1982

Prosodic templates, morphemic templates, and morphemic tiers

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The structure of phonological representations
(Part I)

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1982
FORIS PUBLICATIONS
Dordrecht - Holland/Cinnaminson - U.S.A.

Binary feet require an additional comment. Later I will propose that some metrical feet of finite length have more than two branches. This need not destroy the parallel with autosegmental spreading, however, since in some languages tones spread a finite number of syllables, but more than one, from their source. Hyman and Schuh (1974) mention Sukuma and Kanakuru as possible examples, under the name "displacement".

3. Special thanks to David Gil for first impressing this point on me.

4. In this case we would of course also have to adjust Hayes' definitions appropriately. For example, the stipulation that the recessive nodes of a metrical foot may not branch would be changed to specify that neither dominant nor recessive nodes branch within a foot.

Prosodic Templates, Morphemic Templates, and Morphemic Tiers *

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1. INTRODUCTION

In recent work (McCarthy 1979, 1981; Halle and Vergnaud 1980; Harris 1980; Marantz, to appear; Yip, to appear) a new model of morphology has been emerging, one in which nonlinear phonological representations play a central role. This model, which I will refer to as *prosodic*, was originally developed in an analysis of the complex system of nonconcatenative morphology found in Semitic languages, Classical Arabic in particular. It has since been extended to other, typologically and genetically quite different sorts of phenomena. In this paper, we will see still further empirical consequences of the adoption of this theory.

The fundamental characteristics of the prosodic model of morphology can be described quite briefly. The notational apparatus – association lines and tiers or simultaneous levels of representation – are taken from autosegmental phonology (Goldsmith 1976). But this formalism is given a quite different interpretation. The central notion is that information about the canonical pattern of segments in a form is represented on a different tier from information about the kinds of segments occurring in a form. The canonical pattern tier is called the prosodic template, and a particular type of prosodic template, composed of the units C and V, can be referred to as a CV-skeleton. Other sorts of prosodic templates may consist of higher-level, prosodic units, like syllables σ, metrical feet Φ, subunits of these, and perhaps combinations of units from different levels. The tiers with segmental material are then mapped onto the prosodic templates by the operation of autosegmental rules of association.

Morphemes play a central role in this model. In nonconcatenative morphological systems, morphemes may be segmentally discontinuous. Most importantly, the identity of morphemes or morpheme classes defines

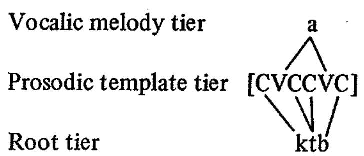
* In examples cited in this article I have occasionally changed transcription symbols in accordance with more familiar usage. Any special features of the transcription are described in the footnotes.

I am indebted to Morris Halle, Alan Prince, and Mark Feinstein for adding to my understanding of the issues discussed here.

the different autosegmental tiers – that is, different morpheme classes are represented on different tiers. The prosodic template is itself in some cases a morpheme or string of morphemes, and the other various tiers will each contain the segmental properties of a particular morphological class. Each such level can be characterized as a morphemic tier. Furthermore, the recognition of morphemes as distinct formal units permits a further abstraction: the number and distribution (in effect, the canonical pattern) of morphemes in a form can be stipulated independently of morpheme identity. Thus, languages may also indicate *morphemic* templates composed of morpheme positions μ, with association of morphemes to these templates also accomplished by autosegmental principles.

These concepts can be illustrated by some examples from the Classical Arabic verb system, discussed more fully in McCarthy (1981). Consider the second derivational class of the verb, which has a transitivizing or ditransitivizing meaning. A representative member of this class, the stem *kattab* 'caused to write', is given in (1):

(1)

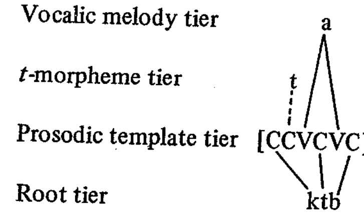


All three of the tiers in (1) constitute separate morphemic levels. The vocalic melody tier contains the inflectional specification of perfective aspect/active voice. This melody can be varied independently to yield, for example, the perfective passive *kuttib*. The root tier is characterized as containing the fundamental lexical morphemes – [ktb] appears in forms referring to writing. And the template is the morphemic mark of the second derivational class. So changing the template to, say, [CVVCVC] yields the third class reciprocal *kaatab* 'corresponded', with the segmental elements assuming a different canonical pattern.

The prosodic template, then, allows us to extract from each derivational class the characteristic pattern assumed by roots and vowel melodies – in fact, the basic generalization underlying Semitic morphological systems. Placing the vowel melody and the root on separate tiers permits these two levels to associate with the prosodic template essentially independently of one another. The levels further allow any one property to be varied apart from the others.

Another effect of morphemic tiers appears in the eighth derivational class *ktatab* 'was registered'. The first *t* of this form is an infixed morpheme with detransitivizing or reflexive force, appearing also as a prefix in the sixth form *takaatab* 'wrote to each other' (and the nonoccurring fifth form *takattab*). *ktatab* is represented formally in (2):

(2)

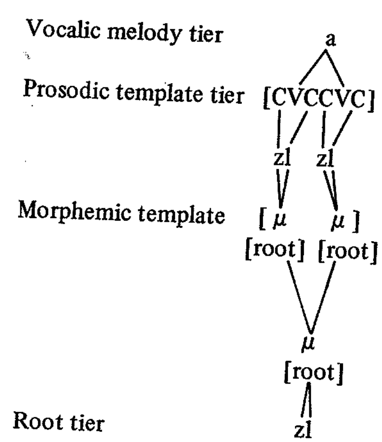


The broken lines connecting the element *t* with the template indicate that it is on a separate morphemic tier from either the vowel melody or the root, although this situation cannot be conveniently represented in a two-dimensional image. Thus, association of *t* with the template is independent of the root or vocalism – the fact that it is infixed is indicated by its association with the second C-slot of the skeleton, and not by insertion into a linear string. This apparent infixation is accomplished by a simple rule of reassociation, accounting for the systematic alternation of *t* between a prefix in the fifth and sixth derivational classes, and an infix in the eighth.

Morphemic templates arise in another set of cases. There is a sense in which such templates have played a role in much earlier morphological models. Structuralist descriptions often contain templates specifying the order of morphemes, the relative positions of different morpheme types with respect to one another and the root. But a considerably more interesting application of morphemic templates develops when they express multiple occurrences of a single morpheme in a form. The particular example of root reduplication, which is met with in many languages, is germane to this point.

Classical Arabic has a root reduplication process applicable to biconsonantal roots, doubling them and associating them with the prosodic template [CVCCVC]. So, the root [zl] appears as *zalzal* 'shook' in the perfective active, represented in (3):

(3)

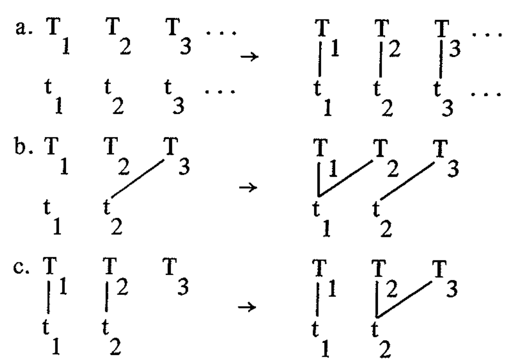


This pattern of verbal derivation, then, stipulates a morpheme template $[\underset{[\text{root}]}{\mu} \quad \underset{[\text{root}]}{\mu}]$, indicating that the root is to be mapped onto two morpheme positions. The product of this mapping is itself then associated with the positions on the CV-skeleton.

In the discussion below we will find considerable empirical justification for this formal system. Section 2 begins with a consideration of a language game in an Arabic dialect in which the root tier, distinct from other representational layers, plays an essential role. A language game in the Philippine language Hanunóo provides further support for the root/template dichotomy, while several other language games involve basic operations on the template, with the recognition of an affix tier like that in (2). Section 3 treats two morphological systems that share many formal properties with Semitic. In the first case, from the South Munda language Gtaʔ, a tier with vocalic melodies is necessary to account for complex patterns of what is called echo-word formation. In the second, the Malayan language Temiar displays an elaborate system of verbal derivation that requires the full use of all aspects of the theory. A concluding section suggests some further consequences, particularly in the realm of higher-level organization of prosodic templates.

But first we will deal briefly with those aspects of the prosodic model that have not yet been adumbrated but that are essential to the analyses. Association between autosegmental tiers is governed by the theory of tonal association of Clements and Ford (1979). Clements and Ford present three universal conventions for association of tonal elements (t) with tone-bearing elements (T). These are summarized in (4):

(4) Universal Association Conventions



Convention (4a) provides for a left-to-right one-to-one mapping of several melodic elements to several unassociated melody-bearing elements. (4b) gives precedence in spreading to an unassociated tone over one that already bears an association – for instance, by the prior application of a language-particular rule. (4c) ensures that all tone-bearing elements will have at least one association (though not the converse), garnered if necessary from the tonal element on the left.

Under the prosodic model of morphology, these association conventions, together with the prohibition against lines crossing of Goldsmith's (1976) Well-formedness Condition, will apply to the units on morphemic tiers, mapping them onto slots on templates. Language-particular association rules, which are met with in many tonal systems, occasionally arise and take precedence over these universal conventions. We will assume that the tier to template association is subject to two further conditions, neither of which has a direct counterpart in the autosegmental theory of tone.

First, following a suggestion made by Halle and Vergnaud (1980), we will say that there must be a matching in major-class membership between any melodic element and the template position with which it is associated. Specifically, I will assume, in view of the essential elimination of the feature [syllabic] in recent nonlinear studies of syllabification, that the feature [vocalic] is the basis of this matching. Thus, only [+vocalic] elements may be associated with V-slots in the skeleton, and only [-vocalic] elements with C-slots. Similarly, the association of morphemes with morphemic templates will be sensitive to the matching of morphological features like [root]. Explicit stipulation in a grammar can override this matching requirement, as when a glide spreads into a V-position.

A second important addition to the tonal autosegmental theory is a prohibition against many-to-one associations. This excludes the mapping of several melodic units onto a single position of the template, and thus has the natural consequence of ruling out in the unmarked case individual segments with multiple specifications for point and manner of articulation. Since such complex segments do arise, as with the short diphthongs discussed in section 3.1, we will permit the stipulation of dispensations from this requirement.

These three conventions – the association rules in (4), the matching rule, and the prohibition of many-to-one associations – constitute the unmarked basis for mapping in this model. Language-particular rules have the freedom to contravene any of these conventions, but only at cost. And, as we will see in section 3.2, language-particular rules can sometimes function as parameters, providing an elegant account of otherwise puzzling interlinguistic variation.

2. NONLINEAR LANGUAGE GAMES

Many previous studies have dealt with language games or secret languages, systematic distortions of speech. Earlier treatments of a phonological sort have been largely concerned with only a single theoretical consequence of such games: their significance for determining the so-called psychological reality of abstract phonological representations. Here we will approach the separate question of the form of phonological representations, which has not usually figured in such discussions.[1]

In particular, the facts of language games provide strong support for the conception of phonological representation outlined above. A Semitic example, taken from the modern Arabic dialect of Hijazi Bedouins, involves a free transposition of elements only on the consonantal root tier, apart from all other levels. Another transposition game, occurring in Hanunóo, also effects only the root tier, leaving the prosodic template unaltered. Further, a very common type of infixing game, illustrated by several languages, inserts material into the CV-skeleton, with associated consonants, while leaving the root tier unchanged.

As with any linguistic phenomenon, data from language games cannot be applied incautiously to theoretical problems. Games which are highly limited in use or which require extensive training to master may invoke nonspecific intellectual capacities rather than purely linguistic ones. We would expect such games sometimes to contravene otherwise reliable notions of phonological representation, as in the case of games that make use of information from another language or the orthography. Clearly no formal linguistic theory should offer a direct account of them.

2.1. Bedouin Hijazi Arabic Transposition Game

The Modern Arabic dialect spoken by Saudi Arabian Bedouins is extremely conservative, retaining many features of Classical Arabic, including such properties as the characteristic passive vocalic melody. In view of this, we can assume that the morphological analysis of Classical Arabic presented above and in McCarthy (1981) carries over with few changes to Bedouin Hijazi Arabic (BHA). BHA segmental phonology has been described in great detail by Al-Mozainy (1981).[2]

BHA has the language game that is illustrated in (5). Forms in the game can be produced and understood unhesitatingly, and to my knowledge it is not explicitly taught.

(5)

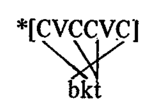
Derivational Class	I	II	III	IV	V	VII	VIII	X
Base Form	difa9	kattab	kaatab	?arsal	tikattab	nkisar	jtima9	staslam
Game Forms	da9af	battak	baatak	?aslar	tibattak	nrakas	mta9aj	stalmas
	fida9	takkab	taakab	?asral	titakkab	nrasak	mtija9	stamlas
	9adaf	tabbak	taabak	?alsar	titabbak	nsarak	jta9am	stasmal
	fa9ad	bakkat	baakat	?arlas	tibakkat	nsikar	9timaj	stalsam
	9afad	kabbat	kaabat	?alras	tikabbat	nkaras	9tijam	stamsal
	'pushed'			'sent'		'broke'	'met'	'surrendered'

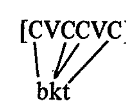
I have listed these stems from the verbal system according to the traditional Western system of numbering. The list contains the base word at the head of each column and an exhaustive accounting of the game forms possible with that base. Initial epenthetic vowels have been suppressed.

It is apparent that this game involves scrambling the order of consonants in a form. Some examples, like *da9af* or *nrakas*, also show a change from the vocalism of the base. Al-Mozainy (1981) has convincingly demonstrated that this game is prephonological, and that any change in the vowels can be attributed to the operation of rules sensitive to the quality of the neighboring consonants. Thus, we can completely define the transformation wrought by this game solely in terms of consonantism.

What makes this game inherently interesting is that many possible transpositions of consonants are judged as ill-formed, considered as outputs of the game. While all 3! permutations of the three consonants in I *difa9* or III *kaatab* are well-formed, only those listed in (5) are possible for II *kattab*. We would expect a total of 4! outputs in this case, but the rest, like **taktab* or **baktat*, are ill-formed.

This observation follows directly from the representational apparatus inherent in the prosodic model. The BHA language game involves free permutation of consonants on the root tier. This scrambling process must necessarily precede the operation of rules of association, since otherwise association lines would cross in violation of the Well-formedness Condition of Goldsmith (1976), as shown in (6a). A sample grammatical output, scrambled before association, is given in (6b).

(6) a. 

b. 

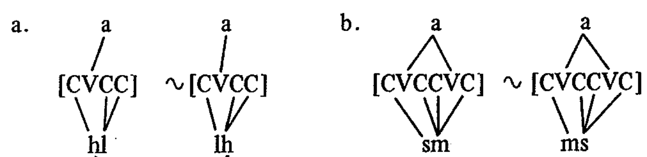
Under this account, prohibited outputs like **taktab* or **baktat* could not possibly be generated without crossing association lines or violating the rules of association applied in this derivational class.

In V *tikattab* and VIII *jtima9* we have to reckon with the affixal element *t*. Again, not all possible results of scrambling all the consonants in the stem are grammatical. Some, like V **tikabtat* or **tibaktat*, are ruled out for exactly the reasons adduced above. Others that are ill-formed include V **kibattat* or VIII **m9ataj*, **mjata9*, **jmata9*, and **9jatam*, in all of which the prefix/infix *t* is scrambled along with the root consonants.

This property also follows from considering the language game to be limited to permutations on the root tier. Affixes like *t*, although composed of consonantal material and even when infixed, are not part of the root proper and therefore do not appear on that morphemic tier, as shown above in (2). Precisely the same mechanism limits the possible game derivatives of classes IV, VII, and X to those listed. Affixal ʔ, *n* and *st* all lie on separate tiers from the root. Similar considerations hold too for inflectional morphemes, which are prefixed or suffixed to the stems in (5). Thus, from *difa9na* 'we pushed', it is possible to derive *fida9na*, *9afadna*, and so on, but not **na9adfa* or **fina9da*. Furthermore, nouns, which are also subject to the game, cannot have affixes scrambled with the root. Thus, the noun *miftaaḥ* 'key', which has a deverbal prefix *m* with the root [ftḥ], can yield *mifḥaat*, *mitfaaḥ*, or *miḥfaat*, but not **tiḥmaaf* or **tiḥfaam*.

Further data from roots with other than three consonants also confirm this approach. As expected, a quadriliteral verb like *taržam* 'translated' can be transformed to *tarmaž*, *martaž*, *žamrat*, *žartam*, and so on for 4! possibilities. Biliteral roots, discussed in detail in McCarthy (1981), form only a single output in the game. The class I verb *ḥall* 'solved' and the class II verb *sammam* 'poison' can become *laḥḥ* and *massas*, respectively, but not **lalḥ*, **laḥl*, **masmam*, or any others. This result follows from the independently-motivated representation of these forms given in (7):

(7)



Scrambling on the root tier before association could yield only the indicated game derivative of each of these forms.

A final point of interest in the BHA language game concerns the treatment of forms with reduplicated biconsonantal roots, like *zalzal* in (3). Scrambling on the root tier, before association, gives the well-formed output *lazlaz*, with all other conceivable possibilities judged ungrammatical: **lazzaz*, **zallal*, **lazzal*.

These data, then, provide very strong confirmation for the conception of Arabic morphology in McCarthy (1981). The basic process in this game is quite simple: permute on the root tier. Nothing else need be said, since other results – ordering of scrambling before association and the exclusion of ill-formed outputs – follow from either the representational system or independently necessary properties of the analysis. It is difficult to imagine how else this complex set of facts could be explained.

2.2. *Hanunóo Transposition Game*

Several games of the Philippine language Hanunóo have been described by Conklin (1959). Here we will be concerned with one that, like the game in BHA, involves scrambling of root material. This game is apparently used productively by young people and learned in early adolescence.

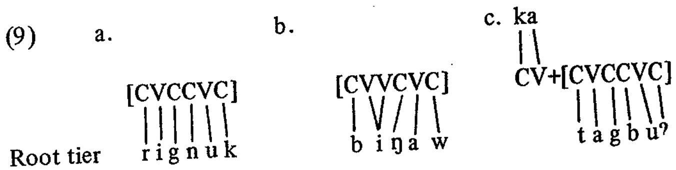
The Hanunóo game exchanges the first and last consonant-vowel sequences in the stem with one another, as shown in (8):

(8)	Base Form	Game Form	
	rignuk	nugrik	'tame'
	bi:ŋaw	ŋa:biw	'nick'
	ʔusah	saʔuh	'one'
	balaynun	nulayban	'domesticated'
	ba:raŋ may bu:ŋa	ra:baŋ may ŋa:bu	(phrase of greeting)
	ʔa:san sa kanta	sa:ʔan sa tanka	
	katagbuʔ	kabugtaʔ	

Two observations Conklin makes about this language game suggest its relevance for a theory of phonological representations. First, vowel length remains unchanged despite the transposition of vowels. So, for example, the long vowel-short vowel pattern of *bi:ŋaw* persists in the game form *ŋa:biw* even though *i* and *a* have been exchanged. Second, only the segments of the root participate in the transposition. Because of this, the prefix *ka+* in *katagbuʔ* is unaltered in the game form *kabugtaʔ*. Both of these phenomena – the invariance of canonical pattern and the limitation of scrambling to root material – are obviously reminiscent of the situation in BHA. The formal interpretation is essentially the same.

We can recognize in Hanunóo two basic levels of representation in a morphologically simplex form. The prosodic template will describe the canonical pattern of the word. Clearly, however, the Semitic consonantal root/vowel melody dichotomy does not carry over to a language of this type. The root tier, then, will contain both consonantal and vocalic elements, mapped according to the matching convention described in section 1. Some sample representations appear in (9):

(9) a. b. c.



In this model, then, the Hanunóo game can be seen as a transposition of the first and last consonant-vowel sequences in the root tier. Material in the prosodic template is unaffected, and thus vowel length remains unchanged (9b). Elements on other morphemic tiers – like the prefix *ka+* in (9c) – are similarly unaffected by the root tier operation.

This preservation of the prosodic and morphological patterns of a word, despite massive segmental disruptions produced by a language game, is met with in the related language Tagalog as well (Conklin (1956)). As in BHA, the segregation of information about canonical form and about other morphemes on different formal levels allows essentially independent manipulation of any one of these factors. The transposition games depend crucially on this formal isolation.

2.3. *Infixation Games*

An extremely common type of language game involves the insertion of some sequence into every syllable or every word of the base. In some cases, the inserted material is fully specified, as in the English Alfalfa and Ob games (Donegan and Stampe 1979). Games of this sort are compatible with the model presented here, but do nothing to distinguish it from others. Many games, however, involve the insertion of only partly specified strings, and, as we will see, provide strong support for the prosodic theory.

Two Cuna play languages described by Sherzer (1976) illustrate this claim. The first, known as *ottukkuar sunmakke* 'concealed talking', is exemplified in (10a); the second, which is unnamed, appears in (10b).

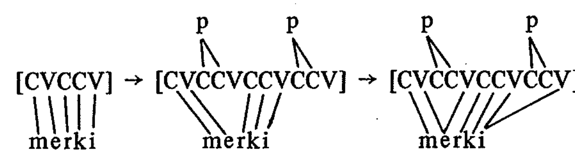
(10)

	Base Form	Game Form	
a.	merki	mepperkippi	'North American'
	pia	pippiappa	'where'
	ua	uppuappa	'fish'
	perk^{W}aple	pepperk^W appapleppe	'all'
b.	merki	mererkiri	
	pe	pere	'you'
	pia	piriara	
	tanikki	taranirikkiri	'he's coming'

Clearly, the basic observation underlying these facts is that both games

involve inserting after the nucleus of every syllable the consonant(s) *pp* or *r* followed by a copy of the preceding vowel. The prosodic interpretation of this is quite straightforward. The infix is of the form CCV (or CV) with both C-slots preassociated to the melody *p* (or *r*), but with the V-slot unspecified. Then, automatic spreading in conformity with clause (4c) of the Association Conventions will yield apparent copying of the preceding vowel. This derivation is illustrated in (11):

(11)



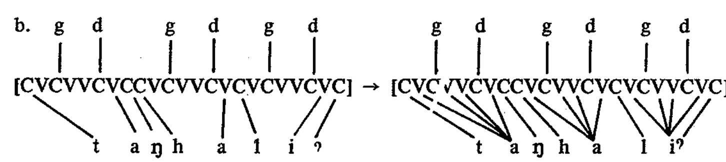
Only one aspect of (11) requires special mention. The melodic elements *p*, which specify the consonants of the infix, are represented on a separate autosegmental tier from the root or any other part of the form. This reflects a plausible conception of these elements as quasi-morphemes, distinct from other morphological units. The result of this representation is that automatic spreading alone is sufficient to yield the observed vowel copying.

It appears that language games with copying infixes are extremely common, and thus it is a distinct advantage of this theory that it is able to provide an elegant account of them. Sherzer (1976) describes two games of Javanese with *f*V and *p*V infixes. Price and Price (1976) describe games collectively known as *akoopína* in Saramaccan creole, some of which involve infixation of an *l*V*l*V sequence. This circumstance, in which more than one infixed vowel is unspecified, is clearly documented in some of the Tagalog language games called *baliktád* (Conklin 1956). In one version, a V*g*VV*d* sequence is infixed after every syllable-initial consonant. This is exemplified in (12a) and represented formally in (12b):[3]

(12)

	Base Form	Game Form	
a.	hindí?	higí:dindigí:di?	'no, not'
	taŋhá:li?	tagá:daŋ hagá:daligí:di?	'noon'

b.



As in the simpler cases, the melodic specification of the infixed C-positions appears on a separate tier, allowing free (and automatic) association to specify the infixed V's. Other infixes appear in *baliktád* games, including the striking VV*p*V*nd*VV*p*, and these are often combined with one another or with transposition games in a single form.[4]

Although I have been unable to document the existence of such a process, this model predicts that there should be games of some language with CV or VC (or longer) infixes where the consonants are unspecified and the vowels are fully specified. What is much more difficult for this theory to express, and therefore ought to be highly marked if not nonoccurring, is a situation in which both elements of the inserted VC or CV are unspecified and copy adjacent material. This hypothetical case must, of course, be distinguished from syllable copying or the like, which is not uncommon, but apart from this the prediction of the prosodic model is clear.

3. TWO NONCONCATENATIVE SYSTEMS

3.1. Gtaʔ

A remarkable example from outside the Semitic family in which the vocalic tier figures prominently is presented by Gtaʔ, a South Munda language. Although the phenomenon we will discuss here is apparently an areal feature of South Indian languages, it is most elaborated in Gtaʔ and has been carefully described there by Mahapatra (1976).

Gtaʔ has a productive process of echo-word formation, a term originally due to Emeneau (1967). These derivatives form a kind of paradigm for each word, as illustrated in (13):

(13)

Base Form		Echo Forms	
a. kitoŋ 'god'		kataŋ	'being with powers equal to *kitoŋ* (e.g., a benevolent ghost)'
		kitiŋ	'being smaller, weaker than *kitoŋ* (e.g., a minor deity)'
		kitaŋ *or* katoŋ	'being inferior in status to *kitoŋ* (e.g., a bad ghost)'
		kutaŋ	'being other than *kitoŋ* (e.g., spirits, ghosts, etc.)'
b. kesu	'wrapper worn against cold'	kasa	'cloth equivalent to *kesu* in size and texture'
		kisi	'small or thin piece of cloth'
		kesa *or* kasu	'large piece of thick cloth, torn or worn out, serving as a *kesu*'
		kesi	'like *kesa/kasu*, but small, thin piece'
		kusa	'any other material usable against cold'
c. bole 'rice'		bala	'food stuff usable as main dish (e.g., millet gruel)'
		bili	'snacks and the like, not constituting staple food'
		bale	'food not made of grain (e.g., tubers or mango stones)'

As is clear from (13), echo-words involve some systematic modifications in the vocalism of the base with a concomitant change of meaning. According to Mahapatra, changing all base vocalism to *i* yields a diminutive or hypochoristic sense, while changing all vocalism to *a* has the opposite, augmentative effect. Changing fewer than all vowels to *i* or *a*, respectively, has the same result, but with an added sense of inferiority. Another vowel pattern, *u-a*, indicates a type "different from" the meaning of the base. Zide (1976) confirms the substantial semantic regularities in echo-word formation.

We will first see a formal analysis of these alternations, and then consider some further details that lend added support to this analysis.

As in the voice and aspect inflection of the Classical Arabic verb system, we can isolate a set of morphemes whose sole realization is as vocalic melodies on a morphemic tier. One subset of these melodic morphemes is purely formal: the vocalic melodies associated with the base words. The other subset, which appears in (14), consists of the echo-word melodies which have the meanings indicated above.

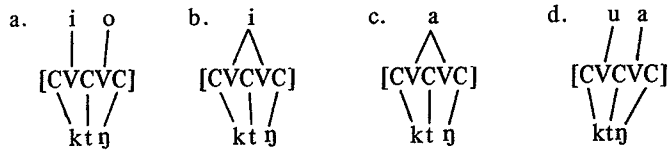
(14) Gtaʔ Echo Word Melodies

[i]
[a]
[u a]

Presence of one of these melodic morphemes on the vocalic tier marks a form as an echo-word.

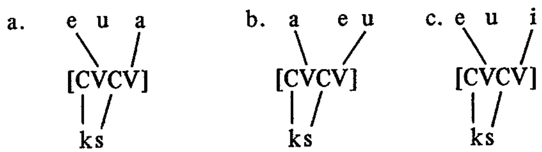
The formation of echo-words will proceed as follows. In one type, represented in (15b, c, d), one of the echo-word melodies appears alone on the morphemic tier. That is, the base-word melody in (15a) is lost:

(15)



In the other type, those forms with the added meaning of inferiority, the base melody and echo melody appear together on the same tier, in either order:

(16)



Here, the prohibition of many-to-one associations between the melody and a position on the prosodic template ensures a one-to-one mapping, with the echo-word melody partly displacing the base melody. The unassociated melodic elements in (16) receive no phonetic interpretation.

A number of further facts suggest slight extensions of this analysis. First, the "differential" melody [u a] is nonoccurring with monosyllabic forms, although the other melodies are possible. This is shown in (17):

(17)

	Base Form		Echo Forms
a.	gnaˀ	'basket'	gniˀ
b.	mni	'name'	mna
c.	gsuˀ	'dog'	gsaˀ
			gsiˀ
d.	gbug	'pig'	gbag
			gbig
e.	sle	'work'	sla
			sli
f.	tboˀ	'earth'	tbaˀ
			tbiˀ
g.	gsɛŋ	'chicken'	gsiŋ
			gsaŋ

The absence of monosyllables with the melody [u a] follows from the prohibition against many-to-one association. This melody cannot be realized on a single element without such a configuration arising. We may presume that association of part of the echo melody, which would be formally permissible, is ruled out by essentially functional considerations

of morphological opacity or recoverability. That is, the full melodic morpheme must appear as a mark of the echo-word class. Similar factors exclude the partial association (as in (16)) of the [u a] melody with disyllables. We shall have occasion to come back to this notion of opacity in greater detail in connection with root association in Temiar, in section 3.2.

This argument is vitiated somewhat by the absence of [u a] echo words among trisyllabic stems, suggesting that perhaps this melody must in any case be limited to disyllables. It may be, however, that the lack of [u a] echoes of trisyllables is an accident due to the relative scarcity of such stems in Gtaˀ. And interestingly, the facts of echo-words in the Desia dialect of Oriya, an Indo-Aryan language also described by Mahapatra (1976), support the explanation offered for (17). In Desia the [u a] melody occurs with disyllabic nouns as in Gtaˀ (18a). It can also occur with monosyllabic nouns, but the template is extended by the addition of a final V position (18b). No information is provided for trisyllables.

(18)

	Base Form		Echo Form
a.	sili	'wheel'	sula
	celi	'goat'	cula
	poti	'book'	puta
	pani	'water'	puna
b.	git	'song'	guta
	dud	'milk'	duda
	tel	'oil'	tuɭa
	ḍol	'drum'	ḍula
	jɔr	'fever'	jura
	mac	'fish'	muca

The augmentation in (18b) does not occur with monosyllabic verbs, which echo with the simplex melody [a] or [u] (the latter when the base is [a]): *por* 'to burn' becomes *par; baj* 'to fry' becomes *buj*. These observations make sense only under a theory in which the [u a] melody must be fully associated with the template, consistent with the prohibition of many-to-one associations.

Another interesting set of facts is presented by base-forms containing diphthongs, as in (19):

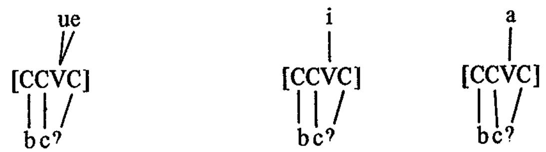
(19)

	Base Form		Echo Forms
a.	bcueˀ	'tamarind'	bciˀ
			bcaˀ
b.	luen	'road'	lin
			lan
c.	nsua	'spade'	nsi

The base diphthongs obviously echo as single, short vowels. The diphthongs do not behave like disyllabic words; they fail to accept the [u a] melody or partial replacement of the base melody by [i] or [a]: **bcuaʔ, *bcieʔ, *bcuiʔ*.

Zide (1976) suggests a compelling explanation for this pattern. If the diphthongs are short – that is, monomoraic – then they would be expected to echo as short vowels, as shown in (20):[5]

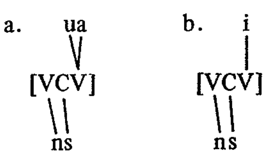
(20) a. Base Form b. Echo Forms



This account obviously presupposes that the prohibition on many-to-one associations is applying in (20b) and the like, to rule out the [u a] melody or partial replacement of the diphthongal melody. The obvious question is why this prohibition does not exclude all representations of monomoraic diphthongs, as in (20a). It would seem that the lexical melody – the base vocalism – is associated with the template in the lexicon, and thus can constitute an explicit exception to the prohibition. Derived melodies in the echo words are nevertheless subject to it. This makes the apparently correct claim that echo-words never contain diphthongs.

The form (19c) brings in a further point of analysis. Zide (1976) points out that the general participation of vowels in the formation of echo words is systematically violated by syllabic nasals: thus *n̩sua* echoes as *n̩si*, not as **isi* or **ĩsĩ*. This demonstrates that echo formation is not simply an operation on syllable nuclei, but specifically a matter of adding a vocalic melody on a morphemic tier. The representation of *n̩sua* and its echo appears in (21):

(21) a. b.



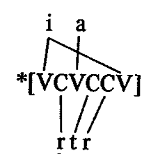
That is, the lexical representations of Gtaʔ explicitly permit the association of [-vocalic] *n* with a [+vocalic] V-position of the template, and therefore this consonant can constitute a syllable nucleus even though it does not appear on the vocalic tier. Further discussion of syllabic nasals in a representational model of this sort can be found in Yip (to appear).

A final point of Gtaʔ echo formation provides quite strong support for the analysis presented here. The melodies [a] and [i] occur quite freely with trisyllabic words, as shown in (22):

(22)		Base Form	Echo Forms
	a.	aṛatra 'up'	iṛitri
			iṛitra
			iṛatra
	b.	picoṛi 'a bat'	pacaṛa
			piciṛi
			pacaṛi
			picaṛa
			pacoṛi
			picaṛi
	c.	sewari 'free drink'	sawara
			siwiri
			sawari
			sewara
			sewiri

As the analysis predicts, the echo melody can fully replace the base melody (*iṛitri, pacaṛa, sawara, siwiri*). The echo melody can also occur in any position on the vocalic tier with the base melody: before it (*iṛitra, iṛatra*), after it (*picaṛa, sewara*), or in the middle of it (*picaṛi*). What Mahapatra (1976) explicitly rules out, however, is the possibility of the echo-word vocalism affecting vowels in nonadjacent syllables, so hypothetical **iṛatri* or **pacoṛa* are excluded. This follows directly from the formalism; a single melodic element cannot be mapped onto two nonadjacent vowels without violating the Well-formedness Condition, as illustrated in (23):

(23)



Under any account of this phenomenon that did not incorporate vocalic melody levels, this observation would necessarily be stipulated in the analysis, whereas here it is a property of the representational system.[6]

There are some remaining puzzles of Gtaʔ echo-word formation. Chief among them is the nonoccurrence of some expected echo-word derivatives of various stems. Mahapatra presents a number of complex principles to exclude certain arrangements of base-word and echo-word vocalism, and it is possible, though unrevealing, to translate these principles into the melodic notation adopted here. Another puzzle is the apparent acceptance of the echo-word melody by prefix vowels: *aʔ+coŋ* 'feed' echoes as *iʔ+ciŋ*; *ma+coŋ* 'eat (pl. obj.)' echoes as *mi+ciŋ*. Since the vocalic melodies associated with the prefix morphemes must appear on different morphemic tiers from the root melodies, they ought to be able to echo or fail to echo independently. This is precisely the behavior in the echo words derived from compounds – the two morphemes constitute separate domains of echo formation. As the analysis currently stands, an ad hoc rule spreading the echo melody to the prefixal template is necessary to explain *mi+ciŋ* and the like, with the spread association displacing the basic melody of the prefix.

3.2 *Temiar Morphology*

The verbal system of Temiar, a language spoken on the Malay Peninsula, is striking in its heavy reliance on both prosodic (CV) and morphemic (μ) templates. The system has close structural parallels with Classical Arabic and is fully compatible with the theory offered here. The data are drawn from a fairly lengthy description by Benjamin (1976).

Verb roots can be divided into three classes according to canonical pattern: biconsonantal roots CVC (*kɔ̄w* 'to call'); triconsonantal roots CCVC (*slɔg* 'to lie down, marry'); and longer roots CV(C)CVC (*halab* 'to go down-river', *sindul* 'to float').[7] These longer, disyllabic roots are largely uninflected and consequently fail to participate in the morphological alternations discussed here, a fact that we will return to at the end of this section. Inflection of the shorter verbs for aspect and voice is largely a function of modifications of this canonical form, sometimes with root reduplication and various affixation phenomena. Representative paradigms, including bracketed forms formed by rule but not actually given for these particular roots, are presented in (24):

(24)

		Biconsonantal Root	Triconsonantal Root	
Active Voice				
	Perfective	kɔ̄w	slɔg	
	nominal	[knɔ̄w]	[snlɔg]	
	Simulfactive	kakɔ̄w	salɔg	
	Nominal	[kanɔ̄w]	[snalɔg]	
	Continuative	kwkɔ̄w	sglɔg	
	Nominal	[kwnɔ̄w]	[snglɔg]	(Kelantan dialect)
		[nwkɔ̄w]	[ngslɔg]	(Perak dialect)
Causative Voice				
	Perfective	trkɔ̄w	srlɔg	
	Simulfactive	[trakɔ̄w]	[sralɔg]	
	Continuative	trwkɔ̄w	srglɔg	
	Nominal	[trnkɔ̄w]	srnlɔg	

The verb forms, except for the simulfactive causative, are apparently productive; the other forms somewhat less so. Nevertheless, these data are faithful to the formal possibilities in Temiar morphology. They are also not as limited in function as (24) indicates. Most deverbal nouns (other than the nominalizations in (24)) are formed according to one of these schemata, and noun plurals follow the active continuative pattern.

Let us first consider the active voice verb forms and then extend the analysis to the causative and the various nominalizations. It is apparent that the perfective active is the formally unmarked category, retaining the unchanged form of the stem. The two perfective types in (24) can be represented as in (25), with root and prosodic template constituting different levels:

(25)

		a.		b.
Template	[CVC]			[CCVC]
	| | |			| | | |
Root	k ɔ̄ w			s l ɔ g

The templates in (25) are the characteristic morphology of the perfective active, since different templates appear in other categories. Thus, the two levels in (25) constitute separate morphemic tiers.

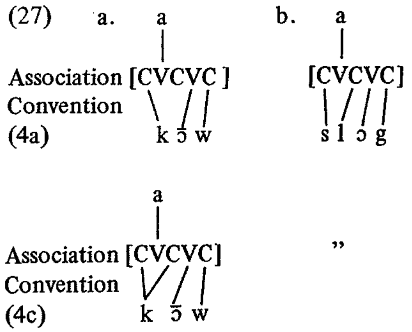
The simulfactive has two stem syllables (with *a* in the first one) and, in the case of the biconsonantal root, reduplication of the initial consonant. Unlike the perfective, in the simulfactive one template suffices for both root types. It appears as in (26), with *a* preassociated to the first V-slot:

(26) Simulfactive Active Template

```
 a
 |
[CVCVC]
```

The element [a], part of the characteristic simulfactive morphology, appears on a separate tier from the root. Association will proceed as in (27):

(27)



In particular, the reduplication of initial *k* in the biconsonantal root follows directly from universal principles. Left-to-right association is governed by the prohibition on many-to-one mappings, which blocks association of ɔ̄ with the first V-slot of the skeleton. *k*, then, must spread to fill the unspecified second C-position. Just as in Arabic, shorter roots are expanded by spreading (with the apparent effect of reduplication) to fill templates that are exhaustively occupied by longer roots.

The continuative form shows a different sort of reduplication – partial copying of the root in both the biconsonantal and triconsonantal types. This is analyzed as full root reduplication – the mapping of the root onto a morphemic template of two μ-categories, just as in the Arabic form in (3) – with association of portions of the copied root to the prosodic template. Formally, for the continuative we will stipulate the prosodic template (28a) and the morphemic template (28b):

(28) Continuative Active Templates

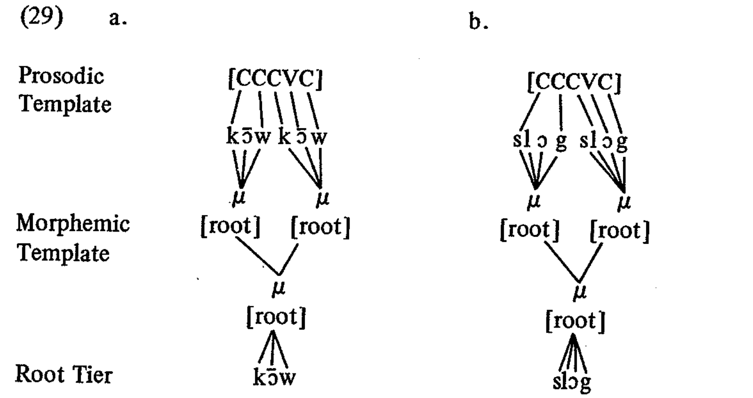
a. [CCCVC]

b. [$\underset{\text{[root]}}{\mu}$ $\underset{\text{[root]}}{\mu}$]

The full representation of the continuative active form appears in (29) (see next page).

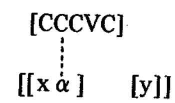
The roots are copied fully by the morphemic template (28b), but the prosodic template of the continuative (28a) provides positions for only four consonants and one vowel, and so only portions of the copied root are mapped onto template positions – just the opposite of the situation in the simulfactive of biconsonantal roots. Remaining, unassociated segments do not receive a phonetic realization. Since the association of the root morpheme with the two positions of the morphemic template is a trivial case of spreading, the real problem presented by (29) is that of accounting for the mode of association between the copied roots and the prosodic template.

(29)



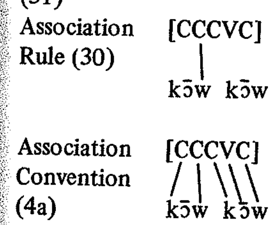
It is clear that the universal principles – left-to-right association (4a) in particular – will not yield the relationships in (29) without further modifications. I suggest, then, the language-particular association rule (30), which associates the last element (α) in the first copy of the root with the second C-position of the prosodic template (this will be modified later):

(30) Continuative Association



For a biconsonantal root like *k ɔ̄w*, left-to-right association applied to the output of (30) yields the correct result, as the derivation in (31) shows (only the relevant parts are shown here and in (32)):

(31)



But the mapping of the triconsonantal root *slɔg* requires the invocation of the functional exclusion of morphological opacity, alluded to earlier. The output of (30) is transformed, by the Association Conventions alone, into the ill-formed structure in (32):

(32)

Association Rule (30)	[CCCVC] slɔg slɔg
Association Convention (4a)	*[CCCVC] slɔg slɔg

In (32), neither copy of the root element ɔ is associated with a template position, and consequently this element receives no phonetic realization. If, as seems reasonable, this sort of situation, where a portion of the root is lost, is ruled out in principle, then we can derive the correct result. Left-to-right association proceeds normally, subject to the condition that all elements of the root must appear at least once in the output.[8] The actual continuative active structure (29b) is the only result that meets this requirement.

This addition to the formal morphological theory is strongly supported by some data from Levantic Arabic which is strikingly similar to the Temiar continuative, differing only in a parameter set by the language-particular association rule (30).

Many Levantine Arabic dialects have a process of intensive/pejorative verb formation that is applicable to both biconsonantal (33a) and triconsonantal (33b) roots:[9]

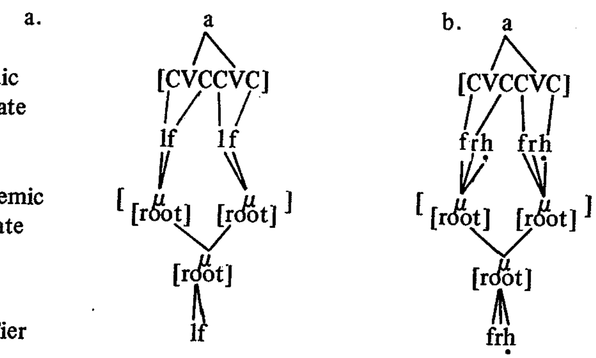
(33)

		Root	Derived form	
	a.	lf	laflaf	'wrapped (intensive)'
		ḥl	ḥalḥal	'untied, undid'
	b.	frḥ	farfaḥ	'rejoiced'
		bḥš	baḥbaš	'sought'
		mrṭ	marmaṭ	'cut unevenly'
		brḍ	barbaḍ	'shaved unevenly'
		dḥl	daḥdal	'rolled gradually'
		šrḥ	šaršaḥ	'criticized severely'
		ḥlṭ	ḥalḥaṭ	'sheared unevenly'
		qrṭ	qarqaṭ	'crunched'
		šḥṭ	šaḥšaṭ	'dragged roughly'

All of these derived forms are regularly associated with verbs in the first derivational class, to which they bear a fairly consistent semantic relationship.

These verbs are formed on the [CVCCVC] template, the unmarked category for stems with four consonants, including quadriliteral roots. They also clearly have root reduplication by virtue of a morphemic template [$\overset{\mu}{\text{[root]}}$ $\overset{\mu}{\text{[root]}}$], like the Classical Arabic form in (3). But unlike this Classical Arabic pattern, Levantine Arabic reduplicates both biliteral and triliteral roots, to yield the output structures in (34):

(34)



There is nothing particularly notable about (34a); simple left-to-right association produces this pattern without other considerations arising. But (34b) is clearly a more complex case. For a triliterial root C_1 C_2 C_3 in Arabic, the surface schema of reduplication is C_1 C_2 C_1 C_3, whereas the schema is C_1 C_3 C_2 VC_3 in Temiar. This interlinguistic difference in two such similar modes of reduplication can be attributed to the setting of a simple parameter: Temiar has the language-particular association rule (30), while Levantine Arabic has that in (35):

(35) Intensive/Pejorative Association

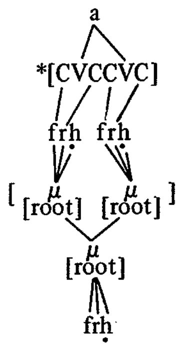
[CVCCVC]

[[x] [αy]]

This rule, then, associates the initial element of the second copy of the root with the third C-slot of the prosodic template.

The Association Conventions alone, applied to the output of Intensive/Pejorative Association (35), yield the ill-formed structure in (36), in which neither copy of the root-final consonant *ḥ* is associated with the prosodic template:

(36)



Here again we must invoke considerations of morphological opacity, requiring that all root elements be mapped onto template positions, to generate the correct pattern of association. The difference between Arabic and Temiar in the realization of reduplicated roots where insufficient template positions are available can be referred solely to a difference in simple language-particular rules of association, providing we have this principle.

The causative voice verb forms of Temiar are related in a systematic way to the corresponding active voice ones. We can recognize essentially three formal differences between the active and causative. First, the causative is formed on a prosodic template taken from the set in (37):

(37) Causative Prosodic Templates
a. Perfective [CCCVC]

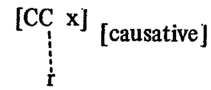
a
|
b. Simulfactive [C+CVCVC]
c. Continuative [C+CCCVC]
(with [$\overset{\mu}{\text{[root]}}$ $\overset{\mu}{\text{[root]}}$] morphemic template)

As I have indicated by the internal boundary in (37b and c), the causative templates of the simulfactive and continuative are identical in all respects to the corresponding active ones, except that they have C prefixed to the template – that is, a template morpheme. No such decomposition is possible with the perfective, however: the perfective active form is different for the two root types ([CVC] and [CCVC]) but the perfective causative is the same for both.

A second difference between active and causative forms is that the latter have the melodic morpheme [r] associated with the second C-slot

of the template. This is accomplished by rule (38), applied before and taking precedence over the mapping of the root onto the template.[10]

(38) *r*-association

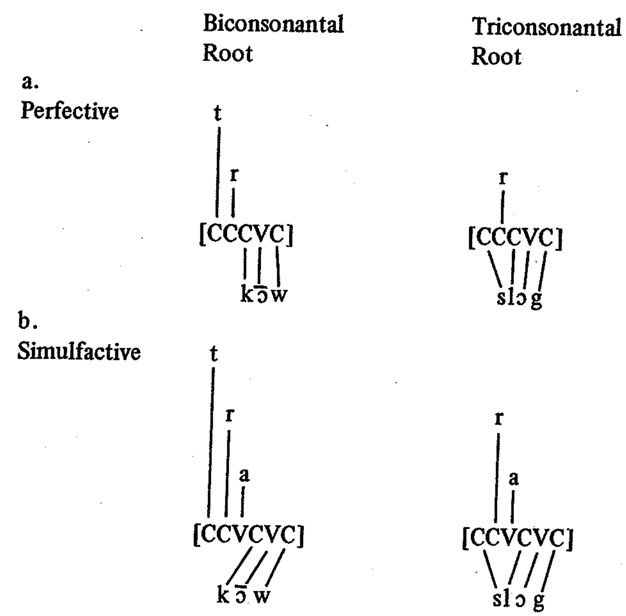


The morpheme *r* will appear on a separate morphemic tier from the root, and thus (38) in some cases has the apparent effect of infixation. This is formally similar to the Arabic representation in (2).

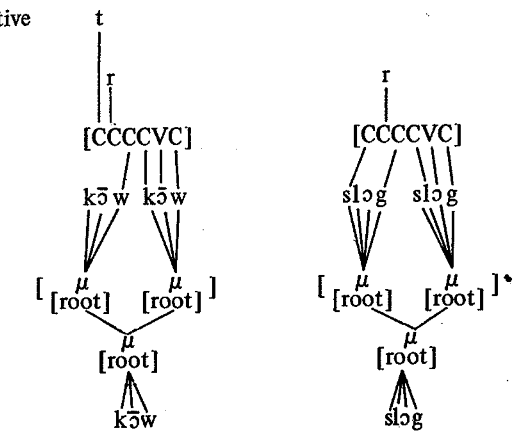
Finally, all causative forms based on a biconsonantal root like *kɔ̄w* have another melodic morpheme, *t*, in prefixal position, associated with the initial C-slot of the template. Like (38), this association will also take precedence over the mapping of root material.

Full representations of the causative verb forms appear in (39):

(39)



c.
Continuative



The derivation of the perfective forms is unremarkable. After the affixation processes attaching [t] and [r], there remain an equal number of unfilled skeleton slots and unassociated root elements, so left-to-right association (4a) applies normally. In the simulfactive, the prior association of melodies [t] and [r] with the first two C-slots blocks the spreading of *k* found in the biconsonantal active simulfactive form *kakɔ̄w* (27a). That is, Association Convention (4c) is inapplicable here, because of the prohibition of many-to-one associations, and the entire result follows from left-to-right association. The model, then, accounts directly for this difference in the surface form taken by the simulfactive morphology in the two voices. Because spreading is impossible in the causative, only the active form shows reduplication.

The continuative aspect of the causative voice involves one additional complication over the corresponding active. By the application of the Continuative Association Rule (30) the active continuative shows copying of the root-final consonant in the second C-position of the template: *kwkɔ̄w, sglɔg*. But the causatives have this same root consonant associated with the third C-slot of the skeleton. This calls for a small revision in the Continuative Association Rule, along the lines in (40):

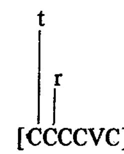
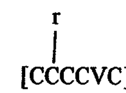
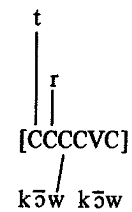
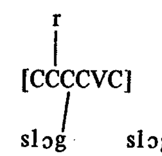
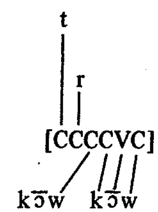
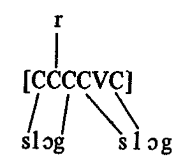
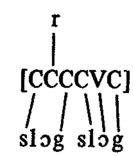
(40) Continuative Association (Revised)
[(C)CCCVC]

[[xα] [y]]

This new version of the association rule distinguishes the two voices according to their templates: active [CCCVC] has mapping onto the second C-slot, while causative [CCCCVC] has association with the third C-position.

With this question aside, we can consider the full derivations of the causative continuative forms. These appear in (41) (again, irrelevant structure has been suppressed):

(41)

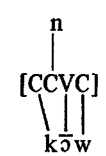
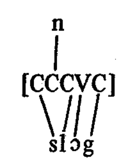
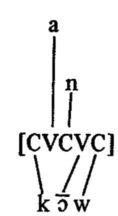
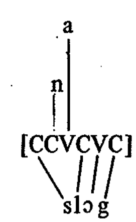
	Biconsonantal Root	Triconsonantal Root
Affix association		
Continuative Association (40)		
Association Convention (4a)		
Morphological Opacity	”	

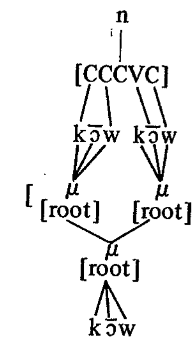
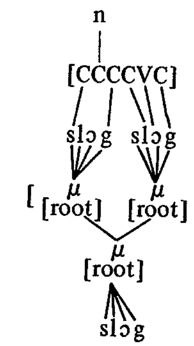
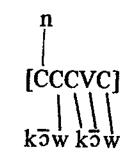
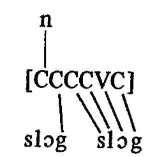
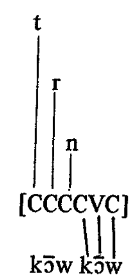
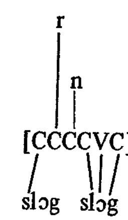
The causative has full morpheme reduplication, by virtue of the morphemic template (28b), like the corresponding active. The causative also clearly presents the same problem of too few slots for the available root material. After the application of Continuative Association (40), left-to-right mapping (4a) can proceed, associating the triconsonantal root's *s* with the first template slot. But this association by convention is blocked in the biconsonantal root by the prior association of affixes [t] and [r]. The effect of this is that the biconsonantal root appears to have a preposed copy of its final consonant, a surprising situation that arises quite automatically under the analysis developed here. Notable also is that prior association of these affixes accounts for the difference in reduplication between the active and causative continuative of the biconsonantal root, parallel to the result presented above for the simulfactive. Finally, we see in (41) that morphological opacity blocks left-to-right association for its failure to associate ɔ, and so the correct output provides a realization for all root elements.

The nominalizations constitute an interesting and complex variation on the verb analysis. Part of the complexity is no doubt due to their lesser productivity and the indicated dialect variation. Nominal forms are not given for the active and simulfactive causative; they are given, however, for disyllabic roots, which participate in no other aspect of the morphology that we have discussed. Related to the disyllabic roots *golap* 'to carry on shoulder' and *sindul* 'to float' are the nominalizations *gnolap* and *snindul*.

We will first look in (42) at the prosodic structures of the nominalizations of the biconsonantal and triconsonantal roots, and then turn to the rules creating these structures and the special problem of the disyllabic roots.

(42)

	Biconsonantal Root	Triconsonantal Root
a. Perfective Active		
b. Simulfactive Active		

	Biconsonantal Root	Triconsonantal Root
c. Continuative Active Kelantan dialect		
Perak dialect (abbreviated structure)		
d. Continuative Causative (abbreviated structure)		

As indicated in (42), I have suppressed the morphemic template and associated root-reduplication structure where it is merely repetitious.

It is clear that the nominalizations are formally derived from the corresponding verb forms, to which they bear many similarities. The rules of derivation, however, are of considerably less generality than those described above for the verb system, and so our analysis must tolerate a good deal of unexplained government of rules by morphological category or root type.

Prefixation of a C-slot to the template of the corresponding verb takes place in the nominalizations of the perfective of all root types and the nominalizations of the active simulfactive and continuative of the triconsonantal root. I have discovered no systematic character to this distribution, so it must be assumed that the prefixation rule (43) is controlled by category and root type:

(43) Nominal Prefixation
$\emptyset \rightarrow C \; / \; [\_\_x]$

Another process, applied after (43), maps the characteristic nominal melody [n] onto some C-position of the template. In most cases, this can be attributed to the rule (44), which associates [n] with the second C-slot from the left:

(44) *n*-association

```
[C(V) Cx]
      :
      n
```

Rule (44) accounts directly for the perfective and simulfactive nominalized forms.

On the basis of these two nominalization rules, we can consider the treatment of disyllabic roots like *golap* and *sindul*. The structures of their nominalizations are given in (45):

(45) a.

```
  n
  |
[CCVCVC]
 \ ||//
 golap
```

b.

```
  n
  |
[CCVCCVC]
 \ ||||/
 sindul
```

These nominalizations can be derived from the corresponding stem forms by Prefixation (43) applied to the template, with subsequent *n*-association (44). These forms are clearly consistent with this much of the analysis, but there is a deeper moral here as well.

Recall that the disyllabic roots do not undergo any of the verbal morphology described here – they remain uninflected or are subject to some simple affixation processes. It is obviously of some interest to account for the fact that these roots eschew all other nonconcatenative morphology but do undergo nominalization. The disyllabic roots are blocked from appearing in the other morphological categories because the templates stipulated for those categories all contain only one free V-slot. That is, these templates have the property of providing insufficient V-positions, so a

portion of the disyllabic root would remain unassociated, in contravention of the functional avoidance of morphological opacity. The nominalization, which is derived from the basic disyllabic root template by prefixing C, does provide two V-slots in the skeleton, and so is permissible.

The distribution of the [n] melody in the biconsonantal and triconsonantal continuative forms is essentially inexplicable in terms of (44). The failure of [n] to associate with the second C-slot of the causative continuative forms is conceivably due to the prior association of the distinctive causative melody [r] with that position. The [n] might thus shift association to the right, where an unfilled slot is located. But the position of [n] in the active continuative forms must apparently be stipulated for each dialect.

The association of the root with the prosodic template is unremarkable in all nominal forms but the continuatives. The causative continuatives show the expected blocking of Continuative Association (40) by the prohibition of many-to-one associations. The third C-slot in each template is already filled by [n], and therefore Continuative Association cannot apply. The effect of this is that only a single copy of the biconsonantal root appears on the surface, and only the first consonant of the first copy of the triconsonantal root. The active continuative forms show the anticipated pattern of association in the Kelantan dialect, but we would expect Continuative Association to yield **nsglɔg* as the active continuative nominalization in the Perak dialect. In the absence of other information about these dialectal differences, we can only stipulate a special association rule in the latter.

This completes the analysis of the extremely complex morphological system of Temiar. A few other formations described by Benjamin (1976) are clearly compatible with this treatment. For example, expressives – ideophone-like derivatives – involve further cases of root reduplication: *bguy* 'waft (smoke)' becomes *bybguy; rwēg* 'stand conspicuously upright' becomes *rgrwēg*. On the whole, then, Temiar morphology largely confirms the need for all the theoretical devices proposed here.

4. CONCLUSION

There are three major areas for further research in this theoretical model. First, morphemic templates promise an even more general account of reduplication than the one here or in McCarthy (1981). Recent work by Marantz (to appear), done in a slightly different formal framework, shows the need for some sort of root copying operation to account for reduplication of initial CV (or final VC) and the like, which occurs in a wide variety of languages. Second, much richer and more complex systems of morphemic tiers appear in some morphologies or subparts of morphologies. For example, it appears that the system of ideophones in Korean is largely dependent on the recognition of distinct, meaningful morphemic tiers for vowel quality, consonant quality, and the laryngeal state in obstruents. Equally elaborate is the system of levels underlying the inflectional morphology of Western Nilotic languages. Third, the possibilities of forming prosodic templates are undoubtedly richer than just linear strings of C's and V's. In McCarthy (to appear) I discuss cases of prosodic templates demonstrably made up of syllables and of metrical stress feet. These are but a few of the issues that considerations of this sort can lead us to.

NOTES

1 Yip (to appear) is a notable exception.

2 I am grateful to Hamza Al–Mozainy for providing me with information about his language and for his perceptive grasp of the issues. The Arabic transcription has the following special features. A subscripted dot in *ṭ*, *ḍ*, and *ṣ* indicates emphatic (pharyngealized) articulation. *9* and *ḥ* are the voiced and voiceless pharyngeal glides, respectively. Other symbols have their familiar values.

3 In the transcription of the game form for *hindî?* I have corrected an obvious typographical error; in the original it reads with final *ŋ*. Note that we would expect infixation alone to yield . . *ha:gá:da* . . . for the second game form, rather than the observed . . . *hagá:da*. As Conklin (1956) points out, this and the other trisyllabic sequences are each treated as single prosodic words, with stressed penults. Long vowels do not occur to the left of the penult in Tagalog (Carrier 1979), so shortening is to be expected in this and similar cases.

4 Conklin (1956) stipulates that transposition precedes infixation in forms that combine these two game processes. This ordering has the effect of ensuring that the infixed vowels copy adjacent vocalism, rather than copy some vowel that is subsequently transposed to the other end of the word. This result follows without ordering from the nature of the representational system in the prosodic model, since such nonlocal vowel copying would necessarily require crossing association lines.

5 Zide (1976) indicates that this conception of Gta? diphthongs as short is supported elsewhere in the phonology, but he gives no details. Both sources sometimes write diphthongs with onglides, but I have ignored this subtlety here.

6 Of course, it would be possible to affect two nonadjacent vowels by adding the vocalic melody twice, say at each end of the basic melody. But this is entirely excluded by the nature of all morphemes, including melodic ones: morphemes do not double or reduplicate except by explicit stipulation. No such stipulation is made in this case since no evidence supports it.

7 Two points are of significance in the phonemicization of Temiar followed here. First, I assume that vowels with a macron are distinguished from vowels without one by the feature values [±tense]. This accords well with the detailed phonetic description by Benjamin (1976) and the lack of evidence from syllable structure and phonological rules for a moraic length distinction. Second, the phonemicization abstracts away from entirely regular processes of epenthesis described by Benjamin (1976) and Diffloth (1976), which serve to break up many of the initial clusters in the cited forms.

8 Apparently somewhat marginal categories, like the Arabic quinqueliteral roots described in McCarthy (1981), can lose root material in templates that simply contain too few positions.

9 The significance of these data for nonconcatenative morphological theory was first noted by Munther Younes. I am indebted to him for bringing them to my attention and for providing me with a wealth of examples.

10 *r* could as well be preassociated with the templates in (37). This alternative would not affect the overall analysis.