



Prosodic Organization in Morphology

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Authors	McCarthy, John J.
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PROSODIC ORGANIZATION IN MORPHOLOGY*

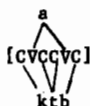
John J. McCarthy

1. INTRODUCTION

Paralleling developments in phonology, recent research in morphology (McCarthy 1979, 1981, 1982a, 1982b; Halle and Vergnaud 1980, forthcoming; Harris 1980; Marantz 1982; Yip forthcoming) has led to a significant enrichment of the representational system. This enrichment has been largely in the direction of incorporating autosegmental or nonlinear formalism into the theory of morphology, eschewing the conventional segment-and-boundary notation. Specifically, this new theory provides minimally that utterances are represented on two isochronous formal levels, called tiers: a skeleton or template characterizing canonical pattern in terms of the units C (consonant or glide) and V (vowel); and a melody of segment types, describing point and manner of articulation. Morphology is organized on at least these two levels, and sometimes more. Gestures on different levels are orchestrated with respect to one another by autosegmental conventions and rule of association.

This theory was originally devised to account for morphological regularities of the sort obtained in the Semitic languages. An example from Classical Arabic shows the basic properties of the system. The stem kattab 'caused to write' is illustrated formally in (1):

- (1) Vowel Melody Tier
 CV-template Tier
 Consonantal Root Tier



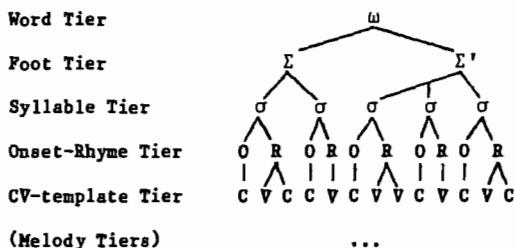
Peculiar to Semitic morphology is the recognition of two separate segmental tiers, one for vowel melodies and the other for consonantal roots. These tiers represent distinct morpheme types in Arabic, with the vowels indicating the inflectional categories of aspect and voice in verbs and the consonants serving as the basic units of lexical organization. The CV-template is fundamental to the derivational system. It is the chief formal indication of different derivational categories -- in this case, the causative or factive verb form. By virtue of the association lines linking them with positions on the template, melodic elements are given a phonetic realization. Thus, a appears in both syllables and t is geminated in kattab.

These results have been extended to a number of languages unrelated to Arabic and to typologically quite distinct phenomena, such as reduplication (Marantz, 1982), phonetically-underspecified morphemes (Halle and Vergnaud 1980; Harris 1980), secret language transformations (Yip, forthcoming; McCarthy 1982a), and echo-word formation (McCarthy 1982a). From the wide distribution of such nonconcatenative morphological processes we can conclude that all languages have access to representations similar to (1) and that these representations function in the morphological organization of words. Of course, most languages exploit the template/melody dichotomy only, not recognizing the

characteristically Semitic consonantal root. It is the CV-template, then, that is presumed to be common to the morphologically-relevant representations of all languages.

The development of nonlinear theories has focused considerable attention as well on the phonological representational system. Phonological theory arguably recognizes a variety of prosodic units like syllables, syllable subconstituents like onsets and rhymes, metrical feet, and others (Selkirk 1980, forthcoming; Kiparsky 1979; Hayes 1980; McCarthy 1979; Hale and Vergnaud forthcoming). Moreover, Clements and Keyser (1981) have shown the need in the phonology for the CV-template and segmental melody formalism, with the C and V positions incorporated as terminal nodes of syllables. Following these earlier insights particularly Selkirk's, we will adopt an overall model of the hierarchy of prosodic units like that in (2):

(2) Prosodic Hierarchy



Clearly, details of (2) are controversial, particularly the existence of exclusively binary-branching nodes and of some categories in the prosodic hierarchy. Here we will rely only on the mildest claims, calling directly on just the CV-template, the syllable, and the foot, related to one another solely by exhaustive domination without regard to details of their internal structure.

Given the dual morphological and phonological role of the CV-template, an obvious question is whether other, higher-level categories in the prosodic hierarchy can also function in the organization of the morphology. A small number of such cases have been collected. In McCarthy (1979) it is proposed that a rare Biblical Hebrew verbal derivational class (the *pə al al*) involves reduplication of the final stem syllable and that English reduplicative forms (like *higgledy-piggledy*) copy a metrical foot, albeit with some idiosyncratic variation in the segments. Marantz (1982) shows, following Nash (1980), that a rule of Yidin^y must reduplicate exactly the first two syllables of a stem. Finally, Yip (forthcoming) explores the use of subsyllabic constituents in several Chinese secret language reduplication rules, although her results on this point are inconclusive.

What these cases have in common is the hint they offer that morphological processes can have access to prosodic units other than the CV-template, and thus that the phonological and morphological representational systems are partly or entirely homogeneous. Here I will present two more extensive examples of the morphological status of prosodic categories, drawing on phenomena quite different from the suggested syllable and foot copying rules.

syllabic templates, a move with interesting empirical consequences. We will return to the issue of the differences between Modern Hebrew and Classical Arabic at the conclusion of this section.

In Modern Hebrew two binyanim of the verb are regularly used for most denominal forms as well as other sorts of neologisms. The pi'el binyan is usually transitive, while the hitpa'el is ordinarily intransitive, sometimes with reflexive or middle force. Some representative denominal pi'el and hitpa'el forms are given in (4):²

(4)	Pi'el	Hitpa'el	Source Noun
a.	nicer 'convert to Christianity (tr.)'	hitnacer 'become a Christian'	nocri 'Christian'
b.	yiven 'Hellenize (tr.)'	hityaven 'id.(intr.)'	yavan 'Greece'
c.	rikez 'concentrate (tr.)'	hitrakez 'id.(intr.)'	merkaz 'center'
d.	mimes 'realize'	hitmames 'be realized'	mamas 'reality'
e.	ziyen 'have intercourse with'	hizdayen 'have intercourse (intr.)'	zayin 'penis'

Note in particular that, in cases where the source is a proper noun, there can be no doubt that these verbs are denominal formation. As in essentially all such cases in Semitic, the derived verb form shares with its source only the consonantal root and some largely unpredictable aspects of meaning -- all other properties of the verb are determined by its membership in a particular binyan.

The pi'el binyan forms in (4) are characterized by a [CVCVC] template, which would be stipulated as part of the Hebrew derivational system. This template, in the pi'el, receives the [ie] active vowel melody or [ua] in the corresponding passive and is associated with some triconsonantal root like [rkz].³ It may also appear with a prefix interpreted as hit-, which then marks the hitpa'el binyan. Formal representations of the verbs in (4e) appear in (5), with the irrelevant vowel melody structures suppressed:

(5)	a. Pi'el	b. Hitpa'el
Affix Tier		h t
CV-template Tier	[CVCVC]	[CVC+CVCVC]
Root Tier	\ / rkz	\ / rkz

The traditional terms pu'el and hitpa'el are usually confined to verb forms with three consonant roots associated with the templates in (5). But essentially the same derivational class -- denominal verbs with transitive and intransitive forms -- can also be illustrated with a slightly longer CV-template, associated with four consonant roots:

(6)	[CVCCVC]	hit+[CVCCVC]	Source Noun
a.	pinčer 'cause a mishap'	hitpancer 'fail because of a mishap'	pančer 'mishap'
b.	'ixzev 'disappoint'	hit'axzev 'be disappointed'	'axzava 'disappointment'
c.	kifter 'button'	hitkafter 'button up'	kafter 'button'

Verb forms like those in (4) and (6) clearly represent the same derivational class. We can say, then, that the pi'el binyan, as well as the corresponding hitpa'el, may be formed on either of the templates [CVCVC] or [CVCCVC], with the shorter one applying to trilateral roots and the longer template to quadrilateral roots.

This solution of providing two CV-templates in the pi'el essentially fails to generalize to a number of verb forms with even longer roots. Yannay (1974) has collected quite a few such verbs, all attested in various sources, and they are grouped below according to canonical stem pattern:⁴

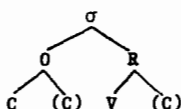
(7)	Verb	Source Noun
a.	[CCVCCVC] šlimper 'make s.o. sloppy' praklet 'treat s.o. as a lawyer would' šnarkel 'snorkel'	šlumper 'sloppy person' praklit 'lawyer' šnorkel 'snorkel'
b.	[CVCCVC] xintreš 'talk nonsense' 'argmen 'color mauve' hit'argmen 'become mauve' tilgref 'telegraph' tirklen 'arrange a room' sinkren 'synchronize' pandrek 'spoil (child)' hitpandrek 'become spoiled' 'iškenez 'make Ashkenazic' hit'ašknex 'become Ashkenazic' 'anglez 'make English' hit'anglez 'become English' sindler 'cobble'	xantariš 'nonsense' 'argaman 'mauve' telegraf 'telegraph' traklin 'room' sinkroni 'synchronic' (portmanteau word) 'aškenazi 'an Ashkenazi' 'inglizi 'English' sandlar 'cobble'
c.	[CCVCCVC] hitpravselev 'become Orthodox Christian' stingref 'take shorthand'	pravoslavi 'Orthodox Christian' stenografit 'stenographer'

Not all speakers recognize all of even most of these forms -- many are spontaneous or jocular formations. There is however, considerable agreement that all are well-formed verbs, even the unfamiliar ones. That is, the verbs in (7) meet any internalized canons of Hebrew verb formation. This is confirmed as well by the readiness with which speakers conjugate these verbs. The fact that most are loan words is, of course, irrelevant, since the point here is that they have been assimilated into the native morphological system.

It is clear from the facts in (7) that the pi'el and hitpa'el are formally much richer derivational classes than they had first seemed. They are characterized by any of the templates [CCVCCVC], [CVCCVC], and [CVCCVC] in roots of five or six radicals, as well as the two templates [CVCVC] and [CVCCVC] with three or four consonant roots. A basic insight underlying these assorted facts is the observation that essentially any well-formed sequence of two syllables is a possible pi'el form when combined with the appropriate vowel melody (and similarly for the hitpa'el).⁵ The formal mechanism underlying this idea can be made considerably more precise.

In general, Modern Hebrew permits syllables with two consonant clusters in the onset, subject to various constraints on sonority that are of no interest here. The overall syllable structure appears in (8):

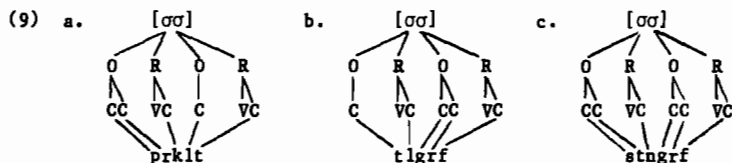
(8)



By this rule, all forms in (7) may be properly syllabified with simplex codas and with syllable-initial clusters in various positions of the word.

The grammar of Hebrew will also contain a morphological template [σσ], characteristic of the pi'el binyan of the verb (and, with prefix *hit-*, of the hitpa'el). This template, composed of two syllable units, together with the independently necessary characterization of a possible Hebrew syllable in (8), generates the full set of possible CV-templates for the pi'el: [CVCVC] [CVCCVC], [CCVCCVC], [CVCCVC], [CCVCCVC]. Therefore, this aspect of Hebrew verb morphology is essentially described by stipulating the morphological template [σσ]. Doron (1981) also develops similar templates for the other Hebrew binyanim based on the existence of other forms with complex onsets like the hif'il *hispric* 'squirt'. The only alternative analysis, conflating the five possible CV-templates of the pi'el by parentheses, would involve the clear redundancy of twice repeating the information about Hebrew syllable canons given in (8).

Under this analysis, then, some representative forms will appear as in (9):



In the introduction, we provide that a choice between several available templates is made by considerations of minimal complexity: given a particular melody, the shortest template is selected consistent with having that entire melody associated with the template.⁶ This principle is at work in (9), providing different templates for the three, four, five, and six consonant roots. There is an interesting class of cases, however, where it is violated. Consider the forms in (10):

(10)	Verb	Source Noun
a.	[CVCCVC]	
	sifrer 'assign digits'	sifra 'digit'
	'ivrer 'air (room)'	'avir 'air'
	bilfef 'hluff'	blof 'hluff'
	hitkarses 'take a course'	kurs 'course'
	hithokses 'box (fight)'	boks 'boxing'
b.	[CCVCCVC]	
	flirtet 'flirt'	flirt 'flirt'

In (10a), triconsonantal roots are associated with templates with four C-slots; in (10h), four consonant roots appear with templates with five C positions. I will assume that this is explicitly stipulated for these particular lexical items. The effect of this excess of template slots is a one-to-many mapping of melody to template, as illustrated in (11) (higher-level structure is suppressed.):

(11)	a.	[CVCCVC]	b.	[CCVCCVC]
		$\begin{array}{c} \diagdown \quad \diagup \\ \text{blf} \end{array}$		$\begin{array}{c} \diagdown \quad \diagup \\ \text{flrt} \end{array}$

The doubling of the final root consonant, rather than any other, is attributable to the left-to-right mapping inherent in the association conventions (McCarthy 1981).

Another interesting class of exceptions is presented by forms that violate the usual canons of Hebrew syllabification in (8). Yannay (1974) has three such examples, apparently nonce forms but judged as fairly well-formed: striptež, abstrekt, kimpleks 'give s.o. a complex'. The three consonant onset in the first two examples and the two consonant coda in the last two are quite marginal in Hebrew syllables. It is interesting, however, that the syllabic analysis of the pi'el template readily generalizes to these forms, assuming somewhat greater freedom in syllable formation.

We see, that there are fairly compelling reasons for characterizing Modern Hebrew verb formation in terms of syllable-based morphological templates, rather than the CV-templates exploited in the analysis of Classical Arabic (McCarthy 1981). An obvious question is whether the syllabic template alone is sufficient cross-linguistically, generalizing to the Arabic case as well. Since Classical Arabic limits syllables to one-consonant onsets and codas, no data like (7) will be forthcoming, but simplicity might nevertheless dictate this move.

There are two forceful arguments against this suggestion and in support of maintaining the different analyses of Modern Hebrew and Classical Arabic. First, Arabic must distinguish between separate derivational classes differing only in the form of templates like [CVCVC], [CVCCVC], and [CVVCVC], all of which are disyllabic. The differing form of the initial syllables in these templates is critical to the morphology. conceivably we could somehow label the first syllable of the template for each derivational class to ensure that it expanded correctly as CV, CVC, or CVV, but this ad hoc gesture is nothing more than a notational variant of the CV-template analysis it purports to replace. Second, Arabic has several derivational classes with stem-initial

clusters: [CCVCVC], [CCVVCVC], and [CCVCCVC]. The stem-initial consonant is ultimately syllabified with a preceding vowel, either a prefix or leftward across word-boundary. If no vowel immediately proceeds, then an epenthetic vowel arises to the left of the initial consonant. Here, then, the morphology requires the recognition of an extrasyllabic consonant, followed in the template by two syllables of particular sorts. We could imagine a solution that allowed the template to specify a free coda, not syllabifiable until later in the phonology, but again this seems a notational variant of the CV-template analysis. Thus, although the syllable template is well-motivated in Modern Hebrew, it fails in Arabic, so linguistic theory must countenance both systems of representation.

3. CUPEÑO⁸

The case of Cupeño, a Uto-aztecan language spoken in Southern California, provides unusually strong support for a foot-based morphological template to account for certain kinds of reduplication phenomena. Information on Cupeño has been obtained from the data and analyses in Hill (1966, 1970, 1973). The 1970 paper contains an explicit statement of the paradox presented by Cupeno, and I will first summarize it here.

Cupeño recognizes a category of verbal mood, called *habilitative*, that glosses roughly as 'can do x'. The *habilitative* is formed by irrelevant morphological processes in the verb types known as *volitional* and *nonvolitional*. But in verbs belonging to neither of these types, the natural verbs, the *habilitative* takes one of the shapes in (12):

(12)	Verb Stem	Habilitative	Gloss
a.	čá1 təw hə1ʔəp qáw kə1áw ŋiy kʷá	čáʔaʔa1 təʔəʔəw hə1ʔəʔəʔəp qáʔaʔaw kə1áʔaʔaw ŋiʔiʔiy kʷáʔaʔaʔ	'husk' 'see' 'hiccup' 'be sick' 'gather wood' 'go away' 'eat'
b.	pácik cásp l ʔfəax ^w cáŋŋəw	páciʔik cáspəʔəl ʔfəax ^w cáŋŋəʔəw	'leach acorns' 'mend' 'sing men's songs' 'be angry'
c.	pínəʔəwəx xáləy w	pínəʔwəx xáləyəw	'sing enemy songs' 'fall'
d.	cí hú pí ʔáyu	cíʔ húʔ píʔ ʔáyu	'gather' 'fart' 'bewitch' 'want'

The fundamental observation underlying these data is as follows. In (12a, 12b, 12c), the stressed syllable of the *habilitative* is followed by two syllables in the stem. In (12a) both of these posttonic syllables contain ʔ copies of the stressed vowel. In (12b) the final syllable contains a single ʔ copy of the vowel in the immediate posttonic syllable. And in (12c) no

copying has occurred at all. The forms in (12d) obviously differ from the others; they display no reduplication and have final vowels.

The analysis of these facts is quite straightforward up to the point of formalization. All stems in (12a, 12b, 12c) are consonant-final, whereas those in (12d) are vowel-final. Vowel-final stems do not undergo any morphological processes in forming the habilitative. The final ? in the words c? , h? , and p? is a regular development after final stressed vowels. In other words, the habilitative form and the stem are identical in (12d), modulo this phonological consideration.

Consonant-final stems do undergo the curious habilitative morphology. Informally, the algorithm for forming habilitatives is this: if no syllables follow the stress, then two ?V copies of the last stem vowel are inserted before the stem-final consonant; if one syllable follows the stress, then one ?V copy of the last stem vowel is inserted in that position. Forms with two syllables following the stress remain unchanged, with the habilitative differing from the underlying stem only by the action of phonological rules.

These facts lead Hill (1970) to posit a new type of grammatical rule, called a peeking rule, with global power. The rule forming the habilitative can be seen as an instruction to generate ?V copies of the last vowel in the stem until an output target with two syllables following the stress is achieved. The global capacity lies in the need for the rule to have access to its own output, and this is clearly necessary for a revealing formulation of the Cupeno habilitative rule in anything like conventional terms. The Cupeno habilitative has therefore been considered one of the most compelling and intractable counterexamples to the usually Markovian mode of rule application (Anderson 1974).

It is evident that the notion of an output target functioning in morphological rule application, the device invoked in Hill's analysis, is subsumed under the representational system of morphological templates. It remains only to specify the template of the Cupeno habilitative and its mode of association with the melody of the verbal root. The output of the habilitative rule is a sequence of a stressed syllable followed by two unstressed syllables -- that is, a dactylic foot.

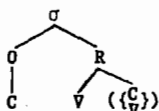
It is proposed in Selkirk (1980) and supported in McCarthy (1982c) that trisyllabic (dactylic and anapestic) feet belong to category Σ' , distinct from the disyllabic feet. A dactylic foot is left-dominant (Hayes 1980); that is, it has its branching and strong nodes on the left (as opposed to the right-dominant anapest). With these definitions, we can say that the morphological template stipulated for the Cupeno habilitative is that in (13):

(13) Habilitative Template

$[\text{x}\Sigma']$ where x is a variable and Σ' is left-dominant.

The variable x provides that the dactylic foot end the word and allows stems with nonfinal stress to form habilitatives. The dactylic foot expressed in (13) itself dominates three syllables. The independently necessary characterization of what constitutes a Cupeno syllable appears in (14):

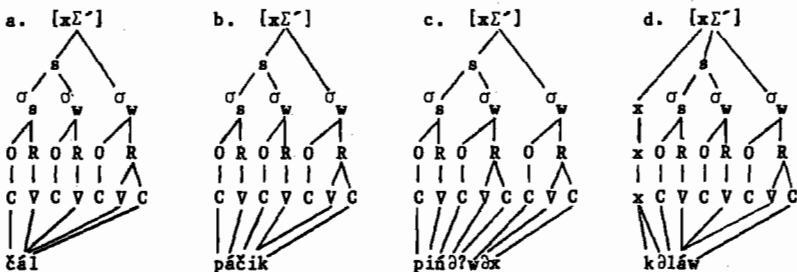
(14)



That is, a syllable contains an optional coda and an obligatory onset. Slightly richer possibilities occur in Spanish loan vocabulary, and Hill (1966) describes a limitation of codas to consonants other than oral stops. But (14) alone suffices for our purposes here.

Given the stipulated habitative template and the characterization of a possible syllable, we can arrive at the structures of some representative habitative forms, anticipating the details of the association procedure:

(15)



According to the structures in (15), the Cupeño reduplication phenomenon is a consequence of one-to-many association of a vowel in the root melody with V-positions on the CV-tier. A vowel is doubly reduplicated (15a) or singly reduplicated (15b) only to fill out otherwise vacant slots. If no slots are vacant (15c), then no reduplication ensues. The template for each root is, according to the principle stated in the introduction, minimally complex. This means that the optional element of each foot and each syllable -- in this case, only the codas -- do not appear in the template unless needed to associate a root fully, like the one in (15c). A form with material to the left of the stressed syllable associates it with the free variable x (15d). We shall deal shortly with the glottal stops that fill the (obligatory) vacant onset positions.

In this analysis, then, the formation of habitatives is indicated in the grammar by stipulation of the foot-based template (13). A verb root melody is mapped onto this template according to the following association procedure. First, the stressed vowel of the root is associated with the stressed V-position of the CV-tier (that is, the V-position dominated by the strong syllable of the foot Σ^*). Most Cupeño roots have a fixed lexical stress, and the few others (like tv in (12a)) receive a stress prephonologically by morphologically governed rules. I will assume that this lexical or nonphonological stress is represented by a feature [+stress] on a vowel of the root melody, not unlike the analysis of lexical accent systems. This [+stress] root vowel is then matched by and associates with the V of the strong syllable in the template foot, presumably by universal conventions.

Second, a stipulation is necessary to the effect that the final consonant of the root melody is to be associated with the final C-position of the CV-tier, according to (16):

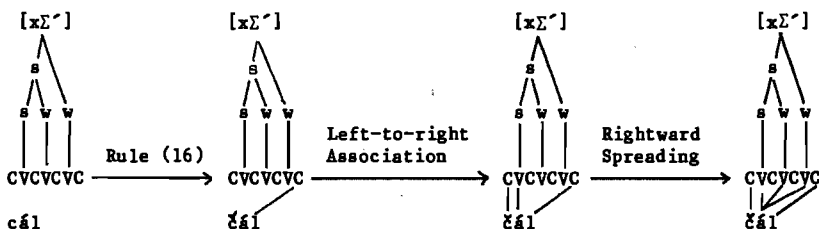
(16) Final Association

C]
 .
 .
 .
 α]

This rule, like any other language-particular rule of association, takes precedence over the operations of any universal association conventions. Final Association will, of course, apply only when α is [-syll] and can therefore be matched with a C-slot in the template. Recall that vowel-final stems, as in (12d), do not undergo the habitative reduplication at all, retaining the unaltered form of the stem. It would seem, although this idea is difficult to formalize, that rule (16) must apply if the derivation is to continue.

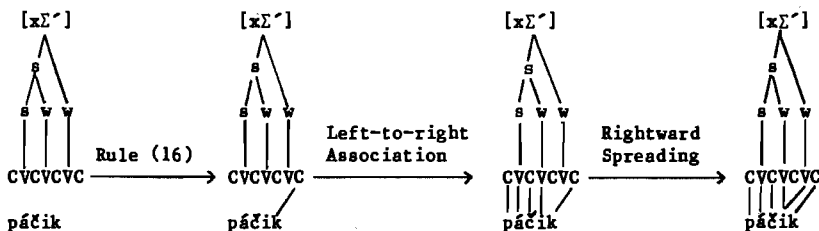
All properties of root association other than Final Association follow from the universal conventions of left-to-right one-to-one association and of spreading from the left (McCarthy 1981). To see this, consider the derivation of čá?al from the root melody čál (irrelevant structure is suppressed):

(17)



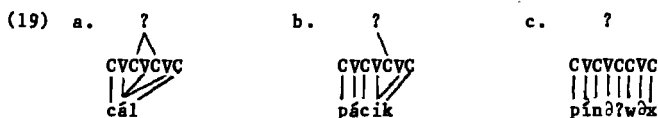
A similar derivation applies to yield páci?ik from páçik, but with a single reduplication. This emerges in (18):

(18)



Forms with two syllables following the stress, like pinʔwʔx, are subject only to rule (16) and the convention left-to-right association, since they have no free positions on the CV-tier (cf. (15c)).

Only one property of the habilitative forms has not yet been accounted for: the intrusive glottal stops in the forms with reduplication. After the conventional rightward spreading of a root vowel in (17) and (18), several C-positions, the indispensable onsets of syllables, remain unassociated and incapable of being associated with any consonantal root material without crossing association lines. We may assume, following Harris's (1980) account of Spanish e-epenthesis, that ʔ is available floating on a separate tier from the root for association with any unfilled C-position. This is represented formally in (19), where all prosodic structure has been suppressed to allow room on the page for the intrusive glottal stops:



Clearly we must day that association of the root takes precedence over association of the epenthetic ʔ melody. Intrusive glottal stops do not appear in habilitative forms like pinʔwʔx because they have no free C-slot on which to dock the floating ʔ. This analysis receives strong support from the independently necessary rule of ʔ-insertion after final stressed vowels, as evidenced in (12d). This latter process can be handled by inserting a C-slot on the template to which the floating ʔ then docks.¹⁰

In sum, there are just two stipulations specific to Cupeno habilitative morphology, the foot-based template (13) and the Final Association rule (16). With this quite limited apparatus, the range of Cupeno habilitative reduplication phenomena can be quite elegantly derived. The apparent output condition follows from widely supported aspects of morphological theory rather than an arbitrary condition on a particular morphological rule.

4. CONCLUSION

The thesis of this paper is that morphological templates have access to a richer variety of categories than the CV-tier that had been demonstrated in earlier analyses. Although foot and syllable reduplication had been suggested previously, here we have seen the need for templates -- conditions on the form of words of particular morphological types -- that refer to syllables in Modern Hebrew and to feet in Cupeno. In the course of the analyses I have suggested a number of technical proposals: a specific version of the prosodic hierarchy, a procedure for expansion of morphological templates containing higher-level prosodic units, and another procedure for expansion of morphological templates containing higher-level prosodic units, and another procedure for selecting the appropriate CV-skeleton in case of ambiguity. The fundamental point, however, is that phonological theory and morphological theory manipulate essentially the same categories embedded in the same representational system.

FOOTNOTES

*I wish to thank Alan Prince, Mark Feinstein, Shmuel Bolozky, Jane Hill and particularly Morris Halle for their comments on earlier versions of this work.

¹An early version of this material was originally presented at MIT in 1980. Quite similar ideas were developed independently in a valuable paper by Doron (1981).

I am grateful to Shmuel Bolozky and Nirit Kadmon, who acted as consultants. Many of the examples cited here are taken from the interesting and useful discussion in Bolozky (1978).

²Various morphophonemic processes account for alternations in (4): the stop-spirant changes analyzed in Doron (1981); metathesis of the ʔ in hitpa'el forms with a following fricative; and voicing assimilation in clusters. The root [mms] (4e) is an idiosyncratic violation of the Obligatory Contour principle of McCarthy (1981).

³The pi'el vowel melody is subject to various irrelevant morphophonemic complications. In particular, it is sporadically [ae] with certain quadriliteral and longer verbs, and is invariably [ae] in prefixed forms (like hitpa'el). The e of the second syllable also alternates with a under inflection.

⁴The a vowel of the initial syllable in forms like ʔargmen or pandrek in (7) is a lexically governed property of the pi'el melody with certain verbs (cf. footnote 3).

⁵The syllabic character of the pi'el generalization is confirmed by the consultants' rejection (or correction to disyllabic forms) of the few trisyllabic pi'els in Yanny's (1974) data: hupnetex, stenogref, antegrel 'integrate a function'. There are a few surface trisyllabic pi'els arguably derived from underlying disyllabic ones by epenthesis of a after a glottal stop; si'atnex 'mix wool and linen' is the best known of these, Yanny also gives hit'apaskel 'become Episcopalian' and ʔamargen 'work as an impresario'. Clearly these facts are also consistent with the disyllabic analysis of the pi'el.

⁶The selection of a template for a five consonant root is not fully determined by the minimality principle of the introduction, since there is a choice between equally simple CCVCCVC and CVCCVCV skeleta. It appears from the data that this choice is purely lexical. In the formation of new verbs, the choice is usually (but not always) determined by similarity with the source noun or even the source form in another language, as Bolozky (1978) demonstrates. I claim that this aspect of the formation of pi'els is not a rule of grammar but rather an ad hoc strategy for dealing with loan words and other neologisms.

Note that the pi'el syllable template and (8) also generate CV-templates with final open syllables. These occur and are lexically restricted to the so-called third-weak roots, as in pi'el yipa 'make beautiful' and hitpa'el hitvapa 'become beautiful'.

⁷Doron (1981) offers a different account of the facts in (10), treating them by root reduplication (as in the corresponding biconsonantal roots (McCarthy 1981)).

⁸A much different version of this analysis appears in McCarthy (1979). I am grateful to Paul Kiparsky for first calling the Cupeno facts to my attention.

I have attempted to normalize the transcription systems of the various sources to that in Hill (1966). I have not written underlying stem-final schwas, since they must in any case be deleted before the formation of habilitatives.

⁹I have no explanation for why a stressed root vowel may spread to unstressed positions on the CV-tier, although it also must be associated with the stressed position. It seems that only the positive matching (of stressed with stressed) is relevant. Interestingly, the vowels copied in the habilitative, although unstressed, are systematic exceptions to a complex rule of vowel deletion. This case of rule underapplication in reduplicated forms is treated by Hill (1970) with postphonological ordering of habilitative formation. A number of formal alternatives suggest themselves but would require a much better understanding than I have of the elaborate vowel deletion process.

Following Hayes (1980), we might suppose that Cupeno roots bear the [+H] diacritic for lexically marked stress, rather than the possibly superfluous [stress] feature. This choice has no consequence for the analysis.

¹⁰Some interesting confirmation for this overall approach to Cupeno habilitative formation comes from another morphological category of the language. Nouns borrowed from Spanish, of which there are many, as well as some native nouns, form the plural by adding a ʔV stem extension followed by the plural suffix -m , where V copies the stem-final vowel:

(i)	gáatuʔum	˘cats˘
	temáatiʔim	˘tomatoes˘
	tóoruʔum	˘bulls˘
	síinkuʔum	˘five˘
	mínikiʔim	˘non-relatives˘

If we suppose that the actual form of the stem extension is a fully unspecified CV-skeleton suffix +CV+, then other aspects of its surface shape are accounted for by the analysis developed in the text. This is illustrated in (ii):



In particular, the floating ʔ docks onto the unspecified C-slot of the plural stem extension, and the stem vowel spreads to the V-slot.

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