Cyclic spell-out and the typology of word minimality*

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"Why is language the way it is [and not otherwise]?"
(adapted from O'Grady 2003)

Abstract

This paper rejects the view that a minimal size requirement on words is emergent from the satisfaction of a binarity condition on the foot. Instead it proposes an autonomous minimality condition (MINWD) that regulates the mapping between morpho-syntactic structure and phonology. This structure is determined by principles of Distributed Morphology, and the mapping proceeds cyclically, as defined by phase theory. The paper postulates that, by language-specific choice, MINWD may be satisfied on either the first or last derivational cycle. This parametric choice underlies the observation that some languages (e.g. Turkish, Woleaian) may paradoxically both violate and enforce the constraint. It also helps to explain why some languages actively enforce the constraint by augmenting words (e.g. Lardil, Mohawk), while others do not have to resort to such a strategy (e.g. Ojibwa, Cariban languages). The theory of word minimality advocated in this paper generates a restrictive typology that fits the attested patterns without over-generating some unattested types that are sanctioned by other frameworks.

1. Introduction. Some languages disallow (content) words that consist of just one light (i.e. CV/CVC) syllable. Hayes (1995: 88) lists forty languages that display this "minimal word syndrome". The cited evidence for the syndrome includes cases where a truncation process is blocked to avoid creating words that are too short and also in cases where the size of a CV/CVC input is increased by a phonological process of word augmentation. For example, Lardil (Hale 1973) normally truncates underlying word-final vowels, but such vowels must be retained in disyllabic words. Underlying CV or CVC sequences in this language are also systematically augmented to a CVV, CVCV or CVCCV shape. Word augmentation is also a feature of Mohawk (Michelson 1988, 1989), Slave (Rice 1990, 1992) and Choctaw (Lombardi & McCarthy 1991). Some languages merely ban CV/CVC words but make no use of blocking or augmentation strategies. English is generally considered to be such a language. Other members of this class are the Cariban languages, Hixkaryana (Hayes (1995: 205-208) and Tiriyó (van de Vijver 1998: 92-100) and the Eastern Algonquian language, Ojibwa (Bloomfield 1957, Piggott 1980).

Since the languages that enforce the minimal word syndrome are from a number of very different families, it is reasonable to infer that this condition is a design feature of language. Nevertheless, a comprehensive explanation of the phenomenon has not yet been provided; we do not yet have a theory of minimality that accounts for the various manifestations of the syndrome. The most widely accepted analysis follows McCarthy & Prince (1999) and postulates that the minimal word emerges from constraint interaction

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that requires a (prosodic) word to contain at least one foot and disallows the possibility of degenerate (i.e. non-binary) feet (FOOT BINARITY (FTBIN)). Since satisfaction of the latter constraint may hold at either the syllabic or moraic level, the smallest word would be disyllabic or bimoraic, depending on the language. Serious doubts about the viability of the emergent minimality hypothesis (EMH) were raised by Garrett (1999) who points to a number of cases of mismatches between word size and foot size. Among the problematic cases are languages that tolerate sub-minimal words but, paradoxically, also provide evidence for the "minimal word syndrome". The latter type includes Micronesian languages like Ponapean (Rehg & Sohl 1981) and Woleaian (Sohn 1975), where a process of vowel lengthening only targets disyllabic (CVCV) inputs whose final has undergone a general process of attrition/reduction. There are also languages that qualify as apparent counter-examples to EMH. Among such languages are those that tolerate degenerate feet but not as the only component of a word; Arawan languages (Everett 1995, 1996, 2003) exemplify this pattern. The realization of minimality in the Algonquian language, Southern East Cree (Brittain 2000) also constitutes a counter-example to EMH. The FTBIN constraint is strictly enforced in this language but the smallest sequence that constitutes a well-formed foot is too small to be a word. EMH would obviously have to be supplemented to account for the apparent counterexamples.

This paper departs from the conventional view of the minimal word in a number of ways. First, EMH or its equivalent is relegated to a secondary role. I propose instead that there is an autonomous condition that determines the size of the smallest word. However, the truly innovative element lies in the role attributed to word structure. Adopting the theory of Distributed Morphology (DM) (Halle & Marantz 1993, 1994) and a theory of cyclicity that correlates cycles with phases (Chomsky 1999, 2005), I argue that some languages choose to enforce a minimal size requirement on the first cycle, while others delay enforcement until the end of the derivation (i.e. the word level). The proposal leads to a genuine explanation for the contrast between languages that employ an augmentation strategy to achieve the required minimum size and those that do not. The appeal to derivation also illuminates our understanding of how and why a language may paradoxically both enforce the word minimality requirement and tolerate the existence of sub-minimal words.

The paper is structured along the following lines. The next section (§1.1) focuses on the conventional description of the syndrome and an evaluation of the purported link between word minimality and foot binarity. I review the evidence that shows EMH to be untenable. I then develop in §2 a new and more explanatory analysis of the syndrome. I first introduce the relevant morpho-syntactic properties of word structure that figure in my new analysis and postulate that the condition on word size is directly imposed on the mapping between morphology and phonology. Assuming DM Theory and the hypothesis that derivation proceeds by phases (Chomsky 1999, 2005), I introduce in §2.1 a parametric choice that allows word minimality to be imposed early (i.e. at the spell-out of the first phase) or late (i.e. at the spell-out of the final phase). The next section (§2.2) is devoted to a detailed examination of the manifestation of the minimal word in the Algonquian language, Ojibwa. It provides very strong support for the early enforcement of the size requirement. The realization of possessive constructions (§2.2.1) is a crucial part of the Ojibwa story. In §2.3, the focus is on the late enforcement of the requirement, while §2.4 deals with the combination of factors that trigger word augmentation. In §3, a

general overview of the typology of languages is provided, based on the options for enforcing the minimality requirement and other conditions on the well-formedness of a prosodic word. The final section of the paper (§4) reflects on some implications of my analysis for phonological theory and more generally for a theory of grammar.

1.1. The conventional view of word minimality. As noted in the introduction, Lardil, indigenous to Australia, is widely regarded as a typical example of a language that displays the minimal word (MINWD) syndrome. Hale (1973) and Hale, Farmer, Nash and Simpson (1981) report that content words in this language never take CV or CVC forms. It actively enforces the restriction. If an underlying root has such a shape, it must be augmented when uninflected, as illustrated in (1).

(1)		Roots	Uninflected	Inflected	
	a.	yak	yaka	yak-in	'fish'
		yur	yura	yur-in	'body'
		ʈurk	ʈurka	ʈurk-in	'black'
	b.	wun	wunta	wun-in	'rain'
		ɽil	ɽilta	ɽil-in	'neck'
		kaŋ	kaŋka	kaŋ-in	'speech'
		l̪u	l̪uwa	luy-in	'fat'

The requisite augmentation is achieved by the addition of a vowel (1a) or a consonant-vowel sequence (1b).[1]

Lardil also has a process of apocope that targets underlying word-final short vowels in the uninflected forms of words like those illustrated in (2).

(2)	Roots	Uninflected	Inflected	
	yalulu	yalul	yalulu-n	'flame'
	wiwala	wiwal	wiwala-n	'bush mango'
	miyara	miyar	miyara-n	'rainbow'
	karikari	karikar	karikari-n	'butter-fish'

In contrast, the uninflected words in (3) are not subject to vowel loss; such a loss would obviously produce the disfavoured CVC(C) output.[2]

(3)	Roots	Uninflected	Inflected	
	mela	mela	mela-n	'sea'
	wanka	wanka	wanka-n	'arm'
	ŋuka	ŋuka	ŋuku-n	'water'
	pape	pape	papi-n	'father's mother'

[1] Augmentation of monosyllabic CV roots seems to produce a CVV output when the vowel is [a] (e.g. /ja/ → [ja:] 'foot').

[2] A vowel lowering process is responsible for the vowel alternation illustrated by the last two pairs in (2).

Stress is not marked in the Lardil data. Hale, Farmer, Nash & Simpson (1981: 8) state that the rules governing stress assignment have not been fully determined. They agree, however, that the first syllable of a word and the first syllable of any disyllabic morpheme within a word are always stressed.

In contrast with Lardil, the Cariban languages, Hixkaryana and Tiriyó, enforce the MINWD requirement passively; they disallow CV/CVC roots. Hence, the smallest word is disyllabic (Hayes 1995: 205-208). Within such a domain, requirements on foot and word structure are met. For example, a NON-FINALITY constraint prevents a final syllable from being the head of word. To satisfy this requirement while ensuring that the foot is iambic and binary, the initial syllable of the smallest word in Hixkaryana must be bimoraic.

(4) Hixkaryana disyllabics

a.	/kwaya/ → [(kwá:)ya]	'red and green macaw'
b.	/kana/ → [(ká:)na]	'fish'
c.	/tuna/ → [(tú:)na]	'water'
d.	/wɔtɔ/ → [(wɔ:)tɔ]	'game'

Tiriyó (van de Vijver 1998: 92-100) respects the NON-FINALITY by switching to a trochaic foot in disyllabic words.

(5) Tiriyó disyllabics

a.	páta	'village'
b.	tə́pu	'stone, rock'
c.	épi	'tree'
d.	nápi	'potato'
e.	máya	'knife'

The fact that the stressed vowel in a disyllabic Tiriyó word is not lengthened is considered to be evidence that the foot is trochaic.

Given the realization of the minimal word in Lardil, Hixkaryana and Tiriyó, it is not surprising that that EMH is widely accepted. According to McCarthy & Prince (1999), the bimoraic or disyllabic minimum size is supposed to emerge from the interaction of a set of constraints that crucially includes the following.

(6) a. HEADEDNESS/PRWD
Every prosodic word contains a foot

b. FOOT BINARITY (FTBIN)
Feet are binary under syllabic or moraic analysis

c. PARSE-SYLL (PARSE-σ)
Every syllable belongs to a foot

d. ALL-FT-LEFT/RIGHT
Every foot is initial/final in a prosodic word[3]

[3] This is really an abbreviation of two independent constraints.

These constraints are considered to be independently motivated, because they are supposed to be active, cross-linguistically, in the description of phenomena other than the minimal word. When the latter takes a disyllabic or bimoraic form, none of the constraints in (6) is violated. Hence, McCarthy & Prince (1999: 262) assert that the minimal word is "emergent as the most harmonic possible prosodic word", as defined by this set. Only a word containing just one foot does every foot have to strictly aligned with both the left and right edge of a word.

In the Micronesian language, Woleaian (Sohn 1975), it is less obvious that EMH determines the realization of the minimal word. A process of vowel weakening in this language devoices final short vowels. The following data (in a modified version of Sohn's transcription) illustrate some results of this process.

(7) Vowel weakening in Woleaian

a.	/mata-la/	[matalę̥]	'his eyes'
b.	/ita-la/	[italę̥]	'his name'
c.	/tagunu/	[tagunų̥]	'to turn around'
d.	/metagi/	[metagi̥]	'pain'
e.	/ʃɔɔbuto/	[ʃɔɔbuto̥]	'woman''
f.	/mwaremware/	[mwaremwarę̥]	'lei'

The satisfaction of word minimality emerges when weakening applies to disyllabic inputs containing two short vowels; the remaining voiced vowel must be lengthened.

(8)

a.	/mata/	[maatę̥]	'eyes'
b.	/kabu/	[kaabų̥]	'dull'
c.	/rigi/	[riigi̥]	'running'
d.	/jeta/	[jeetę̥]	'one'
e.	/laŋo/	[laaŋo̥]	'house fly'

The restriction of 'compensatory lengthening' to disyllabic forms is prima facie evidence for the enforcement of a minimality requirement.

A potential problem for EMH lies in the fact that Woleaian tolerates words containing just one short vowel. Some of these are derived from underlying CVV forms by a vowel shortening process (9a); others have an underlying CV shape but are affected by devoicing (9b).

(9)

a.	/waa/	[wa]	'canoe'
	/tʃaa/	[tʃa]	'blood'
	/bee/	[be]	'divinations'
	/faa/	[fa]	'string, cord'
	/fee/	[fe]	'sexual intercourse'
b.	/ki/	[ki̥]	'hot'
	/tto/	[tto̥]	'deep'
	/tti/	[tti̥]	'to close'

Vowel shortening is a persistent process; it applies not only to monosyllabic words like those in (9a) but also to polysyllabic ones (10).

(10)	a.	/peʃaa/	[peʃa]	'flint'
	b.	/peʃee/	[peʃe]	'leg'
	c.	/feluu/	[felu]	'mat'
	d.	/werii/	[weri]	'see it'
	e.	/mwoŋoo/	[mwoŋo]	‘to eat’
	f.	/katʃitoo/	[katʃito]	‘movie’

The vowel shortening process clearly applies at the expense of the hypothetical FTBIN constraint.

The hypothesis that the minimal word always emerges from the satisfaction of FTBIN seems to predict that no language should tolerate non-binary feet and also require the smallest word to be disyllabic/bimoraic. The existence of such language should therefore provide evidence that EMH is untenable. According to Everett (2003), the Arawan language, Paumari, qualifies as one of the ‘impossible’ types. Stress in this language is determined by constructing iambic feet from right-to-left, resulting in stressed final syllables. In addition, the initial syllable of odd-parity words is always stressed. Everett attributes the latter to the fact that parsing is exhaustive in this language, thereby producing degenerate feet. The parsing that accounts for final and initial stress is illustrated below.

(11) a. Even-parity words

(kajó)(viȓi)	'island'
(kabá)(hakȉ)	'to get rained on'
(katà)(rará)(rakȉ)	'unequal, uneven'
(sohȉ)(ribá)(nakȉ)	'complete, well-formed circle'

b. Odd-parity words

(má)(sikò)	‘moon’
(ká)(rahò)	‘large’
(à)(haká)(barà)	'dew'
(sà)(narά)(hakȉ)	'to bifurcate'

Note that main stress falls consistently on the antepenultimate syllable. When the final foot is excluded from consideration, the dominance of the rightmost foot would then account for the location of main stress (Everett 2003). Consequently, a degenerate foot at the beginning of an odd-parity word may carry either main or secondary stress, depending on the number of syllables in the word.

Although Paumari tolerates degenerate feet, Everett maintains that the smallest word in the language must contain two moras. A few examples of bimoraic words are given in (12).

(12) a. bahá ‘rain’
bodá ‘to open’
vainí ‘river’

b. koá ‘mouse’
hió ‘liquid’
miá ‘mother’

Crucially, there are CV feet but no CV words. To rule out this type of word under EMH, we would appeal to some constraint that applies to well-formed words but not to well-formed feet. A hypothetical constraint that produces the desired effect penalizes words in which the same mora is associated with both word edges. Such a stipulation would of course be equivalent to positing an autonomous minimality requirement.

Another language that undermines EMH is SE Cree (Brittain 2000). The stress system of this language is typically Algonquian; it is iambic and parsing is left to right. Brittain also contends that final syllables are usually prominent but, as in Paumari, final feet are extrametrical. Main stress is therefore assigned to the penultimate foot.

(13) Stress in Southern East Cree (Brittain 2000)

a. (iskwàa)(sîi)(kanùu) 'burned'
(wèe)(pináa)(kanùu) 'thrown'
(ùu)(tàam)(híi)(kanùu) 'hit'

b. (miskáa)(kanùu) 'found'
ma(nisîi)(kanùu) 'cut off'
(wáa)pu(suyàan) 'rabbit skin'

c. (namée)(p̃ii) 'sucker fish'
(ahtʃáa)(p̃ii) 'bow'
(tʃistée)(màaw) 'tobacco'

These data show that the iambic foot may contain a light-heavy sequence of syllables or it may consist of just a heavy syllable; there are also some cases of feet consisting of light-light sequences. All possibilities for the realization of an iambic foot are attested except for the degenerate CV/CVC shape. The obvious conclusion is that FTBIN must be strictly enforced. However, although SE Cree permits feet containing just a CVV syllable, it provides no examples of words with this shape. Brittain (2000:202) attributes the absence of such words to a disyllabic condition on word size. All of the following satisfy the condition.

(14) Minimality in SE Cree

nisît	'my foot'	(LL)
wáapus	'rabbit'	(HL)
pimíi	'fat'	(LH)

The absence of CVV words is therefore compelling evidence of a mismatch between the smallest binary foot and the smallest word.[4]

Interesting indirect evidence that a foot containing just a heavy syllable does not qualify as a minimal word comes from restrictions on foot extrametricality. Recall that the final foot of the words in (13) is not the locus of main stress. Foot extrametricality is, of course, expected to be suspended when a word contains only one foot (14). However, surprisingly, the exemption also applies to some words that contain two feet.

(15)	a.	(nàa)(péew)	'man'	*(náa)(pèew)
		(wɨ̀i)(yáas)	'meat'	*(wíi)(yàas)
		(tʃɨ̀i)(máan)	'canoe'	*(tʃíi)(màan)
	b.	(mèes)(kanúu)	'road'	*(mées)(kanùu)
		(màa)(nitéew)	'stranger'	*(máa)(nitèew)
		(mùus)(kamíi)	'moose broth'	*(múus)(kamɨ̀i)

Notice that the application of extrametricality to the above words would leave a residue consisting of just one heavy syllable. The relevance of this feature comes sharply into focus when the words in (15b) are compared with trisyllabics like those in (16).

(16)	a.	(namée)(pɨ̀i)	'sucker fish'	*(namèe)(píi)
	b.	(ahtʃáa)(pɨ̀i)	'bow'	*(ahtʃàa)(píi)
	c.	(tʃistée)(màaw)	'tobacco'	*(tʃistèe)(máaw)

The two groups of trisyllabic words (i.e. 15b, 16) contain two feet. However, the location of main stress on the penultimate syllable in (16) is proof that these words are subject to foot extrametricality. Notice now that the difference between (15) and (16) can be reduced to the number of syllables in the first foot. The generalization is that domain in which main stress is computed must contain at least two syllables and, cross-linguistically, main stress is always assigned to prosodic words. Hence, the residue that is left over from the application of foot extrametricality in SE Cree must qualify as a minimal word.

In summary, if EMH is reduced to the interaction of the constraints in (6), it is clearly untenable. It makes the counterfactual prediction that a language that tolerates degenerate feet could not require words to be bigger. Another counterfactual claim is that when a language enforces FTBIN, ceteris paribus, the smallest word will always be reducible to the smallest licit foot. Rejection of EMH entails that linguistic theory must allow for an autonomous minimality requirement. In the next section I offer a formulation of this requirement and begin to address the issue of where and when it applies.

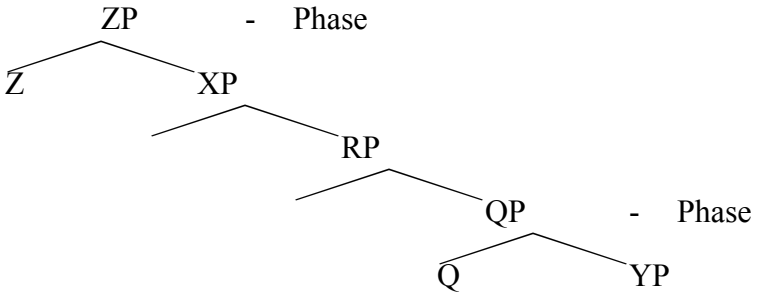
[4] There are some SE Cree words like *káakw* 'porcupine' and *nísk* 'Canada goose' containing a single 'super-heavy' syllable. All such words are arguably variant realizations of disyllabic inputs. Even if these CVVCC and CVCC sequences were analyzed as monosyllabic, they would also contain a consonant that is not part of that syllable. Consequently, it could still be maintained that the smallest word in SE Cree is always bigger than one syllable.

2. Explaining word minimality. Since the 1980's, the hypothesis that morphological and syntactic entities are mapped to phonological structure has shaped the development of phonology (cf. Selkirk 1984). The phonological category that emerges from this mapping at the level of word is the prosodic word (P-Word), while the morphological input has been referred to as the lexical word (Prince & Smolensky 1993: 43) or the grammatical word (Kager 1999:111). This mapping hypothesis is an essential element of the conception of grammar as a formal device that captures the relation between sound and meaning. It also entails that phonology is (partly) an interpretive system, assigning a phonetic interpretation to the output of the computational system that assigns structure to words. Morphology must therefore identify the structure that phonology interprets.

One theory of word structure that implicitly acknowledges the interpretive nature of phonology is Distributed Morphology (DM) (Halle & Marantz 1993, 1994). Words in DM have an internal syntactic structure, generated by essentially the same principles that underlie the formation of sentences. Categories such as nouns and verbs are really head-complement configurations consisting of root morphemes and category-defining functional elements (little-*x*). The constituents of words (i.e. morphemes) are basically bundles of abstract features such as [human], [plural], [animate], [past], etc. These abstract entities are provided with phonological content by inserting vocabulary items (sometimes Ø) that match the feature specification of morphemes. Vocabulary Insertion (VI) is a crucial process in the mapping between morphological and phonological structure, because the substance provided by inserted items constitutes the real input to phonology.

When does VI occur? Embick & Noyer (2001) propose a model within the Minimalist Program that provides for the insertion of vocabulary items after a syntactic representation has been transferred to the PF interface. According to Chomsky (1999, 2005), such transfers take place in a series of stages or cycles called phases. At each phase, phonetic interpretation is assigned at PF and semantic interpretation at LF, yielding a schema like the following, where QP and ZP qualify as phases.

(17)

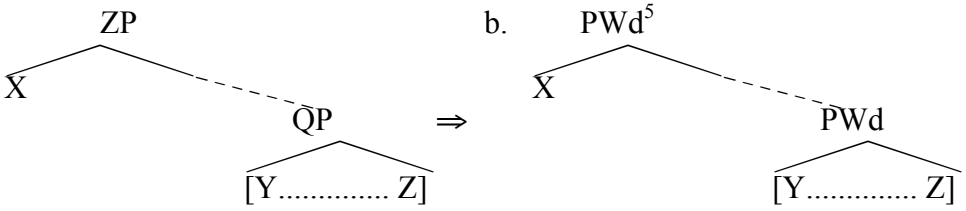


When QP transfers a chunk of structure to the PF interface, vocabulary items would be inserted and the resulting string becomes the input to the phonology. In current thinking, phonology applies to prosodic words. Consequently, it is reasonable to postulate that the phase defines the morpho-syntactic structure that corresponds to a P-Word. The mapping between morphological structure and phonological form is therefore partly regulated by the following principle.

(18) *P-Word Projection*
The constituents of a phase containing a root morpheme must project a prosodic word.

This principle is considered to be universal. The following schema illustrates how it would regulate the mapping from morphology to phonology.

(19) a. b.



Since the composition of a P-Word must make reference to phonetic substance, the projection described in (18) can only be evaluated after vocabulary items are inserted into the terminal positions in (19a). Notice that only the exponents of phase-internal morphemes figure in the projection of a P-Word. This observation is one of the consequences of the *Phase Integrity* principle proposed by Piggott & Newell (2008).

(20) *Phase Integrity/PF*
Conditions on the well-formedness of prosodic categories are imposed on all elements that emerge within a phase α, if the elements are solely within phase α.

Elements in one phase are prosodically invisible to elements in another phase.

A P-Word must satisfy any PF interface condition that is in effect when it is projected. The MINIMAL WORD syndrome is such a condition.

(21) MINIMAL WORD (MINWD)[6]
A P-Word contains more than one syllable (or mora).

This formulation provides languages with an option. In a language that requires a P-Word to be more than one light syllable, a bimoraic (i.e. CVV, CVCV) form would satisfy the requirement. In contrast, if a language requires a P-Word to be at least disyllabic, a CVV word would be considered too small. If MINWD determines that a well-formed P-Word cannot be projected from the vocabulary items that make up a phase, the derivation must crash.

2.1 Phases and the timing of spell-out. In the original conception of phases, Chomsky (1999:14) asserts that "[i]f categorical features are eliminated from roots, then a plausible typology might be that phases are configurations of the form F-XP, where XP is a substantive root projection, its category determined by the functional element F that

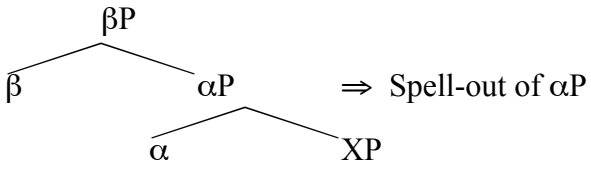
[5] Recursion is not automatic. In a configuration like (19b), the spell-out of X will result in a P-Word projection, only if the morpheme is realized *in situ*.

[6] Such a minimal size condition is probably linked to an extra-systemic perceptibility requirement on words. A monosyllabic word is undoubtedly harder to perceive than a disyllabic one.

selects it." This description provides a necessary but not a sufficient condition for phase-hood. In practice, phases were initially limited to CP and transitive vP. However, the question of what constitutes a phase is not completely settled. Svenonius (2004), for example, recognizes DP as a phase. This designation has also be extended in the DM framework to categories headed by the category-defining elements *n* (noun), *v* (verb) and *a* (adjective). Justification for the latter extension is provided by Marantz (2001, 2007), Marvin (2002), Di Sciullo (2003), Barragan & Newell (2003), Newell (2004, 2008), Arad (2005) and Piggott & Newell (2008). Consequently, content words (i.e. nouns, verbs, adjectives) may normally contain more than one phase. One of these would be an early projection, defined by the presence of a category-defining little-*x* element; the other would be the maximal functional projection (e.g. CP, DP, etc).

It is generally accepted that phase-heads of functional projections (i.e. C, D) are spelled out after their complements (Nissenbaum 2000, Chomsky 2005). In contrast, Marvin (2002), Newell (2008) and others maintain that the category-defining elements *n*, *v*, and *a* are spelled out at the same time as their complements. This apparent difference can be reconciled if we adopt a position, championed by Svenonius (2004), that requires a phase-head α to be in a C-command relation with a higher head β before α and its complement can be spelled out.

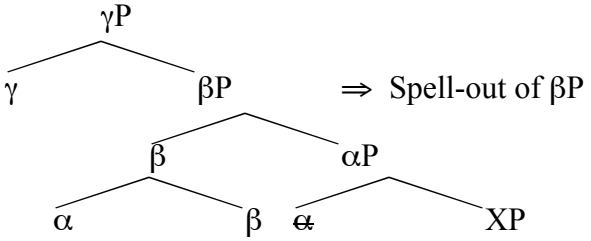
(22)



If little-*x* elements are the earliest heads in a derivation, they will always be spelled out simultaneously with their complements.

The configuration in (22) is necessary to trigger transfer of structure to the interfaces. However, it is not sufficient. Svenonius (2004) also argues that the chunk of structure to be sent to Spell-out cannot contain unvalued features. The presence of such features on β will trigger raising of α and force a delay in the spell-out of the latter until another head γ enters the derivation.

(23)



The spell-out of α in (23) would occur as part of a complex head in the βP projection.[7]

Now that we have established the relation between P-Words and morpho-syntactic structure, we can consider where the MINWD constraint (21) applies. We have

[7] In a configuration like (23), if α is a phase-head, it seems reasonable to maintain that the projection βP that dominates α qualifies as a phase.

observed in §1.1 that it is not necessarily a condition on all P-Words in a given language. Recall that Micronesian languages may enforce the requirement while tolerating sub-minimal words. This pattern contrasts with that in a language like English where the constraint applies to all P-Words. Clearly, linguistic theory must allow for some cross-linguistic variability in the application of MINWD. I postulate that there are only two options; the word minimality requirement may be imposed as soon as a root morpheme is spelled out or it may apply to all the morphemes that merge in a derivation to make up a word. More formally, a language may impose MINWD when the first chunk of structure containing a root morpheme is transferred to the interface, or it may delay satisfaction of this condition until the spell-out of the first DP or CP projection that dominates a root morpheme. Allowing languages to vary in such a manner is not a novel idea. It has long been recognized in theories of cyclic derivation that some processes or constraints may be limited to a particular cycle. This possibility is a cornerstone of lexical phonology (Kiparsky 1985). In the next two sections, I explore the consequences of imposing a minimality requirement early in a derivation.

2.2 Early minimality As pointed out earlier, DM theory postulates that every lexical category is a complex entity containing a root morpheme and a category-defining head (little-*x*). In many cases, the little-*x* element has no phonetic realization. When the latter is the case, the spell-out of a root-*x* combination would meet the requirements of MINWD, only if the exponent of the root morpheme contains two syllables (or moras). Such a restriction on the size of roots occurs in many languages including the two Cariban languages, Hixkaryana and Tiriyó (at least in their nominal system), and Tawala, an Austronesian language of Papua New Guinea. The normal effect of enforcing early minimality is a ban on monosyllabic (or monomoraic) words, and there is evidence that Cariban languages avoid such words. In Tawala, according to Ezard (1997: 33), underived roots typically have two syllables and words are minimally disyllabic. There are some 'apparent' exceptions, but these are limited to CVC words that end in a bilabial nasal, and, significantly, the nasal is syllabic.

Another language where the satisfaction of MINWD is pervasive is Ojibwa, a member of the Eastern group of Algonquian languages (Bloomfield 1957, Kaye, et al 1971, Piggott & Kaye 1973, Piggott 1980, Piggott & Newell 2008). With the possible exception of a few intransitive verbs and one modifier, Ojibwa nouns, verbs and modifiers do not have CV, CVV or CVC shapes. The absence of such shapes is proof that the size of the smallest (content) word must be greater than one syllable. Although this observation applies to all lexical categories, I will focus primarily on nouns. Examples of disyllabic nouns that conform to the minimality requirement are given below.[8]

(24) a.

akwe:	'woman'
mitig	'tree'
amik	'beaver'
anim	'dog'
na:be:	'male animal', 'man'

[8] There are several dialects of Ojibwa. In most dialects, unstressed vowels are reduced or deleted, but vowel deletion depends on speech rate. The data featured in this paper are from the dialect described by Piggott (1980). Similar facts are found in Bloomfield (1957).

b. nika 'goose'
makwa 'bear'
miʃi 'piece of firewood'
paŋgwi 'ashes'
miskwi 'blood'

The second group of words (24b) is significant, because each ends in a short vowel; such a vowel is usually absent in longer words. Evidence from alternations points to a process of vowel deletion that targets final short vowels (Bloomfield 1957, Piggott 1980). Their presence in (24b) is therefore evidence that the word minimality condition is enforced in Ojibwa.[9]

The two final vowels /a, i/ in (24b) also have a morphological status; they are markers of singular number. The variation is correlated with the 'gender' class of the noun; the suffix /i/ is attached to inanimate nouns and /a/ is attached to animate ones (Bloomfield 1957:39). The exponent of the root morpheme in each of the words in (24b) therefore has a CVC(C) shape, and the realization of the singular suffix is necessary to achieve the minimal word-size. This observation would appear be problematic for the hypothesis that MINWD is enforced early in the derivation of Ojibwa words. The NUMBER (NUM) morpheme must be a higher head than category-defining *n*-element and would enter the derivation too late to make a difference, if *n*P phase had already been spelled out. Since the head of the *n*P projection is not phonetically realized in Ojibwa, the spell-out of a CVC(C) root would be too small to satisfy MINWD and should cause a derivation to crash, before the merger of NUM could be a factor.

The problem posed by the forms in (24b) can be solved only if the spell-out of the *n*-head is delayed. Delay in the spell-out of the *n*P phase is probably not the norm, cross-linguistically, and should therefore be attributed, in this case, to some property of Ojibwa. The most likely feature is the gender specification. Noun roots are obviously specified as [+/-Animate] (i.e. [+/-A]). This difference is reflected in certain systematic ways in the grammar of Ojibwa. For example, the gender of intransitive subjects and the transitive objects controls certain aspects of verbal inflection. Number morphemes also show a gender contrast, reflected in the choice of different suffixes. Less obvious is the specification of the category-defining morpheme for gender.[10] I propose that each *n*-morpheme has such a specification and selects a root that agrees with its gender. The fact that all gender-marking affixes are suffixes in Ojibwa is considered to be evidence that gender agreement triggers head movement. Consequently, the realization of simple singular or plural nouns in Ojibwa contains the configuration of elements in (25). (A strikethrough is used to identify the original site of a displaced element.)

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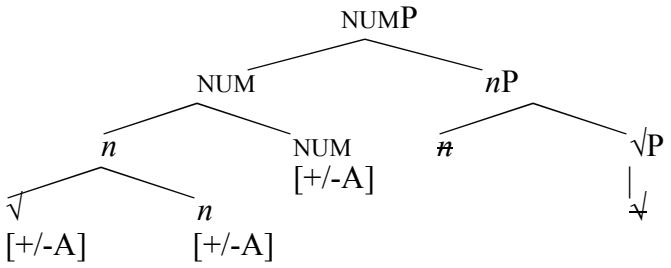
[9] The hypothesis that Ojibwa enforces a minimal disyllabic size on words appears to be undermined by occurrences of words with either a CVVC (e.g. *mi:n* 'blueberry') or CVVCC (e.g. *ma:ŋg* 'loon') shape. Notice, however, that these are examples of the so-called super-heavy syllable. The analysis of this sequence as constituting more than one syllable is widely accepted in the literature (Giegerich 1985, McCarthy & Prince 1990, Piggott 1999). See also footnote 4.

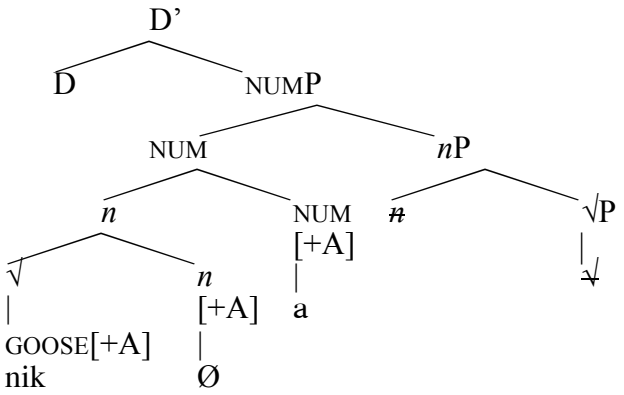
[10] This is not considered to be a unique Ojibwa feature. In all languages that assign nouns to arbitrary grammatical classes, the class specification is associated with the category-defining elements, entailing, for example, that class markers in Bantu languages match the features of the *n*-head.

(25)



For expository reasons, I assume that the root morpheme originates in a √P projection and raises to merge with the *n*-head that selects it. The complex head is then raised and adjoined to NUM. All features in the NUMP projection are now valued and it is sent to Spell-out as the complement of D. Consequently, the singular noun *nika* 'goose' is the realization of the following structure.

(26)



In the above structure, the root-affix combination in NUMP (the first spelled-out chunk) projects a well-formed disyllabic P-Word, thereby satisfying the MINWD constraint. This is the only condition under which the singular suffixes have to be phonetically realized in Ojibwa. Deletion of a final short vowel in such a context would produce an illicit P-Word; it would be too small.

Since gender plays a fairly significant role in Ojibwa grammar, contrasts like those in (27) are provided as additional evidence that it is an arbitrary lexical property.

(27)

a. Animate		b. Inanimate	
wa:goʃ	'fox'	ani:bi:ʃ	'leaf;
a:gam	'snowshoe'	makizin	'shoe'
miskomin	'raspberry'	ode:ʔimin	'strawberry'
ʒi:ʃi:b	'duck'	maʃkimod	'bag'
name:	'sturgeon'	maʃkode:	'field
wi:ndigo:	'monster'	okwi:	'cloud'

The different endings that mark the gender contrast in singular nouns have already been shown in (24b). The plural contrast is illustrated below.

(28)

	Singular	Plural	
a.	wa:goʃ	wa:goʃag	'fox'
	a:gam	a:gamag	'snowshoe'
	name:	name:g	'sturgeon'
b.	ani:bi:ʃan	ani:bi:ʃan	'leaf'
	makizin	makizinan	'shoe'
	maʃkode:	maʃkode:n	'field

The plural endings are basically /ag/ (Animate) and /an/ (Inanimate); the suffix-initial vowel is predictably lost after another vowel.[11]

There are a few cases where an animate-inanimate pair contains phonetically identical root morphemes.

(29)

a.	oda:ba:n	oda:ba:nag	'car'	(Animate)
	oda:ba:n	oda:ba:nan	'sled'	(Inanimate)
b.	abwi:	abwi:g	'propellor'	(Animate)
	abwi:	abwi:n	'paddle'	(Inanimate)

The animate member of each pair in (29) is the innovation. Since lexical contrasts that depend solely on the gender of the root are not systematic and the difference in meaning is not predictable, I will assume that each member of a homophonous pair corresponds to a separate entry that differs only in the specification for gender. In other words, the exponent of the morpheme [VEHICLE, +Animate] is *oda:ba:n* 'car', while *oda:ba:n* 'sled' corresponds to [VEHICLE, -Animate]. Like singular endings, the two plural affixes /ag/ and /an/ appear in the head of NUMP and are inserted to reflect agreement with gender specification of the root.

Returning now to the timing of the enforcement of MINWD, the Ojibwa facts presented so far are compatible with either early or late satisfaction of the constraint, since the initial spell-out of material does not occur at the *n*P stage. Convincing evidence that this language enforces early minimality comes from the realization of constituents in possessive constructions. The phonology of these constructions is the focus of discussion in the next section.

2.2.1 Early minimality and Ojibwa possessive constructions. Cross-linguistically, a contrast between two types of possessive constructions, labeled alienable and inalienable, is widely attested. In the inalienable type, the possessed noun is normally a term for kinship or a part of the body, while other possessed nouns belong to the alienable class. The two types occur in Ojibwa. Both contain a pronominal prefix marking the person of the possessor followed by possessed noun. The alienable type may also contain an overt possessive suffix /im/, but all descriptions agree that this suffix does not always occur. As a result, examples in (30) illustrate options with or without this

[11] An alternative analysis in which the vowel is epenthetic between consonants is untenable. Epenthesis would not occur in Ojibwa between a nasal and a velar stop.

suffix, with no discernable difference in meaning. (The optionality of the ending is indicated by the parenthesis.)

(30) a. niwa:bigon(im)[12] 'my flower'
ni-wa:bigon-(im)
'1P-FLOWER-POSSESSIVE'

b. niʒi:ʃi:b(im) 'my duck'
ni-ʒi:ʃi:b-(im)
'1P-DUCK-POSSESSIVE'

When a possessed noun is plural, the number affix always follows the possessive, yielding plural forms like those in (31).

(31) a. niwa:bigoniman 'my flowers'
ni-wa:bigon-im-an
'1P-FLOWER-POSSESSIVE-PLURAL'

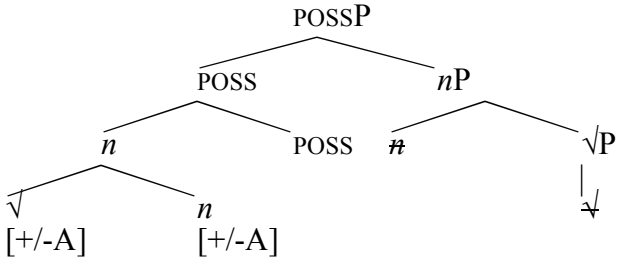
b. niʒi:ʃi:bimag 'my ducks'
ni-ʒi:ʃi:b-im-ag
'1P-DUCK-POSSESSIVE-PLURAL'

Other affixes such as the diminutive and pejorative may precede the possessive suffix.

(32) niʒi:ʃi:be:nsimag 'my little ducks'
ni-ʒi:ʃi:b-e:ns-im-ag
'1P-DUCK-DIMINUTIVE-POSSESSIVE-PLURAL'

The possessive suffix is always attached to a noun root. This selectional restriction can be captured formally by postulating that the POSSESSIVE (POSS) morpheme is specified for a nominal feature that must be checked before spell-out by raising the root morpheme to the POSS head, as illustrated in (33).

(33)

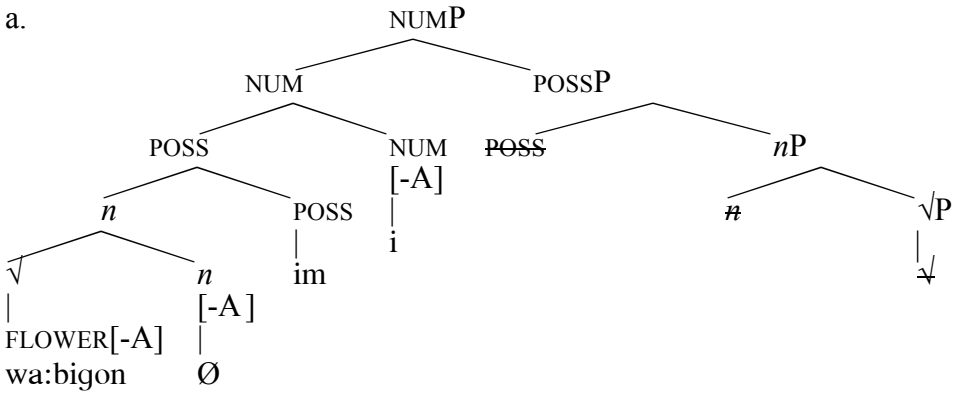


The introduction of the NUMBER morpheme at this derivational stage would be expected to initiate a probe for gender agreement. If successful, head movement would be triggered and the NUM, POSS and root morphemes would be spelled out together in the

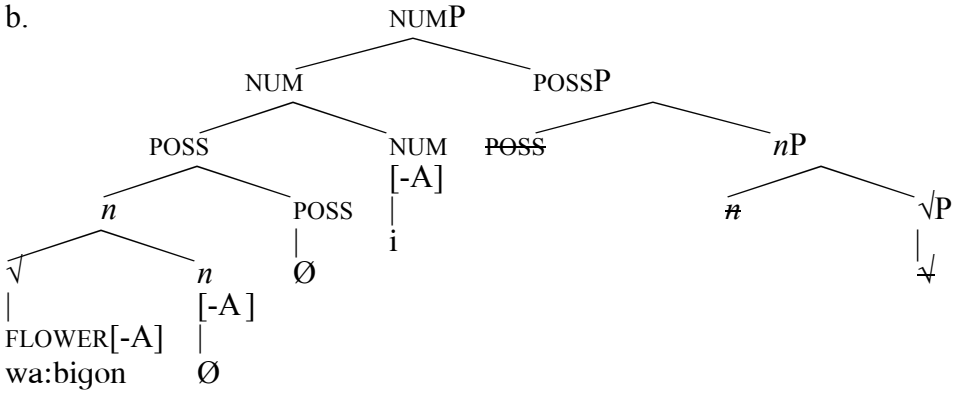
[12] Bloomfield (1957: 41-42) and others note that the suffix /im/ usually does not occur after noun stems that end in a nasal consonant. This observation plays no role in the analysis of possessive constructions adopted in this paper.

first chunk of structure that is transferred to the interfaces. The phonological and semantic properties of the words in (30) and (31) are consistent with such a hypothesis. Assuming that the variation in the occurrence of the possessive suffix is the result of allomorphy selection, vocabulary insertion would yield either (34a) or (34b).

(34) a.



b.



The phonological outputs /wa:bigonimi/ and /wa:bigoni/, respectively, are well-formed and each corresponds to a coherent interpretation at LF - 'a single flower possessed by someone'. Later, a pronominal prefix that indicates the Person of the possessor argument is inserted and the final vowel is lost.

While the PF and LF interpretations of the words in (30) and (31) are consistent with the spell-out of NUM, POSS and the root morpheme together, additional Ojibwa data show that such an analysis cannot be maintained. The crucial evidence comes from words containing monosyllabic noun roots. The apparent freedom of the possessive suffix to vary between /im/ and /Ø/ is systematically curtailed, when it combines with a root that has a monosyllabic exponent; in this context, only the /im/ variant occurs.

(35) a. ninikim 'my goose'
ni-nik-im-a
'1P-GOOSE-POSSESSIVE-SINGULAR'

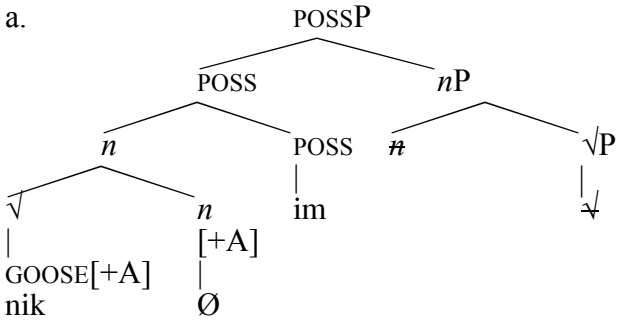
b. *ninik 'my goose'
ni-nik-Ø-a
'1P-GOOSE-POSSESSIVE-SINGULAR'

(36) a. nimisim, 'my piece of firewood'
ni-mis-im-i
'1P-FIREWOOD-POSSESSIVE'

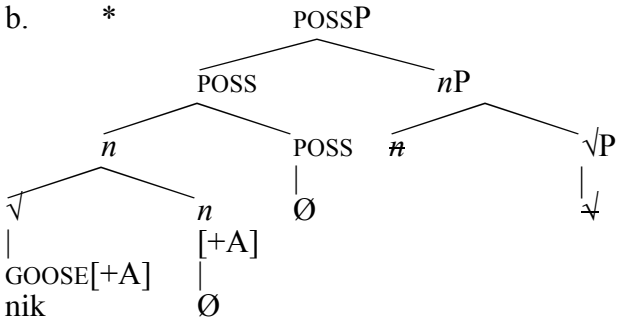
b. *nimis 'my piece of firewood'
ni-mis-Ø-i
'1P-FIREWOOD-POSSESSIVE-SINGULAR'

Each of these forms contains an underlying singular suffix that would be routinely deleted. Notice, now, that, if the ending /im/ is also missing, the resulting word is ill-formed. Therefore, the realization of the POSSESSIVE morpheme can play a crucial role in the well-formedness of an alienable possessive construction. This conclusion entails that PF interpretation is imposed on the POSSP projection. Vocabulary insertion into this structure would yield a pair of outputs like the following.

(37) a.



b. *



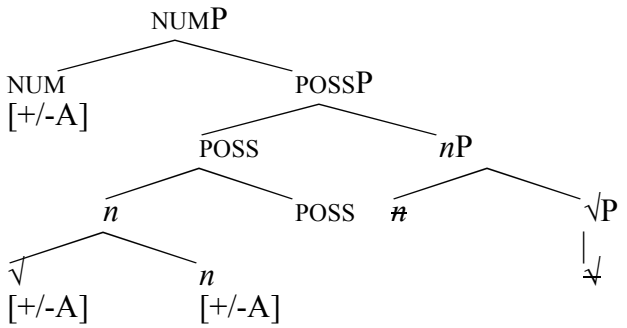
The well-formed disyllabic output [nikim] (37a) contains the ending /im/, but the second option *[nik] (37b), containing the null (Ø) allomorph of the possessive morpheme, is monosyllabic and ill-formed. Imposition of MINWD on the spell-out of the POSSP projection, first chunk of structure transferred to the interfaces, would therefore appropriately induce a derivation like (37b) to crash at PF.

The fact that a phonologically well-formed output cannot emerge from (37b) is proof that minimality is computed at the earliest possible stage in the derivation of an Ojibwa word. The alternative that MINWD only comes into effect at the last phase would counterfactually allow the number suffixes and the possessor agreement prefixes to be potential contributors to its satisfaction. An agreement prefix is inserted in the head (D) of DP as determined by the features of a pronominal element (*pro*) in the [Spec, DP] position (McGinnis 1995, Newell 2008, Piggott & Newell 2008). The prefix /ni-/ '1st Person' is one of three vocabulary items that may occupy this slot; the other two are /gi-/

'2nd Person' and /o-/ '3rd Person'. Hypothetically, one of these prefixes would combine with a monosyllabic root to produce a disyllabic form. The derivation of the incorrect form **ninik* 'my goose' after the singular ending is dropped would result. This hypothetical word would be big enough to satisfy the minimality requirement, but it is not a licit Ojibwa word. The fact that **ninik* 'my goose' is unattested is proof that the number endings and the possessor prefix enter an alienable possessive construction too late to contribute to the phonological well-formedness of the resulting word.

From the perspective of meaning, the evidence is indeterminate whether the NUMBER and POSSESSIVE morphemes interpreted in the same phase or in different phase. However, the phonological evidence is unambiguous; it clearly supports the hypothesis that the two morphemes are not spelled out at the same time. It also throws light on the syntactic context in which gender agreement is satisfied. In a configuration like (38), the probe for gender agreement cannot be successful.

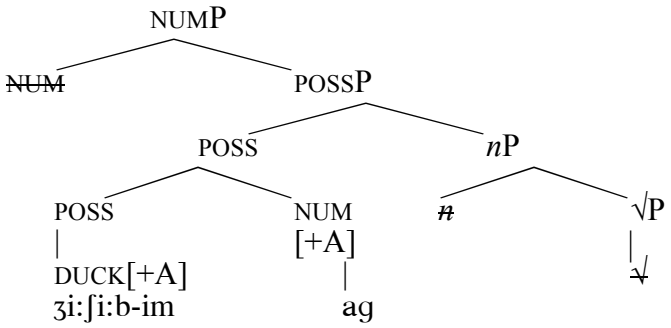
(38)



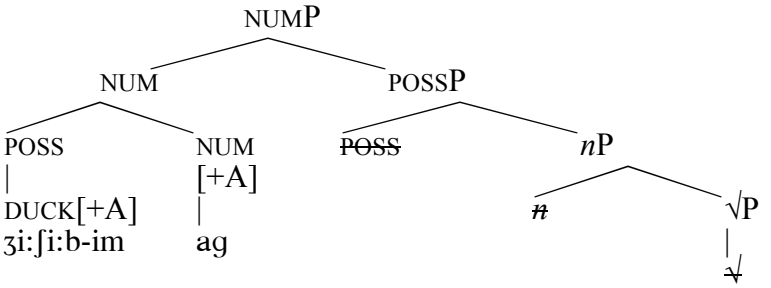
The unsuccessful probe for gender agreement in (38) entails that the number morpheme is too far away from a head that is also specified for gender. In other words, Ojibwa requires elements that match for gender to be structurally adjacent. When the POSSESSIVE morpheme, which is unspecified for gender, intervenes between NUM and the *n*-head, the locality condition for agreement is not met and head movement is not triggered.

Although the complex POSS head in (38) does not merge with NUM before any structure is spelled out, the linear order of the two morphemes still has to be accounted for; some operation must position the number affix after the possessive. There are two possibilities. We may appeal to a post-syntactic Lowering operation (Embick & Noyer 2001, Skinner 2009) that adjoins the NUMBER morpheme to the right of the spelled-out POSS head (39a). The alternative is to postulate head movement after spell-out that raises POSS to NUM (39b). Either representation corresponds to the meaning 'more than one duck possessed by someone'.

(39) a.



b.



For the present purpose, it is not crucial to take a position on which of the options in (39) is appropriate. Under either scenario, a transformation places the NUMBER morpheme in the same phase (and in the same phonological domain) as the root and possessive morphemes. At the point when number affixes are inserted, all other vocabulary items in the same domain are visible and are subject to phase-internal well-formedness conditions. For example, we would expect VV hiatus between a root and number affix to be resolved by vowel loss (Piggott & Newell 2008). An example like that in (40a) where the final vowel of a root would be directly visible to the initial vowel of the plural suffix shows that our expectation is met.

(40) a. niname:g 'my sturgeons
ni-name:-Ø-ag
'1P-STURGEON-POSSESSIVE-PLURAL'

b. niname:mag 'my sturgeons
ni-name:-im-ag
'1P-STURGEON-POSSESSIVE-PLURAL'

The loss of an affix vowel in (40a) is comparable to a similar loss in (40b). In both cases, the loss occurs when the adjacent vocabulary items are in the same P-Word.

The presence of the POSSESSIVE morpheme in an alienable possessive construction is a crucial factor in delaying the spell-out of the NUMBER morpheme. However, the situation is different in the inalienable counterpart. There is no evidence that the POSSESSIVE morpheme is present in the latter; attachment of /im/ generates an ill-formed word. Each of the following words contains a possessor prefix and a following root, but the only suffix is the marker of singular number, which is deleted by the apocope rule.

(41) a. nida:nis 'my daughter' *nida:nisim
ni-da:nis-a
'1P-DAUGHTER-SINGULAR'

b. nida:mikan 'my chin' *nida:mikanim
ni-da:mikan-i
'1P-CHIN-SINGULAR'

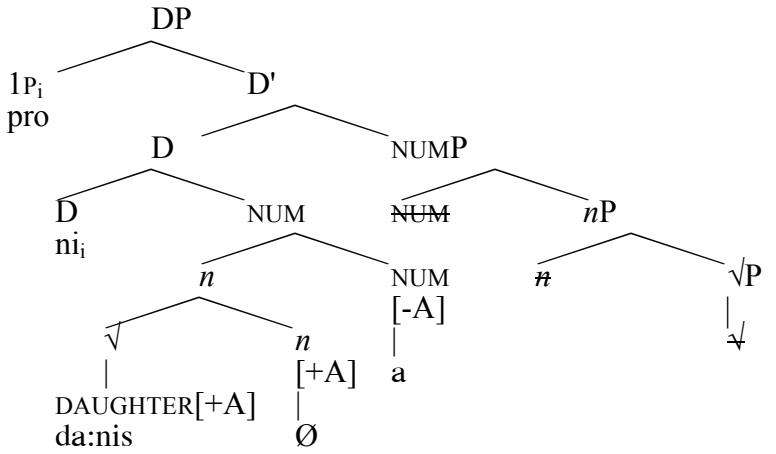
c. nimiʃo:mis 'my grandfather' *nimiʃo:misim
ni-miʃo:mis-a
'1P-GRANDFATHER-SINGULAR'

d. ninamidinik 'my left arm' *ninamidinikim
ni-namidinik-i
'1P-LEFTARM-SINGULAR'

I consider the total absence of the possessive suffix in the inalienable possessive construction to be prima facie evidence that there is no POSSP projection. In other words, the POSSESSIVE morpheme cannot select an *n*P that contains an inalienable root morpheme. The absence of a POSS head entails that a probe for gender agreement by a NUM head would be successful. The root and NUMBER morphemes would therefore be spelled out in the same phase.

There is another morpho-syntactic difference between the two possessive constructions; an inalienable root is always preceded by a pronominal prefix that agrees with the Person features of the possessor. This difference may be attributed the claim that an inalienable noun is lexically specified for an obligatory possessor argument (Tellier 1988, Vergnaud & Zubizarreta 1992). However this lexically property is represented, it requires an inalienable root to merge with a morpheme that fills the role of the obligatory possessor argument before it is spelled out. Assuming that the pronominal agreement prefixes are always inserted in a D-head, the configuration of elements in (42) would constitute the first chunk of structure to be interpreted in the derivation of (41a).

(42)



The first (and only) phase in the derivation of an inalienable possessive construction therefore contains a pronominal prefix, a root and a number suffix.[13] This constituency contrasts sharply with the first phase of an alienable possessive construction where the root and possessive morphemes are the only elements available for interpretation.

The morpho-syntactic differences between the two types of possessive constructions would be expected to correlate with phonological differences. Piggott &

[13] The order of morphemes (pronominal prefix–root-number suffix) cannot be derived by adjoining the complex NUM head to the higher D-head. Such a merger by head-movement counterfactually predicts that the exponent of D, the possessor morpheme, would follow the singular or plural suffixes. This problem can be solved if we assume that the possessor morpheme and the root merge early and the combination is treated as a unit by subsequent head-movement, thereby ensuring that the possessor is always realized to the left of the root. The latter analysis would still maintain the crucial phonological difference between the two types of possessive constructions.

Newell (2008) point out that VV hiatus between a pronominal prefix and a vowel-initial root is resolved by consonant epenthesis in an alienable possessive construction (e.g. /ni-ogima:-im/ [nidogima:m] ‘my leader’ and vowel loss in the inalienable type (e.g. /ni-o:s/ [no:s] ‘my father’). Another phonological difference is in the make-up of the sequence that qualifies as a minimal word. The prefix and the number affix are not contributors to the satisfaction of minimality in an alienable possessive construction. In contrast, such entities contribute to the phonological well-formedness of a P-Word in an inalienable type. Notice that even after the deletion of final vowel that marks singular, the following words are still well-formed.

(43) a. ninik 'my arm'
ni-nik-i
'1P-ARM-SINGULAR'

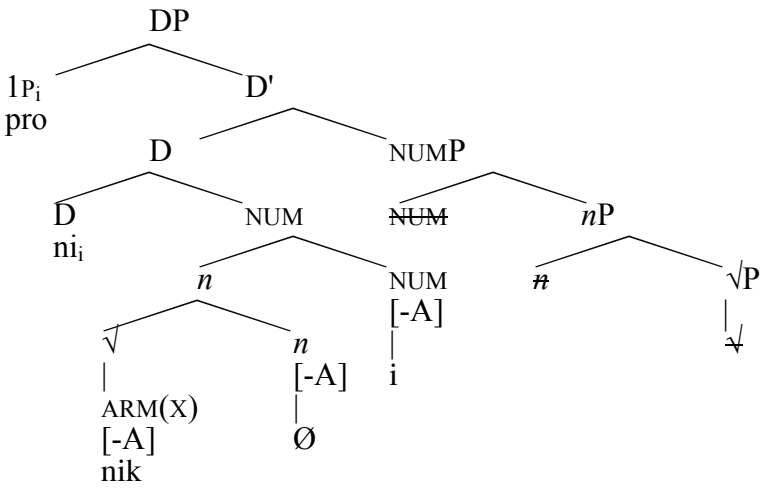
b. nikon 'my liver'
ni-kon-i
'1P-LIVER-SINGULAR'

c. nigwis 'my son'
ni-gwis-a
'1P-SON-SINGULAR'

d. niday 'my dog, my pet'
ni-day-a
'1P-DOG/PET-SINGULAR'

Each of the above words contains a pronominal prefix and a monosyllabic root. For example, the word *ninik* 'my arm' (43a) is the realization of the configuration of elements in (44).

(44)



When the DP phase in such a construction is transferred to the two interfaces, the semantic and phonological requirements can be readily satisfied. The inalienable noun has a possessor argument as required for interpretation at LF, and the PF interface condition that the projected P-Word must be at least disyllabic is satisfied. The sequence

/ni-nik-i/ undergoes the truncation process to yield the output [ninik] 'my arm' that still conforms to the minimality requirement.

The two Ojibwa possessive constructions strongly confirm the hypothesis that the MINWD constraint is imposed on the first chunk of structure that is transferred to the PF interface. The constituents of this chunk are not arbitrarily pre-determined but are derived from general syntactic principles. Consequently, POSSP constitutes the first phase in an alienable possessive construction, while DP is the first phase in the inalienable counterpart. In either case, Ojibwa is regulated by early enforcement of the minimality requirement.

This is a convenient point to summarize the analysis so far. I claim that a language may impose a word minimality condition early in a derivation. If the inserted vocabulary items are insufficient to satisfy the requirement, the derivation must crash. Vocabulary items inserted at phase X cannot play a role in determining the prosodic well-formedness of a P-Word at phase X-1. One of the empirical consequences of this restriction is that some languages require that the exponents of root morphemes must contain at least two syllables. Other languages may tolerate monosyllabic roots but limit their occurrence to contexts where the realization of another morpheme must be overt. Syntax determines the domain in which word minimality is computed; a morpheme may, therefore, display variable behaviour with respect to the satisfaction of the requirement, dependent solely on the stage of a derivation when it is provided with phonetic content. Hence, Ojibwa pronominal prefixes and number suffixes are visible when minimality is first assessed in an inalienable possessive construction but not in an alienable one. In the next section, I examine the consequences of enforcing the MINWD condition only after all the morphemes that make up a (morpho-syntactic) word are spelled out.

2.3 Late minimality. When a language enforces the minimality requirement late, a sub-minimal P-Word projected at an earlier derivational stage would be well-formed at the point when it was projected. What effect would late enforcement of MINWD have on such a P-Word? If the answer were none, we would expect to find languages that impose the minimality requirement on some words but also tolerate sub-minimal words. Turkish is such a language. The following examples show that it tolerates monosyllabic words.

(45) Sub-minimal Turkish words

a.	at	'horse'	ev	'house
	dil	'tongue'	ham	'unripe'
	ek	'affix'	kök	'root
b.	do	[musical note]	re	[musical note]
	mi	[musical note]	fa	[musical note'
	ye	'eat'	de	'say'
	su	'water'	ko	'put'

However, the combination of monosyllabic roots and an affix does not always yield a licit output. Inkelas & Orgun (1995) point out that, while combinations like those in (46a) are attested across all dialects of Turkish, one dialect (identified as Group B) rejects words like those in (46b).

(46) a. ye-di [yedi] 'eat-PAST'
de-mek [demek] 'say-PASS'
fa-miz [famɨz] '[note]fa-1PL.POSS'

b. ye-n *[yen] 'eat-PASS' (i.e. 'be eaten')
de-n *[den] 'say-PASS' (i.e. 'be said')
fa-m *[fam] '[note]fa-1SG.POSS' (i.e. 'my [fa]')
fa-n *[fan] '[note]fa-2SG.POSS' (i.e. 'your [fa]')

The suffixes in (46b) readily combine with bigger roots like those in (47) to produce possible words.

(47) a. tʃi:ne-n [tʃi:nen] 'chew-PASS' (i.e. 'be chewed')
b. kafa-m [kafam] 'head-1SG.POSS' (i.e. 'my head')
c. kaza-n [kazan] 'accident-2SG.POSS' (i.e. 'your accident')

Clearly, Turkish does not enforce the minimality requirement across the board, since the words in (45) are attested. Nevertheless, the ineffability of the words in (46b) has to be attributed to the violation of such a condition. The difference between the attested monosyllabic words in (45) and the ineffable ones in (46b) must be located in their derivational histories.

Each of the words in (45) minimally contains a root morpheme and a category-defining little-*x* element that would be spelled out at the first phase. In contrast, the hypothetical words in (46b) contain morphemes that are associated with higher functional categories (e.g. VOICE, AGR). Turkish therefore provides evidence that if a P-Word emerges as well-formed at the first phase, it retains this status, but the minimality requirement can be imposed on P-Words that are projected later in a derivation. How late? I propose that it is imposed on the spell-out of the final phase.

A full analysis of the Turkish case will not be pursued here. Instead, I will look at another language that enforces minimality late; it is Mangap-Mbula, an Austronesian language of New Guinea (Bugenhagen 1995). Like Turkish, it also tolerates monosyllabic words.

(48) a. Monosyllabic nouns
zoŋ 'sun'
kar 'village'
mbeŋ 'night'
yok 'water'

b. Monosyllabic verbs
ŋo 'you (sg.) gnaw'
so 'you (sg.) say'
pet 'you (sg.) appear'
ndu 'you (sg.) cross)'

The only visible morphemes in (48) are roots. In nouns, the *n*-head and number morphemes are unrealized. The *v*-head is also not realized in verbs. In addition, Person agreement is normally marked by overt prefixes, but the 2nd Person singular is exceptionally a null (Ø) affix.

The assignment of stress provides some of indirect evidence that MINWD applies late in Mangap-Mbula. Canonically, main stress is assigned to the initial syllable, when the second syllable is light (49a). However, when the initial syllable is light and the second one is heavy, the latter attracts stress (49b).

(49) a. mólolo 'long (plural objects)'
nákabàsi 'axe'
pázaŋàna 'something planted'

b. tomó:to 'man'
bobó:bo 'you (sg.) are calling'

The stress patterns in (49) can be attributed to weight-sensitive trochaic footing, assigned from left to right. However, in a morphologically complex word, where the first morpheme is a Person agreement subject prefix, stress assignment ignores the prefix.

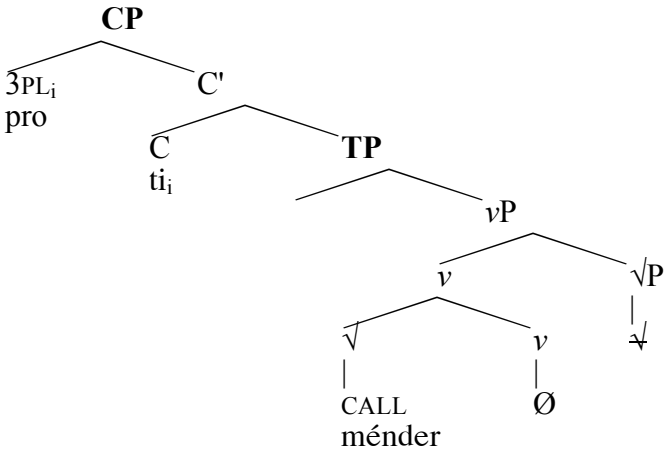
(50) a. ti-ménder 'they stand' *tí-mender
ti-pómbol 'they cause to be strong' *tí-pombol

b. aŋ-bó:bo 'I call' '*áŋ-bò:bo
aŋ-bobó:bo 'I am calling' '*áŋ-bobò:bo
aŋ-garáu 'I approach' *áŋ-garàu

In (50a), stress is assigned, non-canonically, to the second of two light syllables, while we see in (50b) that one or two light syllables to the left of a heavy stressed syllable may remain unstressed.

The vocabulary items that are invisible to stress assignment in Mangap-Mbula are inserted at the CP phase. From the derivational perspective, stress cannot be assigned at the word level in this language. However, when it is assigned, a root morpheme and its category-defining *x*-head are visible. The invisibility of subject prefixes can be readily captured if stress is assigned to the chunk of structure that is spelled out as the complement of the C-head. Prima facie, this is the first piece of a verb that is interpreted at the interfaces. For expository purposes, I identify this chunk as the TP projection in the representation of the word *ti-ménder* 'they stand', illustrated below.

(51)



When the TP chunk is phonologically interpreted, trochaic footing locates stress on the first syllable of the string [ménder]. The subject morpheme is not visible at this stage.

The prefix is inserted later at the stage when the C-head is spelled out, but it has no effect on stress assignment. The two stages in the PF interpretation of (51) are sketched below.

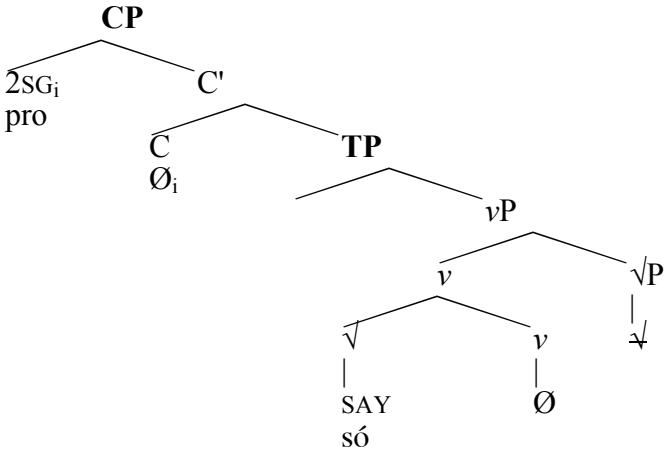
(52) a. [CALL-*v*..TP]
[(ménder)PWd] (Spell-out of TP)

b. [3PL[CALL-*v*..TP]...CP]
[ti[(ménder)PWd] PWd] (Spell-out of CP)

Once a subject prefix is inserted, it would remain *in situ* and be interpreted as unstressed, because there is no phonological imperative in Mangap-Mbula that forces the persistent parsing of syllables into feet.

In (52), the MINWD condition is satisfied, whether it is imposed early (at the spell-out of TP) or late (at the spell-out of CP). However, we can readily deduce from the existence of monosyllabic words (48) that the minimality requirement cannot be imposed on the first chunk of interpreted material. This chunk is evidently sub-minimal in the representation of the word *so* 'you (sg.) say'.

(53)



At the spell-out of TP, the monosyllabic root /so/ is inserted. The enforcement of MINWD at this stage would, counterfactually, induce this derivation to crash. We have to conclude that, if the condition is in effect, it is satisfied late.

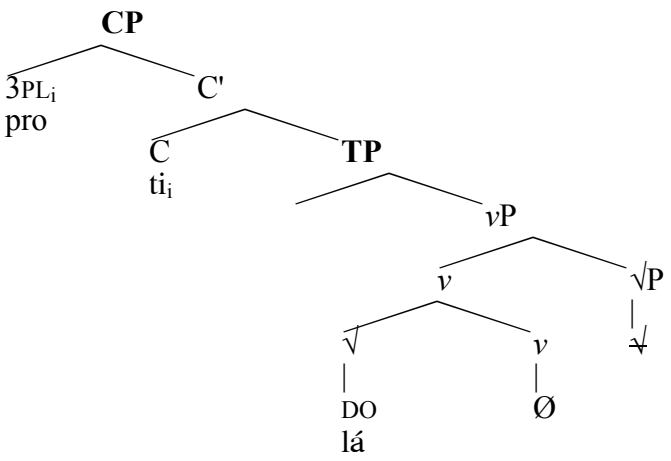
Late enforcement of MINWD in Mangap-Mbula leads to the expectation that subject prefixes would contribute to its satisfaction. This contribution is evident in the following disyllabic words. In each of case, the prefix bears stress.

(54) a. tí-la 'they do'
b. áŋ-bot 'I stay'
c. áŋ-du 'I cross'
d. kó-so 'you(pl.) say'

Since subject prefixes are normally invisible to stress, they can become candidates for bearing stress only if some condition forces them to be in the same prosodic word as the

roots. The satisfaction of MINWD would have such an effect. After vocabulary items have been inserted at the CP stage, (54a) would be represented as in (55).

(55)



This representation contains two syllables, but they are projected in different P-Words (associated with the spell-out of TP and CP, respectively) and cannot combine to satisfy a prosodic requirement, given the *Phase Integrity* principle (20). To conform to MINWD, the subject prefix must be dislocated from its insertion site and combine with the exponent of the root in a single P-Word. The post-syntactic movement of the subject morpheme constitutes a case of Local Dislocation (Embick & Noyer 2001) or phonological cliticization (Piggott & Newell 2008). In this instance, it is an optimal solution to the MINWD requirement, a PF interface condition in the sense of Kratzer & Selkirk (2007). The effect is illustrated below.

(56) a. [3PL[DO-*v*..$_{TP}$]...$_{CP}$]
[ti[(lá)$_{PWd}$]] (Spell-out of CP)

b. [3PL[DO-*v*..$_{TP}$]...$_{CP}$]
[~~ti~~[(tilá)$_{PWd}$]] (Cliticization of subject prefix)

After cliticization, the location of stress on the prefix can be readily attributed to the persistence of trochaic foot structure in Mangap-Mbula. To bring the result of cliticization into conformity with the trochaic requirement, stress, assigned to the root at the spell-out of TP, must shift to the subject prefix.

(57) a. [3PL[DO-*v*..$_{TP}$]...$_{CP}$]
[~~ti~~[(tíla)$_{PWd}$]] (Trochaic adjustment)

b. [(tíla)$_{PWd}$] (Surface form)

It is reasonable to assume that cliticization relocates the subject prefix without leaving a trace. When a vocabulary item is displaced, there is no evidence that it maintains a presence at its original site. The fact that (57b) contains a prefix is not recoverable from the surface representation of this word; it contains no internal phonological or morphological boundaries.

The hypothesis that the MINWD condition applies in Mangap-Mbula produces an apparent paradox; the language tolerates sub-minimal words but also requires them to be at least disyllabic. Stress provides insight into the source of the apparent contradiction. The location of main stress identifies the constituent that qualifies as the head of the word. In Mangap-Mbula, the head of the word is normally located in the first chunk of structure that is spelled out. Consequently, the prima facie evidence suggests that the HEADEDNESS condition, repeated below as (58), is satisfied early.

(58) HEADEDNESS/PRWD
Every prosodic word contains a foot

Early satisfaction of this requirement entails that the first P-Word projected in a derivation is a 'perfect' prosodic entity. This perfection is inherited at all subsequent stages. The occurrence of monosyllabic P-Words in Mangap-Mbula follows from this generalization. When they are assessed by the MINWD, in effect at the word level in this language, they are opaque to its effects. Note that a 'perfect' P-Word projected early in a derivation can be modified by the later addition of phonological material. One source of the new material can be the Local Dislocation of a vocabulary item from its insertion site, as illustrated in (56). Whenever a post-spell-out process results in the addition of new phonological material to a spelled-out string, the output must undergo phonological reinterpretation. This requirement follows from a principle that is widely assumed but, as far as I am aware, never explicitly stated in the literature. I call it the *Prosodic Completeness Theorem* (PCT).

(59) *Prosodic Completeness Theorem*
All phonological material must be incorporated into prosodic structure.

The incorporation of new material into an existing P-Word renders it accessible to all constraints that are in effect. Hence, late MINWD would regulate the well-formedness of such 'derived' P-Words but would have no effect on sub-minimal P-Words that were projected before this constraint became active.

Universally, the head of a P-Word is located near an edge. The hypothesis that this location is computed early is easy to verify in a language like Mangap-Mbula where foot structure is linked to stress; certain vocabulary items are systematically ignored for the purpose of defining the location of the main stress in a word. The Uto-Aztecan language, Cupeño, provides similar evidence for early location of the head of a word (Newell 2008). The specific algorithm for computing the location of the head of a word must not be confused with the general parsing of syllables into feet. As pointed out explicitly by Goedemans, van der Hulst & Visch (1996) (implicitly by others), the two phenomena are distinct. For example, Newell (2008) and Piggott & Newell (2008) show that, while the parsing of syllables must occur at the earliest derivational stage and is persistent in Ojibwa, the location of the head foot must be determined at the final stage (the word level). Hence, HEADEDNESS must be satisfied late in this language.

The head of a P-Word is an abstract and, arguably, universal property of a word that is only indirectly linked to the determination of stress or prominence. In principle, it is dissociable from the manifestation of prominence. In Turkish, for example, stress or

prominence is either determined by arbitrary properties of certain suffixes or it is assigned to the final syllable in a word. Hence, the location of prominence can only be computed late in a derivation, after all the morphemes in a word are spelled out. Nevertheless, the manifestation of word minimality in the language can be explained, in the present framework, only if HEADEDNESS applies early but MINWD late. Recall that Turkish tolerates monosyllabic words (see examples in (45)). The early satisfaction of HEADEDNESS entails that such words are 'perfect' at the point when they are first projected and remain immune to the judgment of the word minimality requirement. In contrast, the hypothetical Turkish monosyllabic words in (46b) are unattested. These are obviously derived by incorporating a suffix into a P-Word that was spelled out earlier (e.g. /fa-m/ *[fam] '[note]fa-1SG.POSS' (i.e. 'my [fa]'). When such 'derived' P-Words are evaluated by late MINWD, they are judged to be ill-formed. The hypothesis that Headedness is active in Turkish therefore helps to explain why the language both tolerates and disallows sub-minimal words

In Mangap-Mbula, Ojibwa and Turkish, the satisfaction of the two constraints, MINWD and HEADEDNESS, occurs at different derivational stages. It is therefore appropriate to consider other logical possibilities. For example, what would be the consequences of delaying the satisfaction of both MINWD and HEADEDNESS until the final derivational stage (the word level). In the next section, I argue that the use of an epenthesis strategy results from such a choice; the focus is on the Iroquoian language, Mohawk.

2.4 Late minimality and late head assignment. Mohawk is widely cited in the literature as a language that is regulated by the word minimality syndrome. The following disyllabic words, taken from Michelson (1988, 1989), meet the requirement. In each case, the first morpheme is a Person agreement prefix.

(60) a. óʔta 'shit'
yo-ʔt-aʔ
'3 NEUTER SG-SHIT-NOUN SUFFIX'

b. rá:kwas 'he picks it'
hra-kw-as
'3 MASCULINE SG-PICK-HABITUAL'

c. kérhaʔ 'I fill it in'
k-r-haʔ
'1SG-FILL IN-HABITUAL'

d. sérhos 'you coat it with something'
s-rho-s
'2SG-COAT SOMETHING-HABITUAL'

In (60a, b), the prefix contributes a vowel and hence a syllable to the output, while the disyllabic output is achieved in (60c, d) only after the insertion of the vowel /e/. Epenthesis in the latter cases is caused by conditions on syllabification (Michelson 1988, 1989) that disfavour certain consonant sequences. However, there is another epenthetic vowel; it is added to a representation when the phonological material provided by

inserted vocabulary items is insufficient to project a minimal word. This vowel is invariably [i], and it is always stressed. Like other stressed vowels, it is subject to tonic lengthening in an open syllable (61c).

(61) a. íkyʌs, *kyʌ́s 'I put it'
k-yʌ-s
'1SG-PUT-HABITUAL'

b. íktats, *ktáts
k-tat-s 'I offer it'
'1SG-OFFER-HABITUAL'

c. í:keks, *kéks 'I eat'
k-ek-s
'1SG-EAT-HABITUAL'

Given the assumption that subject agreement prefixes are inserted at the CP phase, the location of the epenthetic vowel to the left of these affixes is proof that the minimality condition applies after the realization of the last morpheme to enter the derivation.

The penultimate stress in (60) and (61) can be correlated with the assignment of a trochaic foot (Michelson 1988, 1989; Piggott 1995, 1998). Normally, this foot encompasses the last two syllables, illustrated by the following examples.

(62) Penultimate stress in Mohawk
a. sató:rat 'hunt (imp.)'
b. wakashé:tu 'I have counted it'
c. katirútha? 'I pull it'
d. kerúnyus 'I sketch'

However, stress is sometimes assigned to the antepenultimate syllable (63a) or even to the pre-antepenult (63b).

(63) a. Antepenultimate stress
tékeriks 'I put them together'
wákeras 'it smells'
tʌkahsúterʌ? 'I will splice it'

b. Pre-antepenultimate stress
ónerahte? 'leaf'
tʌ́kerike? 'I will put together side by side'
wa?tkatátenake? 'I scratched myself'

The two patterns in (63) are linked to occurrences of epenthetic /e/, identified by the italics. The presence of this vowel in an open syllable prevents it from being a candidate for bearing stress. Furthermore, the stress assignment process consistently ignores a final syllable ending in a glottal stop that also contains the epenthetic vowel (63b). Different explanations for the prosodic effects of epenthetic /e/ on stress assignment are provided by Michelson (1989) and Piggott (1995, 1998). However, they reduce to the general

conclusion that an open syllable containing this vowel cannot be the dominant syllable in a foot. This restriction together with the extrametricality of glottal-final syllables predicts the antepenultimate and pre-antepenultimate patterns.

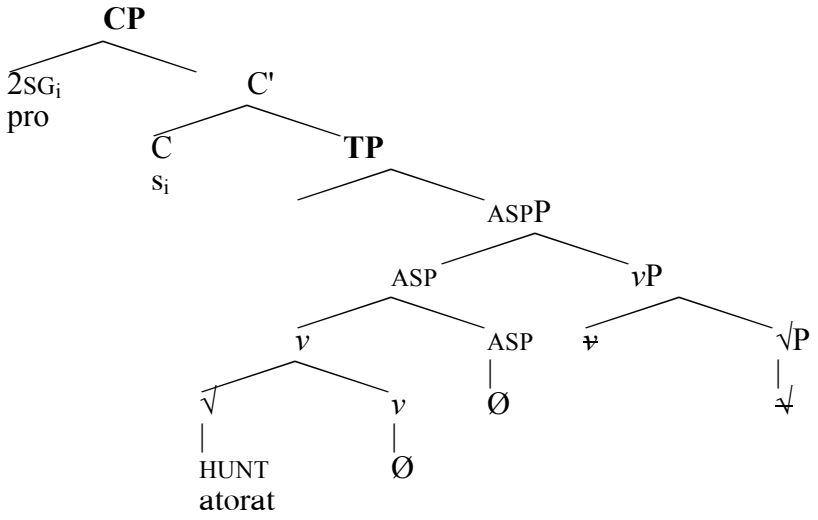
(64) a. [(téke)riks] 'I put them together'
*[te(kériks)]

b. [(tʌ́ke)rikeʔ] 'I will put together side by side'
*[(tʌ(kéri)keʔ]
*[tʌke(ríkeʔ)]

In (64a), parsing of the last two syllables would inappropriately place the penult in the head position. Hence, the foot is displaced leftward to include the antepenult. In (64b), the final syllable is not visible and the antepenult cannot be in a dominant position. Therefore, the pre-antepenult has to be parsed as the head of the trochaic foot.

Given the phase-based theory of cyclic spell-out, the most conservative position is that the complement of a C-head is the first chuck of structure to undergo interpretation in Mohawk. I assume that this chunk is the TP projection, but I also follow Baker (1996) in recognizing that a Mohawk verb is specified for aspect and therefore contains an ASPECT morpheme. The insertion of vocabulary items in the derivation of the word *satóːrat* (62a) would therefore take place in two stages. The root and aspect morphemes would be inserted when TP is spelled out and the pronominal prefix is inserted at the next derivational stage.

(65)



The PF treatment of the configuration of elements in (65) is summarized below.

(66) a. [HUNT-ASP$_{ASPP...TP}$]
[(atorat)$_{PWd}$]] (Spell-out of TP)

b. [2SG[HUNT-ASP$_{ASPP...TP}$]...$_{CP}$]
[s[atorat)$_{PWd}$]] (Spell-out of CP)

c. [2SG[HUNT-ASP$_{ASPP}$…$_{TP}$]…$_{CP}$]
[~~s~~[satorat)$_{PWd}$]] (Cliticization)

d. [sa(toːrat)$_{PWd}$] (Stress assignment and V-lengthening)

Since syllabification cannot apply across P-Word boundaries, cliticization is one mechanism that would place the pronominal prefix and the root in the same P-Word.

The P-Word that emerges in (66a) at the spell-out of TP satisfies MINWD, but this outcome is not assured in every derivation. The first stage in the interpretation of any of the disyllabic words in (60) and (61) would be a sub-minimal P-Word. Since these derivations do not crash, we readily infer that MINWD must apply late in Mohawk. The complete absence of monosyllabic words in the language means that HEADEDNESS must also apply late. Consequently, P-Word projected at the spell-out of TP are 'imperfect'; they are headless. Intermediate steps in the derivation of *íːkeks* (61c) illustrate the emergence of such a form.

(67) a. [EAT-ASP$_{ASPP}$…$_{TP}$]
[[ek-s $_{PWd}$]] (Spell-out of TP)

b. [1SG[EAT-ASP$_{ASPP}$…$_{TP}$]…$_{CP}$]
[k[keks$_{PWd}$]] (Spell-out of CP)

c. [~~k~~[keks$_{PWd}$]] (Cliticization)

The P-Word that emerges at the CP stage in (67b) must satisfy two conditions; it must contain a head and it must contain at least two syllables. Neither condition is met. However, the derivation does not have to crash, because the prosodic structure of the P-Word is incomplete. I now propose that these are the conditions that trigger word-augmentation. The completion of the derivation in (67) therefore proceeds as follows.

(68) a. [1SG-EAT-ASP$_{ASPP}$…$_{TP}$]…$_{CP}$]
[ikeks$_{PWd}$] (Augmentation)

b. [1SG-EAT-ASP$_{ASPP}$]$_{CP}$]
[(íkeks)$_{PWd}$] (Head assignment)

c. [(íːkeks)$_{PWd}$] (Stress assignment and V-lengthening)

With regard to the interface conditions that regulate the mapping between morpho-syntactic structure and phonological form, the augmentation process is cost-free. If augmentation does not occur, the constituents of the derived monosyllabic P-Word would have to be parsed as a degenerate foot. Since such a sub-optimal foot is not generated by conditions that regulate the mapping between morpho-syntax and phonology, it cannot be favoured.

In a language like Mohawk where there is a link between headedness and prominence assignment, the head foot in a word must qualify as unit that can bear main stress. The conditions on foot structure would therefore be expected to be factors in word augmentation. Recall that the binary traochaic foot is displaced leftward to avoid placing an open syllable containing epenthetic [e] in a stressed position (e.g. see (64)). This

restriction on Mohawk foot structure would be expected to trigger word augmentation to accommodate the leftward displacement of a foot. The prothetic vowel in each of words in (69) serves this function. Without this vowel, the P-Words could not be provided with a head that also qualifies as the bearer of stress.

(69) a. îs*e*riht, *sé́riht, *se*ríht 'Cook!'
s-riht-Ø
'2SG-COOK-IMPERATIVE'

b. î*te*nehr*e*ʔ, *té́nehr*e*ʔ, *t*enéhr*e*ʔ 'you and I want'
t-n-ehr-ʔ
'1INCL-DUAL-WANT-HABITUAL'

Notice that, in each case, syllabification requires the vowel /e/ be inserted between the subject prefix and the following morpheme. This type of epenthesis would be sufficient to achieve an output that contains at least two syllables, thereby satisfy the word minimality requirement. However, the derived word would still be headless, since a syllable headed by epenthetic /e/ cannot be the head of a trochee. The derivation of (69a) is sketched below.

(70) a. [COOK-ASP$_{ASPP}$...TP]
[riht-Ø$_{PWd}$] (Spell-out of TP)

b. [2SG[COOK-ASP$_{ASPP}$...TP]...CP]
[s[riht$_{PWd}$]] (Spell-out of CP)

c. [2SG[COOK-ASP$_{ASPP}$...TP]...CP]
[~~s~~[s*e*riht$_{PWd}$]] (Cliticization and [*e*]-epenthesis)

d. [(îs*e*)riht$_{PWd}$] (Augmentation and Head assignment)

Only by augmenting the P-Word is it possible to ensure that the required head foot is a binary trochee.

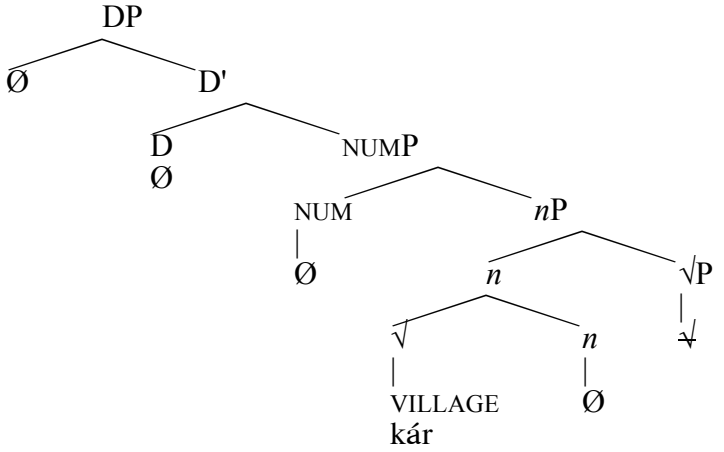
Let me now summarize the factors that underlie word augmentation. First, the mapping between morpho-syntactic structure and phonological form requires the projection of a P-Word at the first phase of a derivation in every language. The string of segments in this early P-Word does not have to contain a foot when HEADEDNESS is satisfied at the word level. In the latter situation, the completion of prosodic structure is regulated by all the conditions that apply at the word level. The combined effects of late MINWD, late HEADEDNESS and conditions on foot structure trigger word augmentation in Mohawk (and, arguably, in languages like Lardil, Slave, Choctaw, etc.).

3. The typology of word minimality. Mohawk and Mangap-Mbula both enforce MINWD at the word level, but the crucial difference between them is that the headedness of a P-Word is determined early in the latter and late in the former. When HEADEDNESS must be satisfied early, *P-Word Projection* (18), the PF-interface condition that determines the mapping from morpho-syntactic to phonological structure, ensures

that a sub-minimal input cannot be augmented. Consider the following illustration of the structure of a Mangap-Mbula monosyllabic noun.

(71) a. kar 'village'

b.



The mapping from morpho-syntactic structure to phonological form requires that the vocabulary item /kar/ be organized as a P-Word and early assignment of a head requires it to contain a foot. The foot cannot be binary, because the addition of material that has no morphological affiliation would contravene the requirement that a P-Word be projected from the available vocabulary items. Hence, the occurrence of monosyllabic words in Mangap-Mbula follows automatically from late enforcement of MINWD and the early satisfaction of HEADEDNESS. If the latter applied late in Mangap-Mbula, the monosyllabic but headless P-Word would emerge at the word level, and the assignment of foot structure to this derived P-Word would automatically trigger augmentation to achieve the optimal binary foot (as in Mohawk).

Languages that enforce the minimality requirement late therefore fall into two sub-types. They are either like Mangap-Mbula and Turkish that tolerate monosyllabic words, because they assign word-heads early or they are like Mohawk, Choctaw, Slave and Lardil that employ a word augmentation strategy to ensure that outputs contain at least two syllables or two moras. Languages that enforce early minimality would systematically disallow sub-minimal (monosyllabic or monomoraic) words. Hence, P-Words would not have to be augmented to accommodate a binary foot, even when HEADEDNESS is satisfied late. Ojibwa and, perhaps, other members of the Algonquian family represent this type of language. The Austronesian language, Tondano (Sneddon 1975), shares with Ojibwa a proscription of monosyllabic words, indicating that MINWD is satisfied early.[14] The occurrence of stress provides evidence that HEADEDNESS is also enforced early. Normally, the final syllable of a Tondano word is stressed if it is heavy (72a), but stress shifts to the penult when the final syllable is light (72b, c).

(72) a. mawɛ́: 'is giving'
mənaːŋáːn 'is continually eating'
lumɔ́:ʔ 'will drink'

[14] Sneddon (1975) cites a few monosyllabic words (e.g. *tow* 'person', *key* 'we', *mey* 'come').

b. wɛ́:nu 'will be given by you'
tikɔ́:ku 'my throat'
kiná:ŋku 'has been eaten by me'
wanuá:sa 'one village'
kapajá:səm 'sour papaw'

c. wále 'house'
wúter 'heavy'
ɣórəm 'inside'
wanúa 'village'
karimáŋkaʔ 'spider'

We can readily deduce from these patterns that the location of the stressed syllable is determined by a right-oriented moraic trochee. However, Tondano, like many other languages, avoids assigning stress to a syllable containing the vowel schwa. When such a syllable is penultimate in a word, stress is shifted to the left.

(73) wiŋkɔ́təna 'will be asked by him'
ká:nəna 'will be eaten by him'
ikətɔ́rəna 'will be used by him to cut with'
kətɔ́rəna will be cut by him'

Clearly, in both Mohawk and Tondano, stress is determined by constructing a trochaic foot at the right edge of words, shifting the stress domain leftwards to avoid parsing 'unstressable' (schwa-headed) syllables as heads of feet. However, unlike Mohawk, Tondano does not augment words to accommodate the trochaic foot. Stress on the final syllable of (74a) produces a non-canonical iambic profile, while a schwa-headed syllable is stressed in (74b).

(74) a. səráʔ 'fish'
ədɔ́ 'day'
ərís 'sand'

b. rə́pət 'fast'
pə́rəŋ 'blind'
áləw 'lid'

Clearly, while the optimal foot in Tondano is a moraic trochee, this form does not have to be respected.

The emergence of exceptional feet in Tondano follows straightforwardly from the hypothesis that HEADEDNESS applies early in this language. The words in (74) contain root morphemes and are therefore manifestations of P-Words, spelled out when the first chunk of structure is interpreted. They are well-formed only if they contain a head foot, constructed from the same phonological material that realizes the P-Word. In (74a), the only way to avoid stressed schwa is by parsing the final syllable as the head of the obligatory foot. However, the avoidance of stressed schwa is impossible in (74b). Tondano has no option but to assign one of the two schwa-headed syllables to the head of a foot. The augmentation option is unavailable to this language, because the projection of a P-Word cannot be facilitated by adding material that has no morphological affiliation.

The timing of HEADEDNESS satisfaction may also explain why the two Cariban languages cited earlier have different realizations of the foot in disyllabic words. Recall in examples (5) and (6) that while the vowel of the first syllable is stressed in both languages, tonic lengthening applies in Hixkaryana but not in Tiriyo. Early application of HEADEDNESS in the latter would result in the inheritance of a 'perfect' prosodic word at the final stage of a derivation. The enforcement of NON-FINALITY at this stage would prevent the head of syllable from being final in the word, but no other adjustment to the word would be commanded. In contrast, the late satisfaction of HEADEDNESS in Hixkaryana would produce 'imperfect' P-Words at the final stage of a derivation that are then required to be headed and also conform to NON-FINALITY. Vowel lengthening is the strategy that increases the size of the first syllable to accommodate FTBIN and the iambic shape of the foot in Hixkaryana. The response to HEADEDNESS in this language is therefore similar to the word augmentation strategy that applies in Mohawk.

So far, we have focused on languages where the minimal word contains at least two syllables, but the typology also allows for a class of languages where the smallest word is bimoraic. Within the latter class, the theory predicts sub-types, determined by the early or late enforcement of MINWD and HEADEDNESS. I have not yet investigated such languages, but, based on descriptions by Hayes (1995) and Garrett (1999), some candidates for membership in various sub-groups can be provisionally identified. Two languages that seem to enforce minimality late are Lenakel and Fijian; both tolerate monomoraic P-Words at the first spell-out stage. However, while such outputs persist in Lenakel, word augmentation applies in Fijian and converts monomoraic CV inputs to bimoraic CVV surface forms. The difference between the two languages is determined by the timing of the satisfaction of HEADEDNESS; it is early in Lenakel but late in Fijian. Kokota (Palmer 2009) also lengthens the vowel of monosyllables and seems to be the Fijian-type. Consider, next, the type in which the minimality syndrome applies early. English must be one of these; it is widely acknowledged to be a language in which a (content) word must contain at least two moras. The timing of satisfaction of HEADEDNESS in English is not clear, although the exclusion of certain affixes suggests that it is early. English may therefore be a minimally bimoraic language in which MINWD and HEADEDNESS both apply early.

If the occurrence of monomoraic words is diagnostic of the early satisfaction of HEADEDNESS and late enforcement of MINWD, then Micronesian languages provide very interesting examples of languages that enforce a bimoraic minimality requirement. Recall that Woleaian tolerates words like those in (9), repeated here as (75).

(75)	a.	/waa/	[wa]	'canoe'
		/tʃaa/	[tʃa]	'blood'
		/bee/	[be]	'divinations'
		/faa/	[fa]	'string, cord'
		/fee/	[fe]	sexual intercourse'
	b.	/ki/	[k̟i]	'hot'
		/tto/	[tt̟o]	'deep'
		/tti/	[tt̟i]	'to close'

The group in (75a) becomes monomoraic as a result of a persistent process that shortens all final long vowels. The set in (75b) is also the result of an attrition process that devoices final short vowels. The output of this process is considered to be weightless and, hence, moraless.

As mentioned in the introduction to this paper, it is generally assumed that languages signal the enforcement of MINWD by blocking application of an attrition process when it would create a sub-minimal output. The application of vowel shortening to the words in (75a) would therefore appear to be incompatible with the imposition of a bimoraic minimality condition on words. Nevertheless, the process of vowel lengthening that applies to the Woleaian words in (8), repeated below as (76), is proof that such a condition is operative in this language.

(76)

a.	/mata/	[maatᵒ]	'eyes'
b.	/kabu/	[kaabᵘ]	'dull'
c.	/rigi/	[riigʲ]	'running'
d.	/jeta/	[jeetᵒ]	'one'
e.	/laŋo/	[laaŋᵒ]	‘house fly’

In obvious compensation for the devoicing of final short vowels, the only other vowel in each of these words is lengthened. Since the lengthening process is restricted to disyllabic words, it must be linked to the satisfaction of a minimal size requirement. The vowel devoicing process deprives the word of a mora and vowel lengthening restores the bimoraic quality. The paradox in Woleaian therefore takes a very interesting form; the language actively enforces the MINWD condition, but it also allows sub-minimal words to be derived.

The solution to the Micronesian paradox is available, if HEADEDNESS and MINWD are enforced at different derivational stages. Early satisfaction of the latter entails that perfect P-Words emerge after the spell-out of the first chunk of structure, thereby licensing words that are not required to be bimoraic. At the word-level, such P-Words may freely undergo vowel shortening or vowel devoicing, without compromising their well-formedness.

(77)

a.	[CANOE-$n_{n\mathrm{P}}$].	
	[waa-Ø $_{\mathrm{PWd}}$]	(Spell-out of *n*P)
b.	[CANOE-$n_{n\mathrm{P}}$]	
	[(waa) $_{\mathrm{PWd}}$]	(Head assignment)
c.	[[CANOE-$n_{n\mathrm{P}}$]...$_{\mathrm{DP}}$]	
	[(waa) $_{\mathrm{PWd}}$]	(Spell-out of DP (vacuous))
d.	[(wa) $_{\mathrm{PWd}}$]	(Vowel shortening)

A derived monomoraic word in Woleaian is sanctioned by the same principles that license monosyllabic words in languages like Turkish and Mangap-Mbula. Even the occurrence of ostensibly weightless words like those in (75b) is licit.

Since early headedness guarantees that all P-Words are well-formed in Woleaian, the obligatory lengthening process that applies to the disyllabic words is somewhat

surprising. By itself MINWD cannot command such an outcome. We therefore have to postulate some language-specific weight-preservation condition. Speculatively, it would assert that, if the minimal size requirement is present in an input, it must be preserved in an output. Such a hypothetical condition has the familiar flavour of a faithfulness constraint in the OT framework.

(78) a. [EYES-n_{n}P].
[mata-Ø $_{\text{PWd}}$] (Spell-out of *n*P)

b. [(mata) $_{\text{PWd}}$]] (Head assignment)

c. [[EYES-n_{n}P]...$_{\text{DP}}$]
[(mat̪e) $_{\text{PWd}}$] (Spell-out of DP (vacuous))

d. [(maat̪e) $_{\text{PWd}}$] (Vowel devoicing and MINWD preservation)

As indicated in the introduction, Ponapean is another Micronesian language that displays compensatory vowel lengthening under conditions similar to those that are found in Woleaian; the proximate trigger in the former is a process of final vowel deletion. However, the hypothesis that links the process to a language-specific MINWD preservation strategy entails that there could be a language that is otherwise like Woleaian or Ponapean but lengthening does not occur. Indeed, the predicted pattern is found in another Micronesian language, Mokilese (Harrison 1976), where the loss of final vowel short vowels is not accompanied by vowel lengthening. Compare Ponapean [kiil] with Mokilese [kil], both derived from /kili/ 'skin'.[15]

This is a convenient point to provide a summary of the types of languages that are predicted by a theory where MINWD and HEADEDNESS may be enforced at different derivational stages and where there is a choice to satisfy the minimal word syndrome at the syllable or mora level.

(79) a. Syllable Minimality

	Late HEADEDNESS	Early HEADEDNESS
Late MINWD	Mohawk	Mangap-Mbula
Early MINWD	Ojibwa	Tondano

b. Mora Minimality

	Late HEADEDNESS	Early HEADEDNESS
Late MINWD	Fijian, Kokota	Lenakel, Woleaian
Early MINWD	English??	English??

[15] Micronesian languages undermine the assumption that the enforcement of MINWD blocks application of an attrition process to inputs that would become sub-minimal. Recall, for example, that the loss of final vowels does not apply to Lardil disyllabic words. This observation is also consistent with the hypothesis that deletion is blocked by the NON-FINALITY condition.

The uncertainty about the languages that represents the expected mora minimality types is not necessarily indicative of a theoretical weakness but is more likely the result of a lack of information at this stage of the research.

A confounding factor in researching the mora minimality types is the potentially ambiguous status of some of the cues. For example, augmentation by vowel lengthening is usually interpreted as a signal that a bimoraic minimum is in effect. However, this type of evidence also seems to be compatible with the enforcement of a minimal disyllabic size. The latter interpretation is appropriate for Maybrat, a language spoken in the Papua Province of Indonesia. According to Dol (2007: 19), an underlying short vowel is lengthened in a stressed monosyllabic word.

(80)	a.	/i/	[íː]	‘ant’
	b.	/to/	[tóː]	‘rattan rope’
	c.	/ɛt/	[ɛ́ːt]	‘tattoo’
	d.	/put/	[púːt]	‘leech’

Prima facie, the above facts would be indicative of a Fijian-type language that enforces a bimoraic minimum. However, the disyllabic words below also meet the minimal size requirement, but they are probably not bimoraic.

(81)	a.	/tfo/	[təfó]	‘machete’
	b.	/mtax/	[mətáx]	‘dog’
	c.	/peka/	[pəká]	‘sacred thing’
	d.	/tre/	[təré]	‘bracelet’

The initial syllable of these words contains a schwa that Doll considers to be epenthetic, but, phonetically and phonologically, the output is disyllabic. The questionable status of these words as bimoraic entities arises because of the way they are stressed. Stress usually falls on the initial syllable of disyllabic (and trisyllabic) words (Doll 2007: 38), except when this syllable contains a schwa. The skipping of schwa by stress assignment is predictable, if it is weightless.

More evidence that Maybrat requires words to be minimally disyllabic comes from the realization of Person agreement prefixes. Underlying representations of these affixes are provided below; each is just a single consonant or glide.

(82) Maybrat Person prefixes

a.	t	‘1st Singular’
b.	p	‘1st Plural’
c.	n	‘2nd Singular/Plural’
d.	j	‘3rd Singular (masculine)’
e.	m	‘3rd Singular (non-masculine)/Plural’

When one of these prefixes combines with a monosyllabic CV or CVC root, it triggers schwa epenthesis.

(83) a. /t-no/ [tənó] 'I do'
b. /t-se/ [təsé] 'I place'
c. /t-nit/ [tənít] 'I tell a story'
d. /t-per/ [təpér] 'I step on'

The occurrence of the prefixes before monosyllabic roots stands in sharp contrast with their absence before consonant-initial roots that are disyllabic or bigger. Words like the following lack prefixes and are multiply ambiguous.

(84) a. [kápuk] 'I/you(sing.)/you (pl.)/we/he/she/they close eyes'
b. [sáyim] 'I/you(sing.)/you (pl.)/we/he/she/they share'
c. [təpé] 'I/you(sing.)/you (pl.)/we/he/she/they open'

The descriptive generalization, also captured by Doll, is that Person agreement prefixes must be retained when attached to a C-initial monosyllabic root and they must be deleted when such a root contains more than one syllable. The obvious conclusion from the contrast is that prefixes are retained, because they contribute to the satisfaction of the word minimality requirement (83), but they are not needed for this purpose in (84) and are missing.[16]

Notice that, if minimality were computed at the moraic level in Maybrat, there could be a logical alternative to the pattern in (83). Instead of the triggering of epenthesis by prefix retention, the pre-consonantal deletion of the affix could be persistent while inducing 'compensatory' vowel lengthening. This seemingly logical possibility is actually ruled out in the framework of this paper. Late enforcement of MINWD by Maybrat must trigger the Local Dislocation of a Person prefix from its insertion site in a C-Head. The movement or cliticization of the prefix places it in the same P-Word as a monosyllabic root and schwa-epenthesis would automatically be triggered. The derivation of (83a) would proceed roughly as follows.

(85) a. [DO-v_{vP}]
[no-$Ø_{PWd}$] (Spell-out of *v*P)

b. [1^{ST} SING[DO-v_{vP}]$_{CP}$]
[t[no$_{PWd}$]] (Spell-out of CP)

b. [1^{ST} SING[DO-v_{vP}]$_{CP}$]
[ŧ[tənO$_{PWd}$]] (Cliticization and [ə]-epenthesis)

The conditions that trigger cliticization of Person agreement prefixes in Maybrat are the same as those that apply to the equivalent process in Mangap-Mbula and other languages where MINWD applies late. These prefixes, when attached to disyllabic or longer roots, would remain *in situ*; at their insertion their consonantal nature makes them ineffable. Maybrat then does not enforce a bimoraic minimality requirement, although it employs

[16] Maybrat Person prefixes also occur freely before vowel-initial roots, presumably because they provide optimal CV syllables.

the vowel lengthening augmentation strategy. We have to conclude that long vowels in this language are heterosyllabic.

4. Concluding remarks. The analysis of word minimality proposed in this paper is novel and explanatory. An important element is the hypothesis that the condition is either imposed early on the first P-Word that emerges in a derivation of a word or, restrictively, to the word-level. HEADEDNESS and MINWD are considered to be universal constraints that differ, cross-linguistically, only in the timing of their satisfaction. Consequently, the minimal word syndrome is a feature of every language, although its effects may be masked by the fact that it is satisfied late in a derivation. Limiting processes/constraints to particular derivational stages can be found in most theories of cyclicity and is a crucial feature of Lexical Phonology (Kiparsky 1985, Inkelas 1993) and Stratal Optimality Theory (Kiparsky 2000; Bermudez-Otero, in prep). However, although the issue is not explicitly addressed in this paper, the processes/constraints that may vary between early and late application are likely to be very limited.

The characterization of derivational cycles in terms of phases has recently been added to the linguistic discourse and is exploited by a number of recent phonological analyses (Marvin 2002, Newell 2008, Barragan & Newell 2003, Piggott & Newell 2008, Skinner 2009). The explanatory adequacy of the new analysis is greater than that of any alternative proposed to date. For example, the paradox of enforcing a minimality requirement and also tolerating sub-minimal words in languages as diverse as Turkish, Mangap-Mbula and Woleaian is now fully explained. I also explain why certain languages must increase the size of words by adding a syllable. We would not expect to find a language that resembles Mangap-Mbula in assigning stress (and headedness) early in a derivation but augments words. This prediction underlines an important difference between the analysis of word augmentation proposed in this paper and the standard description of this phenomenon. In current thinking, augmentation is possible in Mohawk because the language permits epenthesis, but it is ruled out in Mangap-Mbula, because the latter disallows epenthesis. Following this logic, we should find languages that resemble Mohawk but prohibit word augmentation (Mohawk´). Equally possible should be languages resembling Mangap-Mbula that permit augmentation (Mangap-Mbula´). Neither Mohawk´ nor Mangap-Mbula´ is attested. There is therefore a clear empirical basis for choosing between the theory of minimality proposed in this paper and any current or recent descriptions of the phenomenon.

The contrast between the standard analysis of word minimality and the approach advocated here is brought sharply into focus by considering how the characterize a hypothetical ‘language’ with the properties sketched in (86).

(86)

	Indefinite	Definite	
a.	---	ka-lu	‘cup’
	---	po-lu	‘tree’
b.	motu	motu-lu	‘dog’
	pusi	pusi-lu	‘cat’

This language has systematic lexical gaps in paradigms like those in (86a) where the exponent of the root morpheme is monosyllabic. In other words, there are no words with

the meanings ‘a cup’, ‘a tree’, etc. In contrast, there are no gaps when a root morpheme is disyllabic or bigger (86b). This description of this hypothetical language in a framework that adopts EMH would be straightforward; FTBIN and the constraint against epenthesis are inviolable. It is therefore surprising that no language with such a profile is attested. Proponents of EMH would have to treat the gap as an accident. In comparison, the theory of minimality proposed in this paper characterizes our hypothetical ‘language’ as an impossible language; it could not exist. The lexical gaps in (86a) would occur only if both MINWD and HEADEDNESS must be satisfied early. The inability of a ‘bare’ monosyllabic root to project a well-formed P-Word would induce a derivation to crash before the suffix /lu/, representing the definite morpheme, is inserted. A derived word like *kalu* ‘the cup’ would therefore be impossible, if /ka/ ‘a cup’ is ineffable. The impossibility of a language with the lexical profile in (86) is compelling evidence for cyclic computation of phonological well-formedness.

In demonstrating that there is tight link between morpho-syntactic structure and the computation of word minimality, the paper provides strong support for a derivational approach to explanations in phonology. The manifestation of minimality in Ojibwa is especially problematic for non-derivational theories of phonology. In such frameworks, it would be difficult to explain the variable visibility of pronominal prefixes to the computation of word minimality without making reference to differences in the structural configurations in which they are found. A descriptive tool that is sometimes employed in non-derivational frameworks is to appeal to construction-specific constraint interaction, so-called co-phonologies linked to specific constructions. Such a possibility would allow one to stipulate that, for the purpose of computing minimality, a pronominal prefix and the following root must be in the same P-Word in an inalienable possessive construction but not in the alienable type. However, such a stipulation would not be explanatory; it would treat any correlation between morpho-syntactic structure and the phonological 'closeness' of an affix-root combination as coincidental. We might therefore expect to find cases where the reverse situation holds and a possessor affix is 'closer' to the possessed root morpheme in an alienable possessive construction than in an inalienable one. The latter prediction is not supported by the cross-linguistic evidence. In fact, Dobler (2008) shows that, when there is a structural difference between the two types of possessive constructions, there is strong cross-linguistic support for the observation that the possessor affix is always phonologically closer to the possessed root in the inalienable construction than in the alienable one.

The contrast between the alienable and inalienable possessive construction in Ojibwa presents non-derivational theories of phonology with a second challenge. The obligatory affixation of the possessive ending /im/ to monosyllabic noun roots in alienable possessive constructions is explained by recognizing an early stage where minimality must be satisfied. It is difficult to envisage an alternative explanation in a framework in which the derivational history of a word is irrelevant to its phonological form.

This paper is part of a research program to examine the implications of the hypothesis that phonology is fundamentally an interpretive system and interpretation proceeds cyclically, as determined by phase theory. Indeed, if the Strong Minimalist Program (SMP) (Chomsky 2005) is correct, evidence for phases must be present at PF

and hence in phonology. The realization of word minimality provides examples of the sort of evidence that we would expect to find.

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