, as it does in (30b) below.

(30)

/gnwanwe/ "long-tailed"	MAXσ^1	*COMPLEX:MARGINS	DEP(V)
a. •gnə.wan.we	*****	*!	*
b.→ gən.wan.we	*****		*

MAX σ^1 does not predict Potawatomi's consistent preference for a complex onset preceding an epenthesized vowel.

Drawing on work by Beckman and Zoll, Alber (2001) proposes a constraint COINCIDE: σ^1 which requires as much of the output as possible appear in the initial syllable's onset. The argument for the cross linguistic reality of this constraint, includes examples of languages where marked behaviors occur in order to create prominence maximization of both the first syllable and its onset. One such case is Sardinian where a

[15] Assuming that MAX σ^1 is dominated by ONSET. If the inverse ranking holds true, and MAX σ^1 >> ONSET, then this constraint would prefer a candidate superficially like (30a), but only by 'stealing' the onset from the previous syllable (which is not the syllabification described by Buszard-Welcher). This syllabification seems particularly unlikely as we know that epenthesis occurs in this language to prevent onsetless syllables of the type that would be made here.

/gnwanwe/	MAX σ^1	ONSET	*COMPLEX:MARGINS
→ gnəw.an.we	****	*	*
gən.wan.we	*****!		

regular process of metathesis occurs to create a complex initial onset (Alber 2001). In addition, Alber discusses psychological findings and motivation for the idea of prominence maximization. She argues that maximization of the initial onset is motivated by the psychological prominence of word beginnings and consonants, which suggest that the ease of word recognition is increased when consonants appear at the beginning of a word[16].

Alber's COINCIDE: σ^1 constraint very nearly works for Potawatomi except that, being a positional markedness constraint, concerned only with the output, the constraint generates non-local effects.

COINCIDE: σ^1: a violation is incurred for every segment in the output which is not part of initial syllable onset[17]

Because the COINCIDE: σ^1 constraint counts violations for each segment in the output that is not a part of the initial syllable onset, it predicts that there should blocking of epenthesis by this constraint's domination of DEP(V) and *COMPLEX:MARGINS (31). COINCIDE: σ^1 must dominate *COMPLEX:MARGINS else it will be unable to create the initial complex onset, but in doing so it blocks epenthesis elsewhere as well. The candidate in (31b) is not optimal under this ranking because the epenthetic vowel counts as a violation, making (a) the more maximized of the two candidates according to this constraint.

---

[16] Alber and Beckman both cite a variety of studies on the prominence of the initial position in the word including: Horowitz et al. 1969, Nooteboom 1981, Freedman and Landauer 1966, Cole 1973, and Hawkins and Cutler 1988. For discussion of implications for other languages featuring complex onsets and codas, such as Arabic coda and onset dialects, please see section 3.1.3.4.

[17] Alber uses this constraint name for another positional markedness constraint as well, one applying to the entire initial syllable.

(31)

/CCVCCCV/	COINCIDE: σ¹	*COMPLEX:MARGINS	DEP(V)
a. → CCVC.CCV	*****	**	
b. CCVC.Cə.CV	******!	*	*

As we never see complex medial margins like those in (31a) in Potawatomi, this constraint cannot be active in this language.

If however we propose a faithfulness constraint, concerned with the appearance of the input in the output but otherwise similar to Alber's markedness constraint[18], the locality problem can be solved. A faithfulness constraint like the one defined below shares the same psychological motivations as Beckman and Alber's constraints, but predicts a different pattern, providing us with a way to account for the appearance of these initial clusters in Potawatomi.

MAXσ¹:ONSET: A violation is incurred for every segment of the input which does not have a correspondent in the initial onset in the output.

Unlike COINCIDE: σ¹, the faithfulness constraint MAXσ¹:ONSET is unaffected by epenthetic segments, and thus will not cause violations of lower ranked markedness constraints. Because it counts violations based only on the input, no epenthetic consonant or vowel will ever incur a violation. Thus, in (32) below, both forms violate MAXσ¹:ONSET the same number of times, although one contains an additional segment to satisfy the lower ranked markedness constraint.

[18] For some discussion of broad typological ramifications of different types of positional based constraints (including positional faithfulness, positional neutralization, and positional markedness as well as COINCIDE constraints) see Smith 2002.

(32)

/CCVCCCV/	MAXσ¹:ONSET	*COMPLEX:MARGINS	DEP(V)
CCVC.CCV	*****	*!	
→CCVC.Cə.CV	*****		*

----3.1.2.2.3 Predictions of MAXσ¹:ONSET

The constraint MAXσ¹:ONSET makes many different typological predictions based on its ranking relative to constraints like MAX and the various markedness constraints. For example, in languages where *COMPLEX:ONSET ranks above MAXσ¹:ONSET, the allowed maximization of the onset will be a single consonant, as any attempt to add more would violate the markedness constraint preventing complexity. Where MAXσ¹:ONSET dominates a constraint like *CCC, or individual constraints preventing consonant combinations, then increasingly large initial onsets may be generated, even where they are forbidden in the rest of the word. Other constraints will also have a great effect on this constraint's activity; for example, in a language where LINEARITY (Prince and Smolensky 1993) ranks below MAXσ¹:ONSET, metathesis would occur in order to maximize the onset. This is the situation described by Alber (2001) in her discussion of Sardinian. Other rankings make further predictions: in a language where a constraint like MAX(V) is outranked by MAXσ¹:ONSET, we would expect to see vowel deletion in order to maximize the onset of the initial syllable. MAXσ¹:ONSET would be further justified if a language could be found where an underlyingly CVCV word regularly appeared as CCV to satisfy it.

This constraint does not interact directly with the DEP constraints, as it does not motivate epenthesis of consonants or vowels. However this constraint does have something to say about the placement and acceptability of epenthesis motivated by other constraints. When MAXσ¹:ONSET is ranked above *COMPLEX:ONSET or *COMPLEX:MARGINS the prediction is that, regardless of its ranking with regard to DEP(V), where a vowel is being epenthesized into the first syllable a complex onset will be preferred. In this way this constraint selects for the pattern we see here in Potawatomi. In initial syllables it seems that it is preferable to have a complex onset rather than a coda, while in medial and final syllables these complex onsets do not occur.

(33)

/gnwanwe/ "long-tailed"	MAXσ¹:ONSET	*COMPLEX:MARGINS	DEP(V)
a. → •gnə.wan.we	*****	*	*
b. gən.wan.we	******!		*

In order to correctly predict the attested pattern, the constraint MAXσ¹:ONSET will need to rank below MAX(V), as there is no vowel deletion in the language to create a complex onset (34).

(34)

/džajeg/ "everyone"	MAX(V)	MAXσ¹:ONSET
džjeg	*!	*
→ • džajeg		***

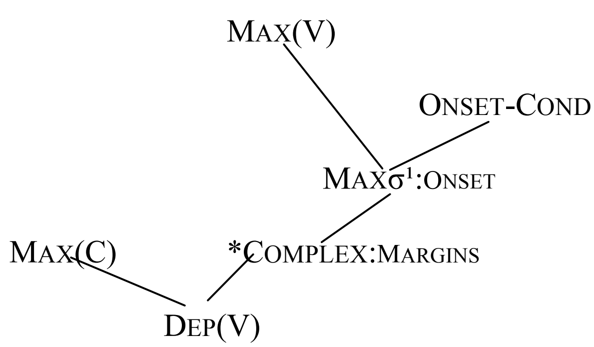
Also, the constraint governing good onsets, ONSET-COND must dominate MAXσ^1:ONSET, or onset maximization would occur regardless of the unacceptability of the resulting onset (35).

(35)

/nktʃwe/ "he wins"	ONSET-COND	MAXσ^1:ONSET	*COMPLEX:MARGINS
nktʃwe	*!	*	*
→ • nkət.ʃə.we		****	*

The diagram in (36) is schematic of the constraint ranking thus far discussed.

(36)



To prevent the deletion of vowels in pursuit of a maximized initial position, the constraint MAX(V) must dominate MAXσ^1:ONSET (34). In order to limit the possible onsets formed, ONSET-COND must also dominate MAXσ^1:ONSET (35). The constraint MAXσ^1:ONSET must dominate *COMPLEX:MARGINS (33), causing complex onsets to be the preferred structure of the initial syllable. Meanwhile, ranking *COMPLEX:MARGINS above

DEP(V), (20), will result in the prevention of all complex codas and complex onsets everywhere they are not required by some other dominant constraint (i.e. initially by MAXσ[1]:ONSET).

Accepting MAXσ[1]:ONSET does not, however, imply that all initial clusters in other languages must be a result of this constraint. The directional constraints used to explain Arabic and Chaha syllables are not to be replaced by this constraint, rather this constraint describes a different kind of onset. As discussed above the complex onsets of Arabic do not fall into the same category as those of Potawatomi. Arabic complex onsets and codas may be described as symmetrical, they demonstrate the same behavior because they fall at a word edge. Arabic complex onsets and codas are the result of crowding in an initial or final syllable brought about by directional syllabification, but there is no such crowding in Potawatomi. Instead Potawatomi seems to have chosen one especially privileged position and tried to 'make the most of it'. The fact that two privileged positions have coincided here, the onset, and the first syllable, is what causes this position to behave exceptionally, which means that we do not expect a similar or symmetrical behavior in the less privileged position of word final coda. If such a language was to be found, that maximized final codas in 'uncrowded' syllables (i.e. CVC.əCC) then we would need to examine whether the final coda might be privileged as well, or alternatively, search for some other process that could explain this and the Potawatomi initial onset. In the case of Arabic, both complex onsets and complex codas are best described as the result of directional syllable construction and not MAXσ[1]:ONSET, however, MAXσ[1]:ONSET is still necessary to explain the Potawatomi data.

3.2. Location of Medial Epenthesis

The constraint ranking thus far discussed, shown above in (36), accounts for the majority of cases but not for the alternation seen in the related forms below in (37).

(37)

Word[19]	Gloss	
kʃatsə	"he is glad"	k ʃ a t s ə
nkəʃatəs	"I am glad"	n k ə ʃ a t ə s

For neither of these forms does our current ranking select an optimal candidate, as can be seen in (38) and (39). Here each set of candidates has an equal number of marked structures, i.e. codas and complex onsets; an equal number of epenthetic vowels, and an equal number of segments in the initial onset, thus far we have no way to choose between them.

(38)

/kʃats/ "he's glad"	Maxσ^{1}:Onset	Dep(V)
a. • kʃat.sə	****	*
b. kʃa.təs	****	*

(39)

/nkʃats/ "I'm glad"	Maxσ^{1}:Onset	Dep(V)
a. nkə.ʃat.sə	****	**
b. • nkə.ʃa.təs	****	**

[19] Examples taken from Hockett (1948)

The key thing to note about these related words though, is that their final syllables do not have the same shape: one is open, the other closed. This is somewhat surprising as we might expect whatever constraint selects the optimal form to select either both (38a) and (39a), or (38b) and (39b). The fact that (38a) and (39b) are the optimal forms instead suggests that a segmental markedness constraint is not the deciding factor in choosing between the candidates above. In the following section I show that by including a low ranked WSP constraint we can account for the location of medial and final syllable epenthesis.

3.2.1 The Role of Stress

Anderson (1992), suggests that the stress system of Potawatomi might explain the location of certain vowels[20]. This language has a very consistent stress pattern[21], discussed earlier and shown again in (40).

(40)

1 syllable: 'σ

2 syllables: σ 'σ unless final vowel is [ə], then 'σ σ

3 syllables: 'σ σ σ̣

4 (or more) syllables: (σ σ̣ σ σ̣) σ 'σ σ σ̣

---

[20] This was offered as a suggestion for a deletion analysis (pg. 157), but proves to be a productive insight for epenthesis as well.

[21] As previously mentioned, Gathercole(1978) contains a different description of stress on two syllable words than that discussed here. He however describes the Kansas dialect of the language while Buszard-Welcher, like Hockett, focuses on the more Northern dialects. Unfortunately, I do not have enough Kansas dialect data to tell if, in fact, this change in the stress placement affects the location of epenthesis as we might expect it to.

Because the placement of stress by position is so regular in this language, it is clear that the Weight to Stress Principle (WSP: Prince 1990), which places stress according to the syllable weight, must be dominated by other constraints which distribute stress by place. One assumption of OT is that all constraints are present in every language, though they may be sometimes ranked too low to have any effect on the language's forms. So even though the WSP plays no role in the placement of stress, we want to suggest that it is still active in the language. These active but low ranked constraints sometimes play a crucial role in the language causing "the emergence on the unmarked" (McCarthy and Prince, 1994).

WSP: a violation is incurred for every heavy syllable which is not stressed

Assuming that a closed syllable is heavy, the WSP will prefer a word in which all closed syllables are stressed to one in which a closed syllable remains unstressed. In (38) and (39), repeated below as (41) and (42), the attested forms both have a stressed heavy syllable, while the other candidates contain an unstressed heavy syllable. All else being equal, the WSP prefers the stressed heavy syllables, as we can see in the tableaux below.

(41)

/kʃats/ "he's glad"	WSP	DEP(V)
a.→• ˈkʃat.sə		*
b. ˈkʃa.təs	*!	*

(42)

/nkʃats/ "I'm glad"	WSP	DEP(V)
a. 'nkə.ʃatṣə	*!	**
b.→ • 'nkə.ʃaṭəs		**

Although in the tableaux above the WSP and DEP(V) are not crucially ranked, we will need to rank WSP below both DEP(V) and MAX to prevent this constraint from motivating changes to the underlying sequence of segments. If the WSP were to dominate MAX then we would predict that deletion might occur, as in candidate (43b), in an effort to prevent unstressed heavy syllables. In addition, the WSP must also be dominated by DEP(V), else epenthesis would occur rather than permit an unstressed heavy syllable (43c). In order for the attested pattern to win, the ranking must be that shown below.

(43)

/gnwanwe/ "long-tailed"	MAX	DEP(V)	WSP
a.→• 'gnə.wanw̩e		*	*
b. 'gən.waw̩e	*!	*	
c. gnə.'wa.nəw̩e		**!	

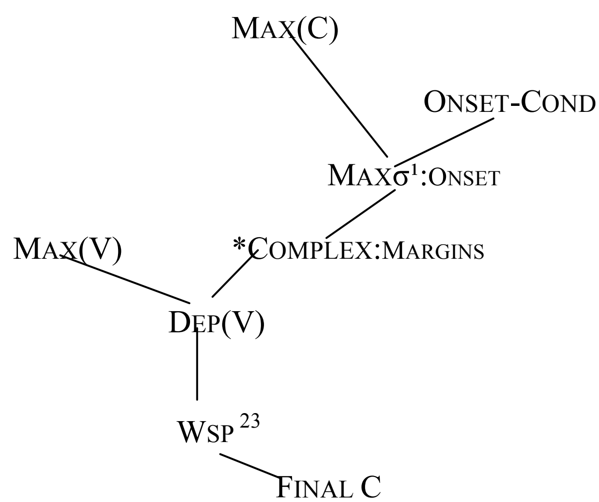
In addition the WSP must outrank FINAL C. If FINAL C>>WSP then the candidates with final consonants would win regardless of syllable weight (44).

(44)

/kʃats/ "he's glad"	WSP	FINAL C
a. →• 'kʃat.sə		*
b. 'kʃa.təs	*!	

This ranking then largely accounts for the distribution of schwa[22], demonstrating that the vowel variation seen for one of the weak vowels can be accounted for without appealing to a deletion process.

(45)



In addition to the constraint ranking shown in (36), (43) shows us that the WSP must rank below DEP(V) else epenthesis will create additional light syllables rather than allow a heavy syllable to be unstressed.

[22] Notice this ranking predicts that in 2 syllable words, the light heavy sequence (C)CV.CəC should never occur. There are at least two forms which do follow this pattern: [mnomən] "rice" and [mdamən] "corn". If these are the only forms which violate expectations, we could account for them by including a constraint like *MN in our ranking: DEP(V)>>*MN>>WSP. This would predict that the sequence [mn] would occur everywhere except where the WSP is the only constraint which prefers the [mn] sequence: [mdam.nək], but [*mdam.nə].

[23] Due to considerations of length and relevance I will not discuss the ranking needed to govern the stress pattern of Potawatomi, however, the ranking of the WSP above is entirely compatible.

The discussion thus far shows that epenthesis is a viable explanation for the vowel variation of Potawatomi, and beyond this that at least some epenthesis is required for any deletion account though the opposite is not necessarily true. In the next section we will see a number of forms which do not follow the general pattern of weak vowel alternation, and how these may be dealt with under the deletion and epenthesis accounts.

4. Invariant Schwa

So far, we have demonstrated the relationship between the permissible distribution of consonant clusters and the behavior of weak vowels in Potawatomi. Additionally we have developed an analysis using epenthesis to explain the vowel variation. Now we turn to forms which do not show the same pattern of variation demonstrated by most Potawatomi words, forms which previous deletion analyses have dismissed as exceptions but which are easily accounted for by the epenthesis analysis.

There exist in Potawatomi a number of words which contain [ə] but which do not show the regular pattern of vowel alternation. By examining these forms, and their fit with the two accounts of the variation, one of the analyses emerges with an advantage. The words containing invariant [ə] do not seem to have any uniform features which we can use as a principled explanation for the blocking of deletion. Because of this a deletion analysis must treat each of these forms as an exception to the rule. On the other hand, an epenthesis analysis accommodates the lack of variation in these forms easily, as the invariant [ə] is assumed to be present in the input.

4.1. Invariant Schwa

Although many Potawatomi words show variation in the appearance of schwa, Hockett (1948) observed that some words contain an invariant schwa (46). In (47) we can see forms that, even without comparison to related forms, don't fit our alternation generalizations. We expect two consonants to appear between the word edge and the varying vowel as well as between two varying vowels, and yet in the examples in (46) and (47) fit neither of these generalizations.

(46)

Word[24]	Gloss		Expected
nosəs	"my grandchild"	n o s ə s	nosəs
nosəsək	"my grandchildren"	n o s ə s - ə k	*nossək
motəj	"bottle"	m o t ə y	motəj
motəjən	"bottles"	m o t ə y - ə n	*motjən

(47)

Word	Gloss
nənə	"man"
məʃəgən	"Michigan"

The first group of words seen above in (46), the words for "my grandchild" and "my grandchildren" present a paradigm which does not show the schwa variation. By comparing the singular and plural forms it becomes clear that the schwa alternation usually seen in this language is not occurring here. Using a deletion analysis, the attested form in (48a) is expected, as there is only one weak vowel, and here the deletion is

[24] These forms are from Hockett (1948, pg. 6)

blocked due to the following word final consonant. In (48b), on the other hand, the prediction is that the first [ə] will delete, but this does not match the attested form.

(48)

my grandchild(+pl.)	Delete	Predicts	Attested
a. nosəs	nosəs 1	nosəs	nosəs
b. nosəs-ək	nos(ə)s-ək 1 2	*nossək	nosəsək

This is not an isolated example other forms do this as well, for instance, “bottle” [motəj] also shows no variation. In (49a) the attested form fits with the pattern of deletion but in the plural form (49b) we would expect deletion of a schwa that here does not delete.

(49)

bottle(+pl.)	Delete	Predicts	Attested
a. motəj	motəj 1	motəj	motəj
b. motəj-ən	mot(ə)jən 1 2	*motjən	motəjən

This is true of the words in (50) and (51) as well.

(50)

man	Delete	Predicts	Attested
nənə	n(ə)nə 1 2	*nnə	nənə

(51)

Michigan[25]	Delete	Predicts	Attested
məʃəgən	m(ə)ʃəgən 1 2 3	*mʃəgən	məʃəgən

Buszard-Welcher notes that historically the word for “man” in (50) had an initial weak vowel, which might suggest a different underlying representation for these words. However, changing the underlying representation does not result in the correct prediction for either “man” or “Michigan”, as seen in (52).

(52)

“man”	Delete	Predicts	Attested
ənənə	(ə)nən(ə) 1 2 3	*nən	nənə

“Michigan”	Delete	Predicts	Attested
əməʃəgən	(ə)məʃ(ə)gən 1 2 3 4	* məʃgən	məʃəgən

These words cannot be easily characterized as having structural or segmental environments which would motivate blocking of deletion, and thus pose a problem for a deletion analysis[26].

4.2. Consequences for Epenthesis

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[25] This is a native word for the area in which the language is spoken, borrowed into English from Algonquian.

[26] Although there are also many instances of [o] which do not show this variation, these are distinguishable from alternating [o] in their historic origin as separate vowels. Historically invariant [o] was a long vowel, while invariant [o] was short. Invariant [ə], on the other hand, has no clear historic origin, nor does there seem to be any other explanation for its appearance in some words of the language. Because of this, Hockett felt that invariant [ə] was exceptional to a deletion analysis as the two types of [o] are not.

Each of the forms discussed above is easily accommodated by an epenthesis analysis. Like other vowels which appear consistently, [a, i, e, o], invariant schwa can be said to be underlyingly present. This can be seen below in (53), where (a) experiences no variation because there are no sequences present that would be problematic to syllabify; there are no markedness violations to prompt unfaithfulness. In (53b) the first two vowels are both underlyingly present, explaining why there are no consonant clusters, and so only the final vowel must be a result of epenthesis.

(53)

a. /nənə/ "man"	MAX(V)	MAXσ¹:ONSET	*COMPLEX:MARGINS
→ nənə		***	
nnə	*!	*	*

b. / məʃəgn / "Michigan"	MAXσ¹:ONSET	*COMPLEX:MARGINS	DEP(V)
→ məʃəgən	*****		*
məʃəgn	*****	*!	

In fact, richness of the base suggests that, even under an epenthesis account, some forms in the language must have underlying [ə] in the input; invariant schwa is just that. For an epenthesis analysis invariant schwas are unexceptional, they are not unique forms exempt from regular rules, but rather examples of normal, underlyingly present vowels.

4.3. Consequences for Deletion

Under a deletion analysis each of these forms is exceptional, requiring the memorization of an irregular form. While this is hardly unknown in the world's languages, a uniform analysis is generally preferred where possible. One way to provide a deletion analysis with such uniformity would be to find an environment that could cause deletion to be blocked in these forms. However, for each of these words there are near-minimal pairs in the environment of invariant [ə] which make it difficult to assert that deletion is being blocked for uniform and principled reasons.

4.3.1. Consonant Environment

In the following sections I will show that, any blocking occurring here can't be the result of the consonant environment, as the consonants which surround these words are varied and well attested as clusters elsewhere in the language.

4.3.1.1. Antigemination Effects?

Regular application of the deletion rule would lead us to expect forms for "my grandchildren" and "man" that would feature geminate consonants. As previous work has noted that the potential creation of geminates frequently causes deletion rules to be blocked (McCarthy, 1986), this seems a likely explanation for the lack of variation in the underlined schwas below (54).

(54)

Word	Gloss
nənə	"man"
nosəsək	"my grandchildren"

However, in Potawatomi both oral and nasal stop geminates are not only permitted, but occur frequently, as can be seen by the geminate nasal clusters shown below in (55).

(55)

Word	Gloss
nnəktəʃwe	"I win"
nnək	"arm"
nnenejəm	"my mother"
nnowəj	"cheek"

The forms above include those where, under a deletion analysis, the deletion of a vowel between two nasals is required to derive the correct surface form. This is crucial as McCarthy (1986) also demonstrates that in some languages, underlying geminates surface faithfully but derivation of new geminates through deletion is not allowed. In (56) below we can see that, in a similar environment to the one where deletion doesn't occur in "man", an initial [nənə…], deletion must occur in "I win".

(56)

1st sg.+win	Delete	"I win"
nənəkətəʃwe	n(ə)nək(ə)təʃwe 1 2 3 4	Nnəktəʃwe

Hockett (1948) states that fricative geminates are not allowed in Potawatomi, but he does not suggest that they block deletion. Instead, Hockett reports that the geminate is reduced to a single long consonant[27] (57). What is crucial here is that to achieve the attested surface form in (57), deletion must occur, so a [s_s] environment cannot explain the invariant [ə] in "my grandchildren"

[27] Although it is unclear exactly what the difference between a geminate and "single long consonant" might be – the relevant point is that deletion is not normally blocked in this environment.

(57)

3sg.+shine[28]	Delete vowels	Reduce CC	"He shines"
wasəso	was(ə)so 1	was(s)o	was:o

It is fairly conclusive then, that blocking due to potential gemination can't be an explanation for the invariant schwas already discussed.

4.3.1.2. Illicit Clusters?

Other consonant environments also can't explain the invariant vowels, as the surrounding consonants are attested elsewhere as clusters. The form for "Michigan", seen again below in (58), might seem to be the result of blocked deletion due to a forbidden consonant cluster, either [m_ʃ] or [ʃ_g].

(58)

Word	Gloss
məʃəgən	"Michigan"

Blocking due to a dispreference for a nasal+[ʃ] sequence is unlikely however, as this sequence is seen repeatedly in the language, as shown in (59).

(59)

Word	Gloss
nʃəməs	"neice"
nʃəke	"alone"
jo mʃə	"not yet"

If we assume that the word for "Michigan" is has an initial vowel underlyingly, then there is another possible case of blocking due to a forbidden sequence, where the schwa is

[28] Data from Hockett (1948, pg 5)

surrounded by [ʃ_g]. In (60) we can see an attested [ʃg] sequence, as well as sequences at the same place of articulation but with different voicing.

(60)

Word	Gloss
miʃgo	"blade of grass"
nniʃkok	"lymph nodes"
nižgon	"two days"

The consonant environment surrounding the vowel does not seem to be a possible explanation for invariant schwa, as deletion would not result in the creation of illicit consonant sequences in the forms discussed above.

4.3.2. Stress and Position

Those forms containing invariant schwa also do not appear to have any consistent stress or position within the word that we could propose as a source of blocking. The invariant vowel (underlined) occurs as the middle syllable in the forms in (61), but elsewhere schwa in this position is deleted (62b).

(61)

Word	Gloss
nosə̲sək	"my grandchildren"
motə̲jən	"bottles"

In (62) we can see that even though the words for "my grandchildren" and "raccoon" share the same number of underlying vowels in similar positions within the word, they do not have the same surface pattern. In (62a) the first schwa does not delete as it does in (b). The final column shows the form each word would take if it followed the other word's pattern.

(62)

"my grandchildren"	Delete	Attested	w/deletion
a. nosəsək	nosəsək 1 2	'no.səs̩ək	* 'nos:.ək

"raccoon"	Delete	Attested	w/out deletion
b. esəbən	es(ə)bən 1 2	'es.bən	* 'e.səb̩ən

Both of the invariant schwas in (61) are unstressed, but so too would be the deleted schwa in "raccoon", had it remained. In (63) we can see that when the invariant schwa is the first vowel of the word, and in both of these cases, main stress bearing, it is still exceptional. That is, similar forms operate under the normal pattern (63 b and c), and delete schwa where these words preserve it.

(63)

a. "man"	Delete	Attested	w/deletion
nənə	nənə 1 2	'nə.nə	* 'nnə

b. "hand"	Delete	Attested	w/out deletion
nənəč	n(ə)nəč 1 2	'nnəč	* 'nə.nəč

c. “above”	Delete	Attested	w/out deletion
ʃəpəmək	ʃ(ə)pəmək 1 2 3	'ʃpə.mək	* 'ʃə.pəmək

d. “Michigan”	Delete	Attested	w/deletion
məʃəgən	məʃəgən 1 2 3	'mə.ʃəgən	* 'mʃə.gən

4.3.3 OT Deletion

The rule based description of deletion fails to explain these invariant schwas and an OT analysis of the same fares little better. Due to the consonant pattern we know that {COMPLEX:MARGINS, MAX(C) }>> DEP(V) in any analysis of the language, to attribute the vowel variation to deletion we add MAX(V) and a constraint motivating deletion.

MAX(V): a violation is incurred for every vowel which appears in the input but not in the output

*WEAK: a violation is incurred for every weak vowel in a word[29]

To prevent complete satisfaction of *WEAK at the expense of well-formed syllables (64b), *COMPLEX:MARGINS must outrank *WEAK. The faithfulness constraint MAX(V) must be dominated by the constraint *WEAK, else a completely faithful candidate (64a) would be preferred over the attested candidate (64c).

[29] This is just one of many possible ways to formalize the constraint responsible for the variation: it could also be characterized as a constraint against vowels, a constraint against syllables (*STRUC),or even a *MedialLight (Rose 2000) constraint forbidding consecutive light syllables. Defining it in any of these ways would also require the introduction of a higher ranking faithfulness constraint applying only to strong vowels. The definition used here requires no additional constraints, and was selected for the sake of simplicity, not from any particular belief in its superiority.

(64)

/datəbəg/ "leaf"	*COMPLEX:MARGINS	*WEAK	MAX(V)
a. datəbəg		**!	
b. datbg	*!		**
c.→ • datbəg		*	*

Additionally we would need to include a maximization constraint to explain why the initial complex onset is created through deletion instead of being blocked by *COMPLEX:MARGINS (65).

(65)

/gənəwanwe/ "long-tailed"	MAXσ1:ONSET	*COMPLEX:MARGINS	*WEAK
→ • gnə.wan.we	*******	*	*
gən.wan.we	********!		*

Words containing invariant schwa are difficult to explain under this analysis, as they have no clear motivation for their greater violations of MAXσ1:ONSET and *WEAK.

(66)

/nənə/ "man"	MAXσ1:ONSET	*COMPLEX:MARGINS	*WEAK
a. → nnə	**	*	*
b. • nənə	***!		**

4.3.4. Conclusions for Deletion

In the forms discussed here, it is difficult to identify any environment that a blocking effect could be attributed to. For each of these anomalous forms other words can be found with similar stress, word position or consonant environment where the alternation in vowel appearance must occur. Notice also that with the OT deletion analysis sketched out above, words like "Michigan" and "man" violate not only *WEAK which motivates deletion, but also MAXσ¹:ONSET which prefers an initial cluster. These constraints are violated by the attested forms without any possible higher ranking constraint to justify their non-conformity. The presence of invariant schwa recommends an epenthesis approach to the vowel variation, as the attested forms are those predicted, this explanation is more uniform in its application.

5. Weak [o] and Epenthesis

The greatest weakness of the epenthesis analysis discussed thus far is that it has dealt only with one of the two vowel/zero alternations seen in Potawatomi. While the schwa variation is much more prevalent in the language than the weak [o] variation, both are present and must be explained.

(67)

Word	Gloss	
bm**o**se	"he walks"	b m o s e
nbəmse	"I walk"	n-b ə m s e
dabjan	"spoon"	d a b j a n
wd**o**dabjanən	"her spoon"	w d- o d a b j a n -ə n

gwabməg**o**k	"they see you"	g	wa	bm	ə	g	o	-k
gwabməgwa	"he sees you pl."	g	wa	bm	ə	g	-wa	
gwabməgwak	"they see you pl."	g	wa	bm	ə	g	-wa	-k

Several generalizations can be made concerning the appearance of varying [o], notably similar to those made for varying [ə]. This vowel never appears initially, it is always preceded by a consonant. Two consonants appear between the initial word edge and the [o] when it is the first vowel of the word. In a sequence of varying vowels, two consonants appear between [ə] and [o] except where one is in the final syllable. In words containing varying [o], the vowel always appears as [o] or not at all, there is no alternation with [ə]. Nor do schwa and [o] have noticeably different environments within the word; they are found in similar positions and consonant environments.

Because the varying vowels [o] and [ə] exhibit the same alternation it seems logical to explain them with the same mechanism. This is where a deletion analysis seems to have a real advantage: the deletion rule or constraint applies to the [o]'s and [ə]'s present in the language. An analysis using epenthesis seems to run into trouble, if [ə] and [o] appear in similar environments, how and why is [o] epenthesized instead of the default [ə]?

Although the surrounding consonants do not provide a conditioning environment for the appearance of [o] instead of [ə], I suggest that there is a distinct difference between forms with weak [o] and those with [ə], the presence of a ghost vowel. According to Zoll (1996), latent segments in the underlying representation of many languages allow lexically determined effects to appear under certain circumstances, like epenthesis. By applying this work to the constraint rankings previously laid out to govern the appearance and placement of the [ə], we end up with an epenthesis analysis capable of explaining the behavior of both varying vowels.

5.1 What is a Ghost Vowel?

Zoll examines a variety of alternation processes in both consonants and vowels, including Yowlumne glottalization and vowel variation and Slavic yers. Her conclusion was that these different phenomena could be accounted for in relatively similar ways using OT and the subsegmental constraints she developed. What these disparate examples had in common were the unusual behavior of the segments, many of which appeared only in very limited circumstances, often those associated with epenthesis, and which appeared to have some lexical specification. The example shown below in (68) is of Polish yers and shows the vowel zero alternation of this language. In this language, some vowels, called yers (written here as "E"), alternate while other, seemingly similar, vowels do not. In addition, these alternating vowels appear to be lexically specified as they do not always represent a default vowel (Szypra 1992), as can be seen in (68b) where the vowel is phonetically different (and hence written "Y").

(68) from Szypra 1992: ex. 5

a.	nom.sg	gen.sg
"setter"	seter	seter-a
"sweater"	swetEr	swetr-a

b.	Noun	diminutive
"lesson"	lekcj-a	lekcYj-k-a

At times the alternation seen in Slavic yers has been described as deletion of an underlying vowel (Szypra 1992, Steele 1973), or epenthesis to create licit syllable (Laskowski 1975, Piotrowski 1992). Zoll, following work by Rubach (1986) and Spencer (1985), took a sort of intermediary approach to this alternation, analyzing it as a 'ghost vowel' or 'latent segment' but incorporating it into an OT framework.

5.1.1 How does a ghost vowel work?

Zoll (1996) uses an Optimality Theoretic approach to unify the treatment of ghost vowels with that of floating subsegments and latent segments. Although previously analyzed as distinct phenomena of different languages, Zoll treats these as different instantiations of the same phenomenon. Under her analysis, a ghost vowel is a subsegment which lacks an underlying timing slot; without a timing slot, or root node, the subsegment is unable to be realized at the surface level. Depending on the language, the ghost vowel may employ one of two strategies to gain access to a root node: share a node already present elsewhere in the word, or epenthesize one for their purpose. Failing this, the subsegment will remain unrealized. If a language is one in which the subsegment can't be displaced and attach itself to an existing node, then it can only appear when a new node occurs at its location through epenthesis. Languages may be more or less accommodating with this epenthesis, in some it may occur whenever the ghost needs to be realized, while in others it may only happen when required by other constraints.

Yowlumne glottalization is an example of a ghost glottal which prefers to share a node, moving forward in the word until it finds a suitable 'host' to glottalize (69a)[30]. If it can find no appropriate location in the word, it fails to be phonetically realized (69b).

(69)

	Underlying	Surface
a. "shout"	(?) c a w - a a	? c a w a a
"sing"	(?) ? i i l k - a a	? ? i i l k a a
b. "float"	(?) h o g n - a a	h o g n a a

The latent glottalization is represented as (?), realized glottalization appears without parentheses.

Slavic yers, on the other hand, is an example of a ghost which requires a node to be epenthesized for it, appearing in the examples below only when prompted by syllable structure[31].

(70)

a. "sweater"	Underlying	syllabification	Surface
nom.sg	swet(E)r	*swetr	swetEr
gen.sg	swet(E)r-a	swet.ra	swetr-a

The (E) represents the unrealized form, E the surface form

[30] Data from Zoll 1996, pg 168.
[31] This is an oversimplification of Polish yers, as in other words the appearance of yers is prompted by things other than well-formed syllables. So although the motivation in the examples shown here seems clear other factors complicate it elsewhere in the language.

The most restrictive of these patterns seems to fit the description of Potawatomi, where the weak [o] appears only in those instances where we might otherwise expect an epenthetic vowel.

5.1.2 A Ghost in Potawatomi

Assuming that epenthesis provides an empty vocalic slot, it can provide a ghost vowel the opportunity to surface. We can then use this as an explanation for the matching distributions of [ə] and [o]. Ghostly [o] can only appear where epenthesis has occurred and provided it with an empty root node.

To incorporate the ghost vowel into this analysis I rely heavily on Zoll (1996), where she proposes a number of constraints for dealing with this class of subsegment. First she divides MAX into two separate constraints, MAX(SEG) and MAX(SUBSEG):

MAX(SEG): a violation is incurred for every segment which appears in the input but not the output

MAX(SUBSEG): a violation is incurred for every subsegment[32] which appears in the input but not in the output

This division is necessary, so that the two MAX constraints can be ranked differently, as in many languages floating subsegments are realized only under certain conditions, while underlying segments are more often faithfully represented in the output.

Because we do not see extra epenthesis of root nodes in Potawatomi just to allow the ghost to be realized, DEP(V) must rank above MAX(SUBSEG) otherwise a vowel would

[32] Zoll (1996, pg. 61) defines the subsegment as "an undominated F-element" including both floating class nodes and floating features.

always be epenthesized to allow the subsegment to appear (71). The tableau in (72) shows that this ranking allows the subsegment to surface where epenthesis occurs. In the tableaux below I use a superscript "o" to indicate the unattached subsegment in the input.

(71)

/nbm˚se/	DEP(V)	MAX(SUBSEG)
nbə.mo.se	**!	
→• nbəm.se	*	*

(72)

/bm˚se/	DEP(V)	MAX(SUBSEG)
→•bmo.se	*	
bmə.se	*	*!

Zoll uses CONTIGUITY as an explanation for the location of epenthesis in her description of Yowlumne floating subsegments (Zoll 1996, pg. 186). This constraint won't work as an explanation for the Potawatomi data because there are frequent violations of CONTIGUITY due to epenthesis. In Potawatomi the ghost vowel does not move in through a root, it appears only in one place in all related forms, a high ranking LINEARITY (McCarthy and Prince 1994, 1999) constraint predicts this pattern if we assume that this is the underlying location of the subsegment.

LINEARITY: incur a violation for every segment which does not appear in the same relative order in the output as the corresponding segment or subsegment does in the input.

(73)

/nbm˚se/	LINEARITY	MAX(SUBSEG)
→ • nbəm.se		*
nbom.se	*!	

By ranking this constraint above MAX(SUBSEG) as shown above, we prevent the movement of the subsegments in an attempt to be realized. For similar reasons we must rank LINEARITY above DEP(V) as well, else metathesis will be the preferred repair strategy for markedness (74)

(74)

/gnwanwe/	LINEARITY	DEP(V)
a. gnaw.new	*!	
b. → • gnə.wan.we		*

Analyzing the weak [o] as a subsegment provides us with an explanation for why it shares a distribution with [ə], but begs the question, where are all the other ghost vowels? Respecting richness of the base, we would expect that there be not just one type of subsegment, that the other vowels might appear as ghosts, and even that consonants might appear as subsegments. In the case of the consonants, we need merely assume that

DEP(C) outranks MAX(SUBSEG), this will prevent any consonantal subsegment from being realized except where consonant epenthesis is motivated. With vowels, however, we already know that a vocalic subsegment should be able to appear in the language because weak [o] does. However, [o] differs from the other vowels of Potawatomi in that it is the only vowel described as [+back] (Buszard-Welcher)[33]. If we assume that Potawatomi also contains faithfulness constraints for backness then we can separate [a, e, i] vocalic subsegments from [o] subsegments.

MAX [+back]: A violation is incurred for every [+ back] feature in the input which does not have a correspondent in the output

MAX [-back]: A violation is incurred for every [- back] feature in the input which does not have a correspondent in the output

By ranking MAX [+back] and MAX [-back] with respect to DEP(V), we can create a situation in which not realizing some subsegments (a, i, e) is a greater problem than not realizing weak [o]. This is due, not to their nature as subsegments, but due to the need to be faithful to the features they contain. In (75) and (76) below we can see that by ranking DEP(V) above MAX [+back] and below MAX [-back], we create a situation where all vocalic subsegments except [o] are always realized, and appear to be 'regular', non-varying vowels, while [o] continues to vary.

[33] Buszard-Welcher describes [a] as an "open front vowel"

(75)

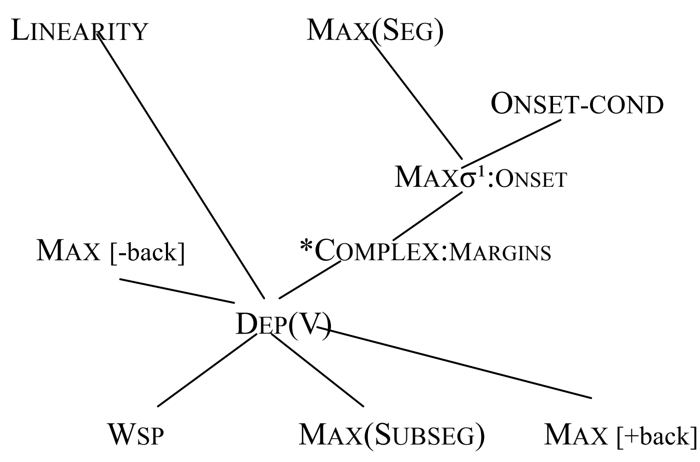
nbm^{a}se	MAX [-back]	DEP(V)	MAX(SUBSEG)
nbəmse	*!	*	*
→ nbəmase		**	

(76)

nbm°se	DEP(V)	MAX(SUBSEG)	MAX [+back]
nbəmose	**!		
→ • nbəmse		*	*

In (77) below then we can see the constraint ranking which allows us to describe the placement of epenthesis and which governs the appearance of the ghost [o].

(77)



New to this diagram are the rankings of MAX(SUBSEG) and LINEARITY. Because epenthesis does not always occur to allow the ghost vowel to be realized, MAX(SUBSEG) must rank below DEP(V) (72). LINEARITY must rank above DEP(V), because metathesis never occurs in the language, instead epenthesis is the attested repair strategy (74). To ensure that only the ghost vowel [o] experiences variation must rank MAX [-back] above DEP(V), while MAX [+back] ranks below them (75 and 76).

5.1.3. Significance of the Ghost

The benefit to using the ghost vowel analysis is that it provides us with a solution to the problem of weak [o]'s alternation, making a viable solution more complete and attractive. At first glance the fact that weak [o] shows the same pattern of alternation as schwa seems a strong factor in favor of an account deleting the vowels rather than epenthesizing. It might seem difficult to explain how epenthesis could be responsible for the appearance of two different vowels in nearly identical contexts, but analyzing weak [o] as a ghost allows us to do just that. The varying vowels have the same distribution because the ghost vowel is able to appear only when and where epenthesis provides it with a timing slot.

Conclusion

Previous accounts of Potawatomi vowel variation have used deletion where I now propose to use epenthesis as an explanation. What I have shown here is that by switching from a rule based analysis to OT, we have demonstrated the superiority of an epenthetic account. While a deletion approach does have appeal in its seeming simplicity and historical correspondence, the more complex epenthesis analysis has the advantage of better representing synchronic reality.

Using the historical underlying representations proposed by Hockett, a deletion approach can cover only a subset of the languages forms. Without any environment that would condition blocking, a class of the language's forms are unavoidably exceptional. These same forms are not only accounted for by an epenthesis analysis but predicted by richness of the base. We expect to find underlyingly present [ə] in the language, and in these forms we have it.

While the deletion analysis certainly has a simpler explanation of why weak [o] and [ə] pattern together, this can still be covered by an epenthesis analysis. Deletion can explain these two vowels as two separate underlying vowels to which the same rule applies, an option unavailable to epenthesis. However, at least one method of incorporating this vowel into the epenthesis analysis exists, here I have presented weak [o] as a ghost vowel following Zoll (1996).

Finally, by using richness of the base I have already shown that epenthesis is a necessary part of the language. This then allows us to use an epenthesis approach as a means of simplifying the constraint ranking; we can unify two behaviors of the language by the ranking of two constraints. Although additional constraints are necessary to govern exact placement, both the consonant cluster pattern of the language and the vowel variation are largely the result of COMPLEX:MARGINS>>DEP(V)

By using OT and richness of the base, we have drastically changed our understanding of Potawatomi vowel variation. Vowel variation is a result of an epenthesis mechanism needed elsewhere in the language, providing us with a more complete explanation than that given by previous approaches.

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