Nuclear Integrity in Prosodic Morphology

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Contents

0. Introduction

The goal of any formal theory of prosodic morphology is to characterize the process in a manner as consistent as possible with other morphological processes. Only those idiosyncratic aspects about which generalizations cannot be made which are consistent with the broader domain of morphology as a whole should be considered peculiar to prosodic morphology.

At least since Marantz (1982), and more recently in McCarthy and Prince (1986), and Steriade (1988), it has been noted that prosodic morphological operations are distinct from other morphological processes in that the output makes reference to prosodic constituency, for example, the syllable or the foot. Another property peculiar to these processes is that the prosodically-defined morphological constituent is melodically dependent upon the base.

It is these two properties -- prosodically constrained output, and melodic dependence upon the base -- that are peculiar to prosodic morphology. Beyond these two peculiarities, the derivation of prosodically-conditioned morphemes should proceed as unexceptionally as possible.

We will see that the extension of more general morphological principles to the domain of prosodic morphology is crucially dependent upon the assumption that prosodic morphological processes are operations on existing surface forms, and not on lexical representations. Specifically, I will invoke the concept of Nuclear Integrity to account for an array of properties that would otherwise force a greater dichotomy between prosodic and non-prosodic morphological derivations. Nuclear Integrity may be defined as follows:

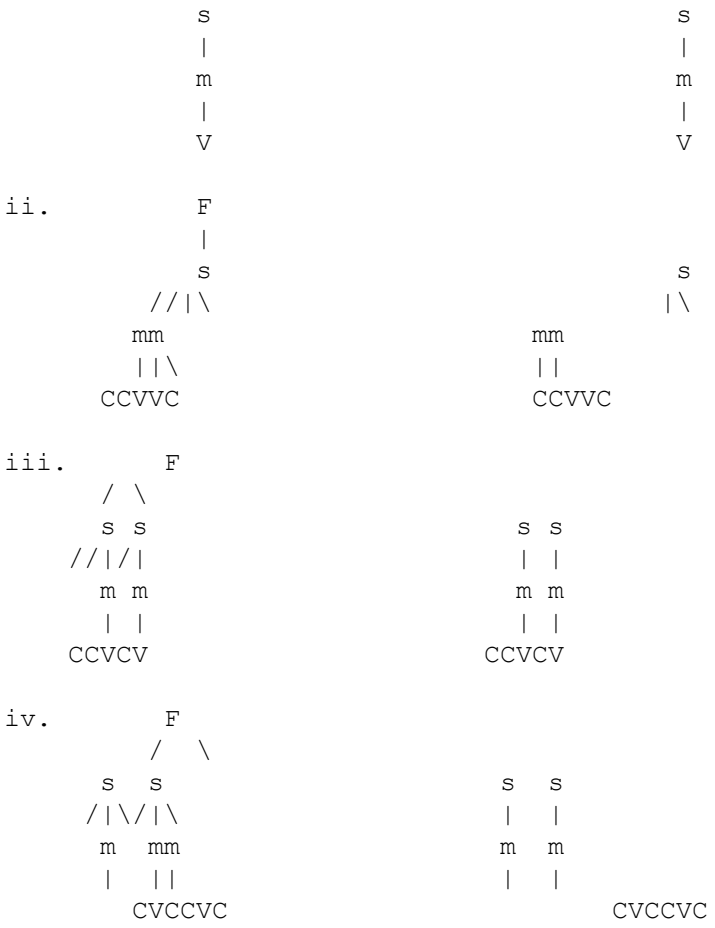
> Nuclear Integrity: The components of a structure that are crucial to the representation of the syllabicity of a given feature bundle are retained with their original association lines as prosodic morphological operations proceed

In other words, all prosodic structure which bears a matrilineal relationship to nuclei, up to the syllable-level, survives intact as prosodic erasure and subsequent reprosodization proceed in prosodic morphological derivations.

Nuclear Integrity is exemplified in the figures in (1).

(1) a. b.

i. F
|



(where F=Foot, s=syllable, m=mora, C=surface consonant, V=surface vowel)

In (1), the (a) structures are the input to the prosodic morphological operation. The (b) structures result from prosodic erasure with Nuclear Integrity: only that structure which bears a matrilineal relationship to nuclei are salvaged from erasure. As syllable nuclei are determined during the course of a derivation, and not specified underlyingly, I assume that prosodic morphological operations proceed from surface representations, not underlying representaions. "Transfer of length" effects will be shown to be a free by-product of Nuclear Integrity.

I will therefore argue against McCarthy and Prince's (1987) "lexical look-up" approach to reduplication, whereby all processes proceed from a re-summoning of the lexical entry(s) of the morpheme(s) targeted. Instead, I will argue in favor of a version of Steriade's "full copy" approach, in which the derivation proceeds from a fully-articulated surface copy of the base.

Since prosodic morphological processes will be argued to proceed from a fully articulated structure, they are provided with a "head start" as reprosodization proceeds. Specifically, only that prosodic structure which dominates base nuclei is retained. All other prosodic structure is erased. As syllabification presumably proceeds from nuclei outward, the "head start" is

literally just that: the head of a syllable survives the derivation, reprojecting structure as prosodic templates constrain output.

In Section 1 I present a critical analysis of Aronoff (1988). Therein the author shows that targeting the head of a complex morphological form (as opposed to the whole of a form) can be extended to account for certain instances of reduplication. The author further shows that reduplication is subject to stratal distinctions: certain instances of reduplication apply at the stem level, while others apply at the word-level. With these two choices to be made (head/whole, stem-level/word-level), reduplication patterns with regular morphological operations. I provide evidence from Indonesian and Fijian in support of Aronoff's general conclusions regarding head/whole, stem level/word-level morphological choices.

In Section 2 I observe that certain non-formalized aspects of Aronoff's analysis may be incorporated into a theoretic framework in which morphological circumscription and Nuclear Integrity play a crucial role.

In Section 3 I discuss Bat El's (1990) analysis of stem modification in Modern Hebrew, supporting her argumentation against McCarthy's (1979) non-concatenative approach to Semitic morphology. However, I further argue that Bat-El's assumption that stem modification entails complete erasure of the prosodic structure of the base makes incorrect predictions regarding observed "cluster transfer" effects. Instead, I show that an approach to stem modification which assumes Nuclear Integrity correctly accounts for the observed phenomenon of "cluster transfer".

1. Morphological Targeting

1.1 Head/Whole, Stem-level/Word-level Operations

Aronoff (1988) notes that the concatenation of morphemes normally requires two choices to be made regarding the domain of affixation:

1) Will the morpheme affix to the whole of the form or the head of the form?

2) Will the morpheme affix at the stem-level or at the word-level?

To exemplify the possibilities admitted by the first question, Aronoff provides data from English inflectional morphology.

(1)

a.	[man]+[pl.]	=	[men]
b.	[postman]+[pl.]	=	[postmen]

(2)

a.	[stand]+[tense]	=	[stood]
b.	[understand]+[tense]	=	[understood]

The (a) examples show that an inflectional marker affixed to a monomorphemic stem displays a lexically idiosyncratic ablaut pattern. The (b) examples show that the same inflectional marker, when attached to a polymorphemic stem with an identical head, displays the same irregular pattern. Aronoff concludes that English past tense is targeting the head of the morphologically complex stem. Derivations of the (b) forms are in (3).

(3) input:
[post+man]+[pl.] [under+stand]+tense]

affixation (head targeting):
[post+[[man]+[pl.]]] [under+[[stand]+[tense]]]

output:
postmen understood

Observe that if affixation targeted the full stem, we would expect the unmarked morphology to surface:

(4) input:
[post+man]+[pl.] [post+man]+[pl.]

affixation (stem targeting):
[[post+man]+[pl.]] [[understand]+[tense]]

output:
*postmans *understanded

In fact, assuming affixation to the whole of the form, the only way to account for irregularities in the head of the compound to further assume that forms like "postman" and "understand" are also lexically idiosyncratic. But note that such an analysis would miss an obvious generalization regarding the patterning of irregular forms. To maximize the efficiency of the grammar, all generalizable properties should be derived by rule. The rule of head-targeting therefore characterizes the observed morphological patterns in a maximally efficient manner.

Hoeksema (1984) provides the following definition of a head operation:

(5) F is a head operation if F(Y)=Z, and W=XY (where Y is the head of W) together imply that F(W)=X+F(Y)=X+Z

The second choice that any affixational process must make is repeated in (6)

(6) Will the morpheme affix at the stem level or at the word level?

Aronoff exploits the fact that there are two types of affixes, which are, in theory, ordered in an exceptionless relation to one another. Stem level affixes are ordered first. They may trigger lexical rules such as resyllabification and stress re-assignment. Word-level affixes are always ordered after stem level affixes. This second type of affix undergoes post-lexical rules, and does not affect syllabification or stress of the stem. Aronoff assumes that word-level affixes induce "prosodic closure" on the stem, resulting in the stem being treated as a phonological word.

English stem-level affixes are exemplified in (7).

(7) solemn+ity -> solemnity posit+tion -> position
\|\|/ |\| \|\|/\|\| \|\|/ \|/ \|\| \|/

s s s s s s s s s s s s s s

The stem-level suffixes -ity and -tion affect stress assignment and syllabification.

On the other hand, word-level affixes do not display these properties:

(8) listless#ness -> listlessness posit#able -> positable

Recall that the goal of any theory of reduplication is to characterize the process in a manner as consistent as possible with other morphological processes. We therefore expect four types of reduplication:

(9) (I) stem-level rule; whole operation
(II) stem-level rule; head operation
(III) word-level rule; whole operation
(IV) word-level rule; head operation

Aronoff charactizes Type (I) reduplication as "unexceptional", widely discussed in the literature. These are instances of reduplication in which the copy (either truncated or full) is in the same stress domain as the base. Type (II) is "difficult to detect", requiring a careful analysis of semantic and syntactic scope. Type (III) is "commonly discussed" in the literature on overapplication. In the remainder of this section, I will discuss several examples of Type (IV) reduplication. The first two examples, Kihehe and Makassarese, are discussed in Aronoff. I will in fact provide an alternative account of the Makassarese data. The second two examples, Indonesian and Fijian, have not previously been analyzed in this framework.

1.2 Kihehe

Reduplication in Kihehe copies the whole of the stem. Non-stem material is copied as well just in case this material is syllabified with the stem. Examples follow (Odden and Odden 1985).

(10)

ku-haata	->	ku-haatahaata
(to ferment)		(to start fermenting)
ku-ita [kwiita]	->	kwiita-kwiita
(to pour)		(to pour a little)
ku-lu-ita [kulwiita]	->	ku-lwiitalwiita
(no gloss)		(to pour it a bit)
ku-gohomola	->	ku-gohomolagohomola
(to cough)		(to cough a bit)
mi-oolofu [myoolofu]	->	myoolofumyoolofu
(no gloss)		(fairly plentiful)

Aronoff explains these patterns by categorizing Kihehe reduplication as

Type (IV). The process is a head rule, in that only the stem (the verbal root) is targeted for copying. But also, it is a word-level rule, as syllabification of the copy respects syllabification of the base, i.e. the syllables which compose the stem are not disrupted by reduplication, but copy in full, including non-stem material syllabified with the stem. In other words, word-level affixation has induced "prosodic closure" on the base, in that existing prosodic structure is not disrupted as reduplication proceeds. Therefore, any material which is copied may only target full prosodic constituents, i.e. syllables. Thus, reduplication of kw-iita results in kwiita-kwiita, as the prefix is syllabified with the head of the form at the point in the derivation where prosodic closure is induced, i.e. when word-level reduplication applies. Were prosodic closure not induced on the base at the point where reduplication applies, head reduplication would result in *kwiita-iita. Note that neither McCarthy and Prince nor Steriade can formally account for morphological targeting in Kihehe reduplication. Moreover, the Kihehe data cast strong doubt on McCarthy and Prince's "lexical look-up" hypothesis. McCarthy and Prince would require a stipulation that whenever non-stem material syllabifies with the base, the lexical entry for this morpheme must be summoned along with the lexical entry(s) of the stem:

ku-haata -> ku-haata # /haata/
ku-lw-iita -> ku-lw-iita # /lu/ + /ita/

This derivation comes at a very high price to the grammar, as lexical entries are summoned contingent solely upon superficial properties of syllabification. As copying is dependent on superficial prosodic structure in any case, such forms can surely be accounted for in a more efficient manner if the derivation proceeds from structures that are present on the surface, and not from the re-summoning of lexical entries.

1.3 Makassarese

Aronoff's second example comes from the Indonesian language Makassarese. Makassarese reduplication is sensitive to syllable structure in the following way: "If the base contains two syllables, the rule prefixes those syllables; if, however, the base contains any more material, the final syllable ends in *k*. Thus *golla* is reduplicated *gollagolla*, but *manara* is reduplicated as *manakmanara*" (p.9). Furthermore, stem level suffixes affect stress and syllable structure, whereas word-level suffixes do not, as the following examples show.

lompo (big)		lompolompo	(somewhat big)
lompo+i	(make it big)	lompolompoi	(make it somewhat big)
lompo#i	(it is big)	lompolompoi	(it is somewhat big)
gassing	(strong)	gassinggassing	(somewhat strong)
gassing+i	(make it strong)	gassikgassingi	(make it somewhat strong)
gassing#i	(it is strong)	gassinggassingi	(it is somewhat strong)

Stress in Makassarese is penultimate. -i-suffixation may apply at the stem-level, in which case stress is re-assigned to the derived penult. But

-i-suffixation may also apply at the word-level, in which case the stress of the stem is preserved: lompo#i. Semantic distinctions between +i-suffixation and #i-suffixation confirm that these are indeed homophonous forms. Aronoff claims that the appearance of -k in gassikgassingi is evidence for the word-level status of reduplication. His reasoning is as follows: The penultimate stress in this form indicates the stem-level status of -i-suffixation. At this point, resyllabification is triggered, and /ng/, which is morphologically associated with the stem becomes prosodically associated with the suffix. The base therefore exceeds bisyllabicity as reduplication applies, thus -k surfaces in the copy. Aronoff concludes that reduplication in Makassarese must be a word-level process, crucially following +i-suffixation.

I will now provide an alternative analysis of the Makassarese data. Note first two facts that are incontrovertible. 1) Stress patterns (and semantic interpretations) indicate that there are indeed homophonous stem-level and word-level suffixes. 2) Reduplication must follow stem-level suffixation, and so we get gassik-gassing+i, not *gassing-gassing+i, since consonantal elements following the second nucleus copy only when syllabified as the second syllable coda.

Beyond these two facts, however, the data are still open to interpretation. I will consider the six logical possible derivations of /gassing/-/i/, employing an Aronovian analysis.

		/gassing/+/i/	/gassing/#/i/
1)	stem-level suffixation:	gas.si.ng+i	
	word-level suffixation:		gas.sing.#i
	word-level redup. (whole):	gas.sik.gas.si.ngi	gas.sing.gas.sing.i
2)	stem-level suffixation:	gas.si.ng+i	
	word-level suffixation:		gas.sing.#i
	word-level redup. (head):	gas.sik.gas.si.ngi	gas.sing.gas.sing.i
3)	stem-level suffixation:	gas.si.ng+i	
	word-level redup. (whole):	gas.sik.gas.si.ngi	gas.sing.gas.sing
	word-level suffixation:		gas.sing.gas.sing.i
4)	stem-level suffixation:	gas.si.ng+i	
	word-level redup (head):	gas.sik.gas.si.ngi	gas.sing.gas.sing
	word-level suffixation:		gas.sing.gas.sing.i
5)	stem-level suffixation:	gas.si.ng+i	
	stem-level redup. (whole):	gas.sik.gas.si.ngi	gas.sing.gas.sing
	word-level suffixation:		gas.sing.gas.sing.i
6)	stem-level suffixation:	gas.si.ng+i	
	stem-level redup (head):	gas.sik.gas.si.ngi	gas.sing.gas.sing
	word-level suffixation:		gas.sing.gas.sing.i

Note that Aronoff is unclear as to whether -k (which I will refer to as the -k-marker) surfaces when the base exceeds bisyllabicity, or whether it surfaces

in a base in which a consonant following the second nucleus syllabifies to the left.

Based on the presented data, it is not possible to conclude which structure will trigger -k-marking. The controversial derivation is (1), in which reduplication is a whole operation: gassing#i. In this structure, /ng/ must syllabify to the left (as #i suffixation is word-level) thus triggering prosodic closure on the stem. Now, the question is whether -k-marking will apply in this structure. There are two possibilities. 1) -k-marking will apply, since reduplication is a whole operation, and hence the stem is more than two syllables. 2) -k-marking will not apply, as the root is prosodically closed, and thus /ng/ syllabifies to the left. It is not possible to determine which outcome to expect.

Nonetheless, employing Aronoff's own assumptions regarding Makassarese reduplication, I will tentatively assume that -k-marking does not apply in this structure. Aronoff claims that weight-marking applies when the stem covers "two syllables plus part of a third" (p.9). As this description does not apply to gassing#i, I for now assume that -k-marking does not apply. Therefore, the expected outcome of reduplication on this form is gassing-gassingi.

With this in mind, observe that all six logical possibilities produce the correct output (I assume that non-cyclic post-lexical syllabification will ultimately apply to /ng/s in the right-hand column). Reduplication in Makassarese may therefore apply at the stem-level or at the word-level. Furthermore, the operation may apply to the head of the form, or to the whole of the form. In other words, Makassarese reduplication contributes nothing Aronoff's theory.

There is evidence from stress patterning that Makassarese reduplication is in fact a stem-level operation. Uhrbach (1987) remarks that Indonesian languages (of which Makassarese is one) differ as to whether reduplication is a Level One or Level Two operation. In languages in which reduplication applies at Level One, stress will be assigned once to the full form. In languages in which reduplication applies at Level Two, stress is assigned to the two halves independently. Note that the reduplicated forms in Makassarese only receive form-penultimate stress: *gassikgassingi, *gassinggassingi. Here, each part of the reduplicated form is stressed independently, indicating that the two halves are independent phonological words.

Further evidence for the word-level status of Makassarese reduplication is available from the analysis of lexical versus post-lexical phonological rules. In Makassarese, glottal stops acquire place features from a following voiceless consonant, resulting in gemination. Uhrbach states (though does not provide evidence) that this process is "clearly limited to within [phonological] words" (p.283). The process applies in Makassarese reduplication: pala? (ask) -> palappala? (no gloss), tepo? (broken) -> tepottepo? (no gloss). Uhrbach concludes that reduplication in Makassarese is a stem-level process. The Makassarese data thus fit a stem-level pattern of reduplication.

As we cannot determine whether Makassarese reduplication is a head- or a whole-operation, we may conclude that Makassarese reduplication contributes nothing to the theory of head operations. Furthermore, it appears to be a stem-level, not a word-level process.

1.4 Indonesian

We now turn to languages which are not discussed in Aronoff, yet which provide evidence supporting his general conclusions regarding head/whole distinctions in reduplicative operations. Indonesian reduplication displays some previously recalcitrant properties that are straightforwardly handled in a theory of reduplication that admits head/whole, and stem-level/word level choices. Indonesian displays at least two of the four possible strategies of reduplication.

Reduplicated forms with the verbal prefix meN- display apparent rule overapplication, together with syllable preservation of the root (Uhrbach 1987):

meN-pilih (think) -> memilih-milih (think over)
meN-kira (approximately)-> mengira-ngira (to guess)
meN-tari (dance) -> menari-nari (dance for joy)
meN-isi (contents) -> mengisi-isi (fill with various things)

Root syllabification is preserved in these forms, in that copied vowel-initial roots are not provided with onsets (cf. *mengisi-ngisi). As syllabification of the base is preserved, we are dealing with a word-level process of verbal prefixation. Furthermore, as reduplication copies only root material, we are dealing with a head operation. Prefixation obviously precedes reduplication, as the copied material is sensitive to rules triggered by meN- (cf. *memilih-pilih). We may therefore logically conclude that reduplication is word-level as well. Evidence supporting this conclusion comes from the behavior of stress in Indonesian reduplicated forms. Each instance of the root is always treated independently for the purpose of stress assignment, which is normally penultimate in the language. Therefore, we derive memilih-milih, and not *memilih-milih.

I conclude that this paradigm displays word-level head-rule properties.

Contrast meN- prefixation with peN- prefixation. Uhrbach reports that the nominal prefix peN- is stem-level, always surfacing inside word-level affixes. (The level of peN- affixation is not crucial here. But note that it must affix before reduplication applies.)

dudak -> peN+dudak -> pendudak-pendudak
(sit) (no gloss) (inhabitants)

This form indicates that reduplication here is a word-level whole rule. It is word-level since reduplication always results in two independent stress domains. It is a whole rule, since the whole base is copied. Derivations of both paradigms follow.

UR: /isi/ /buku/ /dudak/
Level One

affixation: --- buku+nya peN+dudak phonology:
--- -------- pen+dudak
Level Two

1. affixation: meN#isi -------- -------- phonology:
meng#isi -------- ---------

2. redup.: meng#isi#isi buku#buku+nya pen+dudak#pen+dudak
phonology: meng#isi#isi buku#buku+nya pen+dudak#pen+duda

surface: mengisi-isi buku-bukunya pendudak-pendudak

The second example (buku-bukunya) shows that it is indeed the root that is targeted for copying, and not just the last two syllables of the stem.

Finally the form pukul-memukul (to hit each other) displays a different type of head operation: head prefixation. In this paradigm, we assume word-level meN- prefixation follows word-level reduplication, with concomitant semantic

contrast (i.e. head-prefixation of meN- results in reciprocity). Furthermore, prefixation is to the head of the form, not the whole of the form. Note that this paradigm of reduplication presumably prefixes the copy.

We have now seen that reduplication and prefixation in Indonesian exploits two of the four predicted paradigms: Type (III) -- word level; whole (pendudak-pendudak), and Type (IV) -- word-level; head (mengisi-isi, pukul-memukul).

1.5 Fijian

Another language that displays word-level, head reduplication which is not addresses by Aronoff is Fijian (Milner 1956, Dixon 1988). In Fijian, reduplication normally (but not exclusively) consists of the prefixation of a bimoraic template. The language displays several patterns of template filling, for which I will provide an explanation in Section 2.

In the first pattern, the first two moras of the base are copied with their tautosyllabic material. If the base is bisyllabic, consisting of two light syllables (a), or is a monosyllabic heavy syllable (b), we observe full copy. If the base is polysyllabic and the initial syllable is bimoraic (c), only the initial syllable is copied. If the base is polysyllabic and the first two syllables are light, these syllables are copied (d):

a.	caka (doing)	->	cakacaka (working)
	tuku (releasing)	->	tukutuku (reporting)
	qase (old)	->	qaseqase (clever)
b.	va: (four)	->	va:va: (all four)
	dre: (pulling)	->	dre:dre: (difficult)
c.	qoolou (shout)	->	qooqoolou (shout for and extended period)
d.	yaqona (kava)	->	yaqoyaqona (a plant related to kava)
	vinaka (good)	->	(vaka)-vinavinaka (thanking)

Alternatively, sometimes the initial light syllable of a base is copied and lengthened. In bisyllabic forms, this second pattern may be limited to forms that display an identity of syllables within the root:

cici (running)	->	ci:cici (running)
lili (hanging)	->	li:lili (hanging)
dredre (laughing)	->	dre:dredre (laughing)
rere (be frightened)	->	re:rere (be frightended for a time)
vinaka (good)	->	vi:vinaka (good, common pl.)

We may analyze bisyllabic roots with light syllable identity as underlyingly monosyllabic. Dixon reports that the minimal word in Fijian is bimoraic. In order to achieve bimoraicity, the syllable is copied, thus ci -> cici. In order to block the formation of another full copy (*cicicici), we may stipulate that full copying may not apply iteratively.

A third pattern, which may be limited to bases of more than two syllables, copies twice the initial light syllable.

balava (long)	->	bababalava (very long)

As the minimal word is bimoraic, we might therefore hypothesize that reduplication is a word-level operation, as it requires a bimoraic template to be filled. Evidence confirming this hypothesis becomes available when the Fijian stress system is considered. The Fijian stress rule is as follows:

primary stress: syllable containing the penultimate mora

secondary stress: syllable containing the pre-antepenultimate mora, and the syllable containing the sixth mora from the end of the word

We can conclude that binary, left-headed feet are constructed right-to-left over moras, and that the minimal word consists of a single foot.

Analyzing the stress pattern of reduplicated forms confirms the word-level status of reduplication:

buta-butao (steal on a number of occasions)
tui-tuia (hammer it a lot)

In these forms, the copied base is treated independently for the purposes of stress assignment, indicating that reduplication is a word-level morphological process. If it were a stem-level process, secondary stress should be marked on the syllable containing the pre-antepenultimate mora:

*buta-butao *tui-tuia

Further evidence for the word-level status of reduplication comes from patterns of glide formation. Dixon reports that a non-high vowel - high vowel sequence will trigger glide formation within the phonological word: ta+isi -> taysi. However, glide formation is blocked across a phonological word boundary, thus ilo reduplicates as ilo-ilo (cf. *iloylo).

In trisyllabic stems, all three syllables may be reduplicated, the first separately from the second and third:

calidi (crackling noise) -> cacalidilidi (repeated crackling)

Dixon reports that these are special cases of a bisyllabic base reduplicating simultaneously with a stem-level prefix of the "spontaneous" class (he also shows that certain reduplicative processes target prefixes exclusively: vaa-yaga (to use) -> i-vaa-vaa-yaga (way of using)):

ca+lidi
-> stem level redup. -> ca+ca+lidi
-> word level redup. -> ca+ca+lidi#lidi

Evidence for the stem level status of the "spontaneous" class of verbal prefixes (including ta-, a-, ca-, and ra-) is available from analyzing patterns of glide formation. Recall that glide formation may apply across a stem-level boundary, but is blocked from applying across a word-level boundary. In fact, the affixation of "spontaneous" class prefixes to high vowel-initial roots does trigger glide formation: ta-uru -> tawru (become slack). This class of prefix is thus stem-level, and therefore must precede word-level root reduplication.

Also note that here, Fijian reduplication does not simply target the first two moras of a stem. Instead, the verbal root is targeted. In other words, the head of the complex morphological constituent is reduplicated. As Aronoff notes, "...in all cases where reduplication must take place internally to an affix...the base of reduplication is the morphological...head of the whole"(p.3). Thus, in the case of cacalidilidi, "(R)eduplication, which is internal to prefixation, nonetheless follows it in an ordered derivation"(p.3).

calidi -> calicalidi (excessive crackling) is another attested form. Here, reduplication obviously targets the whole of the form. Unfortunately, Milner does not indicate stress on this form.

We may now conclude that Fijian posseses a process of reduplication which is a word-level, head operation. It is a word-level rule based on evidence from stress placement and glide formation. It is a head operation in that only the head is targeted for copy. These findings support a theory of reduplication like Aronoff's in which both head/whole, and stem-level/word-level choices are available for the morphological process of reduplication.

2. Reduplication Recast

Aronoff's whole-head distinction shows that prosodic circumscription is insufficient to characterize certain cases of reduplication. Note that neither McCarthy and Prince nor Steriade make reference to morphological targeting in their accounts of reduplication, and thus cannot account for reduplication in Kihehe, Indonesian, or Fijian, where the morphological head is targeted for copy.

In this section, I will adopt Aronoff's general conclusions, as well as a slightly modified version of Steriade's "Full Copy" approach to reduplication, providing an account of the process that is sufficiently generalizable to explain all the data in question, while sufficiently constrained to prevent overgeneration. This account will recast reduplication in a way that departs minimally from regular morphological and phonological processes.

2.1 A Formal Approach to Morphological Circumscription

While Aronoff does make crucial reference to prosodic constituency, he makes no attempt to formalize the process of prosodic circumscription. For example, in his analysis of Kihehe, he merely states that "...a prefix will be carried along just in case it is part of a syllable that also includes part of the stem" (p.8).

In order to formalize the Kihehe reduplication operation, the base must be circumscribed morphologically, so that the root is targeted for copying. But also, the base must be circumscribed prosodically, so that material tautosyllabic with the head nuclei is copied as well.

I now offer a formal account of Kihehe reduplication in which both morphological and phonological material are circumscribed, thus defining the base of operations.

Full copy:

copy in full the whole base, including prosodic structure
up to the syllable level, and morpheme boundaries.

Morphological circumscription:

<target the relevant morphological constituent>

Nuclear retention:

within the copy, retain all and only prosodic structure which bears a matrilineal relationship to morphologically circumscribed nuclei; erase the residual structure

Reprosodization:

project syllables to encompass all material up to well-formedness

Stray Erasure:

Erase all melodic material which has not been prosodically licensed

Following the theory of reduplication presented in Steriade (1988), this approach to reduplication proceeds from a fully articulated copy of the base. After the base has been copied in full, morphological circumscription proceeds: target either the whole of a form or the head of a form. Morphologically circumscribed nuclei retain all prosodic structure which dominates them, at least up to the level of the syllable. Prosodic structure dominating non-nuclear material is erased. Reprosodization then proceeds, in which syllables are constructed maximally up to well-formedness, from nuclei outward. Finally, all material not prosodically licensed is erased.

As noted in the introduction, since reduplication is just a special case of morpheme affixation, its derivation should be as consistent as possible with all other morphological processes. Reduplicative templates acquire melodic content from the base. Once summoned, the morphological constituent should be assigned prosodic structure in a manner fully consistent with the language-specific phonology: syllables should be constructed maximally up to well-formedness, from nuclei outward.

2.2 Kihehe Again

We may assume the following derivation for Kihehe reduplicated forms (Throughout, prosodic structure both of the base, and the intial full copy, is suppressed.):

input:

ku+haata ku+lw+iita ku+mw+iimbila

full copy:

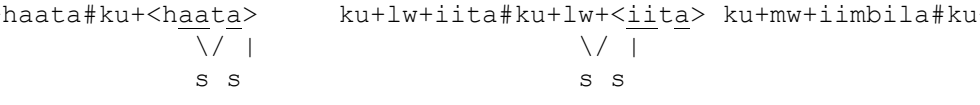
ku+haata#ku+haata ku+lw+iita#ku+lw+iita ku+mw+iimbila#ku+mw+iimbila

morphological circumscription:

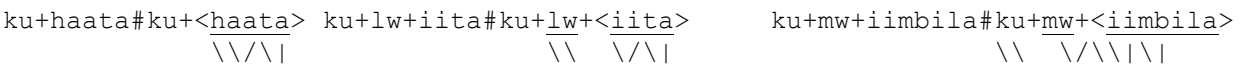
ku+haata#ku+<haata> ku+lw+iita#ku+lw+<iita> ku+mw+iimbila#ku+mw+<iimbila>

nuclear retention:

ku+haata#ku+<haata> ku+lw+iita#ku+lw+<iita> ku+mw+iimbila#ku+mw+<iimbila>



reprosodization:



stray erasure:

ku+haata#haata ku+lw+iita#lw+iita ku+mw+iimbila#mw+iimbila

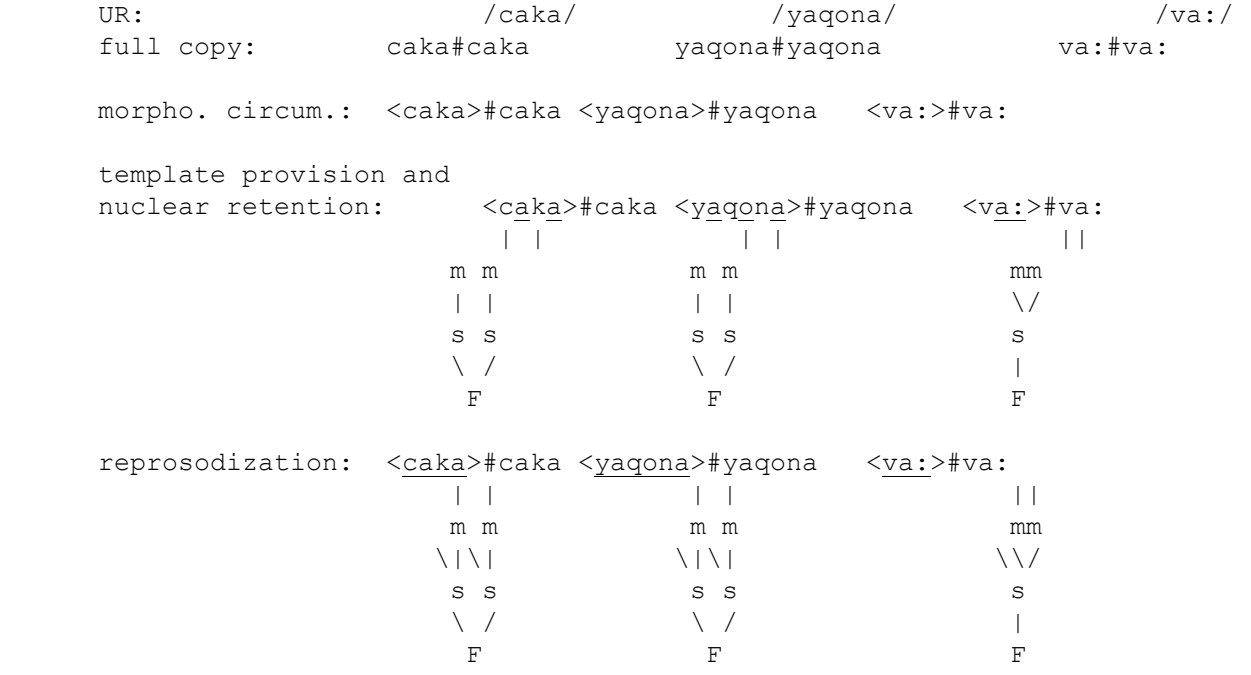
surface:

kuhaata-haata kulwiita-lwiita kumwiimbila-mwiimbila

Reprosodization proceeds unobstructed up to well-formedness, as there is no weight limit placed on the output. Length transfers from the base, as all prosodic structure that dominates the nucleus -- including, crucially, moraic structure -- is salvaged from erasure.

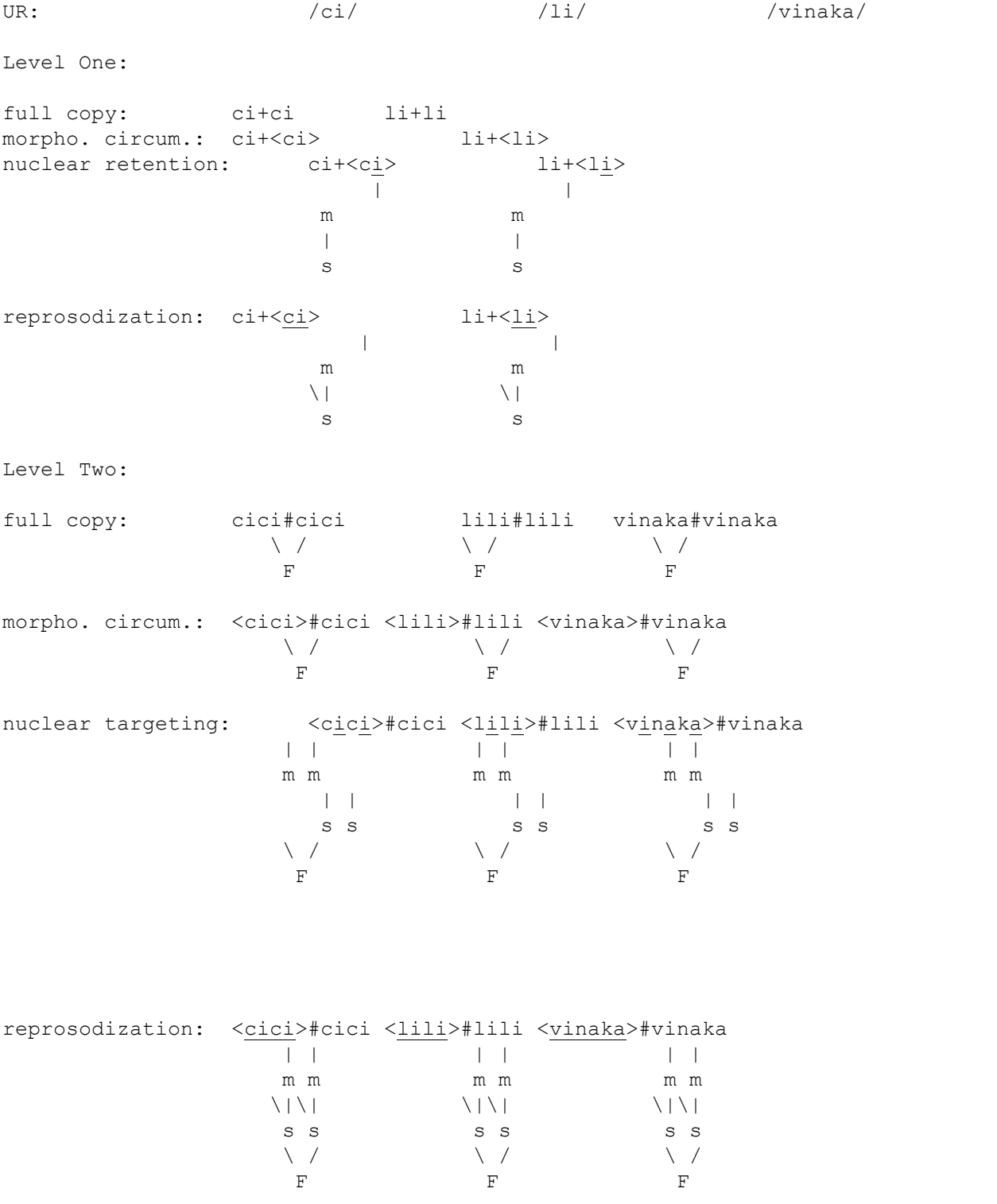
2.5 Fijian Again

In Fijian, as prosodization targets moras instead of syllables, I assume quite naturally that reduplicative operations too make reference to the mora in their prosodic targeting operations. Where Fijian is distinct from the other languages discussed is that this language possesses several methods of filling its reduplicative template, which consists of a single foot. In Section 3 we will discuss the theoretic significance of this fact. I assume that full syllable copy is the unmarked derivation. As the Fijian syllable does not permit codas, consonants are never moraic. Therefore, to maximally satisfy the bimoraic template, two (moraic) vowels must be targeted for retention (cf *cak-caka).



Reprosodization of the morphologically circumscribed constituent departs minimally from prosodization elesewhere: a morpheme is summoned, and prosodic rules proceed to assign structure maximally up to well-formedness. As Fijian syllables do not permit codas, no stipulations need be made concerning the lack of coda provision within the template.

Alternatively, the bimoraic template may be filled by lengthening the vowel of the root-initial light syllable. Recall that this is the only attested form in roots with light syllable identity:



```
stray erasure:          -------          -------          vina#vinaka
truncation:       ci#cici          li#lili          vi#vinaka
V-lengthening:          ci:#cici          li:#lili          vi:#vinaka
surface:                ci:-cici          li:-lili          vi:-vinaka
```

As truncation and V-lengthening are obligatory in roots with light syllable identity, I assume the process is available through analogical extension to other forms, hence vi:vinaka (good, common pl.) (cf. (vaka)vina-vinaka (thanking)).

Note that the various patterns of reduplication in Fijian are all required independently by the grammar. Therefore, template filling is in no sense idiosyncratic. Rather, it merely exploits processes that are attested elsewhere in the grammar, producing novel forms whenever semantic distinctions are necessary (cf vi:-vinaka (good, common pl.) vs. vaka vina-vinaka (thanking)).

Finally, we may easily account for the peculiar form cacalididi: The prefix copies in full, as does the root.

3. Further Evidence for Nuclear Integrity in Prosodic Morphology

Until this point we have provided only theory-driven evidence supporting the hypothesis that reduplication entails a process of nuclear retention and reprosodization. As all examples we have analyzed thus far retain syllabification of the base in the copy, the only "evidence" provided for the hypothesized strategy comes from assumed strategies of lexical prosodization: for a given morpheme, regardless of its origin, prosodic structure is supplied from nuclei outward.

We will now turn to data in which syllabification of the base is not preserved after prosodic morphological operations apply. We will first look at a process of stem modification in Modern Hebrew as presented in Bat El (1990). We will then present data from prosodization strategies in Cantonese loanword phonology (Silverman 1990), which support a theory of prosodization and template fitting in which nuclear targeting is hypothesized.

I will argue that a theory of prosodic morphology in which nuclear retention and maximal reprosodization up to language-specific well-formedness handles the data in a straightforward manner, and departs minimally from less marked instances of morphemic prosodization.

4.1 Modern Hebrew

Hebrew displays the following morphological pattern, termed denominalization by Bat El (1990):

Base		Derived Verb	
xantaris	(nonsense)	xintres	(to talk nonsense)
telegraf	(telegraph)	tilgref	(to telegraph)
sandlar	(shoemaker)	sindler	(to make shoes)
sinxroni	(synchronic)	sinxren	(to synchronize)
praklit	(lawyer)	priklet	(to practice law)

Bat El observes that consonant clusters which exist in the base are preserved in the denominalized forms. And so in the CCVCCVC praklit the initial CC cluster is preserved in the derived form, as is the medial CC cluster in the CVCVCCVC form derived from telegraf. Bat El further observes that cluster preservation cannot be accounted for in the root-and-pattern theory of Semitic morphology, as initially presented in McCarthy (1979). Assuming that all morphological operations in Semitic project from lexical root morphemes, inflectional morphemes,

and skeletal morphemes, there would be no principled way to account for patterns of cluster transfer in Hebrew denominals. Specifically, there is no principled way to account for the fact that the CV skeletal morphemes for tilgref (CVCCCVC) and priklet (CCVCCVC) are distinct in exactly a manner by which consonant clusters present in the base are retained in the derived form.

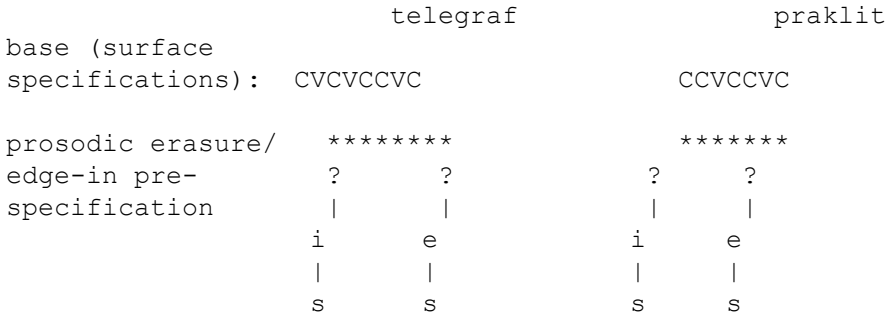
Bat El concludes that denominalized forms (and, by extension, all Semitic morphological alternations) are not derived from the lexical summoning of distinct morphemes which combine to build a form, but instead are derived through modification of the (unmarked) stem.

I will now briefly run through the crucial aspects of Bat El's analysis, along the way pointing out a crucial theoretical problem in her solution. I will then present a modified analysis of the data in which this theoretical problem does not arise.

Bat El assumes that all prosodic structure of the base is erased as stem modification proceeds, as consonants often shift their syllabic association (e.g te**l**egraf -> ti**l**gref). A process of edge-in association of pre-specified vocalic elements accounts for the observed ablaut pattern. At this point in the derivation, syllable nodes are constructed over pre-specified vowels, and full syllabification up to well-formedness subsequently proceeds. Therefore cluster transfer follows not as a principle, but as a natural consequence. All unlicensed material is subsequently deleted from the representation.

(Bat-El states that "*" indicates root nodes or the CV tier)

Note that Bat El makes a crucial assumption concerning the nature of prespecification. As she assumes all prosodic structure to be absent at the stage in the derivation when prespecified segments associate, she provides no principled way to account for which segments are targeted for replacement. As syllabicity is assumed always predictable, no such information is present in the underlying feature bundle out of which each segment is composed (therefore, "*" should indeed represent root nodes, and not a CV tier). It is therefore not possible to provide a theoretically motivated account of vowel replacement (and concomitant cluster transfer) under this analysis. To illustrate, I present the following schematized derivation for the two forms telegraf and praklit, in which syllablicity is not specified in root nodes.



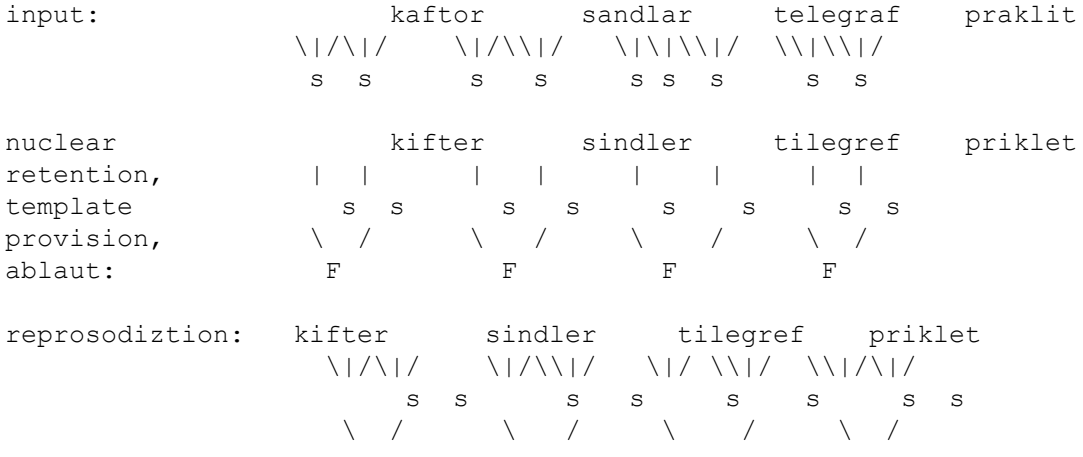
(* represents a feature bundle (i.e. root node) unspecified for syllabicity)

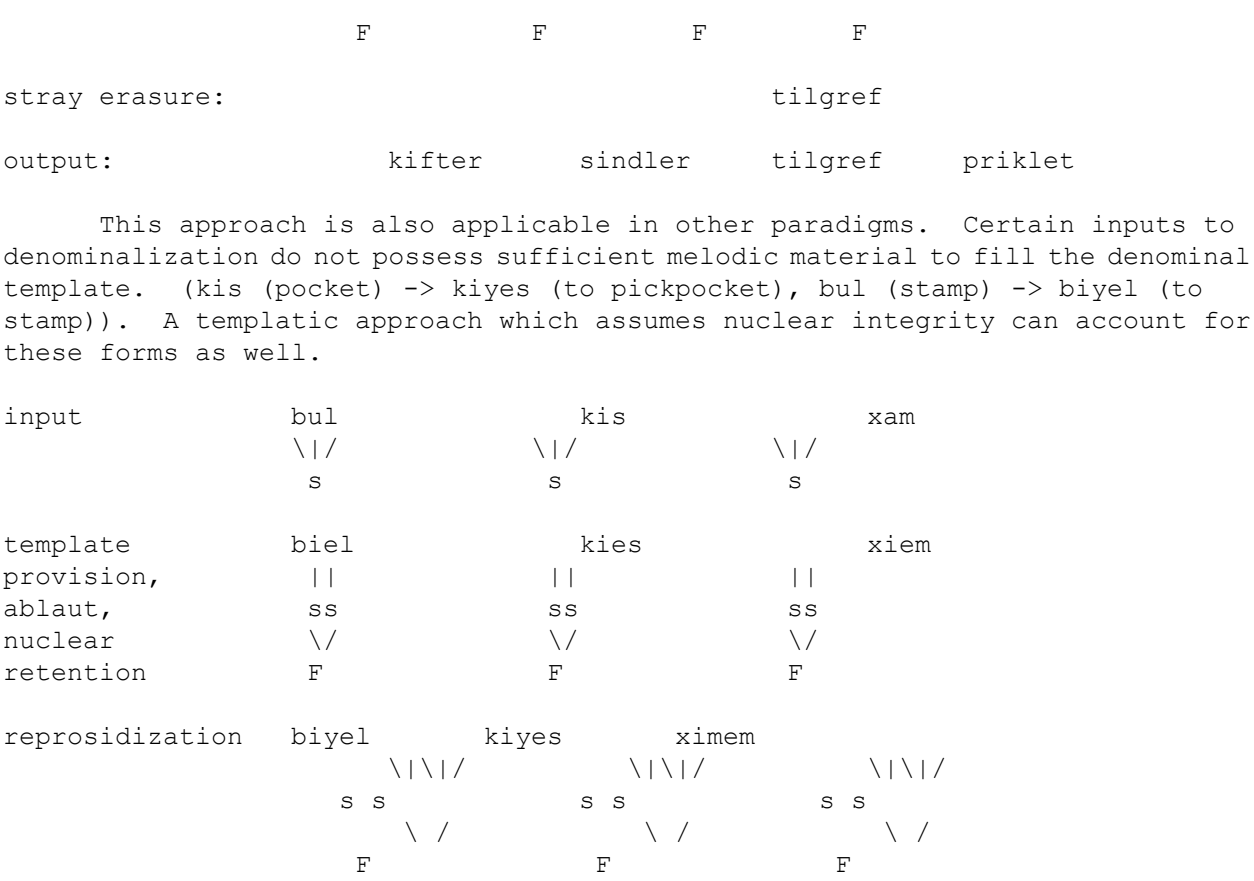
As soon as prosodic structure is erased, all information regarding segmental syllabicity is lost. At this point, prespecified vocalic segments will have no information regarding which segments in the representation they are supposed to be replacing. We would therefore expect association of prespecified vocalic segments to be governed by language specific principles of syllabification, applied unexceptionally. If this scenario were to obtain, we would not expect clusters to transfer from the base, but instead we would expect CV patterning to be completely regular in the derived forms, as the same principles of syllabification apply in each instance: tilgref, *parklit.

As we do not observe these phenomena, I assume that a certain amount of prosodic structure is salvaged from erasure as prespecification and subsequent reprosodization proceed.

I now propose a modification of Bat El's analysis which results in a derivation exactly parallel to that proposed in Section 3 for reduplication.

As denominaliztion proceeds, a binary foot template associates edge-in with the form, targeting nuclear elements, and ablaut applies. All prosodic structure not immediately dominated by the template is erased. Subsequently, full prosodization proceeds, maximizing syllable structure up to well-formedness. Non-licensed material is deleted via Stray Erasure. This approach to stem modification in Hebrew is exemplified below.





This approach is also applicable in other paradigms. Certain inputs to denominalization do not possess sufficient melodic material to fill the denominal template. (kis (pocket) -> kiyes (to pickpocket), bul (stamp) -> biyel (to stamp)). A templatic approach which assumes nuclear integrity can account for these forms as well.

All syllables in Hebrew require onsets. In denominalized forms, there is apparently a choice to be made regarding how onsets are provided for syllables lacking onsets after template-fitting. We witness either glide insertion (biyel, kiyes), or leftward spreading of the final C (ximem). Bat-El actually assumes that the intermediate form of ximem is xime, and that reduplication then copies the base in full, at which point the copied /m/ is incorporated, all residual material deleting). However, this analysis is inconsistent with her observation that elsewhere, edge-in ablaut always seeks the first V after the first C (hence Bat-El considers coda-less final syllables extrametrical). Therefore, from xam, we expect the intermediate form xiem, as edge-in ablaut must first encounter a C, namely /m/.

As already noted, Bat-El's evidence for stem modification in Hebrew calls into serious doubt McCarthy's (1979) root-and-pattern account of Semitic morphology. McCarthy and Prince (1986) in fact re-analyze Semitic in a manner consistent with the theory of prosodic morphology presented therein: Binyanim are not constructed by the filling of CV templates, but rather are constructed by the filling of syllabic templates. Nonetheless McCarthy and Prince hold fast to the non-concatenative approach of McCarthy (1979) in that Binyanim are still assumed constructed from combining the lexical entries of root, inflectional, and prosodic morphemes.

One problem that McCarthy and Prince (1986) do not address in their re-analysis of the Semitic data is the fact that association dichotomies exist between melody and template; between identical melodic material and identical prosodic material. Of the fifteen CV-skeleta McCarthy and Prince list, there exists a one-to-one correspondence between CV-skeleta and syllabic skeleta for only eleven paradigms. In other words, four of the eleven syllabic skeleta accommodate two CV-skeleta each. The four paradigms are listed:

syllabic skeleton	Corresponding CV-skeleta
s_{mm} s	CVVCVC, CVCCVC
s_{mm} s (s)	CVVCVVC, CVCCVVC
(s) s_{mm} s	CCVCCVC, CCVVCVC
(s) s_{mm} s (s)	CCVCCVVC, CCVVCVVC

If syllabic skeleta form the basis of the prosodic template in Semitic, reference to the syllabicity of skeletal slots should not be a consideration. Conversely, if the prosodic morpheme indeed makes reference to the syllabicity of skeletal slots, then the syllabic component of the morphemic representation is redundant, as this information is predictable. McCarthy and Prince themselves argue the former; that the segmental skeleton is entirely superfluous. This being the case, the authors are at a loss to explain how identical melodic material may associate in more than one way to identical syllabic patterns (cf above).

The authors have little to say about how these templates are filled. But observe that under their analysis, the surface distinction between a given pair of underlyingly identical forms must be the result of phonological operations, not a result of lexically contrastive information. To exemplify, consider the hypothetical case of a root, say /ktb/, associating with an inflectional morpheme, say /ia/, and a syllabic skeleton, say /s_{mm} s/. Two Binyanim are derivable:

	CVVCVC	CVCCVC
skeleton:	s s (mm)	s s (mm)
root:	k t b	k t b
inflection:	i a	i a
surface:	kiitab	kittab

In these structures, the underlying morphemes are identical. It is only during the course of the derivation that distinctions arise between them. This is surely an undesirable situation, as morphologically contrastive forms, unless homophonous, should possess underlying structural distinctions.

This problem is not encountered in a theory of prosodic morphology based on stem modification and Nuclear Integrity. Recall that Fijian permits several lexically contrastive strategies of filling its bimoraic reduplicative template (vi:-vinaka vs. vinavinaka). Assuming that Semitic morphology allows for the same type of lexically contrastive stem modification as Fijian allows in its reduplicative morphology, the problem of lexically identical forms giving rise to superficially distinct forms does not arise.

Stem modification does not involve the resummonimg of lexical entries, but instead applies to existing surface forms. Templates of identical prosodic weight may be filled in a variety of fashions. The morpheme is not solely the template itself, but includes the pattern of re-association of the relevant elements within the base.

We can now appreciate the theoretic significance of Fijian's distinct strategies of template-fitting as presented in Section 1.5. The fact that Fijian allows for several methods of template filling shows that prosodic morphology cannot solely rely on language-specific rules of syllabification as template-fitting proceeds. Instead, certain aspects of the derivation -- specifically, segment association to the template -- can play an active role in the prosodic morphology. I still assume, however, that normal syllabification is the unmarked strategy. If prosodic morphological operations proceed from

derived (i.e. surface) forms (as in Bat-El's stem modification approach and Steriade's approach to reduplication), derivational dichotomies are an expected consequence, as the morpheme itself is not derived from lexical representations, but instead possesses the special status of being derived from a surface form. But if prosodic morphological processes proceed from a re-summoning of lexical entries (as in the McCarthy and Prince approach), derivational dichotomies would not be expected, as the re-summoned elements would not have access to their status as prosodically-conditioned elements, and therefore would be expected to undergo phonological processes in solely the unmarked fashion.

The analysis of prosodic morphological processes presented in the preceding paragraph, and exemplified by Fijian, should not be misconstrued as one which admits skeletal templates. Were Fijian to admit skeletal templates of the form CVV, CVCV, $C_1V_1C_1V_1$, the generalization that all these templates are bimoraic would be missed.

To summarize this section, we have argued in favor of Bat-El's stem modification approach to Semitic morphology, as this approach can account for cluster transfer in a principled manner. However, I have shown that Bat-El's theory of full prosodic erasure requires modification in order to properly account for cluster transfer. I assume that Nuclear Integrity holds as stem modification proceeds. Nuclear Integrity thus accounts
for cluster transfer, and additonally, brings Semitic prosodic morphology in line with the reduplication processes discussed in the previous section: prosodic structure dominating nuclei is retained as prosodic morphological processes proceed.

Furthermore, we have reconsidered the Fijian data, which has supplied further support for a theory of prosodic morphology in which derivations proceed from surface representations, and not from lexical representations.on.

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