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Prosodic structure in morphology

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LANGUAGE SOUND STRUCTURE

Studies in Phonology
Presented to
Morris Halle by
His Teacher and Students

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hoto by David Kupferschmid)

Lozano (1979) that show the alternation, as well as of the Basque dialects about which I have been able to obtain sufficient information.

10. All Catalan dialects (except those like Balearic that have total assimilation of nasals in point of articulation) always present nasal-stop sequences regardless of point of articulation: [sóm dós] 'we are two', [sóm gráns] 'we are big', [síŋ bíns] 'five wines', [síŋ díts] 'five fingers'.

11. Malmberg (1971, 412) has already observed, in part, this correlation: "La nasale ... est elle-même une occlusive du point de vue de son articulation buccale ... C'est donc une assimilation de fermeture."

12. The differences found in different dialects of Spanish and analyzed in detail by Lozano (1979) can be treated in much the same way. The basic differences are: (a) the presence in Porteño of a rule similar to the Catalan (11) but restricted to the occurrence of certain consonants after b,d,g; (b) a rule of final obstruent devoicing in Mexican and Castilian; and (c) the existence in Porteño and Mexican of underlying preconsonantal p,t,k beside the voiced b,d,g.

13. This process occurs in only one context that is not word-final—namely, in syllable-final position before the word-final s of the plural. After ʒ has become [dʒ], it assimilates in voicing to devoiced [s], and then the affricate-fricative sequence merges into a single [tʃ]: r̄əβúʒ+s → r̄əβúdʒ+s → r̄əβútʃ+s → [r̄əβútʃ].

Chapter 15

Prosodic Organization in Morphology

John J. McCarthy

Paralleling developments in phonology, recent research in morphology (McCarthy (1979, 1981, 1982a,b), Halle and Vergnaud (1980, forthcoming), Harris (1980), Marantz (1982), Yip (1982)) has led to a significant enrichment of the representational system for words and morphemes. 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 (and possibly more) 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 rules of association.
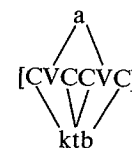
This theory was originally devised to account for morphological regularities of the sort obtaining in the Semitic languages. An example from Classical Arabic shows the basic properties of the system. The formal analysis of the stem *kattab* 'caused to write' is illustrated in (1):

(1)

Vowel melody tier	a
CV-template tier	[CVCCVC]
Consonantal root tier	ktb

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, 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 (1982), 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 to some extent 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 rimes, metrical feet, and others (Selkirk (1980, forthcoming), Kiparsky (1979), Hayes (1980), McCarthy (1979), Halle and Vergnaud (forthcoming)). Moreover, Clements and Keyser (1981) have shown the need in the theory of 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, I will adopt an overall model of the hierarchy of prosodic units like (2):
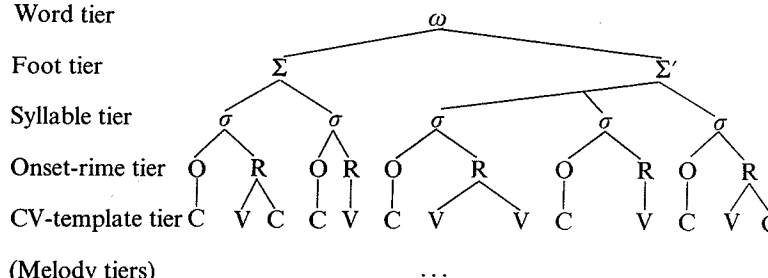
(2)
Prosodic hierarchy

(Melody tiers)　　　　　...

Clearly, details of (2) are controversial, particularly the existence of exclusively binary-branching nodes and of some categories in the prosodic hierarchy. Here I 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.
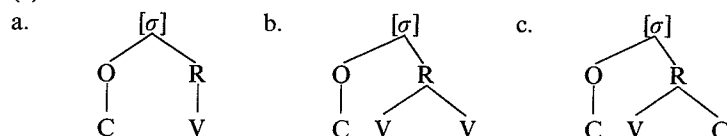
Given the dual morphological and phonological role of the CV template, an obvious question is whether other, higher-level categories in the prosodic hierarchy can also function in the organization of the morphology. A small number of such cases have been collected. In McCarthy (1979) it is proposed that a rare Biblical Hebrew verbal derivational class (the pəʕalʕal) 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 Yidinʸ must reduplicate exactly the first two syllables of a stem. Finally, Yip (1982) 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. The first, taken from Modern Hebrew, analyzes a derivational category cognate to that in (1) stipulating, instead of a CV template, a syllable-based morphological template. The second, from a long-standing puzzle in Cupeño morphology, specifies a template

formed on the metrical foot. Both cases are essentially inexpressible without this prosodic enrichment of the apparatus for morphological representations. Moreover, the argument is in some sense complementary; the purely phonological status of these prosodic categories is supported by their necessity in the morphological analysis.

This use of higher-level prosodic units in morphological templates raises some interesting formal issues as well as analytic ones. I will assume that the stipulation of a template containing some prosodic category generates all well-formed strings of lower-level prosodic categories dominated by it. Thus, a syllable template $[\sigma]$ in some language will generate all CV templates that constitute a single well-formed syllable of that language. If that language permits CV, CVV, and CVC syllables, the $[\sigma]$ morphological template will generate all of the CV-tier strings in (3):

(3)

a.

This convention is to be understood recursively, so that a foot template, for example, will generate strings of syllables and, from them, CV templates.

It follows, then, that stipulation of some higher-level prosodic category in a morphological template will typically generate a family of lower-level categories (including CV templates), given the freedom of languages in expanding nodes like σ and Σ. In principle, this could lead to ambiguities about which CV template a particular melody will associate with. To resolve these, I will further assume that associations are governed by a principle of minimal complexity: in case of ambiguity, the least elaborated structure is selected that allows full realization of the melody. At the lowest level, given a language with the morphological template $[\sigma]$ generating the structures in (3), it follows that a melody *ba* would choose the CV template in (3a) rather than the other two equally compatible ones, since the former is least complex. But a melody *bab* will select (3c), since no other template allows full association and consequent phonetic realization of the melody. At a higher level, given a language with richer syllables than those in (3), an intervocalic sequence of two consonants will be analyzed as heterosyllabic, rather than as a more complex tautosyllabic onset cluster or coda cluster. As I demonstrate below, this principle of minimal complexity is overridden idiosyncratically in particular lexical items or classes.

A final note. These analyses are excerpted from a much longer forthcoming study. Under stringent requirements of brevity, I have considerably compressed the ancillary details of the examples, particularly in the case of Hebrew. Although ideally both examples would be embedded in fuller morphological and phonological accounts of the languages, they nevertheless should stand on their own as support for the delimited issue at hand.

1. Modern Hebrew

As the discussion of (1) has already shown, Classical Arabic formally indicates verbal derivational classes with characteristic CV templates, like the [CVCCVC] skeleton of the causative. The verb forms of Modern Hebrew are also sequestered into derivational classes, traditionally called *binyanim* (singular *binyan*). I will argue that the formal characterization of at least some of the Hebrew binyanim is accomplished not by CV templates, but rather by syllabic templates, a claim that has been made independently in an interesting paper by Doron (forthcoming). I will return to the issue of the differences between Modern Hebrew and Classical Arabic at the conclusion of this section.[1]

In Modern Hebrew two binyanim of the verb are regularly used for most denominal (or deadjectival) 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	'Hellenize (intr.)'	yavan 'Greece'
c.	rikez	'concentrate (tr.)'	hitrakez	'concentrate (intr.)'	merkaz 'center'
d.	mimeš	'realize'	hitmameš	'be realized'	mamaš '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 formations. 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 the prefix *hit-*, which then marks the hitpa'el binyan. Formal representations of the verbs in (4c) 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 *pi'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 classes—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'	hitpančer 'fail because of a mishap'	pančer 'mishap'
b. 'ixzev 'disappoint'	hit'axzev 'be disappointed'	'axzava 'disappointment'
c. kifter 'button (tr.)'	hitkafter 'button up'	kaftor 'button'

Verb forms like those in (4) and (6) clearly represent the same derivational types. 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], the shorter one applying to triliteral roots and the longer one to quadriliteral roots.

This solution of providing two CV templates in the pi'el 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, which I have grouped below according to canonical stem pattern:[4]

(7)

Verb	Source noun
a. [CCVCCVC]	
šlimper 'make someone sloppy'	šlumper 'sloppy person'
praklet 'treat someone as a lawyer would'	praklit 'lawyer'
šnarkel 'snorkel'	šnorkel 'snorkel'
b. [CVCCCVC]	
xintreš 'talk nonsense'	xantariš 'nonsense'
'argmen 'color mauve'	'argaman 'mauve'
hit'argmen 'become mauve'	
tilgref 'telegraph'	telegraf 'telegraph'
tirklen 'arrange a room'	traklin 'room'
sinkren 'synchronize'	sinkroni 'synchronic' (portmanteau word)
pandrek 'spoil (child)'	
hitpandrek 'become spoiled'	
'išknez 'make Ashkenazic'	'ašknazi 'an Ashkenaz'
hit'asknez 'become Ashkenazic'	
'anglez 'make English'	'inglizi 'English'
hit'anglez 'become English'	
sindler 'cobble'	sandlar 'cobbler'
c. [CCVCCCVC]	
hitpravslev 'become Orthodox Christian'	pravoslavi 'Orthodox Christian'
stingref 'take shorthand'	stenografit 'stenographer'

Not all speakers recognize all or even most of these forms—many are spontaneous or jocose 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 loanwords 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], [CVCCCVC], and [CCVCCCVC] 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 clusters of one or two consonants in the onset, subject to various constraints on sonority that are not of 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 $[\sigma\sigma]$, 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 fu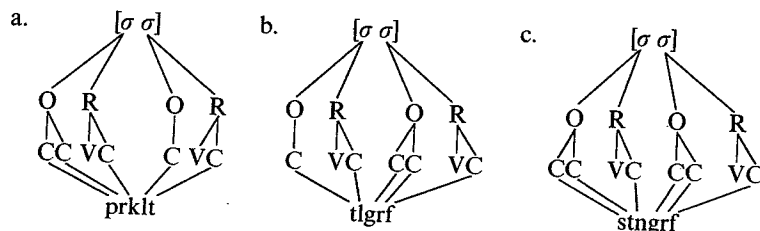ll set of possible CV templates for the pi'el: [CVCVC], [CVCCVC], [CCVCCVC], [CVCCCVC], [CCVCCCVC]. Therefore, this aspect of Hebrew verb morphology is essentially described by stipulating the morphological template $[\sigma\sigma]$. Doron (forthcoming) also develops similar templates for the other Hebrew binyanim based on the existence of other forms with complex onsets like the hif'il *hišpric* '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).[6]

Under this analysis, then, some representative forms will appear as follows:

(9)

a.   b.   c.

prklt   tlgrf   stngrf

In the introduction, I proposed that a choice between several available structures is made by considerations of minimal complexity. This principle is at work in (9), ensuring that the shortest CV template is used consistent with having the full root realized phonetically. Thus, roots with five consonants appear on templates with exactly five available C slots, and so on. Moreover, this principle provides the correct syllabic analysis of the forms, treating the *kl* sequence in *priklet* as coda plus onset, rather than as a logically possible but more complex biconsonantal onset. Minimal complexity does not fully determine the choice for five-consonant roots, however, since the disyllabic templates [CCVCCVC] and [CVCCCVC] are equally simple. This selection is purely lexical, determined in the formation of new verbs usually (but not always) by similarity with the source noun or even a source form in another language, as Bolozky (1978) demonstrates. It appears, then, that this matter beyond the purview of minimal complexity is controlled by ad hoc strategies for dealing with loanwords and neologisms.

In some cases, the requirement of minimal complexity is systematically violated, leading to regular reduplication of a root consonant. An interesting class of such forms appears in (10):

(10)

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

In (10a) triconsonantal roots are associated with templates with four C slots; in (10b) a four-consonant root appears with a template 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):[7]

(11)

a. [CVCCVC]   b. [CCVCCVC]

blf   flrt

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) gives three such examples, apparently nonce forms but judged as fairly well formed: *striptez, 'abstrekt, kimpleks* 'gives someone a complex'. The three-consonant onset in the first two examples and the two-consonant coda in the last two are only marginally acceptable 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.

There are, then, 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 in a prefix or leftward across word-boundary. If no vowel immediately precedes, 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 purely syllabic solution that dealt with the initial consonant by specifying a free coda in the template, not syllabifiable until later in the phonology, or one that provided an initial

syllable with an obligatorily empty nucleus, inaccessible to autosegmental spreading. But again, both of these seem to be notational variants 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.

2. Cupeño

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.[8] Information on Cupeño is taken from the data and analyses in Hill (1966, 1970, 1973). The 1970 paper contains an explicit statement of the paradox presented by Cupeño, and I will first summarize it here.

Cupeño recognizes a category of verbal mood, called the *habilitative*, that glosses roughly as 'can do x'. The habilitative is formed by irrelevant morphological processes in the verb types known as *volitional* and *non-volitional*. 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.	čál	čáʔaʔal	'husk'
	tə́w	tə́ʔəʔəw	'see'
	həlʸə́p	həlʸə́ʔəʔəp	'hiccup'
	qáw	qáʔaʔaw	'be sick'
	kəláw	kəláʔaʔaw	'gather wood'
	ŋíy	ŋíʔiʔiy	'go away'
	kʷáʔ	kʷáʔaʔaʔ	'eat'
b.	páčik	páčiʔik	'leach acorns'
	čáṣpəl	čáṣpəʔəl	'mend'
	ʔísaxʷ	ʔísaʔaxʷ	'sing men's songs'
	čáŋnəw	čáŋnəʔəw	'be angry'
c.	pínəʔwəx	pínəʔwəx	'sing enemy songs'
	xáləyəw	xáləyəw	'fall'
d.	čí	číʔ	'gather'
	hú	húʔ	'fart'
	pí	píʔ	'bewitch'
	ʔáyu	ʔáyu	'want'

The fundamental observation underlying these data is as follows. In (12a–c), the stressed syllable of the habilitative stem is followed by two unstressed syllables. In (12a) both of these posttonic syllables contain ʔV sequences, where V is a copy of the stressed vowel. In (12b) the final syllable contains a single such ʔV sequence, where V is a 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 in the verb stem.

The analysis of these facts is quite straightforward up to the point of formalization. All stems in (12a–c) 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 ʔ in the words čiʔ, húʔ, and piʔ 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 copies of the last stem vowel are inserted before the stem-final consonant; if one syllable follows the stress, then one copy of the last stem vowel is inserted in that position. In both cases, epenthetic glottal stops separate the copied vowels from each other and from the original. Forms with two syllables following the stress remain unchanged, 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 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 Cupeño habilitative rule in anything like conventional terms. The Cupeño 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 Cupeño habilitative and its mode of association with the melody of the verbal root. The output of the habilitat-

ive 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 a category Σ', distinct from the disyllabic feet Σ. 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 Cupeño habilitative is as follows:

(13)

Habilitative template

$[x\Sigma']$

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

(15)

a.

čál

b.

páčik

c.

pinə?wəx

d.

kəláw

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 elements 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). I will deal shortly with the glottal stops that fill the (obligatory) vacant onset positions.

In this analysis, then, the formation of habilitatives is indicated in the grammar by the 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 *táw* in (12a)) receive a stress prephonologically by morphologically governed rules. I will assume that this lexical or non-phonological 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.[9] 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 habilitative 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 autosegmental conventions of left-to-right one-to-one association and of rightward spreading (McCarthy (1981)). To see this, consider the derivation of *čá?a?al* from the root melody *čál* (irrelevant structure is suppressed):

(17)

$$[x\Sigma'] \quad [x\Sigma'] \quad [x\Sigma'] \quad [x\Sigma']$$

$$\text{CVCVCVC} \xrightarrow{\text{rule (16)}} \text{CVCVCVC} \xrightarrow[\text{association}]{\text{left-to-right}} \text{CVCVCVC} \xrightarrow[\text{spreading}]{\text{rightward}} \text{CVCVCVC}$$

čál   čál   č á l   č á l

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

(18)

$$[x\Sigma'] \quad [x\Sigma'] \quad [x\Sigma'] \quad [x\Sigma']$$

$$\text{CVCVCVC} \xrightarrow{\text{rule (16)}} \text{CVCVCVC} \xrightarrow[\text{association}]{\text{left-to-right}} \text{CVCVCVC} \xrightarrow[\text{spreading}]{\text{rightward}} \text{CVCVCVC}$$

p á či k   p á č i k   p á č i k   p á č i k

Forms with two syllables following the stress, like *pínə?wəx*, are subject only to rule (16) and the conventional 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 ? 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:

(19)

a.   ?   b.   ?   c.   ?

CVCVCVC   CVCVCVC   CVCVCCVC

č á l   p á č i k   p í n ə ? w ə x

Clearly association of the root must take precedence over association of the epenthetic ?melody. Intrusive glottal stops do not appear in habilitative forms like *pínə?wəx* because they have no free C slots on which to dock the floating ?. This analysis receives strong support from the independently necessary rule of ?-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 ? then docks.[10]

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

3. Conclusion

The thesis of this paper is that morphological templates have access to a richer variety of categories than the CV tier. Although foot and syllable reduplication had been suggested previously, here I have shown 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 Cupeño. 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 selecting the appropriate structure in case of ambiguity. Furthermore, morphological systems have emerged as a new source of evidence for the nature of prosodic categories, confirming in this case the need for syllables and feet as well as some details of their construction. The fundamental point, however, is that phonological theory and morphological theory must manipulate essentially the same units embedded in the same representational system.

Notes

1. 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).

2. Various morphophonemic processes account for alternations in (4): the stop-spirant changes analyzed in Doron (forthcoming); metathesis of the *t* in hitpa'el forms with a following fricative; and voicing assimilation in clusters. The root [mmš] (4d) is an idiosyncratic violation of the Obligatory Contour Principle of McCarthy (1981).

3. The 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 the hitpa'el). The *e* of the second syllable also alternates with *a* under inflection.

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

5. The 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 Yannay's (1974) data: *hupnetez, 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'atnez* 'mix wool and linen' is the best known of these, and Yannay also gives *hit'apaskel* 'become Episcopalian' and *'amargen* 'work as an impresario'. Clearly these facts are also consistent with the disyllabic analysis of the pi'el.

6. 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 *hityapa* 'become beautiful'.

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

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

I have normalized 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.

9. I have no explanation for the fact that 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 stressless vowel deletion. This case of rule underapplication in reduplicated forms is treated by Hill (1970) with post-phonological ordering of habilitative formation. An interesting alternative is the idea that these vowels are protected from deletion by their formal status as daughters of a lexically stressed vowel, though this analysis depends on uncertain details of the vowel deletion rule.

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

10. Some interesting confirmation for this overall approach to Cupeño habilitative formation comes from another morphological category of the language. Nouns borrowed from Spanish, of which there are many, and 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'
míñikiʔim 'nonrelatives'

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):

(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.