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# Interactions at the syntax–phonology interface: Evidence from Ojibwe

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**Abstract**

This paper provides evidence that word-internal syntax can play a crucial role in the determination of phonological well-formedness. The focus is on an apparent paradox in Ojibwe; the language both avoids and tolerates vowels in hiatus. Adopting the theory of Distributed Morphology, we argue that VV sequences are avoided within domains that are realizations of syntactic phases, based on the theory of cyclic derivation proposed by Chomsky (2001, 2008) and others. In contrast, when a VV sequence spans the boundary between phases, it is tolerated. The apparent paradox is a consequence of the fact that the elements outside the spell-out of a phase cannot be evaluated to determine the well-formedness of prosodic entities like syllables, feet and prosodic words. Derivation by phase and Distributed Morphology also provide insights into two strategies for avoiding vowels in hiatus within a phase-domain; vowel loss applies to combinations of vocabulary items inserted in the same phase, while consonant epenthesis applies to items inserted in different phases but merged phonologically after insertion. The conditions under which consonant epenthesis occurs provide support for post-syntactic movement at the PF interface, triggered entirely by phonological factors.


*Keywords:* Ojibwe; Hiatus resolution; Phase; Word structure; Syntax–phonology interface

## 1. Introduction

In Ojibwe, an Eastern Algonquian language, vowels in hiatus are avoided and a vowel deletion strategy is generally used to block occurrences of VV sequences. Data like those in (1) illustrate the use of this strategy.[2]

(1) Hiatus resolution by vowel deletion

| | | |
|---|---|---|
| a. | name:g | 'sturgeons' |
| | name:-ag | |
| | 'STURGEON-PLURAL' | |

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b. nigi:we:ʔa: ‘I make him go home’
ni-gi:we:-iʔ-a:
‘1-GO HOME-CAUSATIVE-HIM’

c. nigi:wa:daga: ‘I swim home’
ni-gi:we:-a:daga:
‘1-GO HOME-SWIM’

d. giʒiba:bato: ‘run in circles’
giʒiba:-ibato:
‘CIRCLE-RUN’

e. mi:dʒimaw ‘eat something belonging to someone’
mi:dʒi-amaw
‘EAT-APPLICATIVE’

f. ga:ndisaʔ ‘urge someone on, cause someone to push ahead’
ga:nd-isa-iʔ
‘PUSH-FORCEFULLY-CAUSATIVE’

The loss of a vowel under the conditions illustrated in (1) is categorical. Normally, the second vowel in an underlying VV sequence is deleted, but (1c) shows that the first vowel can be targeted. This example has additional significance; it provides positive evidence that the ban on VV sequences applies to long vowels. The obligatory resolution of the hiatus in the above cases contrasts with a tolerance for VV sequences in examples like those in (2).

(2) a. inia:gamose: ‘he walks away in snowshoes’
ini-a:gam-ose:
‘AWAY -SNOWSHOE-WALK’

b. gi:a:gamose: ‘he walked in snowshoes’
gi:-a:gam-ose:
‘PAST-SNOWSHOE-WALK’

c. gi:inia:gamose: ‘he walked away in snowshoes’
gi:-ini-a:gam-ose:
‘PAST-AWAY-SNOWSHOE-WALK’

The VV sequence in (2a) is the product of the combination of a preverbal modifier (i.e. /ini/ ‘away, there’) and a vowel-initial root. Hiatus is also tolerated when a tense marker (e.g. /gi:/ ‘Past’) is followed by a vowel-initial morpheme (2b, c).

The goal of this paper is to reconcile the apparent contradiction reflected in the contrast revealed in (1) and (2). We provide an analysis that brings together two fairly recent developments in linguistic theory. One of these is reflected in our representation of the structure of Ojibwe words in accordance with the tenets of Distributed Morphology (DM) (Halle and Marantz, 1993, 1994). The other is the adoption of the proposal by Chomsky (2001, 2008) that the computational system of language submits bits of abstract structure called phases to the PF component of the grammar where they are given phonetic interpretation and to the LF component where semantic interpretation is assigned. We claim that syntax generates one or more phases in the derivation of an Ojibwe word and certain aspects of the phonology mirror the morpho-syntactic structure. In particular, our paper adds to thework of Marvin (2002), Barragan and Newell (2003), and Adger (2006b) by demonstrating that conditions on syllabification and stress assignment can be constrained by phase boundaries. Derivation by phase yields a straightforward explanation for the difference between the data in (1) and (2).

The outline of the paper is as follows. Section 2 provides a detailed overview of various ways in which the language both avoids and tolerates VV sequences. In section 2.1, we illustrate the range of strategies that are used to eliminate such sequences, while section 2.2 provides examples of constructions where VV sequences emerge and are tolerated. Then, in section 3, an analysis of the contradictory syllabification patterns of Ojibwa that supports a phase-based explanation of hiatus resolution in the language is presented. We give an overview of the structure of Ojibwe nouns and verbs in section 3.1; it identifies the combination of syntactic elements that qualify as phases. We argue that restrictions on syllabification must apply phase-internally and therefore cannot target elements that belong to different phases. In section 3.2, we consider an apparent problem posed by a mismatch between syntactic and phonological structure; certain affixes, syntactically generated in one phase, behave phonologically as if they belong to another phase. We attribute the mismatch to a phonologically conditioned movement operation called *Phonological Merger*, triggered in Ojibwe by conditions on stress assignment. Section 3.3 briefly discusses why the paradox of hiatus resolution in Ojibwe poses problems for approaches like derivational Lexical Phonology and (some versions of) non-derivational Optimality Theory. Finally, section 4 provides a summary and conclusion that draw attention to the broad implications of our analysis of the Ojibwe problem.

## 2. The variable treatment of vowel sequences in Ojibwe

The ban on vowels in hiatus is generally considered to be a condition on the well-formedness of a sequence of syllables within a domain. It requires the nuclei of adjacent syllables to be separated by an onset segment and is enforced, cross-linguistically, by vowel fusion, vowel deletion or consonant epenthesis. Many languages disallow vowels in hiatus within words but tolerate VV sequences across word boundaries; Axininca Campa, for example, (Payne, 1981) is such a language. The Ojibwe case, documented by Bloomfield (1957), Kaye et al. (1971), Piggott and Kaye (1973), Piggott (1980b) and others, is interesting, because, while hiatus is resolved word-internally, some of the contexts in which it is not resolved also qualify as word-internal. In the following two sections, we provide an overview of the treatment of word-internal VV sequences.

### 2.1. The contexts of hiatus resolution

Vowel sequences in Ojibwe never occur morpheme-internally. When they are derived from a concatenation of morphemes, the resulting hiatus is often resolved. This overview of the contexts where hiatus resolution occurs begins with a look at the morphological composition of complex words. Focusing first on the verb complex, the relevant details are provided from constructions belonging to the paradigm described in traditional Algonquian studies as the Independent Order. These verb forms are used in simple declarative sentences. There is general agreement that a verb may be preceded by a set of verbal modifiers, traditionally labeled 'preverbs'. The tense markers /gi:/ (Past), /wi:/ (Future: volitional) and /ga/ (Future: non-volitional) are usually assigned to this class, but it is more appropriate to treat them as members of a separate category, since, as we show below, they are structurally different from the other elements that qualify as preverbs. A tense marker may be preceded by a pronominal prefix, informally identified as the 'subject' marker; there are three pronominal prefixes, i.e. /ni-/ (1st Person), /gi-/ (2nd Person) and /o-/ (3rd Person). In summary, there are three categories of morphemes that may precede a verb.

(3) The Ojibwe verb complex

| Subject | Tense | Modifier | Verb |
|---|---|---|---|

Overt exponents of the categories that precede a verb are not always attested. For example, the present tense morpheme is always null (Ø) and the 3rd Person Subject of an intransitive verb is marked by a suffix rather than a prefix.[3]

It is somewhat misleading to posit a single modifier category. Excluding tense morphemes, Valentine (2001) recognizes that preverbal modifiers may belong to distinct subcategories that may co-occur in a single construction. For example, the word *niminoiʒiaja:* 'I am very well' contains the preverbs *mino* 'good' and *iʒi* 'thus, to such a degree'. Valentine asserts that the range of meanings associated with such elements include desire, obligation, direction, quantity, quality, manner, number, etc. The following list gives an idea of the types of elements that qualify as preverbal modifiers.

(4)

| | | | | | |
|---|---|---|---|---|---|
| a. | nitami | 'first' | k. | bo:ni | 'stop' |
| b. | wa:bi | 'white, gray' | l. | ma:dʒi | 'start' |
| c. | ginibi | 'quickly' | m. | gitʃi | 'big, great' |
| d. | ombi | 'upwards' | n. | aga:ʃi | 'small' |
| e. | iʒi | 'thus' | o. | api:tʃi: | 'currently' |
| f. | gi:mo:dʒi | 'secretly' | p. | mino | 'good, nice' |
| g. | bi | 'here, toward speaker' | q. | dago | 'together' |
| h. | ini | 'there, away from speaker' | r. | madwe: | 'noisy, audible' |
| i. | biba: | 'along' | s. | makade: | 'black' |
| j. | giʒe:ba: | 'early, at dawn' | t. | gagwe: | 'try' |

The relatively large number of preverbal modifiers and the range of meanings they express suggest that they constitute an open, lexical class that should be differentiated from the restricted functional elements like the tense and subject-marking affixes.

Demonstrably, modifiers are morphologically complex, containing at least one root and a morpheme that qualifies as what the Algonquian literature traditionally calls a *Final*.[4] For example, the modifier /ma:dʒi/ 'start' contains the root /ma:d/

[3] As a suffix, the 3rd Person morpheme is realized as either null (Ø) or [w] under phonologically well-defined conditions.

[4] In the discussion here we use the traditional Algonquinist term *Final*. These *Finals* will be reanalyzed as category-defining heads ($v^0$, $n^0$, $a^0$, following Brittain, 2003) below.

and the *Final* /i/. Notice that affixation of the latter causes the root-final /d/ to change to the affricate /dʒ/ by a process of palatalization. This process is restricted to morphologically derived contexts (Kaye and Piggott, 1973). The composition of a modifier can therefore be schematized as follows.

(5) The Ojibwe verb complex

| Root | Final |
|---|---|

Empirically, the modifier *Final* has one overt exponent, the vowel /i/. While this realization is attested after a consonant, it would be phonetically suppressed elsewhere. Predictably, it would be deleted after a vowel but would merge with a preceding glide. Hence, representations like those illustrated in (6) are justified.

(6)
a. biba: ‘along’
biba:-i
‘ALONG-FINAL’
b. madwe: ‘noisy, audible’
madwe:-i
‘NOISY-FINAL’
c. mino ‘good, nice’
minw-i
‘GOOD-FINAL’

Since VV sequences never occur within modifiers and the *Final* /i/ is always suppressed after vowels, we identify internal structure of a modifier as one of the contexts in which hiatus resolution occurs.

Turning to the verb itself, it may contain one or more root morphemes. For example, two roots /bo:n/ ‘stop’ and /a:b/ ‘see’ appear in the verb *bo:na:bi* ‘he stops looking’.[5] Examples like those in (1c, d) show that when such root-root combinations result in VV sequences the hiatus is resolved. A verb root, either simple or compound, must be followed by a morpheme that marks the transitivity of the verb. This class of morpheme, also traditionally labeled *Finals*, provides information about argument structure. Hence, verbal *Finals* are grouped into transitive and intransitive sets. In the intransitive set, they are further divided into those that identify the sole argument as either animate (AI) or inanimate (II).[6] The transitive set is also sub-divided on the basis of information it provides about the grammatical gender of the internal argument of the verb. A transitive *Final* may mark this argument as animate (TA) or inanimate (TI). Some of these *Finals* also have readily discernable meanings. For example, /iʔ/ is the causative suffix and /amaw/ has an applicative/benefactive meaning. *Finals* generally begin with either /i/ or /a/, which is invariably lost after a morpheme that ends in a vowel. Examples (1e) and (1f) contain the applicative and instrumental finals, respectively. Other illustrations of VV sequences resulting from the affixation of a *Final* follow.

(7)
a. manido:wi ‘be a spirit
manido:-iwi
‘SPIRIT-INCHOATIVE’
b. bagone:zi ‘have a hole’
bagone:-izi
‘HOLE-STATIVE’
c. bagone:ʔw ‘make a hole with a tool’
bagone:-aʔw
‘HOLE-INSTRUMENTAL’
d. aja:maw ‘get something for someone’
aja:-amaw
‘GET-APPLICATIVE’
e. nagamoʔ ‘make someone sing’
nagamo-iʔ
‘SING-CAUSATIVE’

[5] The non-initial root in this type of complex structure is traditionally described by terms such as medials, pre-medials, post-medials and pre-finals.

[6] Note that Ojibwe nouns are classified as either animate or inanimate.

In a transitive verb, the *Final* is followed immediately by another obligatory morpheme, a suffix that agrees in person features with one of the arguments and also identifies that argument as either agent or theme/goal. These suffixes, called theme-signs (TS) in traditional descriptions of Algonquian languages, may be classified as either local (limited to a transitivity relation where all (grammatically-marked) participants are either 1st or 2nd Person), or non-local (where one of the participants is marked as 3rd Person). A list of the TS suffixes that occur in simple declarative sentences is given in the following table.

(8) Ojibwe theme-signs

| | Goal/Theme | Agent |
|---|---|---|
| Local: 1st Person | i | ini |
| Non-local: 3rd Person | a: | ig(w) |

Other suffixes follow the theme-sign. These include endings bearing phi-features that agree in Person and number with one of the arguments of the verb (i.e. agent or goal/theme). These agreement suffixes are followed by morphemes signaling aspectual functions such as indicative, preterite, dubitative and preterite dubitative. Finally, the last slot in the verb template is occupied by another set of agreement affixes that identifies a 3rd Person argument of the verb as singular/plural and proximate/obviative (i.e. disjoint in reference from another 3rd Person argument). The composition of a transitive verb (excluding prefixes) can therefore be schematized as follows.

(9) The components of an Ojibwe transitive verb

| Root | Final | Theme-sign | Person-number | Aspect | Number-Obviative |
|---|---|---|---|---|---|

Two illustrations of the post-radical elements that are realized within an Ojibwe transitive verb are provided below.

(10) a. niwe:ʒi:na:na:nig ‘we paint them’
ni-we:ʒi:-in-a:-ina:ni-Ø-ag
‘1-PAINT-FINAL-TS(3 THEME)-1PLURAL-IND-3PLURAL

b. nigi:wa:biwe:ʒi:na:na:nig ‘we painted them white’
ni-gi:-wa:bi-we:ʒi:-in-a:-ina:ni-Ø-ag
‘1-PAST-WHITE-PAINT-FINAL-TS(3 THEME)-1PLURAL-IND-3PLURAL

In (10a, b), the root /we:ʒi:/ ‘paint’ is followed by a *Final* /in/ and the theme-sign /a:/. Affixation of the 1st Person Plural suffix (i.e. /ina:ni/) to this theme-sign creates a context in which hiatus resolution applies. The attachment of the final agreement affix, 3rd Person Plural (i.e. /ag/), creates another context of hiatus resolution. Notice that there is no overt manifestation of aspect in the above words. We assume that the indicative (IND) morpheme is null (Ø).

Turning next to nominal constructions, these provide several additional contexts in which a hiatus is resolved. Root-root combinations can produce such a context. For example, the root /manido:/ ‘spirit’ combines with /imin/ ‘berry’ to form the word *manido:min* ‘glass bead’ and the compound *nabe:mik* ‘male beaver’ is formed from /nabe:/ ‘male’ and /amikw/ ‘beaver’. In each of these nominal compounds, the second member loses its initial vowel, reminiscent of the pattern of vowel loss in verbal compounds. We also saw earlier in (1a) that affixation of a plural suffix may create a VV sequence. The two plural suffixes are /ag/ ‘Animate’ and /an/ ‘Inanimate’. Each is realized as just a consonant after a root ending in a vowel, as shown in the following additional examples.

(11) a. ogima:g ‘chiefs, leaders’
ogima:-ag
‘CHIEF-PLURAL’

b. maʃkode:n ‘fields, clearings’
maʃkode:-an
‘FIELD-PLURAL’

c. o:dʒi:g ‘flies’
o:dʒi:-ag
‘FLY-PLURAL’

d. manido:g ‘spirits’
manido:-ag
‘SPIRIT-PLURAL’

The obviative and the locative suffixes, respectively /an/ and /iŋ/, are also realized as bare consonants after vowel-final roots.

Possessive constructions provide a number of additional contexts in which a hiatus must be resolved. For example, the possessive suffix is realized as /im/ post-consonantally (12a), but the vowel is missing after a vowel-final root (12b).

(12) a. nigo:ko:ʃim 'my pig'
ni-go:ko:ʃ-im
'1-PIG-POSSESSIVE'
b. niname:m 'my sturgeon'
ni-name:-im
'1-STURGEON-POSSESSIVE'

The possessive suffix always co-occurs with a prefix that agrees with the Person features of the possessor argument, and it may be followed by a set of post-radical agreement suffixes. Significantly, the agreement suffixes are identical in form and function to those that appear in verbs. The suffixes /ina:ni/ '1st Plural' and /wa:/ '2nd and 3rd Plural' agree in both Person and number with the possessor argument. A second set of agreement suffixes /ag/ 'Plural' and /an/ 'Obviative', respectively, indicate the number and obviation status of the possessed noun. Since the agreement suffixes in nouns and verbs are identical, it is hardly surprising that they can provide contexts for hiatus resolution in possessive constructions. For example, in the derivation of (13a), affixation of the 1st Plural and Plural suffixes produces a sequence of short vowels (i.e. /i-a/) and the second vowel is dropped. The obviative suffix in (13b) loses its initial vowel after the 3rd Plural morpheme.

(13) a. nigo:ko:ʃimina:nig 'our pigs'
ni-go:ko:ʃ-im-ina:ni-ag
'1-PIG-POSSESSIVE-1PLURAL-PLURAL
b. oname:miwa:n 'their sturgeon(s)'
o-name:-im-(i)wa:-an
'3-STURGEON-POSSESSIVE-3PLURAL-OBVIATIVE'

An interesting case of hiatus resolution in nominal constructions comes from diminutive formation. There is general agreement that the productive diminutive suffix is /e:ns/. It is attested in its full form after consonants.

(14) a. ʒi:ʃi:be:ns 'little duck, duckling'
ʒi:ʃi:b-e:ns
'DUCK-DIM'
b. e:mikwa:ne:ns 'little spoon'
e:mikwa:n-e:ns
'SPOON-DIM'
c. wi:giwa:me:ns 'little house, outhouse'
wi:giwa:m-e:ns
'HOUSE-DIM.

However, when the same suffix is attached to a vowel-final root, it appears in a reduced form, without the initial long vowel. This pattern, also documented by Valentine (2001: 494–496), is illustrated below.

(15) a. ase:ma:ns 'cigarette'
ase:ma:-e:ns
'TOBACCO-DIM'
b. manido:ns 'bug, flying insect'
manido:-e:ns
'SPIRIT-DIM'
c. iʃkode:ns 'match'
iʃkode:-e:ns
'FIRE-DIM'
d. o:dʒi:ns 'little fly'
o:dʒi:-e:ns
'FLY-DIM'

The realization of the diminutive suffix in a post-vocalic context provides additional proof that hiatus resolution may apply to sequences of long vowels and that vowel deletion may be employed as a strategy for resolving this type of hiatus.

In summary, a range of evidence from modifier, verbal and nominal constructions shows that VV sequences are not tolerated. When all contexts for hiatus resolution are taken together the following generalization emerges.

(16) Within a combination of morphemes consisting of a root and a sequence of post-radical morphemes, VV sequences are unattested.

The vowel clusters that undergo simplification are quite varied. We have presented direct evidence showing that the short vowels /i/ and /a/ are suppressed after long vowels (/i:, e:, a:, o:/) and also after other short vowels. In a sequence of short vowels, the second one is deleted, regardless of its identity. Compare the treatment of the /i-a/ sequence in (1e) and the /a-i/ sequence in (1f); in each case, the first vowel is preserved. Hence, vowel quality does not appear to be a factor in determining how a hiatus is resolved. The prohibition of VV sequences also applies to long vowels. We have shown that the vowel /e:/ is suppressed before /a:/ (1c), and /e:/ as the initial vowel of the diminutive suffix does not appear after any long vowel.

While the generalization in (16) is robust, we pointed out earlier that vowel sequences are not completely banned within Ojibwe words. Sequences identical to those that must be modified to satisfy the generalization in (16) occur in other contexts. These contexts are described in the following section.

### 2.2. The contexts of hiatus tolerance

Hiatus resolution is widely attested (Casali, 1997). In most cases, it is a word-internal process. It is therefore not surprising that Ojibwe readily tolerates VV sequences between words. Each of the following sentences contains two stress peaks (i.e. two loci of primary stress), signaled by the acute accent, and must therefore contain two distinct words.[7]

(17) Hiatus tolerance between words

a. aníʃinà:bè: á:kozìnikè: ‘The man has a pain in his arm’
aniʃina:be: a:kozi-nike:
‘MAN BE SICK-ARM’

b. aníʃinà:bè: inìkozò ‘The man is wounded’
aniʃina:be: inikozo
‘MAN BE WOUNDED’

Consider now the examples in (18), each of which contains a single stress peak. The occurrence of VV sequences is unexpected, if these qualify as words.

(18) a. gí:anòkì: ‘he worked, hunted’
gi:-anoki:
‘PAST-WORK’

b. gí:ikìdò ‘he said’
gi:-ikido
‘PAST-SAY’

c. gí:onì:kè: ‘he trapped’
gi:-oni:ke:
‘PAST-SET A TRAP’

The above words contain the Past tense prefix /gi:/. Affixation of this vowel-final morpheme to a vowel-initial root never triggers hiatus resolution. Notice that root-initial short vowels are attested after the long vowel of the prefix, in contrast with the pattern illustrated in (7) where a short vowel is deleted after a long one. A sequence of long vowels created by affixation of the Past tense morpheme is also preserved, as shown by an earlier example (2b). The Future tense prefix /wi:/ displays identical phonological behavior.

Of course, the problem presented by the data in (18) disappears, if the tense morpheme and the verb are separate words. However, these items do not display the distributional independence expected of separate words. While word order in Ojibwe is relatively free, the linear order of a tense morpheme and a verb never changes. The evidence from the

[7] More details on stress assignment in Ojibwe are provided in §3.2. For the moment, it is sufficient to note that it helps to determine what constitutes a word.

occurrence of adverbs (which are morpho-syntactically different from the modifiers in (4)) is also instructive. An adverb can appear in different positions in a sentence without affecting the meaning (19a, b, c). However, (19d) shows that an adverb cannot separate a tense morpheme from a verb.

(19) a. owadi gi:namadabi 'he sat over there'
owadi gi:-namadabi
'OVER THERE PAST-SIT'

b. ogima: gi:namadabi owadi 'the chief sat over there'
ogima: gi:-namadabi owadi
'LEADER PAST-SIT OVER THERE'

c. gi:namadabi ogima: owadi 'the chief sat over there'
gi:-namadabi ogima: owadi
'PAST-SIT LEADER OVER THERE'

d. gi: (*owadi) namadabi 'he sat over there'
gi: (*owadi) namadabi
'PAST OVER THERE SIT'

The occurrence of the negative particle *ga:wi:* 'not' is further proof that the tense morpheme and the verb are not treated as completely separate words. While the negative particle always precedes the verb, it cannot appear between the tense morpheme and the verb. Hence, (20a) is well-formed but not (20b).

(20) a. ga:wi: wi:namadabisi: 'he will not sit'.[8]
ga:wi: wi:-namadabi-si:
'NOT FUTURE-SIT-NEG'

b. wi:- (*ga:wi:)-namadabisi: 'he will not sit'.
wi:- ga:wi: -namadabi-si:
'FUTURE NOT-SIT-NEG'

We are not aware of any semantic reasons why hypothetical forms like (19d) and (20b) are ill-formed.[9]

Using stress as a diagnostic tool, we can identify another word-internal context where hiatus is unresolved; it is marked by the presence of a modifier. In the following examples, the stress peak falls on the preverbal modifier. Hence, the VV sequences are word-internal.

(21) a. iníagwà:bizò 'he sails away to shore'
ini-agwa:-ibizo
'AWAY-TO SHORE-DRIVE'

b. minóinè:ndàm 'he is content'
mino-ine:ndam
'WELL-THINK'

c. minóiʒìajà: 'she is very well'
mino-iʒi-aja:
'WELL-THUS-BE'

The hypothesis that a modifier-verb combination is a word is also supported by evidence from the possible occurrence of adverbs; they cannot occur between a modifier and a verb.[10]

Primary stress can also appear on modifiers that precede nouns, and VV sequences are readily tolerated in a modifier-noun combination.

[9] Valentine (2001: 61–62) and others have observed that the emphatic particle /sa/ may appear immediately after a tense morpheme. This should not be construed as prima facie evidence that the tense morpheme constitutes a separate word. The location of the emphatic particle may be prosodically controlled, in a manner similar to the location of an English expletive like 'fucking' (e.g. 'fan-fucking-tastic') (see McCarthy, 1982).

[8] The negative particle co-occurs with an obligatory negative suffix /-si:/ on the verb.

[10] The first of the above examples (21a) contains a modifier followed a root-root compound. Hiatus is resolved within the compound but not between the modifier and the verb. Note also in (21c) that hiatus is unresolved between two modifiers and between the second modifier and the verb. The difference between (21a) and (21c) is explained later.

(22) a. agà:ʃíò:dʒì: ‘small fly’
aga:ʃi-o:dʒi:
‘SMALL-FLY’
b. gitʃíè:sibàn ‘big raccoon’
gitʃi-e:siban
‘BIG-RACCOON’
c. gitʃíogìmà: ‘great leader’
gitʃi-ogima:
‘GREAT-LEADER’

Restrictions on coordination also support the hypothesis that modifier-noun combinations are complex words rather than phrases. While a noun may be preceded by more than one modifier (e.g. *gitʃi-madʒi-e:siban* ‘big, wicked raccoon’), the modifiers cannot be linked by a conjunction (e.g. *gitʃi (*gaje*:) *madʒi e:siban* ‘big and wicked raccoon’). The ban on conjoined elements within words seems to be a robust, cross-linguistic condition on word-formation.[11]

Significantly, the vowel sequences that emerge and are preserved in modifier-verb/noun combinations are identical to ones that are subject to hiatus resolution by vowel loss. Note, for example, that the sequences /i-a/ and /o-i/ are preserved in (21a) and (21b), respectively, while identical sequences in (1e) and (7e) are not. In addition, in contrast with the obligatory suppression of a short vowel after a long vowel illustrated in (7c-e) and (9a-c), a long vowel at the end of a modifier can be readily followed by a short vowel.

(23) a. biba:iʒa: ‘go along’
biba:-iʒa:
‘ALONG-GO’
b. biba:inika: ‘go around on business’
biba:-inika:
‘ALONG-BE DOING SOMETHING’
c. biba:agomo ‘float along’
biba:-agomo
‘ALONG-FLOAT’
d. biba:oda:bi: ‘pull along’
biba:-oda:bi:
‘ALONG-PULL’

There is also no prohibition against sequences of long vowels that emerge in a modifier-verb/noun combination (e.g. *biba:a:gamose*: ‘walk along in snowshoes’).

In summary, vowels in hiatus are tolerated in tense-verb, tense-modifier, modifier-verb, modifier-noun, and modifier-modifier combinations, while other combinations of morphological elements do not tolerate VV sequences. The challenge now is to explain how the Ojibwe grammar generates words in which a hiatus must be resolved and also allows words to contain VV sequences.

## 3. Explaining the paradox of hiatus resolution in Ojibwe

Given the observations so far, we could consider an analysis that links the variability of hiatus resolution in Ojibwe to arbitrary properties of morphemes. For example, we could postulate that the status of affixes as prefixes or suffixes determines their phonological behavior. This, as we will see later, cannot be the correct analysis of the Ojibwe data. Instead, we propose an analysis in which the syntactic derivation of words plays a crucial role and, demonstrably, offers a truly explanatory account of the observations. As mentioned in the introduction, our analysis is informed by the theory of cyclic derivation now referred to as derivation-by-phase (Chomsky, 2001, 2008). The issue of what constitutes a phase is currently the subject of much debate. The data in Ojibwe support the recognition of cyclic domains (i.e. phases) at the nP, aP, vP, DP, and CP projections, all of which are already recognized in the linguistic literature (e.g. Marantz (2000),

[11] Halle and Marantz (1993) state that the analogous preverbal modifiers in Potawatomi constitute separate words. It is also noted in Brittain (2003) that some speakers of Algonquian languages have the intuition that modifiers are separate words, even though ‘‘Morphologically, the ‘‘compound verb’’ (preverb + verb stem) is a single word. . .’’(27). It is unclear if the ‘word’ status of these modifiers is cross-linguistically variable, or if speakers do not recognize that a ‘word’ can be part of a compound word. What is clear is that these modifiers are word-internal in Ojibwe. Whether the same can be said for Potawatomi and other related languages would necessitate further investigation.

Heck and Zimmermann (2004), Legate (2003)). We will also adopt the proposal of Travis (2010) that Event Phrase (EP) is a phase. We argue that hiatus is resolved within a phase through deletion and, normally, remains unresolved between vowels interpreted in separate phases. However, the isomorphism between syntax and phonology is not absolute. Certain morphemes introduced in one phase may interact with morphemes from another phase to trigger hiatus resolution in Ojibwe. This exceptional pattern is marked by consonant epenthesis. We argue the conditions for the latter are created, post-syntactically, by a readjustment operation that is phonologically conditioned and independently motivated.

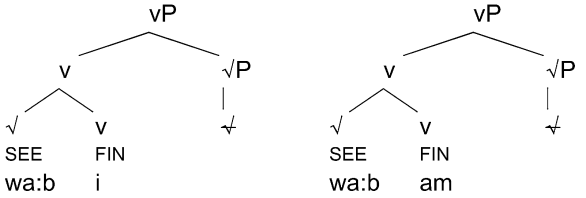
### *3.1. The syntax and phonology of phases in Ojibwe*

In section 2, we presented an overview of the morphological elements that make up a verb form. We will now examine how morpho-syntactic theory and the grammar of Ojibwe provide for the way a form is derived. Consider first the post-radical morphemes known as *Finals*. As pointed out earlier, these morphemes provide information about one of the arguments of a verb and its gender specification (cf. Grafstein, 1984; Piggott, 1985). They produce contrasts like those in (24a) and (24b).

(24) a. wa:bi ‘see’ b. wa:bam ‘see someone’
wa:b-i wa:b-am
‘SEE-FINAL’ ‘SEE-FINAL’

Brittain (2003) proposes an analysis of *Finals* in the DM framework that identifies these morphemes as realizations of category-defining (little-x) heads. If we postulate that Ojibwe is a head-initial language, the suffix-status of a *Final* could be attributed to head movement (Travis, 1984). Assuming this to be the case, the structures that underlie the two verbs in (24) would be represented by (25a) and (25b), respectively.

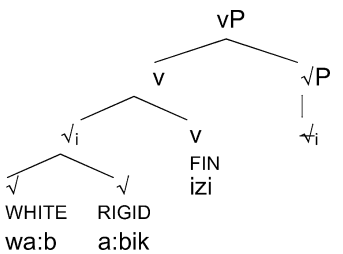
(25) a. Intransitive verb b. Transitive verb




Each of the verbs in (25) contains a simplex root, but we noted earlier that root-root compounds are possible. For example, in the derivation of (26a), the two roots /wa:b/ ‘white’ and /a:bik/ ‘rigid’ first merge as a complex root that subsequently combines with the little-*v* head /izi/ to form a verb, producing the output in (26b).

(26) a. wa:ba:bikizi 'be white (rigid object)'
wa:b-a:bik-izi
‘WHITE-RIGID-FINAL’

b.

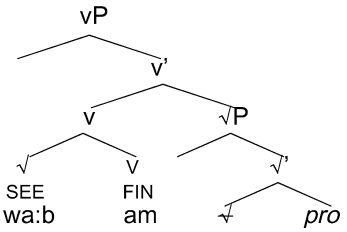



The meaning of an Ojibwe root-root combination is often idiosyncratic (i.e. non-compositional). For example, we saw earlier that the combination of the roots /manido:/ ‘spirit’ and /imin/ ‘berry’ provides a context for hiatus resolution the word *manido:min* which also has the unpredictable meaning ‘glass bead’. The allosemy in root-root compounds is not surprising, if, as we argue below, the two roots are realized in the same phase. Within a theory of parallel phonological and semantic interpretation at each phase, as proposed in Chomsky, 2001 and subsequent work, the domains for special phonology and special meaning are predicted to coincide. Other research on idiomatic interpretation within cyclic

word-internal derivations (e.g. Marantz, 1984, 2000, 2013; Marvin, 2002) supports this conclusion; the simplest system is one wherein semantic and phonological phases are isomorphic.[12] It is therefore unsurprising that a context for idiomatic interpretation in Ojibwe can coincide with a context for hiatus resolution.

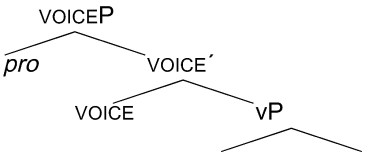
The category-defining v-head of an Ojibwe verb also provides information about argument structure. For example, the presence of the TA suffix /am/ (25b) indicates that the verb requires an internal (theme) argument. Following Baker (1996), we assume that full DP's cannot occupy argument positions in a polysynthetic language like Ojibwe. We postulate that argument requirements of verbs are met by *pro* morphemes that are not (directly) phonetically realized. According to proposals by Bobaljik and Harley (2013), Harley (2005, 2011), Kratzer (1996) and Marantz (1997), objects are merged as sisters to √.

(27)



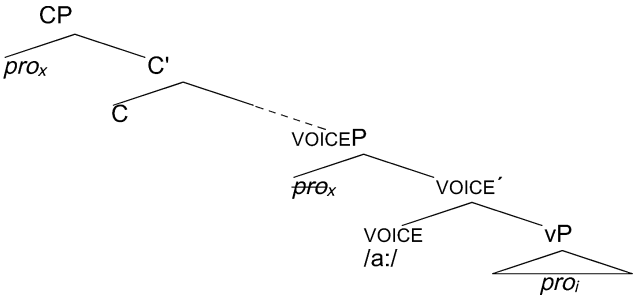

As the template given earlier in (9) shows, a *Final* may be followed by a number of morphemes. For example, in the derivation of a TA verb, one of the morphemes identified earlier as theme-signs appears after the *Final*; it introduces the external argument. Bruening (2001, 2005, 2009) postulates that, in Algonquian languages, the head that introduces the external argument is VOICE. It is also noteworthy that the choice of vocabulary item in VOICE depends not only on the features of the external argument, but also on those of the internal argument. [13]

(28)




Bruening also argues that either the external or internal argument of a verb must move to (the equivalent of) [Spec, CP] to satisfy an EPP feature.[14] The choice of argument targeted for movement is determined by the particular theme-sign (i.e. /a:, igw, i, ini/) that occupies the VOICE head. For example, the merger of the morpheme /a:/ triggers movement of the external argument, identified as $pro_x$ in (29a), while /igw/ results in the movement of the internal argument, identified as $pro_i$ in (29b).

(29) a.

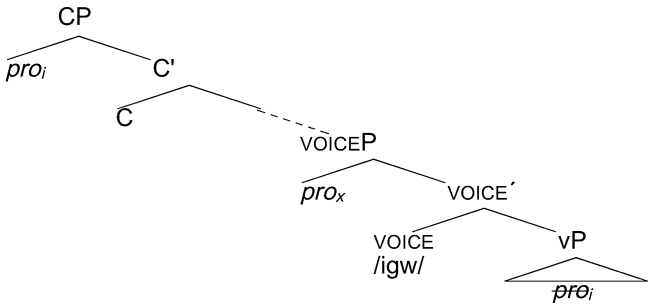



[12] This parallelism has been occasionally questioned (ex. Marušič, 2005).

[13] Lochbihler (2008) also claims that allomorphy of voice is conditioned by whether both arguments are speech act participants (1st and 2nd person).

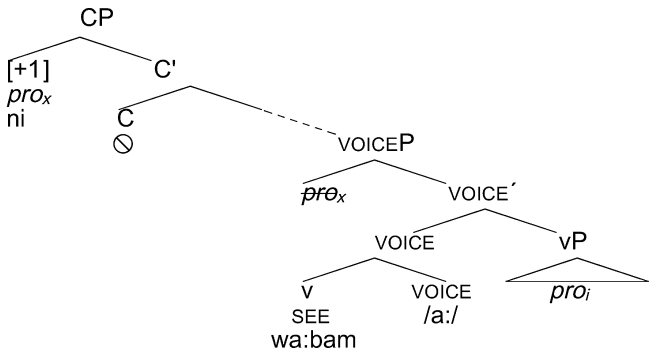
[14] Bruening's analysis is challenged by Lochbihler (2008), but her proposed alternative is compatible with claims of this paper.

b.




The argument in [Spec, CP] is realized as pronominal prefix/clitic. The 1st Person prefix/clitic in the word *niwa:bama:* 'I see him' emerges as illustrated in (30).

(30)




The merger of a theme-sign provides for one set of features that are crucial to the realization the arguments of a verb. However, arguments also bear number specification. As pointed out in our overview of the Ojibwe verb (§2.1), this language has two sets of number marking suffixes, one carries number and Person features and the other carries number and obviation features. For reasons that are not explored in this paper, morphemes that express Person/number agreement enter a derivation before the number/obviation marker. Proof of this is the fact that suffixes marking aspect (called Mode in the traditional Algonquian literature) appear between the two number agreement morphemes. Consequently, in the two examples in (31), the respective DUBITATIVE (/dige:n/) and PRETERITE (/banj/) endings follow the 2nd Person Plural suffix /wa:/ and precede the 3rd (proximate) Plural suffix /ag/.

(31) a. giwe:ʒi:na:wa:dige:nag 'you (pl.) must be painting them'
gi-we:ʒi:-in-a:-wa:-dige:n-ag
'2-PAINT-FINAL-TS(3 THEME)-2PLURAL-DUB(ITATIVE)-3PLURAL

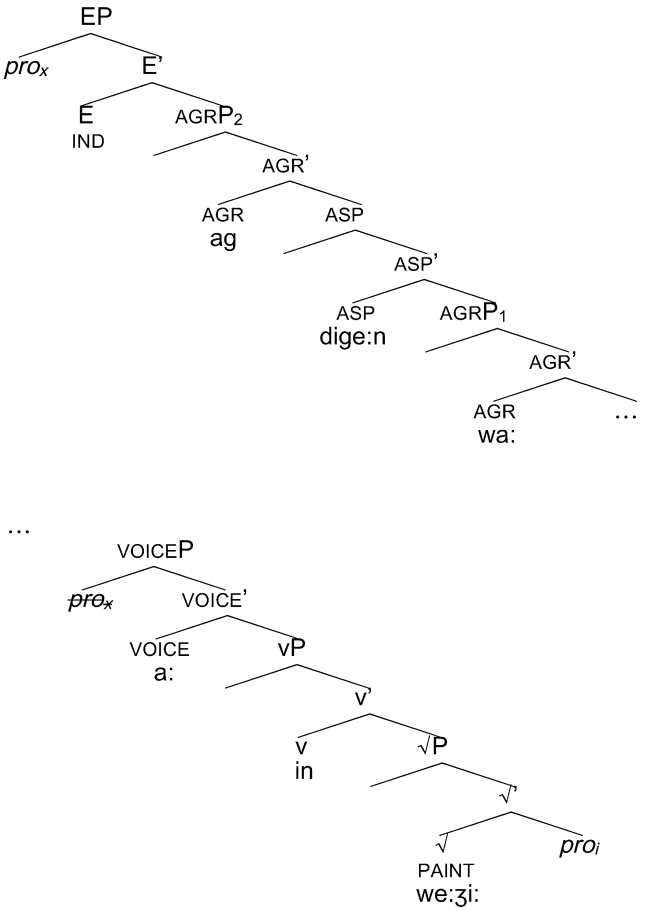
b. giwe:ʒi:na:wa:bani:g 'you (pl.) used to paint them'
gi-we:ʒi:-in-a:-wa:-banj-ag
'2-PAINT-FINAL-TS(3 THEME)-2PLURAL-PRETERITE-3PLURAL

As pointed out at the beginning of section 2.1, we focus on verb forms belonging to the Independent Order. The verbs in (31) are members of this paradigm. There are significant morphological differences between Independent verb forms and those of the other prominent Order, the Conjunct, the latter appearing in interrogative sentences and subordinate clauses. One of the differences, observed by Bloomfield (1957:53), is that in the Conjunct the theme-sign /a:/ ''is lacking in the indicative and preterite forms with other than third person actor''. Another difference between the two paradigms is the absence of Subject agreement prefixes in Conjunct forms; appearances of the three pronominal prefixes, i.e. /ni-/ (1st Person), /gi-/ (2nd Person) and /o-/ (3rd Person) are restricted to Independent forms. To capture this difference Lochbihler and Mathieu (2008) propose that phi-features are encoded in different syntactic positions in the Independent and Conjunct Orders. In the Independent Order, phi-features in CP condition the insertion of the prefixes, while in the Conjunct Order these phi-features are situated below TP in the verbal domain. Clearly, the syntax of the Ojibwe verb must provide for the formal marking of a verb form as either Independent or Conjunct. We propose that this distinction is marked

in EP, considered by Travis (2010) to be the highest phrase in the l-syntactic, or lexical/verbal, domain.[15] As the highest member of the articulated verbal domain, EP is recognized as a phase.

The verb root and suffixes in a word like (31a) would therefore emerge from a structure like the following.[16]

(32)




Following the earlier discussion of the phasal status of category-defining little-x heads, the little-v head, the traditional *Final*, is considered to be a phase-head. This smaller domain does not, however, constitute a spell-out domain.[17]

The structures in (30) and (32) are consistent with many analyses of Ojibwe and related languages in the literature (e.g. Brittain (2003), Bruening (2001, 2005, 2009), Lochbihler (2008a,b)). We assume, in agreement with Lochbihler and Mathieu (2008), that suffixation in Algonquian languages is due to head-movement. Prefixes, on the other hand, constitute separate heads and are cliticized to a verbal (or nominal) complex head in their complement (cf. Halle and Marantz, 1993). Some support for this assumption is introduced later in our discussion of inalienable possession constructions.[18] Note that

[15] A reviewer points out that this distinction in clause-type is standardly indicated in CP, but the morpho-syntactic distinctions between these two orders necessitate in Ojibwe that the Conjunct-Independent distinction also be marked in the verbal domain.

[16] An anonymous reviewer has pointed out that agreement phrases are not normally positioned inside the verbal domain. However, Koizumi (1995) argues that agreement with the object is realized by an AGROP in the verbal domain. As both AGR heads in Ojibwe may agree with the object, and are part of the innermost phonological domain in the word, we postulate that they are low in the structure.

[17] Lochbihler (2012) designates this head as TransP, as it introduces an internal argument.

[18] Note that we are not making the larger claim here that suffixation must be universally linked to head movement. DM specifically allows for the absence of any link between head movement and linearization. See Hall (1999), Julien (2002), among others, for a discussion of the links between affixation and morpheme order. It is interesting that cross-linguistically there is a tendency for prefixes to behave as though they are phonologically separate from the rest of the stem (e.g. Hungarian VH, Germanic separable prefixes, SiSwati imperatives (T.A. Hall (1999)), while suffixes behave as though part of the stem's phonological domain. Ojibwe possessive prefixes in inalienable constructions are a counter-example to this tendency, as we will see below. Other specific counter-examples to this generalization can be found, for example, in Itelmen and Malagasy. Bobaljik and Wurmbrand (2001) demonstrate that the causative morpheme in Itelmen is prefixal and constitutes part of the same phonological domain as the verb and its suffixes. Dobler et al. (2009) show that the Malagasy syntactic causative, while a suffix, sits outside of the innermost phonological domain in the verbal word.

while Déchaine (1999) agrees with this analysis of prefixation in Algonquian languages, she proposes that agreement suffixes are also clitics. Their status as clitics derives from her proposal that the order of agreement suffixes is best captured if verbs and nouns raise by phrasal movement. Her argument is based on the assumption that Number agreement is merged prior to Person in the syntactic structure. A confounding fact for her analysis is that both number and person features are relevant for allomorph selection in both agreement positions. The inner agreement head (i.e. AGR$_1$) tracks both number and person. The outer agreement head (i.e. AGR$_2$) displays only number features, but only agrees in number with 3rd person arguments, indicating a necessary sensitivity to person features, contra Déchaine's analysis. It is beyond the scope of this paper to reconcile the two accounts. It is of note that Déchaine's argumentation predicts a closer phonological relationship between suffixes and the root when suffixation is due to head movement (rather than phrasal movement). This phonological prediction is in line with the data. McGinnis (1995), in contrast with Halle and Marantz (1993) and Déchaine (1999), offers an account where the order of affixes in the verbal word is stipulated, but where the verb raises to C. Of note is that neither McGinnis nor Déchaine provide examples that include the preverbal tense markers. Their examples gloss the aspectual (preterite) head as Tense, ignoring the fact that a higher, prefixal Tense head exists in the language. We consider the prefixal tense marking to be an indication that the verb in Ojibwe remains low in the structure (in vP).

Let us return to the structure in (32) and determine what is sent to Spell-out. On the (traditional) assumption that each phase head sends its complement to interfaces, it might be expected that the VOICE head (where the external argument is introduced) would trigger the first phase of interpretation, as VOICEP may be considered here to be the equivalent of the vP phase proposed originally in Chomsky, 2001. More recently, as noted above, little-x heads (i.e. category defining-heads) have been proposed to be phase-heads. A number of people (e.g. Marantz, 2000; Marvin; 2002; Di Sciullo, 2003; Newell, 2004, 2008; Arad, 2005; Embick and Marantz, 2008; Embick, 2010, 2013; Bobaljik and Wurmbrand, 2013) adopt such an extension of phase theory. Even Chomsky (2001, 2008) allows that xPs are good candidates for phase-hood. The following quotation from Chomsky (2008:155) is highly informative: ''Phases should, presumably, be as small as possible, to minimize computation after Transfer and to capture as fully as possible the cyclic/compositional character of mappings to the interface.'' We might therefore also expect the v-head realized as the *Final* /in/ in (32) to trigger interpretation. Were either v or VOICE (or both) to induce spell-out, the above structure would be interpreted in two or three cycles. This would then lead to the prediction that hiatus would remain unresolved between suffixes at these phase boundaries, contrary to fact. The solution to this problem lies in recent modifications to phase theory that force the extension of a spell-out domain under certain syntactic or morphological conditions. These include analyses found in Svenonius (2004), Skinner (2009), Embick (2010), and Bobaljik and Wurmbrand (2013). Svenonius and Bobaljik and Wurmbrand propose that spell-out is suspended until all uninterpretable features in a relevant domain are checked. Bobaljik and Wurmbrand propose the following condition on Domain Suspension (relativized to the domain of syntax):

(33) If $Y^0$ is the highest projection of a (potential) cyclic domain, then $Y^0$ constitutes a phase, unless Y depends on X for its interpretation. (p. 186)

In the same spirit, Svenonius (204: 263) proposes that

> ''. . .if a phase head H has uninterpretable features then HP will not have a coherent interpretation at one or the other interface. Assume that some higher head Z merges and values those features, allowing HP to be spelled out; call Z the trigger. If the trigger also has features that attract XP out of HP, then by assumption this occurs simultaneously with the checking of features on HP, and extraction is possible.'' (p.263)

We adopt a model of phase extension and assume, following Svenonius, that the interpretation of a phase HP will not occur before a head (Z) exterior to HP is merged. If the combination of a phase-head and its complement contains an uninterpretable feature, transfer to the interfaces will be delayed until the merger of a later head with the capacity to check this feature. If no such delay is motivated by either the featural properties of H or Z, Spell-out can occur as early as the merger of the category-defining head.

The first phase head merged in the derivation of a verb in Ojibwe is therefore the category-defining little-v. Under Svenonius' theory of phase-by-phase interpretation mentioned above, v will not induce spell-out of its complement before the merger of VOICE. Remember that the VOICE head in Ojibwe is the first to play a role in determining which argument will raise to CP. The person hierarchy in Ojibwe plays a crucial role in determining agreement relations in the language, and therefore the phi-features of both arguments must be accessible at the point where VOICE undergoes vocabulary insertion.[19] The requirement that VOICE have access to the features of the object in vP will cause domain suspension (34a). Spell-out of the vP phase is necessarily delayed. At the merger of the VOICE head all of the arguments are present, but

[19] Specifically, these unchecked features must be related to the Inverse System of agreement in Ojibwe (Lochbihler (2008b)).

again spell-out will not occur until an outer head is merged. The verb must be able to enter into a local relationship with the higher agreement heads in order to check their relevant features, indicating that there are unchecked phi-features on the AGR heads. Spell-out of the VOICEP phase must therefore be delayed by the merger of $AGR_1$ (34b). As the AGR and ASP heads are not cyclic, it is therefore only at the merger of E that all of the features of the verb and/or its suffixes are checked, allowing spell-out to occur. We can readily conclude, therefore, that in the Independent Order an Ojibwe verb root and all the morphemes that follow it constitute a Spell-out domain (34c).[20]

(34)

a. [$pro_x$[[we:ʒi: $pro_i$ √P] in vP] *a:* VOICEP]
b. [[$pro_x$ [[we:ʒi: $pro_i$ √P] in vP] a: VOICEP] *wa:* AGR1P]
c. [$pro_x$ [[[~~$pro_x$~~ [[we:ʒi: $pro_i$ √P] in vP] a: VOICEP] wa: AGR1P] dige:n ASPP] ag AGR2P] ∅ EP]

It is probably not too surprising that there are similarities between nominal and verbal structures in Ojibwe. Apart from obvious verb-specific morphemes such as voice and aspect, the other verbal suffixes have counterparts in the nominal system. Every noun must be inflected for number and obviation. Each NUMBER/OBVIATIVE morpheme also bears a gender feature (i.e. [+Animate] or [-Animate]). For purely phonological reasons, singular is normally not overtly marked (Piggott, 1980a, 1983), while the two plural endings were identified earlier as /-ag/ (animate) and /-an/ (inanimate). In a possessive construction, suffixes bearing features that agree in Person and number with the possessor argument may also appear. The following example illustrates the typical set of morphemes that occurs in an alienable possessive construction.

(35) niʒi:ʃi:bimina:nig ‘our ducks’
ni-ʒi:ʃi:b-im-ina:ni-ag
‘1-DUCK-POSSESSIVE-1PLURAL-PLURAL’

This word contains a prefix/clitic /ni/ ‘1st Person’ that identifies the possessor. We postulate that the possessor prefix appears in a syntactic position comparable to the position in which prefixal agreement is found in verbs. In the literature, the verbal prefixes are uncontroversially considered to be found in CP. The possessor argument is therefore proposed here to be realized in [Spec, DP]. The possessed noun /ʒi:ʃi:b/ ‘duck’ is followed by a POSSESSIVE (POSS) morpheme and two agreement suffixes. The suffix /ina:ni/ contains features that agree with the Person and number of the possessor argument, while the last morpheme /ag/ agrees with the number feature of the possessed noun. The possessed noun must therefore remain syntactically accessible until the number agreement morpheme can be checked. The POSS morpheme, which introduces an external argument, combines with alienable noun roots (36a) but not with inalienable ones (36b).

(36) a. niʒi:ʃi:bim ‘my duck’
ni-ʒi:ʃi:b-im
‘1-DUCK-POSS’
b. nika:d(*im) ‘my leg’
ni-ka:d-(*im)
‘1-LEG-(*POSS)’

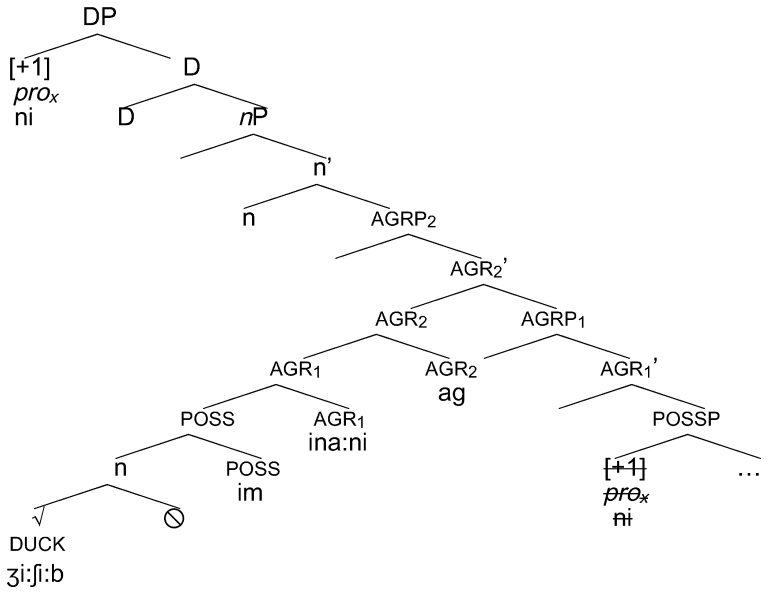
Like verbs, nouns realize a complex of morphemes up to and including at least the $AGR_2$ head, because the feature-checking relations between the nominal arguments and the AGR heads must, as argued above with respect to the verbal domain, lead to Domain Suspension. Therefore the merger of some phase head (F), outside of $AGR_2$, triggers a transfer to the interfaces. We assume that hypothetical FP is nP; the nP phase in nouns parallels the EP phase in verbs (see also Svenonius, 2004). This structure is therefore consistent with Abney (1987) and subsequent work, where nP is selected by D.

The Ojibwe nominal domain displays no overt morphology indicating the presence of a category-defining n-head. We will assume however, by analogy with the verbal structure above, and the modifier structure discussed below, that a

[20] As the head of EP in Ojibwe is null there is no direct evidence bearing on whether E is interpreted as part of the lower domain. However, there is evidence from Malagasy (Dobler et al., 2009) that E is interpreted as part of the verbal domain.

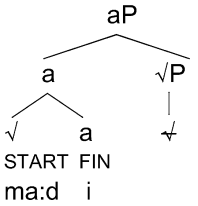
null n-head that merges with the root is nonetheless present.[21] This brings the Ojibwe nominal structure in line with the DM proposal, assumed throughout this paper, that all roots are category-less. The full structure of (35) is therefore found in (37), after head movement.

(37)




Like nouns and verbs, modifiers are also complex entities. In section 2.1, we claim that a modifier consists of a root and a *Final*. Hence, *ma*:*dʒi* 'start' is the realization of the following structure.

(38)




The little-a *Final*, like its nominal and verbal counterparts, defines a phase. We saw earlier (6) that a hiatus created by affixing a little-a Final to a root is resolved by vowel deletion. Given that hiatus is resolved by deletion within a phase, this entails that a little-a head is interpreted in the same phase as its complement. Interestingly, there are two motivations for the spell-out of a little-a Final with its complement. First, the Ojibwe modifiers neither take arguments nor undergo agreement. It is plausible that the structure in (38) contains no unchecked features. Within a Svenonius model of spell-out the a-head has no motivation to delay spell-out; it is interpretable at the point in the derivation when it is merged. Another motivation for the spell-out of a with its complement is that no further merger will extend the adverbial projection, therefore precluding movement out of aP. Notably, this argument does not fall prey to the criticism of look-ahead. According to the theory of Multiple-Spell-Out (Uriagereka, 1999), adjuncts will be interpreted at the interfaces before they are merged with the node they adjoin to (see also Johnson's (2003) discussion of 'Numerphology'). The Ojibwe modifiers, being optional syntactic elements, are prime candidates for the status of adjuncts. Constraints on linearization motivate Uriagereka's proposal, leading to the conclusion that spell-out of an adjunct will occur before its merger to a larger structure (here vP) regardless of the properties of its own syntactic structure; aP will be interpreted at PF separately from vP even if a phase head in this configuration would not normally induce spell-out. A consequence that necessarily follows is that adjuncts (and subjects) will be phonologically isolated. Each of these explanations gives an account of the spell-out of the little-a phase head with its complement, and of the difference between the first phases in (32) (37) and (38). This late-adjunction

[21] In line with the assumptions outlined above, this nominal head will not induce spell-out of its complement due to domain suspension.

analysis of adverbial modifiers is crucial for our explanation of the difference in phonological behavior between modifiers and other pre-radical morphemes discussed section 3.2.[22]

Having identified the first configuration of elements (i.e. the first phase) that is sent to Spell-out in the derivation of verbs, nouns and modifiers, we can now demonstrate that hiatus resolution by vowel deletion applies within a phase, while VV sequences are tolerated between phases. For example, in the derivation of the word *niwe:ʒi:na:na:nig* 'we paint them' (10a), the root and following suffixes constitute the EP phase and are interpreted together.

(39) a. [PAINT-FINAL-TS(3 THEME)-1PLURAL-IND-3PLURAL$_{vP}$]
we:ʒi: -in -a:- ina:ni -Ø -ag]
b. [we:ʒi:na:na:nig]
c. *[we:ʒi:ina:ina:niag]

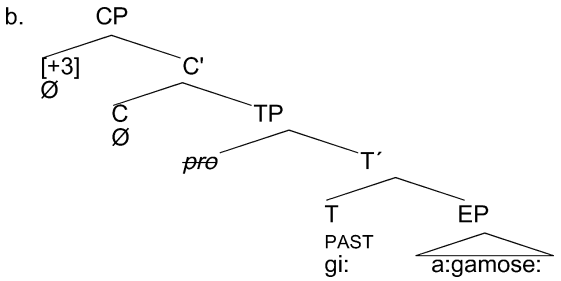
Three potential VV sequences are generated by the insertion of vocabulary items in (39): (a) between the root and the *Final*, (b) between the theme-sign and the 1st Plural suffix, (c) between the 1st Plural and the 3rd Plural endings. In each case, the hiatus is resolved by eliminating one of the vowels. Affixation of the plural suffix has a similar effect in the derivation of *name:g* 'sturgeons' (1a). Remember that the phonetic form of the plural morpheme depends on the gender of the root. Phase interpretation must therefore be suspended until the root checks its features in AGRP. The root and plural morphemes must be in the same phase.

(40) a. [STURGEON-FIN-PLURAL$_{AGRP}$]
name: - Ø -ag
b. [name:g]
c. *[name:ag]

Other vowel-initial nominal suffixes such as the possessive morpheme /im/ and the 1st Plural marker /ina:ni/ must also trigger hiatus resolution under the appropriate conditions. Notice that in (39) and (40) when a hiatus involves a combination of long and short vowels, its resolution favors the long vowel. We know however that long vowels can also be deleted. When the two roots /gi:we:/ 'go home' and /a:daga:/ 'swim' combine to form a complex root, the long vowel at the end of the first root is deleted, as illustrated earlier by *nigi:wa:daga*: 'I swim home' (1c).[23]

The restriction of hiatus resolution in Ojibwe to vocabulary items inserted in the same phase entails that the combination of a tense affix and a verb would not be expected to trigger hiatus resolution. The verb does not raise out of vP, and the tense morpheme heads a Tense Phrase. The tense morpheme is therefore realized when Spell-out of the CP phase is triggered. Consider the location of the tense marker /gi:/ 'Past' in (41b) below.

(41) a. gi:a:gamose: 'he walked in snowshoes'
gi:-a:gam-ose:
'PAST-SNOWSHOE-WALK'

b.



The phase-boundary between T and EP must be associated with a barrier that renders the final vowel of the tense prefix invisible to the initial vowel of the verb for the purpose of hiatus resolution. A similar barrier arises in a construction consisting of a modifier and a verb or noun. Since a modifier contains a phase head and is an adjunct, the whole of aP

[22] See also Piggott and Travis (2013) for an analysis of the interpretation of modifier adjuncts as phases.
[23] See Casali (1997) for a discussion of factors that determine which vowel in a VV sequence is normally targeted by deletion.

would be spelled out in a different phase from the verb or noun it modifies. The word *inia:gamose*: 'he walks away in snowshoes' (2a) contains an aP and an EP phase and would correspond to the realization in (42b) at Spell-out.

(42) a. [[AWAY-FIN$_{aP}$][SNOWSHOE-WALK-FIN$_{EP}$]$_{EP}$]
b. [[ini][a:gamose:]]

At this point, the lack of interaction between vowels that emerge in different phases might be attributed to effect of the *Phase Impenetrability Condition (PIC)* (Chomsky, 2001) at PF. An equivalent phonological PIC would be a principle like the following, regulating the mapping between syntactic form and phonological realization.

(43) *Phase Integrity/PF*
An element **X** cannot contribute to the prosodic well-formedness of the exponent of a phase $\alpha$ if **X** is phonologically realized in the interpretation of another phase $\beta$.

The *Phase Integrity* condition embodies the claim that, cross-linguistically, prosodic well-formedness is computed when a phase in sent to Spell-out, and the categories which emerge in that phase must be well-formed. Hiatus resolution by vowel deletion removes the head of a syllable because a sequence of syllable heads is ill-formed. Such a process would not apply across a boundary like that in (42b), because it would entail that well-formedness of either the aP or EP phase be determined by an external element.

The informed reader might have noticed that there is a distinction between the behavior of tense morphology in English and Ojibwe. The fact that English tense morphology can condition suppletion of a verb root has led to the proposal that phonological interpretation cannot be operative at EP (or its equivalent (vP) in Embick, 2010). In Ojibwe, however, root suppletion is never conditioned by T, although it may be conditioned by morphemes internal to the EP. For example, the root morpheme meaning 'eat' surfaces as /amw/ in the environment of an animate object, and /mi:dji/ when the object is inanimate. Bobaljik and Wurmbrand's (2013) theory of Domain Suspension, relativized to environments of allomorphy as in (44), predicts the difference in the phase-status of vP/EP in English and Ojibwe:

(44) If X is a cyclic head, then Y$^n$ is a spell-out domain, unless Y depends on X for its interpretation. (186)

Their proposal is that if allomorph selection is based on a head that falls outside of a phase, then that phase must delay spell-out until the merger of the conditioning head.[24] The data in Ojibwe do not motivate this type of Domain Suspension, and we therefore predict a phase boundary between T and EP.

While the evidence presented so far points to a correlation between suffixation and hiatus resolution in Ojibwe, our analysis predicts that, under the appropriate syntactic conditions, prefixation may also provide a context. The following data are therefore not surprising.

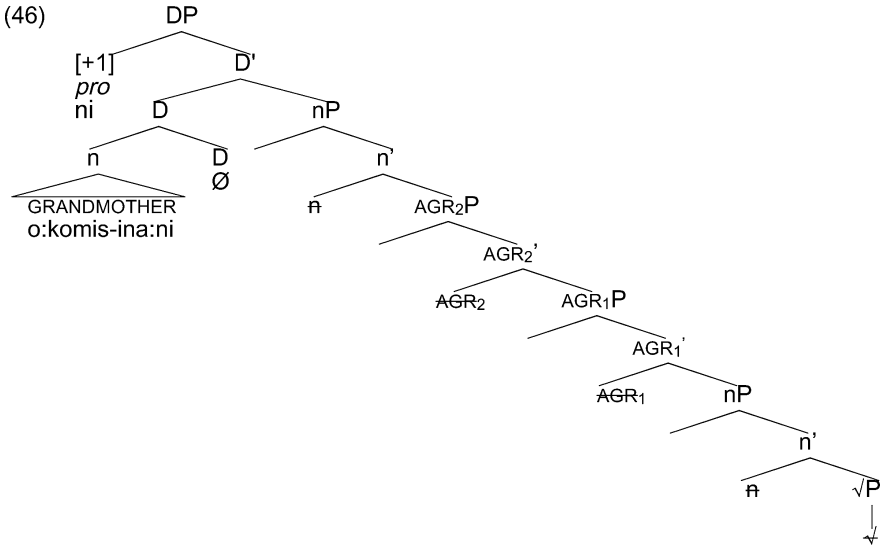
(45) a. no:s 'my father'
ni-o:s
'1-FATHER'
b. no:komis 'my grandmother'
ni-o:komis
'1-GRANDMOTHER'
c. no:komisina:n 'our (excl.) grandmother'
ni-o:komis-ina:ni
'1-GRANDMOTHER-1PLURAL'
d. ni:ta: 'my brother-in-law (male speaker)'
ni-i:ta:
'1-BROTHER-IN-LAW'
e. ni:ka:nis 'my dear friend'
ni-i:ka:nis
'1-DEAR FRIEND'

[24] Interestingly, this type of domain suspension can only be operative on the PF branch, as it is dependent on operations that are not accessed until the phase has been sent to interpretation. This predicts that these environments will be a principled exception to the isomorphy of PF and LF phases. The LF interpretation of EP cannot be suspended due to allomorphic selectional restrictions. We therefore predict that even in the cases of suppletion across a phase boundary, the domain for potential allosemy will not be extended. Exploring this prediction must be left to future work, but the lexical domain appears to be an upper bound for allosemy (Marantz, 1984, 2013).

The words in (45) are examples of inalienable possessive constructions. The nouns in these constructions include terms referring to kinship relations, body parts and some 'exceptional' items such as 'pants', 'socks' and 'lice'. Whenever a vowel-initial noun of the inalienable class is preceded by a pronominal prefix, the vowel of the prefix must be deleted.

The crucial property of an inalienable noun is that it must combine with an obligatory possessor argument (Tellier, 1988; Vergnaud and Zubizarreta, 1992; Larson, 1999). The semantics of an inalienable possessive construction therefore requires that the noun and the morpheme that functions as the possessor argument be interpreted in the same phase. As there is no POSSP in inalienable constructions, we propose that the initial merger site of the possessor is in [Spec, DP]. Consequently the argument requirement of an inalienable noun would only be satisfied when the root undergoes head movement and is adjoined to the D-head. Hence (46) is the appropriate representation of (45c).

(46)




As all morphemes in (46) escape interpretation in any earlier nP phase by head-movement and emerge in the edge of DP ($D^0$ and [Spec,DP]). The hiatus in the prefix-noun combination then must be resolved when the elements in the edge of DP are interpreted.

(47) a. [1-GRANDMOTHER-$1PL_{DP}$]
ni -o:komis -ina:ni
b. [no:komisina:n]
c. *[nio:komisina:n]

Given the representation required to accommodate the semantics of an inalienable noun and the phono-semantic isomorphy predicted by a theory of phases, it is not surprising that hiatus resolution is triggered by the prefix-noun combination. Indeed, the analysis developed in this paper would be seriously (perhaps, fatally) weakened if VV sequences were tolerated in inalienable possessive constructions.

Note that it could not be the case that the possessive argument in an inalienable construction is merged low (in, say, the specifier of √P or nP) and that the root and its possessor are interpreted in nP.[25] Such an analysis would yield the correct phonological output; all morphemes would be interpreted in the same phase and hiatus would therefore be resolved between the root and the person prefix, as well as between the root and the suffixes. This alternative, however, does not account for another salient feature of the inalienable possession construction; an inalienable noun cannot be modified. Modifier adjuncts only occur in alienable possession constructions.

[25] We thank Jon Nissenbaum (p.c.) and an anonymous reviewer for pushing us to explore this alternative.

(48) a. nigitʃiogima:mina:nig ‘our great/old leaders’
ni-gitʃi-ogima:-im-ina:ni-ag
‘1-OLD/GREAT-LEADER-POSSESSIVE-1PLURAL-PLURAL’
b. *nigitchio:komisag ‘my old grandmothers’
ni-gitchi-o:komis-ag
‘1-OLD-GRANDMOTHER-PLURAL’

We assume that nominal aP modifiers would merge to the highest nP projection in (46), paralleling the merger of verbal modifiers to the highest head in the verbal domain. As the root is never interpreted in the nP domain in inalienable constructions, the modifier could not scope over the root in such a derivation.

We have now resolved the Ojibwe paradox. The language bans vowels in hiatus when the offending sequence is produced by the insertion of vocabulary items within the same phase, while it tolerates VV sequences when the relevant vocabulary items are inserted in different phases. In other words, if a morpheme sequence is a context in which a hiatus is resolved, there is no phase boundary between the morphemes. In contrast, there must be a phase boundary between morphemes in a sequence where a hiatus is tolerated.

### *3.2. Syntax-phonology mismatch in Ojibwe*

The data on hiatus resolution presented so far are incomplete. The conclusion in the preceding paragraph appears to be undermined by examples like the following.

(49) a. ni**d**a:gamose:, *nia:gamose: ‘I walk in snowshoes’
ni-a:gam-ose:
‘1-SNOWSHOE-WALK’
b. ni**d**ode:nima:, *niode:nima: ‘I am jealous of her’
ni-ode:n-im-a:
‘1-BE JEALOUS-FINAL-TS(3 THEME)’
c. ni**d**inia:gamose:, *niinia:gamose: ‘I walk away in snowshoes’
ni-ini-a:gam-ose:
‘1-AWAY-SNOWSHOE-WALK’

According to our analysis, the verb root and following suffixes are realized in the EP phase, and each modifier is the realization of an aP phase, while a pronominal (subject) prefix emerges when the specifier of CP is interpreted. Consequently, there should be a phase boundary after the prefix in each of these examples, and a hiatus should be tolerated. Instead of the predicted preservation of VV sequences, the hiatus is resolved by inserting the consonant /d/ between the vowels. The data in (49) reveal that phonological realization does not always match syntactic structure. The derivation of Ojibwe nouns provides additional evidence of a mismatch between syntax and phonology.

(50) a. ni**d**akwe:m, *niakwe:m ‘my wife’
ni-akwe:-im
‘1-WOMAN-POSSESSIVE’
b. ni**d**ogima:m, *niogima:m ‘my chief, leader’
ni-ogima:-im
‘1-LEADER-POSSESSIVE’

Since the examples in (50) are alienable possessive constructions with the structure of (37) above, the pronominal prefix and the noun should be syntactically generated in different phases. The fact that the alienable noun and its suffixes are interpreted in the complement of nP, while the possessor morpheme is interpreted in [Spec,DP] creates a context where VV sequences should be tolerated.

The context of consonant epenthesis illustrated in (50) involves the pronominal prefix /ni-/ (1st Person). Affixation of any of the other pronominal prefixes, /gi-/ (2nd Person) or /o-/ (3rd Person), in similar contexts produces similar results. In contrast, it has already been established that affixation of a tense morpheme such as /gi:/ ‘Past’ or a preverbal modifier such as /bi/ ‘here, toward speaker’ to a vowel initial verb does not trigger consonant epenthesis.

(51) a. gi:a:gamose:, *gi:**d**a:gamose: ‘he walked in snowshoes’
gi:-a:gam-ose:
‘PAST-SNOWSHOE-WALK’

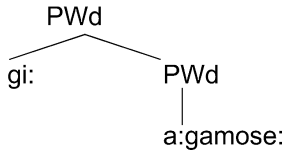
b. bia:gamose:, *bi**d**a:gamose: 'he walks here in snowshoes'
bi-a:gam-ose:
'HERE-SNOWSHOE-WALK'

The contrast between the examples in (50) and (51) is very difficult to explain in the analysis of hiatus resolution developed so far. It assumes that the exponent of a phase is a string of segments that conforms to certain phonotactic restrictions. Why then does the string [ni-a:gam-ose:] 'I walk in snowshoes' (49a) behave differently from the very similar string [bi-a:gam-ose:] 'he walks here in snowshoes' (51b)? Superficially, it appears that the trigger for hiatus resolution by consonant epenthesis is an arbitrary property of a class of morphemes, the pronominal prefixes.

An explanation for the contrast between (50) and (51) can be provided, if we reject the assumption that the exponent of a phase is just a linear string of segments. We propose, in the spirit of DM, that, when a complex head is interpreted at PF, it emerges as a word, more commonly referred to as the prosodic word (PWd). The mapping principle is stated below.

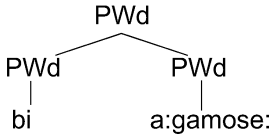
(52) *PWd-Projection*
At Spell-out, exponents of morphemes that make up a (complex) head and contain a root are organized as a prosodic word.[26]

Given this principle, the exponent of the first phase (the verb) in *gi:a:gamose*: 'he walked in snowshoes' (51a) would emerge as a PWd. When the past tense prefix is interpreted in the subsequent phase (the complement of CP), it is adjoined to the PWd exponent of the verb, yielding the following prosodic structure.[27]

(53)


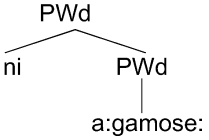

Since the vowels in the VV sequence in (53) are in different PWds, they can be tolerated.

A preverbal or prenominal modifier, since it constitutes a phase, is also realized at PF as a PWd. Its status as an adjunct, as discussed in section 3.1, ensures that this leads to a compound PWd (54) instead of a nested PWd as in (53). Structurally, such Ojibwe constructions are comparable to English compounds such as '*white-wash*', '*deep-fry*', '*back-track*', '*high-chair*', '*top-hat*' and '*straight-jacket*'. The word *bia:gamose*: 'he walks here in snowshoes' (51b) has the prosodic structure illustrated in (54).

(54)



Again a PWd boundary between two vowels renders them invisible for the purpose of satisfying a phonotactic restriction like a ban on VV sequences.[28]

Consider now the derivation of a form like [ni-a:gam-ose:] 'I walk in snowshoes' (49a) in which a pronominal prefix precedes a verb. Like the tense prefix in (53), the pronominal prefix would emerge at Spell-out as a PWd adjunct.

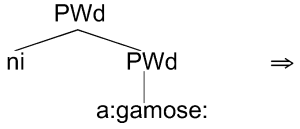
(55)


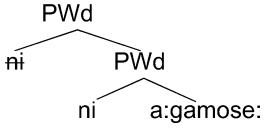

[27] We assume that the tense affix undergoes a post-syntactic operation such as Lowering or Local Dislocation (Embick and Noyer, 2001; Adger, 2006a) before it is incorporated into phonological structure.

[26] An anonymous reviewer suggested that there might be cases of function words that qualify as prosodic words. We do not rule out the possibility that some elements considered to be function words contain a root morpheme.

[28] An anonymous reviewer notes that structures like (53), (54) and (55) are problematic within prosodic theory insofar as they violate the Strict Layering Hypothesis (SLH). In fact, the SLH, even in Selkirk (1995), has been considered to be a violable condition on prosodic structure. Much recent work has argued against a strict adherence to the SLH (Selkirk, 2009 and references therein). Selkirk (2009) goes so far as to argue that the exclusion of recursive prosodic structure cannot have a principled motivation within a theory of the prosodic hierarchy.

Nevertheless, the vowel of the pronominal prefix and the initial vowel of the verb must be visible to each other to form a context for hiatus resolution. We claim that (55) undergoes an adjustment process that incorporates the prefix into the lower PWd, as illustrated below.

(56) a. 

⇒ b. 


The operation that produces (56b) belongs to a set that can be labeled *Phonological Merger*. In all the cases we are aware of, this operation moves a vocabulary item from a position external to a prosodic word to a new position inside the prosodic word.

(57) *Phonological Merger*
[X [.....$_{PWd}$]] → [~~X~~ [.. X....$_{PWd}$]], where X is an affix.

Because the VV sequence in (56b) is within the same PWd, the hiatus must be resolved, and Ojibwe applies consonant epenthesis rather than vowel deletion to this derived representation (i.e. [ni-a:gam-ose:$_{PWd}$] ⇒ [ni**d**a:gam-ose:$_{PWd}$]).

In the linguistic literature, there is considerable support for *Phonological Merger.* Its signature is the appearance of an affix within a domain that qualifies as a prosodic word, when the morpho-syntactic structure indicates that it should be external to the prosodic word. Such a pattern is reflected in many of the examples cited by McCarthy and Prince (1995) as support for the Prosodic Morphology Hypothesis. When some phonological constraint (P) takes precedence over a morphological constraint (M), the surface position of a morpheme may differ from its morpho-syntactic location. Perhaps, the most compelling evidence for *Phonological Merger* comes from cases of infixation, where an affix is inserted into the exponent of a root morpheme.[29] Infixation in Tagalog (and other Austronesian languages) is well documented. When the affixes /um/ 'Agentive focus' and /in/ 'Perfective' are attached to consonant-initial verb roots, they are required to follow the consonant(s) (e.g. /p-um-reno/ 'to brake', /t-in-arbaho/ 'worked'). One of the most compelling cases of *Phonological Merger* by infixation comes from the Nicaraguan language, Ulwa (as cited by McCarthy and Prince (1995) and based on original data from Hale and Lacayo Blanco (1989)). The affix /ka/, glossed as 'his', is always located to the right of a stressed syllable, which corresponds to the first syllable in a word if it is heavy (58a) or to the second syllable if the first is light (58b). The syllable preceding the affix is always stressed.

(58) *Ulwa Possessive: Noun + /ka/*

| | | | |
|---|---|---|---|
| a. | bás | bás-ka | 'hair' |
| | kí: | kí:-ka | 'stone' |
| | sú:lu | sú:-ka-lu | 'dog' |
| | ásna | ás-ka-na | 'clothes' |
| b. | saná | saná-ka | 'deer' |
| | sapá: | sapá:-ka | 'forehead' |
| | siwának | siwá-ka-nak | 'root' |
| | aná:la:ka | aná:-ka-la:ka | 'chin' |

The surface location of the affix /ka/ cannot be correlated with any syntactic position. Since it is sensitive to stress, the location must be established in the phonology after stress is determined.

*Phonological Merger* always occurs to satisfy some purely phonological requirement. In Ojibwe, the movement of pronominal prefixes illustrated in (56) is determined by conditions on stress assignment. We adopt the account of Ojibwe stress proposed by Kaye (1973) and Piggott (1980b, 1983) where the location of stressed syllables is attributed to a process of left-to-right iambic parsing. This system readily generates the canonical light-heavy (LH) CVCVV iamb and also produces feet containing two light (LL) syllables or one heavy (H) one. It requires foot construction to be exhaustive, assigning every syllable to some foot. Consequently, degenerate feet (containing one light or monomoraic syllable) must sometimes be constructed. As shown by the examples in (59a) below, exhaustive parsing can force the emergence of a non-binary foot at the right edge of a word.

(59) a. [(bí:n)(digè:)(batò:)] 'he runs inside'
[(minwà:)(bamí)(nà:)(gozì)] 'she looks beautiful'
[(á:)(gamò)(sè:)] 'he walks in snowshoes'

[29] See Yu (2003) for a fairly comprehensive survey of patterns of infixation.

b. [(wì:)(kwá:)(bò:)(zò)] ‘he is carried along by the current’
[(ginwá:)(bikì)(zì)] ‘it is a long metal object’
[(wà:)(bimí)(nagí)(zì)] ‘it is a pale round object’

The process of parsing syllables into iambic feet selects the syllables that can be stressed, but the determination of which syllable bears the main stress falls to a different mechanism. The algorithm proposed by Piggott (1980b, 1983) captures the fact that main stress is computed leftward and falls no further left than the antepenultimate stressed syllable in a word. For the purpose of computing main stress, all the vocabulary items that make-up a word are visible.[30] Consequently, the most prominent syllable of a word may be located on a verb (60a), a tense marker (60b), or modifier (60c).

(60) a. [(dagó)(ʃin)] ‘he arrives’
c. [(gí:)-(dagò)(ʃìn)] ‘he arrived’
b. [(gì:)-(iní)-(dagò)(ʃin)] ‘he arrived over there’

The algorithm that determines the location of main stress is not relevant to the issues discussed in this paper.

While main stress can be computed across phase boundaries in Ojibwe, the principles and parameters of foot construction that determine the location of all stressed syllables are phase-bound. The latter restriction is a consequence of a robust prosodic constraint; generally, foot structure cannot cross a PWd boundary. In other words, we would not expect the constituents of a binary foot to be associated with different prosodic words. Consequently, persistent, left-to-right foot construction in Ojibwe may result in the emergence of a degenerate foot, word-internally, provided it is located at the right edge of a PWd. For example, the final syllables of the preverbal modifiers *gi:mo:dʒi* ‘secretly’ and *bo:ni* ‘stop’ in (61a) and (61b), respectively, are parsed as degenerate feet, because the next syllable in the word belongs to a different PWd and is therefore inaccessible.

(61) a. gì:mò:dʒízagàswà: ‘he smokes in secret’
[[(gì:)(mò:)(dʒí)$_{PWd}$][(zagà)(swà:)$_{PWd}$]$_{PWd}$]
*[[(gì:)(mó:)(dʒi$_{PWd}$][zà)(gaswà:)$_{PWd}$]$_{PWd}$]
b. gì:bó:nìmawì ‘he stopped crying’
[(gì:)[(bó:)(nì)$_{PWd}$][(mawì)$_{PWd}$]$_{PWd}$]$_{PWd}$]
*[(gì:)[(bó:)(ni$_{PWd}$][mà)(wì)$_{PWd}$]$_{PWd}$]$_{PWd}$]

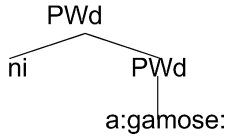
When left-to-right parsing of syllables reaches the right edge of the modifier in (61a), the process is arrested, forcing the last syllable to be parsed as a foot containing only one light syllable. The same restriction applies in (61b). In each case, the last syllable in the preverbal modifier is stressed, bearing the primary word stress in (61a). If it were possible for foot structure to span a PWd boundary, the last syllable of these modifiers would then be initial in an iambic foot and would, counterfactually, not be stressed.

Among the conditions on stress assignment in Ojibwe that have been described so far, two have special significance for the prosodic treatment of pronominal prefixes at PF. These are stated below.

(62) Two conditions on Ojibwe prosodic structure
a. Syllables are exhaustively parsed into feet.
b. A degenerate foot is permitted, only if it is at the right edge of a prosodic word.

Given these conditions, let us now consider the derivation *of ni**d**a:gamose*: ‘I walk in snowshoes’ (49a). The *v*P phase is interpreted first, and the subsequent insertion of the pronominal affix at the CP phase yields the phonological output in (55), repeated below as (63).

(63)




[30] Here a word refers to the dominant node of a nested PWd structure and can therefore encompass morphemes spelled out in multiple phases.

The problem with the above representation is that it places the prefix in a position where it cannot be prosodically organized as part of a foot. Since every Ojibwe syllable must be assigned to a foot, the parsing operation would inappropriately force the monosyllabic and monomoraic prefix /ni/ to be a degenerate foot. The resulting prosodic structure would be illicit, because the degenerate foot would be at the left edge of the PWd. However, the derivation can be saved; the demand that every syllable be parsed can be satisfied, if the prefix is incorporated into the lower PWd, as described in (56) above. After incorporation, the Ojibwe pronominal prefix and the exponent of the verb are constituents of the same PWd, and the first two syllables of this sequence can be readily parsed as a binary foot. The crucial phonological steps in the derivation of *ni**d**a:gamose*: 'I walk in snowshoes' (49a) are captured in (64).

(64) a. [~~ni~~[nia:gamose:$_{PWd}$]$_{PWd}$] - P-Merger
b. [~~ni~~[(ni**d**á:)(gamò)(sè:)$_{PWd}$]$_{PWd}$] - C-epenthesis and Stress

Like other movement operations, *Phonological Merger* is regulated by a strict locality requirement; a target has to be adjacent to its host. Adjacency for phonological operations is determined linearly. While the pronominal prefix attaches to the exponent of the verb in (63), the host can also be a modifier, as shown in *ni**d**inia:gamose*: 'I walk away in snowshoes'.

*Phonological Merger* in Ojibwe does not specifically target pronominal prefixes. These affixes are forced to move from a PWd adjunct position, because they are monomoraic. Tense affixes like /gi:/ (Past) and /wi:/ (Volitional Future) also emerge as PWd adjuncts, but they are not subject to phonological movement. They are bimoraic and can be assigned foot structure at the site where the vocabulary items are inserted. Let us now compare the behavior of the Past and Volitional Future morphemes to that of another tense affix, the Non-volitional Future /ga/. Unlike /gi:/ and /wi:/, the affix /ga/ is monosyllabic and monomoraic. It should therefore be unstable as an adjunct to a PWd. We would then expect it to behave like a pronominal prefix, undergo *Phonological Merger* and be capable of triggering consonant epenthesis. The predicted behavior is attested. Notice that /ga/ is followed by the consonant /d/ in (65a). This consonant has to be epenthetic, since it does not appear in (65b) when the following verb is consonant-initial.[31]

(65) a. nigà**d**á:gamòsè: 'I will (probably) walk in snowshoes'
ni-ga-a:gam-ose:-Ø
'1-FUTURE-SNOWSHOE-WALK-FIN'
b. nigàgí:wè:sè: 'I will (probably) walk home'
ni-ga-gi:we:-ose:-Ø
'1-FUTURE-GO HOME-WALK-FIN'

The only non-arbitrary source for the consonant between the tense affix and the verb in (65a) is epenthesis.

The phonological behavior of the affix /ga/ has broader theoretical significance. It provides support for the hypothesis that elements in a Specifier position are at the edge of a phase and are interpreted later than the other constituents of the phase (Chomsky, 2001, 2008). In the derivation of (65a), cyclic spell-out within the CP phase requires that the tense affix, as the complement of the phase head C, be inserted and prosodically organized before the pronominal prefix (i.e. /ni/) is interpreted. Pronominal prefixes will be inserted in the phase following the interpretation of the tense morpheme as they sit in the domain of the phase-edge. Hence, monomoraic /ga/ emerges in a location where it cannot be assigned foot structure. It then undergoes *Phonological Merger* and triggers hiatus resolution. The pronominal prefix is subsequently inserted, only when [Spec, CP] is interpreted. Note that, if the pronominal prefix and the tense marker were inserted at the same time, the resulting disyllabic sequence (i.e. /ni-ga/) would be readily parsed as a foot. *Phonological Merger* would not be triggered, and epenthesis would not occur. The phonological evidence therefore validates the hypothesis that elements at the edge of the CP (or DP) phase are interpreted only after other elements in the phase.

A vocabulary item that is subject to *Phonological Merger* in Ojibwe must meet three conditions: (a) it must be monomoraic; (b) it must emerge in a domain containing a prosodic word that can be targeted by merger; (c) it is not at the right edge of a prosodic word. Subject agreement prefixes and the marker of the Non-volitional Future meet all three conditions. With regard to second and third conditions, the contrast in behavior between these two types of morphemes and that of modifiers is highly instructive. Consider the two words in (66).

[31] The triggering of epenthesis by the tense affix /ga/ may not be true for all varieties of Ojibwe. It attested in the Odawa dialect (Piggott, 1980b), Maniwaki Algonquin dialect (Jones, 1977) and the dialect described by Baraga (1878).

(66) a. nidíʒà: ‘I go’
ni-iʒa:
‘1-go’
b. bíiʒà: ‘he comes’
bi-iʒa:
‘TOWARDS SPEAKER-GO’

These two words are underlyingly a near minimal pair, differing only in the features of their initial consonants. The initial morpheme of each is monosyllabic and monomoraic, and is followed by the same verb. Nevertheless, there is an obvious surface phonological difference. In (66a), the pronominal prefix is unstressed and a hiatus is resolved by consonant epenthesis, while, in (66b), the preverbal modifier is stressed and a hiatus is tolerated. The phonological difference follows straightforwardly if *Phonological Merger* targets subject agreement prefixes but not preverbal modifiers. The arguments introduced in section 3.1 motivate why *Phonological Merger* cannot target adjuncts. In addition to being aP phases, they are interpreted before merger to the structure they modify. Therefore, the domain of the PWd projected upon interpretation of the modifier does not contain a prosodic word that can be targeted by merger. The initial CV string /bi/ at the beginning of (66b) is therefore at the right edge of a prosodic word and can be parsed as a licit degenerate foot. In contrast, the pronominal prefix /ni/ in (66a) is not at the right edge of a PWd; a target for *Phonological Merger* can be found in its complement. It therefore cannot constitute a foot on its own and must be incorporated into the lower PWd. The following derivations capture the difference between the two words in (66).

(67) a. $[1[\text{GO-FIN}_{EP}]_{CP}]$
$[\text{ni}[\text{iʒa:-Ø}_{PWd}]_{PWd}]$ - Spell-out of EP and CP
$[\text{~~ni~~}[(\text{ni}\mathbf{\acute{d}}\text{i})(\text{ʒà:})_{PWd}]_{PWd}]$ - P-Merger, C-epenthesis & Stress
b. $[[\text{TOWARD SPEAKER-FIN}_{aP}][\text{GO-FIN}_{EP}]_{EP}]$
$[\text{bi-Ø}_{PWd}][\text{iʒa:-Ø}_{PWd}]$ - Spell-out of aP, EP (before merger)
$[[\text{bi-Ø}_{PWd}][\text{iʒa:-Ø}_{PWd}]_{PWd}]$ - Spell-out of EP
$[[(\text{bí})_{PWd}][(\text{iʒà:})_{PWd}]_{PWd}]$ - Stress

The different phonological patterns that emerge in (67a) and (67b) follow directly from the syntactic derivations proposed here.

Importantly, the behavior of data similar to (66), when subjected to *Phonological Merger*, offers evidence for the necessary existence of both phase-by-phase interpretation and the PWd. In each derivation proposed here, spell-out domains and PWd domains have been isomorphic, modulo the independently motivated operation of *Phonological Merger.* A question that may arise is, therefore, what motivates the presence of the representational PWd? If cyclic interpretation gives us the domains of hiatus resolution and foot construction, is an additional representational device not superfluous (Scheer, 2012)? [32] We argue that it is not, and is in fact required to account for examples where the cyclic domains determined by a phase persist throughout the derivation. Consider the foot structure in (68).

(68) (nidì) **(nì)** (á:) (gamò) (sè:)
ni -ini -a:gam -ose:
1 -AWAY-SNOWSHOE-WALK
‘I walk away in snowshoes’

Crucially, the medial degenerate foot ***(ni)*** here emerges not in the interpretation of the aP phase, but only subsequent to the application of *Phonological Merger*. The derivation of (68) proceeds as in (69).

(69) a. $[[(\text{ini})_{PWd}]\text{-}[(\text{a:})(\text{gamo})(\text{se:})_{PWd}]_{PWd}]$
b. $[\text{~~ni~~}[[\text{nid-ini}_{PWd}]\ [(\text{a:})(\text{gamo})(\text{se:})_{PWd}]_{PWd}]$
c. $[[(\text{nid-i})(\text{ni})_{PWd}]\text{-}[(\text{a:})(\text{gamo})(\text{se:})_{PWd}]_{PWd}]$

What is important to note here is that phase domains emerge procedurally, while Phonological Words are representational. In other words, elements such as morphemes and segments are interpreted within a phase, but the phase itself has no representational reality after interpretation is complete. A derivation that did not include a representational device such as the PWd would therefore predict that after the interpretation of the aP and EP phases in (69a) the output would be a purely linear string of segments, syllables and feet. It would predict no enduring,

[32] We would like to thank two anonymous reviewers for pointing out this missing step in our argumentation.

representational boundary between the modifier *ini* and the verb *a:gamose:*. Re-footing in (69b) would therefore be expected to iterate throughout the entire string, producing the optimally footed, yet unattested (70).

(70) *(nidì)(niá:)(gamò)(sè:)

That refooting proceeds as in (69c), indicating the persistence of the boundary between the adverbial modifier and the verb, can only be accounted for by a representational device such as the PWd.

Turning now to the choice of resolution strategy in these constructions, we note that the use of consonant epenthesis rather than vowel deletion as the strategy for resolving a hiatus created by *Phonological Merger* is not entirely accidental. As described in (57), *Phonological Merger* operates on PWds and therefore applies after the spell-out of at least the first phase in a derivation. A morpheme merged in a non-initial phase may be (morpho)-phonologically motivated to merge into the PWd projected by a lower phase. However, the movement of an affix under phonological conditions does not guarantee that the output is phonologically well-formed. Hence, any phonotactic constraint that is violated after such a movement must be repaired. Consonant epenthesis in Ojibwe is an example of the type of repair strategy that applies after *Phonological Merger*. Its salient property is that, while it modifies strings of segments, it preserves the prosodic structure of the input. It is widely recognized that representations tend to be carried over from one cycle to another. For example, stress on the second syllable of the adjective 'oríginal' is preserved as secondary stress on the corresponding syllable of the derived noun 'orìginálity' in spite of an English preference for secondary stress to be on the initial syllable of words (e.g. 'Tàtamagóuchi' (Pater, 2000)). The tendency for phonological structure to be preserved from one cycle to another is documented by Benua (1997). The evidence therefore indicates that a constraint like *Prosodic Persistence* helps to determine phonological form.

(71) *Prosodic Persistence*[33]
Constituents of prosodic categories projected at the interpretation of phase X are preserved at the interpretation of phase X + 1.

Given this constraint, phonological operations that delete segments would not be the preferred strategies for resolving phonotactic restrictions that arise after elements that belong to distinct phases are brought together. We therefore understand why vowel deletion is not employed in Ojibwe to resolve a hiatus resulting from the combining a pronominal prefix or the Non-volitional Future marker with the exponent of the EP or nP phase.

Derivation by phase, regulated by *Prosodic Persistence* (71) and *Phase Integrity/PF* (43), predicts the possibility that different phonological patterns may be associated with the same affix, entirely dependent on the timing of the syntactic merger of the affix. Hence, Ojibwe pronominal prefixes trigger either vowel deletion or consonant epenthesis to resolve a hiatus. The different phonological patterns associated with causative constructions in Malayalam (Mohanan, 2005, Marantz, 2007; Michaels, 2009) can be viewed from a similar perspective. In one pattern, associated in the literature with the lexical or direct causative construction, affixation of the suffix /ikk/ triggers a coalescence process that fuses the final consonant of the suffix with a root-final consonant and also a vowel deletion process that resolves a hiatus (e.g. /aat + ikk/ [aatt] 'Y shakes X', /nana + ikk/ [nanakk] 'Y waters X'). In another pattern, associated with the transformational or indirect causative construction, there is no consonant coalescence and a hiatus is resolved by glide epenthesis (e.g. /paat + ikk/ [paatikk] 'Y makes X sing', /kaɹa + ikk/ [kaɹajikk] 'Y makes X cry'). According to analyses by Marantz and Michaels, the root and causative morpheme merge in the same phase in the lexical causative, while they are realized in different phases in the transformational causative. Hence, consonant coalescence and vowel deletion apply phase-internally. In contrast, consonant coalescence is blocked and glide epenthesis is triggered when the causative affix and the root are inserted in different phases.

Phonological differences between alienable and inalienable possessive constructions in the Luo group of Western Nilotic languages provide very clear illustrations of the variable phonological behavior of a particular class of affixes, determined by the timing of their spell-out. Let us consider how the difference is manifested in Lango, spoken in Uganda. The possessor in this language is realized as a suffix. Prima facie, the same suffixes are attached to both alienable and inalienable nouns, as shown in the following data (cf. Noonan, 1992, Hayes, 2009). (Tones are ignored for expository reasons only.)

(72) a. Alienable possessive construction

| | | |
|---|---|---|
| pala-na | [palana] | 'my knife' |
| pala-ni | [palani] | 'your knife' |
| pala-mere | [palamere] | 'his/her knife' |

[33] This constraint is similar to a proposal by Dobler et al. (2009). The substantive difference is that the latter proscribes any phonological modification to the exponent of a phase, while Prosodic Persistence targets changes that affect prosodic structure. Whether this constraint captures an absolute principle or a strong tendency remains to be determined.

b. Inalienable possessive construction

| | | |
|---|---|---|
| remo-na | [remona] | 'my blood' |
| remo-ni | [remoni] | 'your blood' |
| remo-mere | [remomere] | 'his/her blood' |

Clearly, the 1st, 2nd and 3rd Person markers all begin with a nasal consonant. However, like many languages, Lango disallows medial sequences consisting of an obstruent followed by a nasal consonant (*OBS-NAS), probably a restriction imposed by the familiar Syllable Contact Law (SCL) that does not allow an onset segment to be more sonorant than a preceding coda.[34] Consequently, when a possessor suffix is attached to an obstruent-final noun, the illicit obstruent-nasal sequence must be eliminated. In an inalienable possessive construction, the required adjustment is accomplished by deleting the nasal consonant.

(73)

| | | | |
|---|---|---|---|
| a. | dog-na | [doga] | 'my mouth' |
| b. | bad-na | [bada] | 'my arm' |
| c. | leb-na | [leba] | 'my tongue' |

A different strategy is employed in an alienable possessive construction; the nasal assimilates completely to the preceding obstruent, resulting in a geminate consonant.

(74)

| | | | |
|---|---|---|---|
| a. | pig-na | [pigga] | 'my juice' |
| b. | ot-na | [otta] | 'my house' |
| c. | alop-na | [aloppa] | 'my buck' |

In some cases, the same root may appear in both construction-types, as revealed by pairs like those in (75).

(75)

| | | | |
|---|---|---|---|
| a. | remo-na | [remona] | 'my (own) blood' |
| | remo-na | [remona] | 'my (animal) blood' |
| b. | dog-na | [doga] | 'my (own) mouth' |
| | dog-na | [dogga] | 'my (animal) mouth' |
| c. | bad-na | [bada] | 'my (own) arm' |
| | bad-na | [badda] | 'my (animal) arm' |
| d. | leb-na | [leba] | 'my (own) tongue' |
| | leb-na | [lebba] | 'my (animal) tongue' |

Homophony occurs in (75a), because the suffix is attached to a vowel-final noun. In the other pairs, the semantic difference mirrors a difference in the phonology.

Following Dobler (2008), we may readily assume that the noun root and possessor morpheme are sent to Spell-out together in a Lango inalienable possessive construction. Hence, consonant deletion applies phase-internally (i.e. to a combination of morphemes put together by syntactic merger alone). In the alienable construction, an analysis in which the possessor morpheme and the noun are interpreted in different phases can be justified. Dobler demonstrates that the possessor in Lango is interpreted in [Spec, DP], as in Ojibwe. However, specifiers in Luo languages are on the right, as revealed by the Acholi data in (76).

(76)

| | | |
|---|---|---|
| lok | pa | laco-ni |
| word | POSS | man-DET |

'This man's words' (Dobler, 2008:8)

It is therefore not surprising that the possessor morphemes are suffixes/enclitics in alienable possessive constructions. Although the alienable root and the possessor morpheme are in different phases, we observe that the root-suffix combination provides a context for consonant gemination. This context would have to be the result of some post-syntactic movement. Notice now the similarity between consonant epenthesis in Ojibwe and consonant gemination in Lango. They repair an ill-formed representation that was created by a post-syntactic movement operation, while ensuring that prosodic structure is preserved

[34] SCL alone may not be responsible for triggering consonant-deletion and gemination in the Luo languages. These processes also apply to a liquid-nasal sequence that should be compatible with SCL (e.g. /del-na/ [dela] 'my (own) skin', /del-na/ [della] 'my (animal) skin').

### 3.3. Evaluating some alternative approaches

Returning now to the main topic of this paper, two ideas figure prominently in our explanation of the paradox of hiatus resolution in Ojibwe. First, we exploit the idea that, independent of phonetic content, affixes may have different phonological effects. Secondly, we subscribe to the view that phonological interpretation proceeds in a cyclic manner. Neither idea is new. They were expounded in the earliest stages of the development of modern generative phonology. In SPE (Chomsky and Halle, 1968), English stress assignment is shown to be sensitive to cycles, defined by the order in which affixes are attached to words. SPE also recognizes that certain affixes (e.g. nominal *–ity*) influence the location of stress, while others (e.g. nominal *–ness*) do not. The difference is considered to be a consequence of the type of boundary associated with a particular affix. Post-SPE theories of phonology adopt some version of cyclic derivation. It is intrinsic to the theory of Lexical Phonology proposed by Kiparsky (1982, 1985). This model assigns word formation rules and phonological processes to a series of levels or strata. At each level, the output of a word formation rule must undergo all applicable phonological rules.

In Lexical Phonology, the fact that affixes may differ in their effect on the application of a particular phonological rule is correlated with the level at which they are introduced. For example, the English suffix *–ity* is attached at Level 1 and is visible to the assignment of word stress, which is applicable at that level. In contrast, the invisibility of *–ness* is attributed to its attachment at Level 2. The strict ordering of levels accounts for some of the restrictions on the linear order of morphemes. For example, the hypothetical word **fearlessity* is impossible, because the Level 1 affix *–ity* follows *–less*, a Level 2 affix.[35] From the perspective of Lexical Phonology, all Ojibwe verbal and nominal suffixes would belong to one level (Level X), where the vowel deletion process is the strategy for resolving a hiatus. Root-root compounds would also be formed at Level X, since these are subject to vowel deletion. The failure of the tense markers /gi:/ 'Past' and /wi:/ 'Volitional Future' to trigger vowel deletion would then be attributed to the fact they belong to a later level (Level X + 1) that probably includes modifiers.

The behavior of Ojibwe pronominal prefixes is not consistent with the approach of Lexical Phonology or its offspring, Stratal OT (Kiparsky, 2000; Bermúdez-Otero, in preparation). Since these affixes are further away from the root than the tense affixes, the level-ordering hypothesis would require pronominal affixes to be assigned to the same level (Level X + 1) as the tense markers or later. Affixation of the pronominal affixes at Level X + 1 or later should exclude them as triggers for hiatus resolution by vowel loss, because the latter is supposed to apply at Level X. We saw, however, that pronominal prefixes do serve as triggers for hiatus resolution by vowel loss in inalienable possessive constructions. Moreover, these prefixes always participate in some form of hiatus resolution when the appropriate conditions are met. It is not obvious to us how a level-ordering hypothesis would account for the fact that the same affix can trigger two different hiatus resolution strategies, vowel deletion in some cases and consonant epenthesis in others. The assignment of affixes to levels does not yield any obvious insights into the observation that Ojibwe pronominal prefixes pattern with the Non-volitional Future marker in triggering hiatus resolution by consonant epenthesis, nor does it help us to understand why the Non-volitional Future marker does not pattern with the other tense affixes.

Derivation is obviously crucial to our explanation of the seemingly contradictory treatment of vowels in hiatus in Ojibwe. At first glance, the paradox would appear to be readily handled by the tools of a non-derivational framework like standard OT (Prince and Smolensky, 1993). Disallowing vowels in hiatus would be attributed to the effect of satisfying the No-hiatus constraint. Because this constraint, like all OT constraints, is violable, its demands may be overridden in order to satisfy some other constraint ℚ that sanctions hiatus under certain conditions. Consequently, the ranking ℚ » No-hiatus would yield surface patterns in which hiatus is sometimes permitted and sometimes disallowed. Allowing for the two options for resolving a hiatus can also be modeled in an OT grammar. The vowels of a particular set of affixes could be insulated from vowel loss by enforcing a faithfulness constraint that is indexed to just the members of that set (Faith-$V_P$); the pronominal affixes and the Non-volitional Future marker would be members of this P set. If Faith-$V_P$ outranks No-epenthesis and the demands of No-hiatus still have to be met, affixation of any V-final member of the P set to a V-initial root could trigger epenthesis. Other affixes would be subject to vowel loss, provided that No-epenthesis took precedence over the more general Faith-V constraint. In summary, the ranking in (77) would appear to achieve the necessary descriptive coverage of the Ojibwe facts.

(77) ℚ » No-hiatus, Faith-$V_P$ » No-epenthesis » Faith-V

While the tools available to standard OT seem to provide for a description of the Ojibwe facts, the analysis falls short of an adequate explanation. Note, first, that membership in the set P that triggers epenthesis would have to be stipulated. There is no obviously principled way to include the Non-volitional Future marker and pronominal prefixes in a set that triggers hiatus resolution by C-epenthesis, while affixation of the other tense markers allow a hiatus to be unresolved. The second problem with the OT analysis is, perhaps, the more intractable. With respect to hiatus resolution, affixation of the pronominal prefixes does not induce a uniform strategy; they trigger C-Epenthesis in verbal constructions and one

[35] Note that Fabb (1988) demonstrates that level-ordering cannot account for all of the attested affix ordering restrictions in English.

possessive construction and V-DELETION in the other. Only by appealing to construction-specific constraints would an OT analysis achieve full descriptive coverage of the Ojibwe facts. The phonology of the Ojibwe possessive constructions is therefore pivotal in evaluating the explanatory adequacy of the non-derivational OT approach in comparison with the derivational approach adopted in this paper. Note that problem of explaining why alienable and inalienable possessive constructions display different phonological behavior is not unique to Ojibwe. Consequently, the analysis that explains the Ojibwe pattern should be readily extended to the alienable-inalienable contrast in diverse languages like Lango, Nivk and Akan (Dobler, 2008). More recent modifications to OT such as OT with Candidate Chains (OT-CC) (McCarthy, 2007) that incorporate some elements of a derivational approach to phonology do not appear to offer any genuine insights into the cross-linguistic phonological contrast between alienable and inalienable possessive constructions.[36]

There is a crucial difference between the proposal in this paper and a derivational approach like Lexical Phonology. In the latter, the level at which a process applies is correlated with the affixation of particular morphemes, while our proposal places the burden on the morpho-syntactic structure in which a morpheme is realized to determine whether or not a given process is triggered. The difference between the two classes of proposals is empirically testable. Our proposal predicts that the same morpheme may trigger different processes, solely dependent on the type of construction in which that morpheme appears, while earlier proposals make no such prediction. The phonological difference between alienable and inalienable possessive constructions in Ojibwe and other languages provides very strong support for the validity of our proposal.

## 4. Summary and conclusions

This paper adds to a growing body of literature that demonstrates a link between word structure and the explanation of certain aspects of phonological well-formedness. We set out to explain two properties of Ojibwe phonology that appear to be contradictory; the language both avoids and tolerates vowels in hiatus. We argue that hiatus is avoided phase-internally but tolerated elsewhere. The contexts are independently motivated, because phases emerge from the internal syntax of Ojibwe words. Given the way morphological elements are put together by the syntax and interpreted by the phonology, the conditions under which hiatus is avoided and tolerated in Ojibwe could not be otherwise. In other words, there cannot be an Ojibwe-type language that tolerates VV sequences phase-internally but bans them between phases. The impossibility of such a language follows from the fact that no phonological constraint can be formulated so that it crucially depends on the accessibility of elements introduced in different phases.

While the focus of this paper is Ojibwe, the implications of our analysis extend beyond this language. The Spell-out domains proposed for Ojibwe have counterparts in other languages. We therefore expect to find cases where phonology signals a difference between morphological entities that belong to EP and nP projections and those that are associated with higher categories such as TP, CP and DP. More concretely, we expect to find cross-linguistic contrast between the phonology of determiners and tense affixes and the phonology of number and agreement affixes, especially where these categories are manifested word-internally. The research program is therefore to investigate how patterns of morphologically-controlled phonology can be explained in the DM framework that illuminates the paradox associated with hiatus resolution in Ojibwe.

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[36] Wolf (2008) extends OT-CC to cyclic phenomena by explicitly allowing phonology and morphology to interleave in a framework that incorporates elements of DM. Since phonology is essentially realizational in this approach, it may provide an adequate description of the Ojibwe facts, but an evaluation of its success must be left for future research.

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