On the Proper Characterization of 'Nonconcatenative' Languages

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Contents

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Abstract

Nonconcatenative languages have been claimed to employ a special type of phonological spreading of a consonant over a vowel, which assumes a representation that segregates consonants and vowels on different planes. I argue that this type of spreading can and must be eliminated from the theory, by reducing it to segmental copying as in reduplication. Crucial to this reduction is the notion of gradient violation of constraints in Optimality Theory (Prince & Smolensky 1993), and the notion of Correspondence with its particular application to reduplicative morphology (McCarthy & Prince 1995a). The reduction is demonstrated in detail for Temiar, one of the main indigenous languages of Malaysia, notorious for the complexity of its copying patterns. Extensions of the proposal to Semitic languages are also discussed. Two main theoretical implications of this reduction are then developed. First, the distinction between concatenative and nonconcatenative languages need not and should not be encoded in terms of the special phonological mechanisms of consonantal spreading over a vowel, applying under planar segregation. Second, the locus of the distinction is found to be, instead, in the mode of affixation employed in nonconcatenative languages, namely, a-templatic reduplicative affixation. This type of affixation is predicted, though heretofore undocumented in the typology of word formation.

1. Introduction

Current phonological theory claims that nonconcatenative languages are phonologically special. In these languages, a configuration such as C_iVC_i, where the two consonants are identical, may result from an autosegmental operation that spreads the root of a single underlying consonant over two C positions (see 1). This type of spreading is known as ‘long-distance consonantal spreading,’ henceforth LDC-spreading. LDC-spreading is thought to proceed unobstructed by the intervening vowel because vowels and consonants are represented on different planes. This representational hypothesis is known as V/C planar segregation. Both LDC-spreading and V/C planar segregation are considered to be unique to nonconcatenative languages.

1. V/C planar segregation

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           V-Root                                   Vowel plane
           |
X          X          X      (output: CiVCi)        Skeleton
|
C-Root                                              Consonant plane
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The effect of LDC-spreading is thus to create a copy of a segment over intervening segmental material, an effect similar to that found in the phenomenon of reduplication. Similarity notwithstanding, LDC-spreading and reduplication have been attributed to unrelated mechanisms of the theory. In LDC-spreading, copying is the apparent effect of double linking of a single consonant to two skeletal positions. In reduplication, copying literally creates a second instance of a consonant. The two mechanisms exist within different components of the grammar, LDC-spreading in the phonological and reduplication in the morphological component.

My goal in this paper is to show that there is a redundancy in the theory which admits two distinct operations of segmental copying, and advocate its elimination by reducing LDC-spreading to the same formal mechanism as in reduplication. Crucial to this reduction is the notion of gradient violation of constraints in the framework of Optimality Theory of Prince & Smolensky (1993). I then examine the implications of this reduction for the typological distinction posited between concatenative and nonconcatenative languages. I argue that this distinction is not formally expressed in terms of the special phonological mechanisms of LDC-spreading and V/C planar segregation, but rather in terms of the special mode of reduplicative affixation employed in nonconcatenative languages. Reduplicative affixes in these languages are a-templatic, in the sense that there is no prosodic requirement imposed on the shape of the affixes. The identification of this type of affixation fills a predicted but heretofore undocumented typological gap in the theory of Prosodic Morphology.

This paper is organized as follows. Section 2 introduces the Optimality theoretic notion of correspondence, which has so far been successfully employed to characterize the cross-linguistic facts of templatic reduplication, and which will play a central role in the analyses throughout this paper. Section 3 begins the main part of this paper by a detailed examination of the redundancy between the two copying mechanisms in Temiar, one of the main indigenous languages of Malaysia (Benjamin 1976). I chose to consider Temiar because of three reasons. First, the language is notorious for the complexity of its copying patterns, and despite important attempts (McCarthy 1982, Broselow & McCarthy 1983), it has so far resisted a satisfactory account. Second, Temiar has been argued to require the full deployment of both copying mechanisms, LDC-spreading and reduplication. Finally, the facts of the language illustrate in a striking way the inadequacy of the derivational approach to copying, while at the same time demonstrating the special type of affixation that I will identify as the general characteristic of reduplicative affixation in nonconcatenative languages.

The main part of section 3 presents a unified analysis of segmental copying in the verbal morphology of Temiar. The analysis builds on an understanding of the basic prosodic and morphological properties of the language developed here for the first time. All instances of segmental copying are analyzed in terms of a single notion of correspondence. The full range of patterns emerges from the interaction of correspondence constraints with other constraints expressing independently established regularities of the language. Section 4 discusses previous analyses of the language, demonstrating in particular the superiority of the correspondence approach to copying over derivational alternatives.

Section 5 argues that the elimination of LDC-spreading and its geometric premise of V/C segregation is not only possible but in fact necessary. Reconstructing the argument for having both LDC-spreading and reduplication in the theory, I expose the weaknesses of its premises and the conceptual problems they raise. I argue, in addition, that the theory admitting LDC-spreading and V/C planar segregation fails to explain the fact that whenever LDC-spreading has been claimed to apply, it spreads the whole consonant and never one of its individual features. These problems are resolved under the proposed unification since it is clear that segmental copying, as in reduplication, targets only whole segments, not individual features.

Section 6 develops the typological consequences of the elimination of LDC-spreading and V/C segregation. It begins by examining some basic patterns of segmental copying in Semitic. These languages were thought to provide another type of motivation for V/C segregation, due to the traditionally assumed distinct morphological status attributed to consonants and vowels. Irrespective of the status of this assumption, the same basic reduction of LDC-spreading to copying via correspondence extends to these languages as well. I conclude that the distinction between concatenative and nonconcatenative languages need not and should not be encoded in terms of the special phonological mechanisms of V/C segregation and LDC-spreading. Rather, the distinction is identified with a special type of reduplicative affixation employed in nonconcatenative languages, where reduplicative affixes are not specified for any prosodic target, their exact realization being determined by the constraints of the particular language. Finally, section 7 concludes with a summary of the main arguments and results of the paper.[2]

2. Correspondence in Optimality Theory

Faithfulness in OT expresses the fact that related grammatical forms, such as Input/Output and Base/Reduplicant, tend to be identical. Correspondence theory of McCarthy & Prince (1995a) gives

[2] This paper makes no claims about the representation of true geminate consonants, generally assumed to involve double linking between two skeleton-adjacent positions. It is only long-distance geminates that I argue should not be represented as doubly linked structures. See Itô & Mester (1993) on the status of true geminates in OT.

formal content to the notion of faithfulness[3]. Correspondence defines a relation between two forms, as stated in (2) below.

2. Correspondence: Given two segmental strings S_1 and S_2, *correspondence* is a relation $\mathcal{R}$ from the segments of S_1 to those of S_2. Segments α of S_1 and β of S_2 are referred to as *correspondents* of one another when $\alpha \mathcal{R} \beta$.

A correspondence relation imposes a number of constraints requiring identity between the two segmental strings. Two basic correspondence constraints are given in (3) and (4) for the Base(B)/Reduplicant(R) correspondence relation[4].

3. MAX^{BR}
   Every segment of B has a correspondent in R.

4. DEP^{BR}
   Every segment of R has a correspondent in B.

Perfect correspondence is total reduplication, as in Axininca Campa **nata**-nata 'carry' (copied segments are boldfaced), which fully statisfies MAX^{BR} and DEP^{BR}. Deviations from perfection are found when the reduplicant copies less than the whole base, violating MAX^{BR}, or when the reduplicant contains segments which are not part of the base, violating DEP^{BR}. Both cases of violation correspond to well-attested phenomena, partial reduplication and prespecified reduplication respectively. In Temiar, the simulfactive aspect form $\mathbf{c^1}$a.c^1vc^2 derived from the verbal base c^1vc^2, copies only a single consonant of the base, causing two violations of MAX^{BR} because /v, c^2/ are not

[3] For the motivation of revising the original OT PARSE/FILL conception of faithfulness, see McCarthy & Prince (1994b) and McCarthy (1995).

[4] It is to be kept in mind that an independent set of the same constraints holds for the Input/Output correspondence relation, namely, MAX^{IO} and DEP^{IO}. For extensions of correspondence theory to faithfulness relations between output forms see Benua (1995), Flemming & Kenstowicz (1995), and McCarthy (1995) (cf. Burzio 1994).

copied. Moreover, the output contains /a/ which is not part of the base, a violation of DEP^{BR}.

Other constraints evaluate the quality of the identity between correspondent segments over featural and prosodic dimensions, as in (5) and (6) respectively.

5. IDENT^{BR}(F)
   A segment in R and its correspondent in B must have identical values for the feature [F].

6. SROLE
   A segment in R and its correspondent in B must have identical syllabic roles.

Featural identity may be violated because of higher ranked constraints imposing specific demands on the featural make-up of a correspondent segment. In Temiar voiceless stops are nasalized to become more sonorous in the coda position due to a constraint specific to codas, CODA-COND. When a copy of the base-final consonant is affixed, as in yaap 'to cry' yɛ**m**.yaap, the consonant is thus nasalized: IDENT^{BR}(nasal) is violated because of the higher ranked CODA-COND.

SROLE in (6) is inviolated inTemiar and fully determines the choice of copied consonants. When a base consonant is copied and placed in onset position, it is the first consonant of the base that is chosen for copying, as in $\mathbf{c^1}$a.c^1vc^2. But when the copied consonant is placed in coda position, as in c^1**ɛ**$\mathbf{c^3}$.c^2vc^3, the final consonant of the base is chosen for copying instead. Violations of SROLE are found, for example, in Ilokano plural reduplication pu.sa 'cat', **pus**-pu.sa 'cats', where /s/ is in the coda of the reduplicant but is an onset in the base.

In the following analysis I will show how to account for the entire range of copying patterns in the verbal morphology of Temiar using the same unitary notion of correspondence, extending its use to the domain of nonconcatenative languages. I will also provide support for the basic implementational choices proposed in current Correspondence Theory, and in particular for restricting correspondent elements to segments and not to features of segments. Most importantly, I will argue that any derivational approach to the facts of Temiar relying on an interleaving of morphological and phonological operations is bound to miss significant generalizations, directly captured by the Optimality theoretic model via the parallel application of morphological and phonological constraints.

3. Temiar Verbal Morphology: A Unified Account of Segmental Copying

Temiar [tmɛɛr] is one of the main Austroasiatic languages of Malaysia. It belongs to the Mon Khmer family which, together with the Munda languages, comprise the Austroasiatic family (Ruhlen 1987). The Mon Khmer family includes eleven groups, one of which is the Aslian languages spoken in the Malaysian peninsula[5]. The Aslian branch is further divided into Northern, Central, and South Aslian languages. The Central Aslian subfamily includes about twenty languages. Grammatical descriptions of these languages are limited to Jah-Hut, Semai and Temiar. Of these three, Temiar has been described in the most detail, in Benjamin (1976), and will be the main focus of this paper.[6]

Temiar has two main dialects, Northern and Southern. The description in Benjamin (1976) is based on the Northern dialect spoken in the Betis and lower Perolak valleys of the Kelantan region. This is also the dialect spoken by the Temiar announcers in the *Orang Asli* (Aslian Man) service of Radio Malaysia. It should be noted that the speakers of this language call themselves *Senoi Serok*, meaning Inland or Hill People. To avoid confusion, I will continue to use the name Temiar employed

[5] See Jenner (1969) on Khmer, Svantesson (1983) on Kammu, and Lombardi (1991) on Kambodian.

[6] See Diffloth (1976a,b) for brief descriptions of Jah-Hut and Semai respectively. It is clear from these descriptions that the morphologies of Jah-Hut and Semai are very similar to that of Temiar. Finally, Nicole Kruspe at the University of Melbourne, currently involved in fieldwork on the South Aslian language Semelai, informs me about the close similarities of this language to Temiar.

by Benjamin and Diffloth, whose descriptions of Temiar and other closely related Aslian languages provide the sources of this analysis.

In the Austroasiatic branch of Mon Khmer, Aslian languages have the most developed morphological systems. In fact, the nonconcatenative morphology of Temiar has been characterized as extremely complex (McCarthy 1982). It includes a variety of intricate combinations of infixations and copies of consonants, found in particular in the two main aspects of the language, the simulfactive and the continuative. It is perhaps not an accident that the only thorough analysis of this morphology to date is that of McCarthy (1982). This section attempts a new approach to the verbal morphology of the language. Subsection 3.1 introduces its basic prosodic properties, discusses the verbal paradigms, and uncovers significant generalizations in the locus of affixation of the simulfactive and continuative morphemes. These generalizations will enable for the first time a unified analysis of segmental copying in the morphology of the two aspects, as presented in subsection 3.2. All segmental copying is induced by a correspondence relation holding between the segments of the base and the segments of the affix, obviating the mechanism of LDC-spreading, thought to be necessary in previous analyses of the language.

3.1. Basic Prosodic and Morphological Properties

Temiar has two types of verbal bases, biconsonantal and triconsonantal, shown in (7), where I also give the CV pattern of the verb for future reference. The superscript ‘i’ in the CV pattern indicates the relative order of consonants and ‘.’ stands for syllable boundary.

7.	<u>CV pattern</u>	<u>Example</u>	<u>Gloss</u>
a. Biconsonantal	c^1vc^2	kɔɔw	‘to call’
b.Triconsonantal	$c^1.c^2vc^3$	s.lɔg	‘to lie down’

Biconsonantal bases consist entirely of one syllable. Triconsonantal bases are bisyllabic, exhibiting the special type of underlyingly voweless syllable found in Aslian (and Mon Khmer) languages. In s.lɔg the consonant /s/ is the onset of a syllable, called a *minor* syllable, as opposed to the final *major* syllable of the word, which contains a phonologically specified vowel. Examples of words with one-consonant minor syllables are shown in (8a-c) (ignore for the moment the phonetic forms, which I discuss below). In (8a), **t**.lɛk, **t** is the onset of the minor syllable, followed by the major syllable lɛk. Morphological operations, involving infixations of consonants, can create closed minor syllables, consisting of two consonants as shown in (8d-f). In (8d), the minor syllable is **br** with /b/ as its onset and /r/ as its coda.

8.	a. **t.**lɛk	‘to teach’	[tə.lɛk]	d. **br.**caaʔ	‘to feed’	[bɛr.caaʔ]
	b. **b.**huj	‘guilty’	[bə.huj]	e. **cb.**niib	‘going’	[cɛb.niib]
	c. **s.**lɔg	‘to lie down’	[sə.lɔg]	f. **tʔ.**taaʔ	‘old men’	[tɛʔ.taaʔ]

According to Benjamin, phonetically minor syllables surface with two predictable vowel qualities. Open minor syllables are transcribed with the vowel [ə] as in (8a-c), and closed minor syllables with the vowel [ɛ] as in (8d-f). It is clear that minor syllable vowels have no phonological status. This can be seen in the way these vowels surface in morphological variants of a word. In (9), showing part of the voice/aspect paradigm of s.lɔg ‘to lie down’, the minor syllable vowels [ə/ɛ] are freely substituted by other vowels provided by the morphology or by each other, conditioned apparently only by syllable structure in the latter case.

9.	a. [sə.lɔg]	‘to lie down’	c. [sɛr.lɔg]	‘to lie down-CAUS.’
	b. [sa.lɔg]	‘to lie down-SIM.’	d. [sə.rɛg.lɔg]	‘to lie down-CAUS.-CONT.’

In (9b), when the vowel affix /a/ is added to the verbal base of (9a), the [ə] in the minor syllable of [sə.lɔg] changes to [a]. In (9c), when the consonant affix /r/ is added, the vowel [ə] changes to [ɛ]. Finally, (9d) shows the same alternation in the inverse direction, where the vowel [ɛ] of [sɛr.lɔg] turns to [ə]. This [ə]/[ɛ] oscillation has no phonological basis.

Following the generally accepted view in Mon Khmer languages, I will thus assume that these vowels are not specified underlyingly, but are the phonetic realizations of a syllable with no phonologically specified vowel[7]. This is also the assumption in Diffloth's descriptions of two other Senoic languages, Semai and Jah-Hut, which are closely related to Temiar[8]. Specifically, I will assume that the phonological representation of minor syllables is as shown in (10), where the nucleus has no phonological specification and is interpreted by the phonetic component of the grammar based on the syllabic context.

10. σ

N μ

C (C)

Syllabic structure can always be unambiguously assigned because every syllable in Temiar must have an onset and complex syllabic margins are not allowed. Thus when there is only one consonant,

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[7] Southeast Asianist James Matisoff who introduced the term 'sesquisyllabic' (meaning, one and a half syllables, Matisoff 1978) for words like s.lɔg 'to lie down' also agrees with this interpretation of minor syllable vowels (p.c., May 20, 1995).

[8] There is evidence suggesting that Benjamin's categorical '[ə] in open/[ɛ] in closed' transcription of minor syllable realizations may be an oversimplification of the range of minor syllable vowel qualities. In the closely related Senoic languages, Semai and Jah-Hut, Diffloth notes that minor syllable vowels have various transitional qualities, depending on their context. For example, in Semai, /k.ʔɛɛp/ 'red centipede' is realized phonetically as [kɛʔɛɛp]. As Diffloth (1976a:233) characteristically notes, "the main vowel ɛ: starts where /k/ ends and ends where /p/ begins; the glottal stop is superposed at some time during the utterance of the vowel." This 'anticipation' of the vowel of the major syllable Diffloth finds to be a characteristic of all Aslian languages. Other transitional minor vowel qualities noted by Diffloth include a round [u] in the context of labial consonants and a high front [i] before palatal consonants.

as in **t.**lɛk ‘to teach’, that consonant is the onset of the syllable and when there are two consonants, as in **br.**caaʔ ‘to feed’, the first is the onset and the second is the coda of the minor syllable. This simple syllabic structure can be captured by the two standard constraints of the basic syllabic theory of OT shown in (11) and (12). These two constraints are never violated in this language.

11. ONS
    Every syllable must have an onset.

12. *COMPLEX
    No more than one segment may associate to any syllabic margin.

Another prosodic property of Temiar is that major syllables appear always in the final position, bearing the word stress, and preceded by an optional sequence of minor syllables. This is a general property of the Mon Khmer family. Since stress in Mon Khmer is typically final, this property can be seen as a special case of a widely attested tendency of languages to reduce their vowel inventories in unstressed positions. Typical examples of inventory reductions from stressed to unstressed positions cross-linguistically include, the seven to five vowel reduction of Italian[9], the six to four reduction of Rumanian, the five to three reduction in Sicilian, and the eight to six reduction in Turkish. In Temiar unstressed positions, corresponding to minor syllables, the vowel inventory is reduced to just two predictable qualities [ə/ɛ]. The issue of how to express this generalization using current resources is a problem beyond the scope of this paper. Here I will simply use the constraint 1-V in (13), as a cover name for the set of constraints that may lie behind the Temiar (and Mon Khmer) generalization.

[9] In the prestressed position, the vowel inventory of Italian reduces further to three vowels.

13. 1-V

There is only one specified vowel (hence one major syllable) per word.

I now turn to the morphological properties of the verbal paradigms. There are two voices, active and causative. For each voice, there are three aspects, perfective, simulfactive, and continuative. The aspectual paradigm of the active voice is shown in (14).

14.	Biconsonantal	Triconsonantal
a. Perfective	c^1vc^2	$c^1.c^2vc^3$
	kɔɔw ‘to call’	s.lɔg ‘to lie down’
b. Simulfactive	$c^1a.c^1vc^2$	$c^1a.c^2vc^3$
	ka.kɔɔw	sa.lɔg
c. Continuative	$c^1c^2.c^1vc^2$	$c^1c^3.c^2vc^3$
	kw.kɔɔw	sg.lɔg

The unmarked perfective aspect consists of the verbal base alone, (14a). This perfective is then the base for the formation of the two other aspects, the simulfactive and the continuative. The simulfactive aspect in (14b) is marked by the vowel /a/ and in the biconsonantal case a copied base consonant. The continuative aspect in (14c) involves only copying of base consonants.

The aspectual paradigm of the causative voice is shown in (15).

15.	Biconsonantal	Triconsonantal
Base (Act. Perf.)	c^1vc^2	$c^1.c^2vc^3$
	kɔɔw ‘to call’	s.lɔg ‘to lie down’
a. Perfective	$tr.c^1vc^2$	$c^1r.c^2vc^3$
	tr.kɔɔw	sr.lɔg
b. Simulfactive	$t.ra.c^1vc^2$	$c^1.ra.c^2vc^3$
	t.ra.kɔɔw	s.ra.lɔg
c. Continuative	$t.rc^2.c^1vc^2$	$c^1.rc^3.c^2vc^3$
	t.rw.kɔɔw	s.rg.lɔg

The perfective aspect is formed from the corresponding active perfective base (repeated in 15 as the Base) by addition of the affix /tr/, (15a). This affix is subject to allomorphy, as shown in the case of triconsonantal bases, where it appears as an infixed /r/[10]. As in the active voice, the simulfactive and continuative are formed from the perfective base. The simulfactive is again marked by the vowel infix /a/, (15b), and the continuative by copying of various base consonants, (15c).

An important property in these paradigms concerns the locus of affixation of the simulfactive and continuative morphemes. In all simulfactive patterns the affix /a/ appears immediately to the left of the major syllable of the base, as shown by the forms enumerated in (16a). The continuative patterns have a copied consonant also immediately to the left of the major syllable of the base, as shown in (16b).

16.	a. Simulfactives:	$c^1\underline{a}.c^1vc^2$	$c^1\underline{a}.c^2vc^3$	$t.r\underline{a}.c^1vc^2$	$c^1.r\underline{a}.c^2vc^3$
	b. Continuatives:	$c^1\underline{c^2}.c^1vc^2$	$c^1\underline{c^3}.c^2vc^3$	$t.r\underline{c^2}.c^1vc^2$	$c^1.r\underline{c^3}.c^2vc^3$

The generalization that stands out is that a new segment (/a/ or a copy of a consonant) appears in the rime position of the prefinal syllable. This is a robust property of the language, applying to all continuative and simulfactive forms[11]. I propose to capture it with an alignment constraint, requiring

[10] The allomorphy of the affix /tr/ in the perfectives is prosodically driven. I assume in Gafos (1996) that the perfective outputs are subject to a constraint that requires them to be no more than two syllables. To satisfy this constraint, part of the causative affix /tr/ may be left unparsed. Similar instances of allomorphy are found outside the Aslian branch of Mon Khmer, as for example, in Kammu causative and nominal affixation (Svantesson 1983). The overarching generalization in all these cases is that affix allomorphy is preferred to base allomorphy.

[11] There is one case, out of the twenty-four total patterns, where this property is not observed in one dialectal variant of the continuative in the Kelantan region. This is the pattern $n\mathbf{c}^3.c^1.c^2vc^3$, where the copy of the base-final consonant is not aligned with the left edge of the major syllable c^2vc^3. The 'regular' pattern is $c^1.n\mathbf{c}^3.c^2vc^3$, found in the Perak region. This is a striking case of dialectal variation because the rest of the patterns are the same in the two dialects. In forthcoming work, I show how this variation follows from supposing that the two dialects have the same constraint ranking but different paradigm structures, formalized by correspondence relations between two lexical forms. Specifically, the Perak pattern $c^1.n\mathbf{c}^3.c^2vc^3$ is in a correspondence relation with the nominal perfective base $c^1n.c^2vc^3$ while the Kelantan pattern $n\mathbf{c}^3.c^1.c^2vc^3$ is in a correspondence relation with the verbal perfective base $c^1.c^2vc^3$ (Gafos 1995b).

that the right edge of an affix must be aligned with the left edge of the major syllable of the base. This major syllable, being stressed, is the head of the prosodic word (PrWd) in Temiar. The constraint can then be stated in the alignment schema of McCarthy & Prince (1993b), as in (17). This constraint applies throughout the verbal morphology of the simulfactive and continuative.

17. ALIGN(Affix, R, Head(PrWd), L)
The right edge of an affix must be aligned with the left edge of the prosodic head of the base. (henceforth, α-HEAD)

Apart from this, there does not appear to be any particular prosodic requirement on how these affixes surface in the various outputs. The simulfactive is realized with the vowel /a/, and in the case of biconsonantals with a copy of a consonant of the base as well. The continuative, on the other hand, is always realized with a copy of at least one base consonant. The following analysis will show that the simulfactive and the continuative affixes are both reduplicative and specified as consisting of a single (segmental) Root node. The only difference between the two is that in the simulfactive the Root is phonologically specified to be the vowel /a/, while in the continuative it is not. This difference is illustrated in (18a) and (18b) respectively.

18. a. Simulfactive affix: Root
|
a

b. Continuative affix: Root
(no featural content)

It will be seen that the fact that in the continuative the Root is realized with a consonant follows from the interaction of independent constraints on the prosody of the language. In fact, all other differences between the simulfactive and continuative patterns will follow entirely from the interaction of the independently established prosodic regularities, expressed by *COMPLEX, ONS, and 1-v.[12]

I conclude this section with a discussion of the productivity of the verbal paradigms. Not all bases appear in all possible forms of every paradigm. Benjamin notes that $c^1.c^2vc^3$ bases "commonly lack perfective forms, or they exist only in the causative form" (1976:168) and that it is hardly the case that every root exhibits all possible forms of every voice. This appears to be a general property of the so-called nonconcatenative morphological systems. McCarthy (1979:239), on Arabic, notes that it is "an idiosyncratic property of any root whether it can appear in a particular binyan." Aronoff (1994:124) makes the same observation about the Hebrew Binyan system, noting that "few if any roots actually occur in all five major binyanim." Finally, Prunet (1995:2) identifies this lack of full productivity as one of the main characteristics of Semitic morphology.

At least in Temiar, this phenomenon can usually be ascribed to the semantic incompatibility of the stem with the aspectual category. Benjamin notes that, where the meaning allows, all these forms are productive, with the exception of the causative simulfactive which occurs in certain crystallized forms only, and even then usually with a non-transparent meaning (i.e. different than implied by the inflectional category). Even this form, however, frequently occurs in expressives (Benjamin 1976: 170), and thus is highly productive in ordinary conversation, stories and song lyrics. It seems safe to conclude then that when stems do not exemplify all possible patterns the reasons are primarily semantic, and not related to the complexity of the form *per se*.

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[12] The alignment constraint on the placement of the affixes in Temiar essentially requires that the Root node of the affix be in the rime position of the prefinal syllable. Hence, in operational terms, the aspectual morphology of Temiar can be seen as the addition of a mora to the base. Lombardi & McCarthy (1991) have argued on the basis of cross-linguistic evidence that the "theory must recognize an operation of mora prefixation" (1991: 61). This operation is found in two Muskogean languages, Choctaw and Alabama, and also in two Austronesian languages Balangao and Keley-i. In these languages, as in Temiar, the added mora is also realized with segmental material of the base.

To sum up, the three basic properties of Temiar which will be crucial to the analysis are as follows: every syllable must have an onset (ONS), complex syllabic margins are not allowed (*COMPLEX), and every (output) word must contain only one specified vowel (1-V). Finally, the basic generalization about the locus of affixation in the simulfactive and continuative patterns is that the affix appears aligned with the left edge of the major syllable of the base (α-HEAD).

3.2. Segmental Copying Derived by Correspondence

This subsection presents a full analysis of the simulfactive and continuative aspects, in that order. In the simulfactive forms of (19) there are two voices, active and causative. Each voice exhibits two possible patterns, a biconsonantal and a triconsonantal. Copies of consonants are shown in boldface.

19. ACTIVE	<u>Biconsonantal</u>	<u>Triconsonantal</u>
a. Base	c^1vc^2 kɔɔw 'to call'	$c^1.c^2vc^3$ s.lɔg 'to lie down'
b. Simulfactive	$\mathbf{c^1}a.c^1vc^2$ **k**a.kɔɔw	$c^1a.c^2vc^3$ sa.lɔg
CAUSATIVE	<u>Biconsonantal</u>	<u>Triconsonantal</u>
c. Base	$tr.c^1vc^2$ tr.kɔɔw	$c^1r.c^2vc^3$ sr.lɔg
d. Simulfactive	$t.ra.c^1vc^2$ t.ra.kɔɔw	$c^1.ra.c^2vc^3$ s.ra.lɔg

All simulfactive forms have a prefinal syllable with the vowel /a/, a clear violation of the constraint 1-V, expressing the family-wide generalization of Mon-Khmer languages that allows only for one syllable with a fully specified vowel. This provides us with the first ranking argument in the analysis. Let me assume that the input of the simulfactive consists of the segmental expression of the aspect, namely, the vowel /a/, and the base. For example, in the case of an active triconsonantal base the input will be as shown in the upper left corner of tableau (20) below.

20. Ranking argument: MAX^{IO} >> 1-V

Input: a, $c^1.c^2vc^3$	MAX^{IO}	1-V
a. $c^1.c^2vc^3$	*!	
b. ☞ $c^1a.c^2vc^3$		*

Constraint 1-V favors a candidate like (20a), where the input vowel /a/ does not surface in the output. This candidate, however, incurs a violation of MAX^{IO} which requires that every segment in the input must have a correspondent segment in the output. Candidate (20b) is in perfect correspondence with the input but incurs a violation of 1-V. The two constraints are thus in conflict. To choose the correct candidate, MAX^{IO} must dominate 1-V, i.e. MAX^{IO} >> 1-V.[13] The prosodic regularity expressed by 1-V is thus violated under specific morphological conditions. It is nevertheless evident in the rest of the language and it will be shown to play an active role in the morphology of the continuative aspect.[14]

The output $c^1a.c^2vc^3$ is otherwise unrevealing. The vowel /a/ is simply prefixed to the major syllable of the base as required by α-HEAD. Similarly, the simulfactive of the causative voice, $c^1.ra.c^2vc^3$ in (19d) is formed from the corresponding causative base $c^1r.c^2vc^3$ in (19c) by affixation of /a/ according to the demands of α-HEAD. The only difference between the causative $c^1.ra.c^2vc^3$

[13] The same ranking accounts for the fact that despite the requirement of 1-V, in the lexicon of Temiar and other Aslian languages, one finds bisyllabic words with phonologically specified penultimate vowels (Jah Hut: talon 'python'; Semai: takɔɔy 'a lizard'; Temiar: halab 'to go downriver', Diffloth 1976a). These prefinal vowels are underlyingly present because their qualities are unpredictable, and hence the ranking MAX^{IO} >> 1-V ensures that they will appear on the surface. Such words are not found in the rest of Mon Khmer.

[14] Compare this to a parametric theory of inviolable conditions and repair strategies, where constraints are either "on" or "off" for the whole language (Paradis 1988). In such a theory this situation cannot be coherently characterized. ONS, for example, is "on" for every syllable in Temiar, i.e. it is never violated. Other constraints, however, like 1-V may be violated under certain conditions.

and the active $c^1a.c^2vc^3$ is that the base of the former has one more consonant in its minor syllable, i.e. causative $c^1r.c^2vc^3$ versus active $c^1.c^2vc^3$. This causes the causative output to contain one more minor syllable, as in $c^1.ra.c^2vc^3$. An alternative output, $c^1ra.c^2vc^3$, with a complex onset is excluded because *COMPLEX is undominated. Moreover, c^1 or any other consonant of the causative base cannot be left unparsed because this would incur a violation of the undominated MAX^{IO}. It is easy to see that the other causative simulfactive output pattern of biconsonantals in (19d), t.ra.c^1vc^2, is similar in all respects to $c^1.ra.c^2vc^3$.

Consider now the active simulfactive of biconsonantals $\mathbf{c^1}a.c^1vc^2$ in (19b). Affixation of /a/ here is accompanied by a copy of a base consonant. The constraint α-HEAD will require that /a/ be in a prefinal syllable, which is then required to have an onset because constraint ONS is undominated. This then explains the presence of the new consonant in the output. It also shows that this consonant is not part of some output template specific to the simulfactive, as has been assumed in previous analyses of these facts (McCarthy 1982, Broselow & McCarthy 1983), or even part of some prosodic requirement imposed on the shape of this particular affix.

The affix is thus only partially specified in the input as /a/ and its surface realization is left to be determined by the grammar of the language. It remains to be explained why the needed onset is a copy of a base consonant. I propose that the simulfactive affix is reduplicative in the sense that there is a correspondence relation between it and the base. This correspondence relation is what dictates copying. More specifically, constraint DEP^{BR} requires that the onset of the prefinal syllable be a copy of a base consonant. Had the needed onset been a 'default' consonant, as in Ta.c^1vc^2, it would have no correspondent segment in the base, a violation of DEP^{BR}. The situation is depicted formally in tableau (21) below.

21. Active simulfactive of biconsonantals; copying induced by DEP^{BR}

Input: a, c^1vc^2	ONS	DEP^{BR}
a. $a.c^1vc^2$	*!	*(a)
b. $Ta.c^1vc^2$		*(a)*(T)!
c. ☞ $\mathbf{c^1}a.c^1vc^2$		*(a)

Since /a/ of the affix does not correspond to any base segment there is a violation of DEP^{BR} for each one of these candidates. Candidate (21a) has affix /a/ prefixed to the major syllable of the word. No onset is provided for the prefinal syllable, however, which causes a fatal violation of ONS. Candidate (21b) provides an onset by epenthesizing an unmarked consonant /T/ with no correspondent in the base. This causes a second fatal violation of DEP^{BR}. Finally, candidate (21c) avoids a second violation of DEP^{BR} by copying a base consonant. ONS and DEP^{BR} are unranked with respect to each other.

For copying of the consonant to take place, an additional ranking must be established. Creating a copy of a segment introduces another instance of the original segment, inheriting its markedness. Following Prince & Smolensky (1993), I will assume that segments have markedness characterized primarily by their place of articulation. Let PL/χ stand for a segment with χ place of articulation. The Markedness Hierarchy in (22) directly expresses the fact that certain consonants (usually the coronals) are less marked than others by a ranking of the *PL/χ constraints.

22. Markedness Hierarchy
Some ranking of *PL/Labial, *PL/Dorsal, *PL/Coronal (usually in this order)

Hence, for copying to take place, the markedness violation of the copied segment must never be serious enough to block copying of the consonant, epenthesizing an unmarked /T/ instead. In other words, the dependence requirement must be ranked higher than the markedness violation of the copied segment. Using the symbol $*PL/\chi^{MAX}$ for the highest constraint(s) in the markedness hierarchy, the ranking ensuring that copying is never blocked by the markedness of the copied segment is DEP^{BR} >> $*PL/\chi^{MAX}$ (which is in turn ranked higher than $*PL/\chi^{MIN}$, the constraint for the markedness of the least marked segment /T/).

Consider now the fact that in the rest of the simulfactive outputs, $c^1a.c^2vc^3$, $t.ra.c^1vc^2$, and $c^1.ra.c^2vc^3$, no copying takes place. In previous analyses this has been taken as evidence that the simulfactive involves no reduplication at all and that the copying of the consonant in $\mathbf{c^1}a.c^1vc^2$ is the result of a completely unrelated mechanism, namely, LDC-spreading. A crucial tenet of OT, however, is that constraints are gradiently violable. In particular, MAX^{BR}, which requires that every segment of the base have a correspondent in the reduplicant, shows different degrees of violation: in $c^1a.c^2vc^3$ no segment of the base is copied, incurring four violations of MAX^{BR} , and only one consonant is copied in $\mathbf{c^1}a.c^1vc^2$, incurring two violations of MAX^{BR}. Some constraint(s) must then be forcing these violations.

As discussed above, copies of segments incur markedness violations. The more segments are copied the less optimal the output becomes. In Temiar copying is minimized. For example, in $\mathbf{c^1}a.c^1vc^2$, a consonant is required in the output because of undominated ONS, but in $c^1a.c^2vc^3$ no consonant is required because the base already contains c^1 that can serve the role of the needed onset. Thus no copying takes place. If it did, as in the alternative output $c^1.\mathbf{c^2}a.c^2vc^3$, it would incur the additional violation $*PL/c^2$. MAX^{BR} must then be ranked lower than the markedness constraint of the least marked segment, $*PL/\chi^{MIN}$ >> MAX^{BR}. This ranking has the effect of minimizing copying which takes place only when the presence of a new consonant is required by higher prosodic constraints of the language, in this case, ONS.

Two crucial ranklings have thus been established. DEP^{BR} >> $*PL/\chi^{MAX}$, forcing copying instead of epenthesis of default consonants, and $*PL/\chi^{MIN}$ >> MAX^{BR}, minimizing the number of copied segments. Since, by definition $*PL/\chi^{MAX}$ >> $*PL/\chi^{MIN}$, the overall ranking is DEP^{BR} >> $*PL/\chi$ >> MAX^{BR}, where $*PL/\chi$ is a variable for any constraint of the markedness hierarchy[15]. Tableau (23) formalizes the preceding discussion in terms of the proposed constraints. (I only show the additional violation of markedness caused by copying or epenthesis under the constraint $*PL/\chi$).

23. Active simulfactive of biconsonantals

Input: a, c^1vc^2	ONS	DEP^{BR}	$*PL/\chi$	MAX^{BR}
a. a.c^1vc^2	*!	*(a)		***
b. Ta.c^1vc^2		*(a)*(T)!	*(T)	***
c. ☞ $\mathbf{c^1}$a.c^1vc^2		*(a)	*(c^1)	**
d. $\mathbf{c^1vc^2}$.a.c^1vc^2	*!	*(a)	*(c^1)*(v)*(c^2)	
e. ☞ $\mathbf{c^2}$a.c^1vc^2		*(a)	*(c^2)	**

Candidates (23a-c) have already been discussed in tableau (21). Candidate (23d) copies the whole base, satisfying MAX^{BR} completely but at the expense of violating higher ranked constraints[16]. Finally, candidate (23e) is so far predicted to be an alternative optimal output (at least in those cases where $*PL/c^1$ >> $*PL/c^2$).

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[15] $*PL/\chi$ is, in other words, the encapsulation of the Markedness Hierarchy. See Prince & Smolensky 1993, section 8.4.

[16] A variant of this candidate, $\mathbf{c^1v.c^2}$a.c^1vc^2, avoids the onsetless syllable but causes a fatal violation of another undominated constraint, SROLE, to be introduced below.

I thus turn to the question of what determines the choice of the consonant to be copied, namely, the choice between the two possible candidates $\mathbf{c^1}a.c^1vc^2$ and $\mathbf{c^2}a.c^1vc^2$. Apart from DEP ^{BR}, the copied consonants in these two candidates satisfy another constraint of correspondence theory, which requires that correspondent segments be featurally identical. This in fact is a constraint family, IDENT^{BR}(F), satisfied here for every feature F. The constraints IDENT^{BR}(F) thus cannot be involved in the choice between the two candidates. Aside from their featural composition, however, segments in the output come equipped with other prosodic properties such as their syllabic roles. I propose that this is the property of segments which determines the choice between the two candidates. Putting alternatives aside for the moment, the relevant constraint is SROLE, requiring that correspondent segments have identical syllabic roles.

Tableau (24) shows how SROLE determines the choice of the copied consonant. In (24a) the copied $\mathbf{c^2}$ is parsed as an onset while c^2 in the base is parsed as a coda. In (24b) both c^1 and its copy are parsed as onsets. In Temiar SROLE is never violated, and thus I will assume it is undominated.

24. Choice of copied consonant

Input: a, c^1vc^2	SROLE
a. $\mathbf{c^2}a.c^1vc^2$	*!
b. ☞ $\mathbf{c^1}a.c^1vc^2$	

Note that there is a potential alternative to the analysis just proposed in terms of the constraint shown in (25).

25. ANCHORING (McCarthy and Prince 1994a)

Correspondence preserves alignment in the following sense: the left/right peripheral element of the Reduplicant corresponds to the left (right) peripheral element of Base, if the Reduplicant is to the left/right of the Base.

ANCHORING is meant to capture a generalization about the copying and association rules of operational theories of reduplication (Marantz 1982, McCarthy & Prince 1986). The generalization is that reduplicative prefixes copy base material from the left edge of the base, while reduplicative suffixes copy from the right edge of the base. The continuative forms, however, provide the crucial evidence that this is not the relevant constraint in Temiar. When the copied consonant is placed in onset position, as in the simulfactive $\mathbf{c^1}a.c^1vc^2$, the copy starts from the leftmost segment of the base. But when the copied consonant is placed at the coda position, as in the continuative $c^1\mathbf{c^3}.c^2vc^3$, it is the rightmost segment of the base that is chosen for copying. This then shows that it is not the edge of the base that is crucial here but the prosodic role of the copied segment (i.e. in Temiar SROLE >> ANCHORING; in the Semitic patterns discussed in section 6, the inverse ranking will be at work).

Turning to the analysis of the continuative aspect, consider the four patterns, two for the active and two for the causative voice, shown in (26).

26. ACTIVE	<u>Biconsonantal</u>	<u>Triconsonantal</u>
a. Base	c^1vc^2 kɔɔw 'to call'	$c^1.c^2vc^3$ s.lɔg 'to lie down'
b. Continuative	$\mathbf{c^1c^2}.c^1vc^2$ k**w**.kɔɔw	$c^1\mathbf{c^3}.c^2vc^3$ s**g**.lɔg
CAUSATIVE	<u>Biconsonantal</u>	<u>Triconsonantal</u>
c. Base	$tr.c^1vc^2$ tr.kɔɔw	$c^1r.c^2vc^3$ sr.lɔg
d. Continuative	$t.r\mathbf{c^2}.c^1vc^2$ t.r**w**.kɔɔw	$c^1.r\mathbf{c^3}.c^2vc^3$ s.r**g**.lɔg

It is clear from all four continuative outputs that the choice of the copied consonant(s), is determined by SROLE. There are two other interesting observations that can be made about these patterns, stated in (27).

27. a. Only consonants are copied (i.e. the base vowel is never copied).

b. The number of copied consonants varies. In the case of c^1vc^2 there are two consonants copied. In all other cases there is only one consonant copied.

Regarding (27a), consider the continuative of triconsonantals in s**g**.lɔg. Recall that the continuative affix is required, under α-HEAD, to be prefixed to the major syllable of the base. As in the case of the simulfactive, I will assume that the continuative affix is reduplicative. I argue here that the continuative affix should not be specified for any segmental content, being simply an empty Root node whose realization is determined by the grammar of the language. Noting that the affix is invariantly realized with a copy of at least one base consonant, it could perhaps be specified to be some sort of consonantal segment[17]. However, this fact follows from the regular prosody of the language. Indeed, if the affix was realized by a copy of a vowel, a second syllable with a vowel would be created, a violation of 1-V. The language evades this violation by realizing the affix with a consonant. (I argue below that the affix also lacks a prosodic target).

The situation is expressed formally in tableau (28), where the segment realizing the affix is underlined, and boldfaced if it is a copy of some other segment. In the input shown in this tableau, α indicates the continuative affix, a Root node with no segmental content[18].

28. Continuative of triconsonantals; 1-V in action

Input: α, $c^1.c^2vc^3$	1-V	DEP^{BR}	*PL/χ
a. $c^1\underline{\mathbf{v}}.c^2vc^3$	*!		*(v)
b. $c^1\underline{T}.c^2vc^3$		*(T)!	*(T)
c. ☞ $c^1\underline{\mathbf{c^3}}.c^2vc^3$			*(c^3)

[17] This, in fact, has been suggested in the analysis of Broselow & McCarthy (1983).

[18] I assume, of course, a superordinate constraint that requires empty Root nodes in the input to be filled with segmental material, technically FILL^{Segment} or FILL^{Place} of Prince & Smolensky (1993), section 9.1.2.

Candidate (28a) realizes the affix with a copy of the base vowel /v/, a violation of 1-V, while (28b) fills it with a default consonant /T/, a violation of DEP^{BR}. Finally, (28c) avoids both violations by copying a consonant of the base.

Recall that 1-V is dominated by MAX^{IO}, and thus violated in all simulfactive outputs as established earlier in the analysis. In the case of the continuatives, on the other hand, 1-V plays an active role in determining the optimal candidate. This difference arises from the fact the simulfactive is partially specified as /a/, while the continuative has no prespecified phonological content. It is thus left to the grammar to determine the content of the affix, and hence constraints determining the regular prosody of the language, like 1-V, play an active role in choosing the optimal candidate.

The second observation noted in (27b) highlights the difference between the two active continuative patterns in (26b), namely, the biconsonantal $\mathbf{c^1c^2}.c^1vc^2$ and the triconsonantal $c^1\mathbf{c^3}.c^2vc^3$. As in the corresponding simulfactives $\mathbf{c^1}a.c^1vc^2$ and $c^1a.c^2vc^3$, the biconsonantals copy one more consonant than the triconsonantals. This is because in the case of biconsonantals the affix is realized as $/...\mathbf{c^2}.c^1vc^2/$, according to the demands of α-HEAD and 1-V, and the prefinal syllable then needs an onset because ONS is undominated. This onset is provided by copying a base consonant for the same reasons as in the simulfactive, namely, DEP^{BR}. As in the case of the simulfactive $\mathbf{c^1}a.c^1vc^2$, the copied consonant is not part of some output template specific to continuative formation or part of some specification on the prosodic shape of the affix itself. It is instead required by ONS, an inviolated prosodic property of the language. The emergence of the biconsonantal active continuative form $\mathbf{c^1c^2}.c^1vc^2$ is expressed in tableau (29), evaluating the more relevant candidates.

29. Continuative of biconsonantals (affix realizations are underlined)

Input: α, c^1vc^2	ONS	DEP^{BR}	*PL/χ
a. ε<u>**c^2**</u>.c^1vc^2	*!		*(c^2)
b. Tε<u>T</u>.c^1vc^2		*!*	*(T)*(T)
c. Tε<u>**c^2**</u>.c^1vc^2		*!	*(T) *(c^2)
d. **c^1**ε<u>T</u>.c^1vc^2		*!	*(T)*(c^1)
e. ☞ **c^1**ε<u>**c^2**</u>.c^1vc^2			*(c^1)*(c^2)

Candidate (29a) realizes the affix with a base consonant placed in the coda position of an onsetless syllable, causing a fatal violation of ONS (the phonetic minor syllable vowel [ε] is shown in this tableau to make clear that <u>**c^2**</u> is placed in the coda position as required by α-HEAD). Candidates (29b-d) realize at least one of the consonants of the prefinal syllable by epenthesizing a segment T with no base correspondent. This causes at least one DEP^{BR} violation. The optimal candidate (29e) copies both consonants of the base, avoiding all DEP^{BR} violations[19].

In the triconsonantal output, c^1**c^3**.c^2vc^3, recall that the affix is placed at the position /...**c^3**.c^2vc^3/ and realized with a consonant as established in tableau (28) above. The base includes another consonant, c^1, which can serve as an onset of the prefinal syllable, i.e. c^1**c^3**.c^2vc^3, and thus no additional copying is necessary. The same applies to the other two continuative patterns of the causative voice, t.r**c^2**.c^1vc^2 and c^1.r**c^3**.c^2vc^3. Placement of the affix is determined by α-HEAD and its

[19] It is important to remember that the vowel [ε] is just the phonetic relization of a minor syllable. Also, two other relevant candidates need to be considered here. The first realizes the affix by spreading of the segmentally adjacent consonant ... <u>c^1</u>.c^1vc^2, where the two instances of c^1 share the same Root. Temiar, however, disallows geminate consonants and this candidate can safely be ignored (depending on the representation of geminates in OT, this candidate may also incur a violation of undominated SROLE; see Itô & Mester 1993 for relevant discussion). The second is candidate **c^1**.c^1vc^2, where **c^1** is in the onset position of the prefinal syllable. This candidate violates the undominated α-HEAD, because **c^1** being the onset of its minor syllable is separated by the consonant at the left edge of the major syllable by the empty nucleus node of the minor syllable (see the representation of minor syllables in 10).

realization as a consonant by the regular prosody of the language, namely, 1-V.

This concludes the main part of the analysis. To sum up, the simulfactive and continuative affixes are both specified to be a Root node. The only difference between the two is that in the simulfactive affix the Root node is further specified as /a/. Moreover, the two affixes obey a common placement constraint α-HEAD. The surface shape of the affix-base combination emerges from the interaction of α-HEAD with the regular prosody of the language, that is, mainly the constraints ONS and 1-V. Copying of segments is induced by the correspondence constraint DEP^{BR}. The number of copied segments is minimized because the segmental markedness constraints *PL/χ are ranked higher than the other basic correspondence constraint MAX^{BR}. Two more constraints, IDENT^{BR}(F) and SROLE, require identity in terms of featural composition and syllabic role between correspondent segments.

Some further refinements in the ranking of correspondence constraints are made possible by certain regularities noted by Benjamin. The first regularity is that a voiceless stop in the first position of a medial consonantal cluster undergoes nasalization in Northern Temiar and voicing in Southern Temiar. The effects of this regularity become evident in the formation of the continuative, as shown in (30a-b) below, where a base-final voiceless stop is copied and placed in preconsonantal position.

30. Coda Nasalization/Voicing

	Verb	Gloss	Surface form
a. Northern Temiar	yaap	‘to cry’	y**m**.yaa**p**
b. Southern Temiar	ʔɔɔt	‘to fast’	ʔ**d**.ʔɔɔ**t**

I will assume that a constraint on codas is involved here, requiring that coda consonants be above a certain sonority level, and hence causing unvoiced stops to become nasalized when they are in coda position: COD-COND (see Itô & Mester 1993 on the details of how to formalize constraints like this in OT). This constraint is now in conflict with IDENT^{BO}(F) which requires copied segments to be featurally faithful to their correspondents. The required rankings must therefore be COD-COND >> IDENT^{BR}(nasal) for Northern Temiar, and COD-COND >> IDENT^{BR}(voice) for Southern Temiar.

Another regularity is that nasals assimilate to the place of articulation of a following stop. Examples are given in (31a-b) with the nasal-stop clusters underlined. Benjamin notes that there are 'exceptions' to this regularity, as shown by (31c-d). All examples are from the Northern dialect.

31. Verb	Gloss
a. kandeeʔ	'we (they and I)' (emphatic)
b. c.rɳ.kub naʔ	'that lid' (affix /n/ with the base cr.kub, [ɳ] is a velar nasal)
c. pn.pət	'to long for' (continuative of pət)
d. gn.gr.lut	'spindly-ness' (expressive of gr.lut)

The interesting fact about these 'exceptions' is that they are attested precisely when the nasal consonant is derived by a copy of a base consonant, nasalized due to the ranking COD-COND >> IDENT^{BR}(nasal). The non-homorganic /n/ is a nasalized copy of /t/ in the continuative of (31c) and the expressive of (31d)[20]. Thus when a copied segment is placed in the context where assimilation would normally occur, the segment retains its place identity, remaining faithful in this respect to its correspondent in the base. Assuming that nasal place assimilation is imposed by a constraint NC, these facts motivate the ranking IDENT^{BR}(PL) >> NC.[21]

A couple of conclusions follow. First, these facts can be equally described in a rule-based

[20] Expressives in Temiar and other Aslian languages employ similar types of affixation and copying as found in the verbal morphology of the language.

[21] Compare this with Makassarese (McCarthy & Prince 1994), which has the same constraint on place assimilation of nasals, but the reduplicated form bulam-bulaɳ 'months' (where m corresponds to ɳ) shows that the inverse ranking is involved, i.e. NC >> IDENT(PL).

approach by ordering a rule of ‘nasal place assimilation’ before the morphological operation of ‘continuative formation,’ which is in turn ordered before a rule of ‘coda nasalization’. When the continuative is formed, the nasal place assimilation rule would be inapplicable although the coda nasalization rule creates the environment for its application. Hence a rule-based framework, so far, appears to require no more machinery than the constraint-based approach, which also utilizes three constraints with the ranking COD-COND, IDENT^{BR}(PL) >> NC. However, when a nasal infix is inserted in the base, as in c.rɳ.kub naʔ ‘that lid’ (affix /n/ with base cɛrkub) of (31b), the nasal does assimilate to the place of articulation of the following stop[22]. To account for this fact, the rule-based approach needs to postulate an additional ordering relation: the rule of ‘nasal infixation’ must precede the rule of ‘nasal place assimilation’. In the constraint-based approach, on the other hand, no additional move is necessary. The nasal infix assimilates to the following stop because the nasal does not derive from a copy of a base segment and thus IDENT^{BR}(PL) does not apply.[23]

Second, further refinements in the ranking of the correspondence constraints have been deduced, which in turn provide support for one of the main analytical choices of Correspondence Theory of McCarthy & Prince (1995a). In particular, the featural identity requirement must indeed be seen as a family of constraints IDENT(F) for every feature F. This is required because the featural correspondence constraints are ranked differently. Identity of place features is more important than

[22] The minimal pair sɳ.lɔɔk ‘to hunt successfully’ (base slɔɔk with a nasalized copy of base-final consonant /k/ infixed), and sn.lɔɔk ‘success in hunting’ (affix /n/ with the base slɔɔk) clearly demonstrates the difference between the two nasals.

[23] Assuming that the nasal infix is specified for some place of articulation in the input, then the fact that it surfaces assimilated to the following stop requires the ranking NC >> IDENT^{IO}(PL). The rule-based approach would also require some rule of delinking and reassociation of the place of articulation of the nasal infix. On the other hand, if the nasal infix is not specified for place underlyingly (as would be necessary in the OT approach, according to Inkelas 1994, but could also be the case in the rule-based approach) then both frameworks would again fare equally in the mechanisms needed to account for this fact.

identity of other features such as voicing and nasality.

The next two sections of the paper will further motivate and justify the correspondence approach to copying, comparing it with alternatives which use the additional mechanism of spreading to create copies of segments. Section 4 focuses on evidence from Temiar. Section 5 discusses cross-linguistic evidence.

4. Temiar in Previous Analyses

In this section, I consider previous analyses of the Temiar verbal aspect, addressing the substantive differences between the proposed optimality theoretic solution and those earlier analyses. The focus will be on McCarthy (1982), briefly considering also Broselow & McCarthy (1983) and Sloan (1988). The common characteristic of all previous approaches is their use of templates and association rules, which map underlying melodic sequences to these templates, parametrized for whether association proceeds left-to-right or right-to-left. For brevity, I refer to this approach as the 'Template and Association Approach' (henceforth TA). This section aims to show that templates are not necessary and that association rules miss certain significant generalizations in the data.

The analysis of Temiar in the TA approach assumes that copying in the simulfactive and continuative patterns is the effect of two entirely different mechanisms, namely, "spreading" and reduplication, respectively. Specifically, the analysis of the simulfactive stipulates a prosodic template CVCV(V)C whose first vocalic position is occupied by the simulfactive affix /a/. In (32), I consider the derivation of the biconsonantal base kɔɔw 'to call.'

32. kɔɔw →[kakɔɔw]

```
                           a
                           |
Prosodic Template:     C   V   C   V   V   C
                       |           |  /    |
                       k           ɔ       w
```

The base melody is first associated in a left-to-right (LR) direction to the positions of this template. The empty templatic position C, which remains after this first association step, is filled by spreading of the base-initial consonant /k/, an instance of LDC-spreading applying over the intervening vowel /a/. LDC-spreading is allowed because of the geometry of the representation, namely, segregation of the affix /a/ and the segments of the base /kɔɔw/ to two different planes. This representation is a special case of planar segregation requiring that different morphemes lie on different planes, introduced in McCarthy (1979) and extended later to V/C planar segregation in McCarthy (1989).

The derivation of the continuative patterns ($\mathbf{c^1c^2}.c^1vc^2$ and $c^1\mathbf{c^3}.c^2vc^3$) is more involved and uses a disparate number of mechanisms, given in (33).

33. a. Morphemic template: [Root   Root]
    b. Prosodic template: CCCVC
    c. Continuative Association Rule: Associate the *last* element in the *first* copy of the root with the *second* C-position of the prosodic template. After this rule is applied, association proceeds left to right.
    d. Morphological Opacity: All segments of the base must appear in the output.

I briefly illustrate the use of these mechanisms with an example, the continuative of the verb s.lɔg 'to lie down', sg.lɔg. The morphemic template [Root   Root] in (33a) stipulates that the output must consist of two copies of the base melody, i.e. [slɔg   slɔg]. The segments in these two copies must then be associated to the prosodic template CCCVC, in (33b). The association procedure must begin with a special association step, stated in the continuative association rule, (33c), which essentially stipulates that the final segment of the first copy of the base must be linked to the second C position in the prosodic template, giving CgCVC. Association of the rest of the segments is then initiated in the unmarked left to right direction, and an additional provision, called Morphological Opacity in (33d), is required to derive the correct output, shown in (34) below.[24]

34. s l ɔ g → [s g l ɔ g]

Prosodic Template:	C C C V C
Morphemic Template:	s l ɔ g s l ɔ g
Output:	[s g l ɔ g]

The problem with this account is the continuative association rule in (33c). This rule is ad-hoc because it makes reference to arbitrary templatic positions, by stipulating that the *last* element in the *first* copy of the root melody associates to the *second* position in the template. It also misses a generalization evident in all continuative patterns. The second consonant in the outputs $\mathbf{c^1c^2}.c^1vc^2$ and $c^1\mathbf{c^3}.c^2vc^3$ is a copy of the base-final consonant because it is in a coda position, just like the base-final consonant. The decision of which consonant to copy does not require any ad-hoc rule of association, but follows from the universal correspondence constraint SROLE, requiring identity between the syllabic roles of the copied segment and its correspondent in the base.

Considering the simulfactive and continuative patterns together, the argument against the parametric rule-based approach can be tightened further. The crucial fact is that when the copied consonant is placed in onset position, the first consonant of the base is chosen, as in the case of the simulfactive in (35a) below. However, when the copied consonant is placed in a coda position, the final consonant of the base is chosen instead, as in the case of the continuative in (35b). Any TA

[24] The motivation for Morphological Opacity (MO) is that after the application of the Continuative Association Rule there are only three available C positions in the template CgCVC but five unassociated consonants underlined in the melodic sequence s l ɔ g s l ɔ g. MO thus excludes possible outputs like s g s ɔ g, where/l/ remains unassociated. Notice that MO is a constraint on the output of the derivation, and essentially a predecessor of MAX^{IO}, one of the undominated constraints of the OT analysis proposed earlier.

approach needs two different rules of association with incompatible directional settings[25]. This misses the generalization evident in both aspects, which is directly captured by the correspondence approach, requiring that copied segments must have identical syllabic roles as their correspondents.

35.	Aspect	Output	Direction of Association
	a. Simulfactive	$\mathbf{c^1}a.c^1vc^2$	Left to right
	b. Continuative	$c^1\mathbf{c^3}.c^2vc^3$	Right to left

Broselow & McCarthy (1982) also use a special association rule to derive the continuative forms, although the mechanics of their analysis are slightly different. In particular, derivation of the continuative /s g l ɔ g/ is executed in the following way. A reduplicative infix C is inserted in the context C_CVC, i.e. /s _ l ɔ g/. This infix induces copying of the melody of the base, and "autosegmental association is stipulated to proceed from right to left," yielding /s g l ɔ g/ (Broselow & McCarthy 1982:39). Finally, Sloan (1988) analyzes the continuative as involving the prefixation of a minor syllable consisting of two consonants, CC, to the base. A copy of the base melody is then created and associated to the CC template. Here again, the first step of this association procedure is stipulatory, employing a "Special Association Principle" which associates "the rightmost element of the copy to the affixal template" (Sloan 1988:321). Without considering the details of these analyses, it is clear that a considerable amount of stipulation is involved, missing the important generalizations uncovered by the analysis presented in the previous section.

Finally, another problem with TA approaches is the statement of the templates themselves.

[25] An alternative mode of association in the TA model does not help either. Yip (1988) has proposed an edge-in linking mode, in which the segments at the edges of a copied melody are first linked to the positions at the edges of a template. One of the continuative patterns, $\mathbf{c^1c^2}.c^1vc^2$, suggests edge-in linking, assuming that the template is some sort of reduplicative heavy syllable. However, edge-in linking does not help in $c^1\mathbf{c^3}.c^2vc^3$, where only one consonant gets copied.

Previous analyses stipulate that the outputs of the simulfactive and continuative aspects are the templates Ca.CVC and CC.CVC respectively. As seen in section 3, however, the presence of the first consonant in the simulfactive template Ca.CVC is required because the prefinal syllable, created by prefixing /a/ to the base c^1vc^2, must have an onset. This first C position of the template is thus not arbitrary and should not be stipulated as such. Similarly, in the continuative output CC.CVC, the second C position is the realization of an affixal Root node aligned at the left edge of the final syllable of the base, a property common to all simulfactive and continuative patterns. Moreover, the first consonant position in the template is required because, as in the simulfactive, the prefinal syllable must have an onset. The interaction of affixation with independent prosodic requirements of the language, such as ONS and 1-V, derives the shape of templates that previous analyses had to stipulate. This result is another example of an a-templatic analysis, in the sense that no templates are needed to stipulate the shape of the output or of the affix. Other a-templatic analyses have been presented in McCarthy (1993) for part of Arabic and Akkadian, and Archangeli (1991) for Yawelmani. (I return to this property of the analysis in the typological consequences explored in section 6.)

5. On the Necessity of Eliminating LDC-spreading

In this section I argue that the proposed reduction of LDC-spreading to copying via correspondence is not only possible, but also necessary. Section 5.1 reexamines the traditional argument for the need for both reduplication and LDC-spreading in the theory. Section 5.2 presents independent evidence for eliminating LDC-spreading.

5.1. The Apparent Need for Reduplication and LDC-Spreading

The only argument that I can reconstruct for the existence of two separate mechanisms for creating copies of segments is based on some data of Hebrew and Arabic discussed in McCarthy (1979, 1981)[26]. This argument will be first illustrated with the Temiar data, turning to the original data next.

Consider the derivation of the simulfactive of biconsonantals, kakɔɔw from kɔɔw 'to call', which is argued to employ LDC-spreading, as shown in (36a) below. The consonant /k/ automatically spreads to fill the unassociated position in the CaCVC template. All previous analyses of the simulfactive had assumed that a spreading, as opposed to a reduplicative, mechanism was involved here because, as shown by the other simulfactive patterns (e.g. $c^1a.c^2vc^3$), copying does not always takes place.

36. a. Simulfactive

```
      a
      |
  C   V   C   V   V   C
  |               |   /   |
  k               ɔ       w
(output:)   [kakɔɔw]
```

b. Continuative

```
*  C   C   C   V  V   C
               |   |  /   |
               k   ɔ      w
(intended output:) [kwkɔw]
```

On the other hand, the continuative pattern, kwkɔɔw in (36b), shows that spreading cannot be involved here, because it would create line-crossing. Hence, the other mechanism devoted to copying segments, reduplication, needs to be invoked, which is why the morphemic template [Root   Root] is postulated for the continuative. This template stipulates that a copy of the whole Root must be created. The segments in the two copies of the Root are then associated to the continuative prosodic template CCCVC by a complex set of mechanisms whose details were discussed in section 4.

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[26] It should be mentioned that the arguments in this section, especially those against the distinction between reduplication and LDC-spreading drawn from McCarthy (1979, 1981), are not meant to underscore weaknesses in the specific analyses in question but rather the limitations of the general framework those analyses presupposed, which obscured the similarities between LDC-spreading and reduplication.

Turning now to the original data, a similar situation to that of Temiar exists in Arabic and Hebrew (McCarthy 1979, 1981). McCarthy notes that some quadrilateral verbs in Arabic are of the pattern $c^1vc^2c^1vc^2$, e.g. zalzal 'to shake', waswas 'to whisper' (some shared semantic feature of repetitiveness is claimed to underly this class). This pattern of copying is not productive in Arabic, but the traditional grammar of Hebrew includes two binyanim, known as the Pilpel and the related reflexive Hitpalpel, which show the same pattern. Compared to the first binyan of a biconsonantal root, these binyanim show the patterns in (37) below.

37.

Root:	gl		sʕ	
Binyan I	galal	'to roll (intrans.)'	saʕaʕ	'to be smeared'
Pilpel	gilgel	'to roll (trans.)'	siʕasaʕ	'to stroke'
Hitpalpel	hitgalgel	'to roll oneself along'	histaʕasaʕ	'to indulge oneself'

The analysis suggested of McCarthy (1979, 1981) uses LDC-spreading to derive the form of the first binyan (e.g. spreading of /l/ in galal), but whole root reduplication to derive the form of the Pilpel and Hitpalpel (consisting of two steps: copying of the root gl and then mapping of the two copies gl, gl to the templates CiCCeC, and hitCaCCeC respectively). The point is again that cases like those of the Pilpel and Hitpalpel cannot be analyzed using LDC-spreading because line-crossing would result, while cases like that of Binyan I appear to require LDC-spreading because triconsonantal roots show no copying at all (e.g. gadal 'to grow'). This has led to the conclusion that two substantially distinct mechanisms are at work: LDC-spreading, in the simulfactive of Temiar and the first binyan of Hebrew, and reduplication proper, in the continuative of Temiar and Pilpel and Hitpalpel of Hebrew.

The crucial assumption on which the above conclusion is based is that the simulfactive of Temiar, and the first binyan of Hebrew, involve LDC-spreading, because in both cases triconsonantal roots do not show any copying at all. As was seen in the Temiar analysis, however, the fact that no copying takes place in the simulfactive of triconsonantals ($c^1a.c^2vc^3$) can simply be seen as the extreme case of gradient violation of the constraint MAX^{BR}. In Temiar, because MAX^{BR} is ranked lower than the segmental markedness constraints, copying occurs only when required by constraints ranked higher than the markedness constraints, namely, the undominated ONS (e.g. $\mathbf{c^1}a.c^2vc^3$)[27]. Notice, moreover, that the assumption that two distinct mechanisms of copying are involved is clearly suspect given the simple fact that the alleged cases of LDC-spreading are descriptively similar to the cases of reduplication proper in important ways. For example, in the simulfactive, spreading would be needed to fill an empty C slot in the template CVCVC. In the continuative, the same need to fill the template CCCVC would exist. In both cases there would be a mismatch between the size of the underlying melody (number of segments) and the size of the output (number of prosodic positions). However, in the continuative, copying would not automatically by induced by this mismatch, but would be arbitrarily stipulated as a property of the output by use of the morphemic template [Root Root]. If, as proposed in this paper, the mechanism responsible for the effects of LDC-spreading in the simulfactive is identified as the same mechanism used in the continuative, this problem disappears. Copying of base segments in both the continuative and the simulfactive follows from the unitary notion of correspondence as a response to the common need to fill positions in the output.

To summarize, I have shown that the assumption that reduplication cannot be involved in the simulfactive of Temiar and other similar cases is based on the fact that in some simulfactive outputs

[27] For the Hebrew patterns, it will be shown in section 6 that the size of the bisyllabic template imposed on the output, rather than the segmental markedness constraints, determines the number of copied segments.

no copying of segments takes place. This assumption fails to recognize the identical conditions under which reduplication and LDC-spreading apply. According to the proposal of this paper, this problem disappears because LDC-spreading is reduced to the same formal mechanism as in reduplication, that is, copying induced by correspondence. As shown, the notion of gradient violation of constraints is crucial in achieving the unification of both instances of segmental copying, previously analyzed with two unrelated mechanisms of the theory. At the same time, by obviating LDC-spreading this proposal solves an independent set of problems admitted in the theory which permits this kind of spreading, a point to which I turn in the next section.

5.2. The Exceptional Status of LDC-Spreading

Virtually all discussions of the locality of autosegmental spreading in the feature geometric research program ignore LDC-spreading or treat it as exceptional (see for example Clements 1985, Clements & Hume 1995, NíChiosáin & Padgett 1993). The reason for this is that these discussions focus on concatenative languages, where vowels and consonants are generally assumed to lie on the same plane (see Steriade 1987 for arguments), and thus the geometric premise of LDC-spreading, V/C planar segregation, does not apply. This section shows that in nonconcatenative languages, where V/C planar segregation is assumed, the existence of LDC-spreading is problematic.

In V/C planar segregation, the two consonants in C_1VC_2 are adjacent, as shown in (38a).

38.

```
a. V/C planar segregation       b. /pan/ → [pam]            c. /pad/ → [bad]
        V-Root                          V-Root                       V-Root
          |                               |                            |
   X      X      X               X      X      X               X      X      X
   |             |               |             |                            |
C1-Root       C2-Root         [labial]     [coronal]                     [voice]
```

This representation blurs the distinction between biconsonantal clusters and pairs of consonants separated by a vowel. In both cases the consonants are adjacent according to this geometric notion of adjacency. On the basis of a representation like (38a), we thus expect to find phonological interaction between such pairs of consonants separated by the vowel, which is of the same character as when C_1 and C_2 are string adjacent in a CC cluster. Specifically, we expect cases of long-distance assimilation as in the two examples in (38b-c): (38b) shows a hypothetical process of place assimilation, /pan/ → [pam], and (38c) another process of voice assimilation, /pad/ → [bad], both applying over the intervening vowel. Such processes are widely attested in CC clusters cross-linguistically, but are not attested over intervening vowels, as noted by Clements (1985:46), in either concatenative or nonconcatenative languages[28].

Hence, V/C planar segregation admits unfounded expressive power in the theory, predicting unattested phenomena like those of (38b-c). In other words, LDC-spreading and its geometric premise of V/C planar segregation fail to explain why "spreading" in this configuration always spreads the whole consonant. If, as I have proposed above, putative cases of LDC-spreading in fact involve the same mechanism as reduplication, this problem disappears. As in reduplication, copying targets the whole Root of the segment and not its isolated features.

This fact is in turn captured by McCarthy & Prince's (1995a) restriction of correspondence relations to hold between whole segments and not between their individual features. If correspondence relations were allowed to apply between individual features it would be possible to express 'reduplication' phenomena where the reduplicant selectively borrows certain features from

[28] Place features of consonants, it has been argued, spread over vowels in the case of consonant harmony systems, where the harmonizing features are usually those classified under the coronal place of articulation (Shaw 1991; but see footnote 30). This does not affect the argument in the text. Consonant harmony does not require V/C planar segregation but instead employs tier segregation, where the Roots of vowels and consonants are on the same plane but their features may lie on different tiers. In contrast, LDC-spreading requires V/C planar pegregation, because "spreading" targets the whole segment.

the base. Such phenomena are unattested. What is found instead is that identity requirements apply in parallel for all features of a segment (and other prosodic properties as clearly shown by the facts of Temiar). This identity may be sacrificed always under the demands of higher ranked constraints. For example, in Makassarese bulam-[bulaŋ]^{Base} (see footnote 21), identity of place between /m/ and its correspondent in the base /ŋ/ is violated because of the higher ranked homorganicity constraint on the cluster /mb/.

The rest of this section discusses further evidence for the elimination of LDC-spreading. One type of evidence is presented in detail in Gafos (1996), where I propose that the notion of locality in phonology is directly defined in terms of adjacency of actual articulatory gestures[29]. The basic fact of interest is that the two vocalic gestures in a VCV sequence are articulatorily contiguous, in contrast to the two consonantal gestures in a CVC sequence which are not contiguous. Specifically, in a VCV sequence the vowel gestures form a contiguous vocalic substrate on which the gesture of the consonant is superimposed. Acoustically this articulatory contiguity is manifested in the fact that the vowel formants in the VC- and -CV transition parts of the VCV sequence depend not only on the consonant but also on the vowel on the other side of the consonant. This phenomenon, which is known as V-to-V coarticulation, is a universal property of language (Öhman 1966, 1967, Fowler 1983, Lieberman & Blumstein 1988).

On the other hand, it can be shown that the consonant gestures in a CVC sequence are not contiguous. This follows from the fundamental asymmetry between consonants and vowels, namely, the presence of a constriction with the former versus the absence of a constriction with the latter. In

[29] See Browman & Goldstein (1989) and Sproat & Fujimura (1993) for two explicit proposals on how articulatory gestures can be defined.

the sequence of articulatory events $C^{[+constriction]}$ - $V^{[-constriction]}$ - $C^{[+constriction]}$, the intervening vocalic gesture is bound to completely undo the constriction of the first consonant, and the two consonant gestures cannot be contiguous. If they were, a continuous consonantal constriction would overlap with the articulation of the vowel which is physiologically impossible.

The result is that vowel gestures are contiguous in a VCV sequence but consonant gestures are not contiguous in a CVC sequence (V-to-V contiguity versus no C-to-C contiguity). In Gafos (1996) I propose that the correct notion of locality in phonology is articulatory contiguity. V-to-V contiguity is what makes vowel harmony a local process. At the same time, the lack of phonological interaction noted in (38b-c) above follows from the lack of C-to-C contiguity in the CVC configuration. No contiguity implies no basis for phonological interaction, contra the prediction of V/C planar segregation and in accordance with the facts. In other words, if phonological spreading applies under the condition of articulatory contiguity, it follows that it could not be involved between the two consonants of a CVC configuration. [30]

Other researchers have proposed in various forms restrictions on spreading that are consistent with the results of the above discussion. NíChiosáin & Padgett (1993) propose a similar explanation

[30] The picture is more complex than depicted here but nevertheless the basic result holds. First, V-to-V contiguity in a VCV sequence can actually be interrupted by certain intervening consonants, e.g. palatals which employ the tongue-body (Recasens 1984), the same articulator used for vowels. Second, as was noted in footnote 28, consonant harmony systems are limited to spreading of features usually classified under the coronal place of articulation, such as [anterior] and [distributed]. Spreading of major place feature such as Labial, for example, is not attested over the vowel in a CVC sequence. The geometric notion of locality does not capture these facts: the Labial node of the consonant lies on a different tier from the Dorsal node of the vowel and should thus be able to spread uninterrupted by the vowel. On the other hand, the articulatory notion of locality in Gafos (1996) explains these facts. The Labial node of the consonant cannot spread over a vowel to the second consonant in a CVC sequence because the vowel interrupts the articulatory contiguity between the two consonants. Spreading of the Labial node can take place only if it goes through the vowel. The articulatory locality also predicts correctly the fact that consonant harmony is found in terms of the features [anterior] and [distributed]. These features describe the state of the tongue-tip, an independent articulator from the tongue-body with which vowels are articulated. Hence, the tongue-tip configuration of a consonant can spread through the vowel, maintaining its state while the intervening vowel is articulated with the tongue-body. See Gafos (1996) for detailed discussion of these issues.

for the absence of phonological processes like those in (38b-c). Their explanation is based on the assumptions that spreading is strictly local, in the sense that it cannot apply over an intervening segment, and that place and stricture of consonants form a class of features, spreading together. Thus, if spreading was to apply between the two consonants in the CVC configuration, it must go through the vowel. This will impose a consonantal constriction on the vowel resulting in a fatal violation of syllable structure (this idea is attributed to Bruce Hayes). This idea has obvious affinities with the above proposal. Also, McCarthy (1994) analyzing cases of vowel harmony across what are seemingly transparent coronal consonants in a dialect of Bedouin Arabic, argues that the intervening consonants must participate in the harmony, i.e. spreading of the vowel features cannot apply over an intervening consonant, but rather through it. Building on the same idea, Padgett (to appear) analyzes instances of translaryngeal vowel harmony, arguing that spreading of vocalic features must go through the intervening laryngeal consonants. Finally, Archangeli & Pulleyblank (1994) suggest that long-distance spreading of a segment over a vowel should be universally prohibited.

Before concluding this section, I briefly consider another argument that has been brought in support for phonologically motivated V/C segregation, which appears now to be significantly weakened by recent work in the literature. Specifically, McCarthy (1989) has argued that V/C segregation is the representational manifestation of underspecified linear order between consonants and vowels in languages where sufficiently rich constraints on the shape of the output render this ordering predictable (e.g. Semitic, Yawelmani etc.). The crucial assumption on which this argument rests is that underlying representation must contain only unpredictable information. There has been considerable work undermining the validity of this assumption, especially in OT and Burzio’s constraint-based framework (Prince & Smolensky 1993: Chapter 9; Burzio 1994; Inkelas 1994; Itô, Mester & Padgett 1994; McCarthy 1995; see also Steriade 1995). The basic idea is that properties of lexical forms are not the result of arbitrary conditions on these forms, such as the assumption of the underspecification argument above, but emerge out of the interaction of universal constraints. The arguments for specification of predictable information cover the entire range of lexical specifications, ranging from underlying specification of predictable distinctive features (Smolensky 1993, Inkelas 1994; Itô, Mester & Padgett 1994) and prosodic information (Prince & Smolensky 1993, Burzio 1994, Inkelas 1994), to specification of consonant-vowel ordering in languages previously thought to be prime candidates for V/C planar segregation (McCarthy 1995).

In addition, many cases of languages that have been assumed to employ V/C segregation in the past have been reanalyzed or argued to provide no evidence for this representation. Most notably, Steriade (1987), in what can be seen as a precursor of the proposal in this paper, argues for an alternative account of the Yawelmani facts (Archangeli 1985) that does not rely on V/C segregation and uses melody copying, instead of spreading, to derive multiple copies of segments. Building on Steriade, Bat-El (1994) presents an analysis of Modern Hebrew segmental copying, using no spreading or V/C segregation. Finally, McCarthy (1995) provides a reanalysis of Rotuman metathesis without using V/C segregation.[31]

To summarize the main point of this section, I have shown that the theory which admits LDC-spreading and its geometric premise of V/C planar segregation falsely predicts the existence of unattested long-distance spreading of individual features between the two consonants in a CVC configuration. The present proposal that the alleged instances of LDC-spreading are actually copying

[31] Other less known languages thought to employ V/C segregation include Ainu (Itô 1983), Sierra Miwok (Smith 1985), and Gtaʔ (McCarthy 1982). These have also been controversial as discussed in Steriade (1986) for Ainu and Sierra Miwok, and Odden (1987) for Gtaʔ.

resolves these problems. I thus conclude that LDC-spreading and as a result V/C planar segregation should be eliminated. The next section examines the typological distinction between concatenative and nonconcatenative languages in light of this conclusion.

6. Typological Consequences

This section has two goals. First, it shows that the proposal of this paper to analyze LDC-spreading as copying naturally extends to cases of segmental copying in Semitic languages as well. Then it argues that the distinguishing characteristic of segmental copying found in nonconcatenative languages should be identified with a special mode of morphology, namely, a-templatic reduplicative affixation, where the reduplicative affix is not specified for any prosodic target. This special type of reduplication fills a typological gap in the theory of Prosodic Morphology, providing strong support for the analyses presented herein and for the theory of Prosodic Morphology itself.

6.1. Further Analyses

Consider the well-known Semitic pattern $c^1v.c^2v\mathbf{c^2}$, which is found in Modern Hebrew denominal formation, as in kod 'code' kided 'to codify', and also in the first Measure of the bilateral Arabic verbs, as in samam 'poisoned' (by far the most frequent Measure in the lexicon of Arabic). I will first present an analysis of this pattern in Modern Hebrew denominal formation, turning to the discussion of the Arabic pattern next.

Following Bat-El (1994), I assume that the base for the denominal formation is the corresponding noun and that the shape of the output must consist of two syllables, [σ σ]. In addition, I assume that the output must end in a consonant, due to the general canon of the verbal stems of Semitic, called Final Consonantality in McCarthy & Prince (1990b), henceforth FINAL-C. Essentially, this constraint further specifies the shape of the bisyllabic output.

One difference between the denominal output, $c^1ic^2e\mathbf{c^2}$, and the patterns of copying in Temiar, e.g. $\mathbf{c^1}a.c^1vc^2$, $\mathbf{c^1c^2}.c^1vc^2$, is that the Temiar copied consonant(s) appear to the left of the base, while in the Semitic pattern they appear to the right. This is because the aspectual morphology of Temiar prefixes segmental material to the prosodic head of the base. In the Semitic pattern, on the other hand, I assume that the morphology is suffixational. Specifically, I assume that denominal verb formation involves a constraint requiring that an affix must be aligned with the right edge of the prosodic output, ALIGN(Affix, R, PrWd, R), henceforth $\text{ALIGN}^{\text{AFFIX}}$-R. This affix, as in the case of Temiar simulfactive, will be partially specified for the melody /ie/, and will also be reduplicative in the sense that there is a correspondence relation between it and the base.

Before discussing the choice of the copied consonant, consider first another interesting fact about denominal formation. The output verb does not contain the input base vowel, which has been replaced by the vocalism of the affix. This phenomenon, called 'Melody Overwriting' (McCarthy & Prince 1990a, Bat-El 1994), has apparently been treated as an idiosyncracy of Semitic, implemented as a rule which literally substitutes the vocalism of the base with the vocalism of the affix. A more principled account exists, however, in the case at hand. If all vowels in the input, /o/ of kod, and /i,e/ of the affix, surfaced in the output, then there would be a violation of the undominated templatic constraint, requiring that the output must consist of two syllables (e.g. as in $c^1v[c^2\mathbf{ic^1ec^2}]$). The vowel of the base does not appear in the output in order to avoid this violation, hence the ranking [σ σ] >> $\text{MAX}^{\text{BASE-IO}}$. The fact that no affix vowel gives its place to the base vowel in the output simply motivates the further ranking MAX$^{AFFIX\text{-}IO}$ >> MAX$^{BASE\text{-}IO}$.

Turning now to the issue of the copied consonant, recall that ALIGN^{AFFIX}-R demands that the right edge of the affix be aligned with the right edge of the output. This constraint, together with FINAL-C, dictates that a copy of a consonant be at the right edge of the output. A relevant set of candidates is considered in (39) below. ANCHORING, it will be recalled, requires that the right peripheral element of the reduplicative affix correspond to the right peripheral element of the base. (The final consonant in the output must be a copy of some base segment because of DEP^{BR}, not shown in the tableau.).

39. Ranking argument: ANCHORING >> SROLE

Input: c^1vc^2, ie	ALIGN^{AFFIX}-R	ANCHORING	SROLE
a. ☞ $c^1i.c^2e\mathbf{c^2}$			*
b. $c^1i.c^2e\mathbf{c^1}$		*!	
c. $c^1i.\mathbf{c^2}ec^2$	*!		*
d. $c^1i.\mathbf{c^1}ec^2$	*!		

Candidate (39a) copies the rightmost segment of the base, incurring a violation of SROLE, while candidate (39b) copies the leftmost consonant, violating ANCHORING. To choose the correct candidate, then, the ranking must be ANCHORING >> SROLE[32]. Candidates (39c-d) violate the undominated ALIGN^{AFFIX}-R because the rightmost affixal segment /e/ is not aligned with the right edge of the prosodic output[33].

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[32] Compare this to the case of Temiar where SROLE is ranked higher than ANCHORING.

[33] An account in similar terms can be given for the alternative pattern, $c^1vc^2.\mathbf{c^1}v\mathbf{c^2}$, which according to Bat-El (1994) is selected arbitrarily by some biconsonantal verbs of Modern Hebrew. This pattern is also found in the Pilpel and Hitpalpel of Classical Hebrew, and for a limited number of verbs in Arabic (e.g. zalzal 'to shake'), as discussed in section 5. I assume that verbs which follow this pattern conform to a bisyllabic prosodic target which is further specified

In the above analysis I have assumed that the base of denominal formation is the corresponding noun form. A similar analysis can be given if we assume, following tradition, that the input to denominal formation consists of the consonantal root /c^1c^2/ and the vocalic affix /ie/. The only difference will be that constraints which make reference to the base must now refer to the consonantal root instead. For example, ANCHORING will now require that the right element of the affix correspond to the right element of the root. Everything else remains the same. Such an analysis would be required, for example, for the case of the $c^1vc^2v\mathbf{c^2}$ pattern found in the bilateral verbs of the Arabic first Measure (sama**m** 'poisoned').[34]

It should be pointed out, however, that the role of the traditional concept of a consonantal root like /c^1c^2/ , a peculiarity of Semitic languages, has been significantly reduced in recent analyses in the framework of Prosodic Morphology (McCarthy & Prince 1986 et seq.). Specifically, Bat-El (1994) argues that Modern Hebrew morphology, in fact, need make no reference to such a concept.

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to be a sequence of two heavy syllables (see Bat-El 1994 for an alternative analysis). All other constraints are as in the analysis given in text. The greater capacity of the prosodic target allows, in this case, for both consonants of the base to get copied.

[34] As is well-known, Arabic has an absolute prohibition against roots beginning with two identical initial consonants, as in *sasam, although it appears to allow roots ending with two identical consonants, as in samam (Greenberg 1950, McCarthy 1979, 1986, 1988). This distribution is explained in McCarthy (1979) on the basis of two assumptions. First, underlying forms are subject to the OCP, prohibiting roots with two adjacent identical consonants (*ssm, *smm). Hence, the underlying form of samam must be sm. Second, when mapping this biconsonantal root to a triconsonantal CVCVC template, a rule of rightward LDC-spreading spreads the final consonant to give samam. Clearly, this analysis is not available in OT because constraints applying strictly on underlying forms do not exist. The analysis presented here offers an alternative explanation for the skewed distribution of the so-called geminate roots, while at the same time avoiding the use of the special phonological mechanisms of LDC-spreading and V/C segregation.

Another implication for the OCP is related to the notion of locality. Pierrehumbert (1992) has shown that the cooccurrence restrictions between homorganic consonants in Semitic cannot be adequately described by an OCP that strictly refers to geometrically adjacent identical elements. Instead, OCP effects do cross intervening specifications of the same feature. Hence, the OCP restrictions of Semitic are of the same type as those found in Russian (Padgett 1991) and English (Berkley 1994), where intervening material affects the strength of the OCP. The implication is that OCP effects are in general non-local, precisely as predicted by the notion of articulatory locality discussed in section 5.2: articulatory locality treats the two consonants in a C_1VC_2 configuration as non-local, because their articulations are not contiguous.

All morphology is word based and no mapping operations of consonantal roots to templates are needed[35]. Also, the analysis of the Arabic broken plurals in McCarthy & Prince (1990a) makes no reference to consonantal roots. Most importantly, McCarthy (1993) presents a significant revision of the earlier analysis of the Arabic verbal morphology of McCarthy (1979, 1981). In the new analysis, there is only a single remaining case where reference to a consonantal root is required. This is the case of Measure I of bilateral and trilateral verbs, samam, faʔal, respectively, which are still derived from the traditionally assumed consonantal roots /sm/ and /fʔl/, mapped onto an iambic template (with a required final consonant)[36]. McCarthy argues that there are no other templates and hence no other mapping operations of a consonantal root to a template. All other surface forms of the verb derive from the basic Measure I form by affixation, and in some cases by circumscription of a prosodically defined constituent of the base. This analysis constitutes, as McCarthy (1993) notes, a significant departure from the earlier analyses in McCarthy (1979, 1981), where a different template was posited for every Measure. In any case, however, note that the morphological distinction between consonants and vowels in Semitic, if it exists at all, need not be encoded representationally by the geometric notion of V/C segregation. The obvious alternative is to encode the distinction in terms of consonants and vowels, two phonologically separate categories of sounds. This seems just as adequate, and in fact simpler, requiring no additional geometric devices unique

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[35] The analysis presented here is similar to that of Bat-El (1994) in this respect. It differs, however, from it in one significant respect. Her rule of 'Melody Overwritting,' a peculiar aspect Semitic morphology, is shown here to be the effect of a simple constraint ranking $\text{MAX}^{\text{AFFIX-IO}}$ >> $\text{MAX}^{\text{BASE-IO}}$, requiring that the segmental content of an affixal formative be expressed fully in the output to the expense of the full expression of base segmental material, due to the bisyllabic constraint on the output. This same idea extends straightforwardly to other cases of Arabic morphology as well. For example, the passive of katab 'wrote', kutib is derived by affixation of /ui/ under the ranking $\text{MAX}^{\text{AFFIX-IO}}$ >> $\text{MAX}^{\text{BASE-IO}}$, forcing 'replacement' of the vocalism of the base by the vocalism of the affix.

[36] The analysis above then essentially shows that the single case in Arabic where LDC-spreading was thought to apply can be analyzed without this mechanism.

to Semitic languages.

To sum up, the analysis of Semitic copying requires no use of V/C segregation or LDC-spreading. This result further secures the conclusion that LDC-spreading and V/C segregation can and should be eliminated as previous sections of this paper have demonstrated. Putative cases of LDC-spreading are literally copying, the same phenomenon found in the reduplicative morphology of many languages (Ancient Greek, Diyari, Panopean etc.). Simply put, the distinction between concatenative and nonconcatenative languages need not and should not be encoded in terms of the special phonological mechanisms of V/C segregation and LDC-spreading. This result has the welcome consequence of unifying the representational apparatus in the phonological component of the two types of languages.

6.2. A-templatic Affixation

In the theory of word formation, the program of Prosodic Morphology (McCarthy & Prince 1986 et seq.) has established as one of its central claims that grammatical categories are often expressed by invariant prosodic shapes or templates. These templates are made out of the units of prosody, namely syllables, feet, and prosodic words. As McCarthy & Prince (1995b) show, there are two well-documented species of templatic specification of morphological constituents: templatic specification of the affix and templatic specification of the base.

Templatic specification of the affix is found in ordinary reduplication, where the reduplicative affix is specified for an invariant shape corresponding to some unit of the prosodic hierarchy. For example, as shown below, two reduplicative affixes of Ilokano are specified to be a light syllable in (40a) and a heavy syllable in (40b) respectively (data drawn from McCarthy & Prince 1995b).

40. a.	Affix σ_{μ}	Base	si + σ_{μ} + base	Gloss ("covered/filled with")
		bu.neŋ	si-**bu**-bu.neŋ	"carrying a buneng"
b.	Affix $\sigma_{\mu\mu}$	Base	$\sigma_{\mu\mu}$ + base	Gloss (plural)
		pu.sa	**pus**-pu.sa	"cats"

Examples of templatic specification of the base were seen in the analyses of the Semitic patterns above, where a bisyllabic requirement was imposed on the shape of the output in the case Modern Hebrew denominals. Another case of base templaticism is found in Yawelmani, where the shape of the surface form is determined by a set of prosodic templates applying to some initial part of the stem (Archangeli 1991), as shown in (41). The initial templatically specified part of the stem is in boldface and the given forms abstract away from regular rules of epenthesis, closed-syllable shortening, and rounding harmony (c' is a glottalized c. Data drawn from McCarthy & Prince 1995b).

41.	$\sigma_{\mu\mu}$	$[\sigma_{\mu}\ \sigma_{\mu\mu}]^{Iamb}$	Gloss
CV shape	CvvC	CvCvv	
Biconsonantal	**c'uu**m	**c'umuu**	'devour'
Triconsonantal	**hii**wt	**hiwii**t	'walk'

In the forms under $\sigma_{\mu\mu}$, a bimoraic parse is imposed on the first syllable of the output, while in the forms under $[\sigma_{\mu}\ \sigma_{\mu\mu}]^{Iamb}$, an iambic parse is imposed instead (see McCarthy 1993 for other examples of templatic specification of the base from the noun and verbal morphology of Arabic).

As expected, there are also cases where the morphology specifies no template at all, a special mode of prosodic morphology, known as a-templatic prosodic morphology (Archangeli 1991, McCarthy & Prince 1990b). In the Ethiopian Semitic language Chaha, for example, verbal bases in the morphological category called jussive surface in two forms CCəC or CəCC, as shown in (42), where yä is an agreement prefix (data drawn from McCarthy 1993).

42.	Root	Jussive Verb	Gloss
a.	gfr	yägfər	‘release’
b.	nks	yänkəs	‘bite’
c.	srt	yäsərt	‘cauterize’
d.	trx	yätərx	‘make incision’

The choice between the two forms is entirely predictable from the regular syllabification of the language. The jussive morphology then specifies no template on the surface form of the verb. Other examples of a-templatic base specification can be found in Yawelmani (McCarthy & Prince 1995b), Arabic and Akkadian (McCarthy 1993).

So far, then, the literature on prosodic morphology has documented the following three cases of prosodic specification or lack thereof: templatic specification on the affix (as in ordinary reduplication), templatic specification of the base (as in Semitic, Yawelmani etc.), and no templatic specification of the base (as in Chaha). A fourth case is therefore predicted to exist, namely, no templatic specification of the affix. This is precisely the common characteristic of affixation in the analyses of the Temiar aspect and of the Semitic patterns discussed above. The reduplicative affixes in these analyses have no prosodic requirement on their shape, although they may be partially specified segmentally. For example, the simulfactive of Temiar and the denominal affix of Modern Hebrew are specified as /a/, /ie/, respectively. No prosodic constraint is imposed on the shape of these affixes, however. Similarly, in the continuative of Temiar no prosodic template is imposed on the affix, and in addition the affix also lacks segmental specification. Reduplicative affixation of this type is therefore one special mode of word formation where no prosodic template is imposed on the affix. This fills a typological gap in the theory of Prosodic Morphology, providing strong support for the specific analyses presented in this paper and for the program of Prosodic Morphology itself.

Lack of prosodic specification on the part of the reduplicative affix explains a descriptive dissimilarity between ordinary reduplication and reduplication of the sort discussed in this paper. In ordinary reduplication, the affix is realized as a contiguous string of base segments parsed in some prosodic unit (syllable, foot, or prosodic word), which is arbitrarily specified by the morphology (e.g. σ_{μ}, $\sigma_{\mu\mu}$ affixes of Ilokano). On the other hand, the reduplicative affixes discussed in this paper are realized with copies of isolated segments of the base, in various shapes and quantities. For example, the simulfactive of Temiar copies one or none of the consonants of the base, while the continuative affix copies one or two consonants of the base. The elusive realization of these affixes is simply a consequence of their lack of a prosodic target. Without a prosodic template of their own, matters of realization of these affixes are left to be determined by constraints regulating the prosody of the language (ONS and 1-V in Temiar), or of the particular morphological category involved ([σσ] in Semitic).

7. Conclusion

I have argued that in the phonological component of the grammar there is no place for an operation that spreads a consonant over a vowel (LDC-spreading), with its geometric premise of V/C planar segregation. The theory admitting these two mechanisms fails to explain why LDC-spreading always targets whole segments, predicting unattested spreading of individual features over a vowel under the configuration of V/C planar segregation. I have proposed to replace LDC-spreading with the same formal mechanism used in reduplication, which is independently needed in the theory. What was formerly seen as LDC-spreading is now literally copying. Copying, as in reduplication, targets the whole segment, not its individual features. Hence, the excessive power that the theory admitting LDC-spreading and V/C planar segregation would have is avoided, while at the same time the obvious redundancy between LDC-spreading and reduplication is eliminated.

Temiar is a nonconcatenative language for which both LDC-spreading and reduplication were considered necessary to account for its intricate patterns of copying. I have shown that using the notion of Correspondence in Optimality Theory it is possible to provide a unified account of the copying patterns in the verbal morphology of the language. Copying of segments is induced by a correspondence relation holding between the segments of the base and the segments of a reduplicative affix. Constraints requiring the featural (IDENT(F)) and prosodic identity (SROLE) between correspondent segments evaluate the quality of this correspondence relation. The interaction of these constraints with others expressing general prosodic regularities of the language suffices to account for the full range of patterns.

I have shown that any derivational approach to the facts of Temiar is bound to miss significant generalizations directly captured by the Optimality theoretic approach. The choice of the copied consonants is one such important generalization. It was shown that a derivational approach would require two separate association rules with incompatible directional parameter settings. In the Optimality theoretic approach, on the other hand, the choice of the copied consonant(s) is determined by a single universal constraint, SROLE, and not by language-particular rules of association. In this and other respects, the facts of Temiar support the Optimality theoretic conception of phonology-morphology interaction, where the parallel application of phonological and morphological constraints determine the form of the output.

The proposal to replace LDC-spreading with copying via correspondence was shown to apply to some of the basic patterns found in Semitic languages as well. In effect, segmental copying in languages like Temiar and Semitic does not need to rely on special phonological mechanisms such as LDC-spreading and V/C planar segregation. I argued that the distinction between concatenative and nonconcatenative languages cannot be encoded in terms of these mechanisms. Phonologically speaking there is nothing special to nonconcatenative languages. The descriptive dissimilarity between the types of segmental copying found in nonconcatenative languages and those found in ordinary reduplication is attributed to a special mode of affixation. Nonconcatenative segmental copying is simply a-templatic reduplicative affixation, where the reduplicant is not specified for any prosodic target. This type of reduplicative affixation, in fact, fills a typological gap in the theory of word formation, which had so far predicted but not documented this type of a-templatic affixation.

Improvements over previous theories are achieved when simple intuitions receive coherent accounts in formal terms in the new theory. The success of the correspondence approach in achieving the intuitively desirable unification of all instances of segmental copying, obviating the need for the problematic mechanisms of LDC-spreading and V/C segregation of previous theories, provides strong support for the general approach taken in Optimality Theory and Correspondence Theory, wherein the noted unification has been captured.

References

Archangeli, D.: 1985, 'Yokuts Harmony: Evidence for Coplanar Representation in Nonlinear Phonology', *Linguistic Inquiry* 16, 335-372.

Archangeli, D.: 1991, 'Syllabification and Prosodic Templates in Yawelmani', *Natural Language and Linguistic Theory* 9, 231-283.

Archangeli, D., and D. Pulleyblank: 1994. *Grounded Phonology*. Cambridge, MA: MIT Press.

Aronoff, M.: 1994, *Morphology by Itself: Stems and Inflectional Classes*, Linguistic Inquiry

Monograph 22, MIT Press: Cambridge, MA.

Bat-El, O.: 1994, ‘Stem Modification and Cluster Transfer in Modern Hebrew’, *Natural Language and Linguistic Theory* 12, 571-596.

Benjamin, G.: 1976, ‘An Outline of Temiar Grammar’, in Jenner, Thompson, and Starosta 1976, 129-187.

Benua, L.: 1995, ‘Identity Effects in Morphological Truncation,’ in J.Beckman, S. Urbanczyk, and L. Walsh (eds.) *University of Massachusetts Occasional Papers in Linguistics* 18: Papers in Optimality Theory, Graduate Student Association, Amherst, MA.

Berkley, D.: 1994, ‘The OCP and Gradient Data’, *Studies in the Linguistic Sciences* 24, 1-14.

Broselow, E. and J. McCarthy: 1983, ‘A Theory of Infixing Reduplication’, *The Linguistic Review* 3, 25-98.

Browman, C. and L. Goldstein: 1989, ‘Articulatory Gestures as Phonological Units’, *Phonology* 6, 201-251.

Burzio, L.: 1994, *Principles of English Stress*, Cambridge: Cambridge University Press.

Clements, N.: 1985, ‘The Geometry of Phonological Features’, *Phonology Yearbook* 2, 225-252.

Clements, N. and E. Hume: 1995, ‘The Internal Organization of Speech Sounds’, in J. Goldsmith, (ed.) *Handbook of Phonological Theory*, Blackwell, Oxford, 245-306.

Diffloth, G: 1976a, ‘Minor-Syllable Vocalism in Senoic Languages’, in Jenner, Thompson, and Starosta 1976, 229-248.

Diffloth, G.: 1976b, ‘Expressives in Semai’, in Jenner, Thompson, and Starosta 1976, 249-264.

Diffloth, G.: 1976c, ‘Jah-Hut, an Austroasiatic Language of Malaysia’, *Southeast Asian Linguistic Studies* 2, 73-118.

Flemming, E. and M. Kenstowicz: 1995, ‘Base-Identity and Uniform Exponence: Alternatives to Cyclicity’, Massachusetts Institute of Technology, MA, ms.

Fowler, C.: 1983, ‘Converging Sources of Evidence for Spoken and Perceived Rhythms of Speech: Cyclic Production of Vowels in Sequences of Monosyllabic Stress Feet’, *Journal of Experimental Psychology* 112, 384-412.

Gafos, A.: 1996, *The Articulatory Basis of Locality in Phonology*. PhD dissertation (in preparation), The Johns Hopkins University, MD, ms.

Gafos, A.: 1995a, ‘Correspondence in Temiar: No Need for Long-Distance Spreading Here’, in *Proceedings of the Fifth Meeting of the Southeast Asian Linguistics Society*, Tucson, Arizona, May 20, 1995.

Gafos, A.: 1995b. ‘On the Notion of Paradigm Structure in Temiar’, The Johns Hopkins University, ms.

Greenberg, J.: 1950, ‘The Patterning of Root Morphemes in Semitic’, *Word 6*, 162-181.

Hulst, H. and J. Weijer: 1995, ‘Vowel Harmony’ in J. Goldsmith (ed.) *Handbook of Phonological Theory*, Blackwell, Oxford, 495-534.

Inkelas, S.: 1994, ‘The Consequences of Optimization for Underspecification’, University of California, Berkeley, ms.

Itô, J.: 1984, ‘Melodic Dissimilation in Ainu’, *Linguistic Inquiry* 15, 505-513.

Itô, J. and A. Mester: 1993, ‘Licenced Segments and Safe Paths’, *Canadian Journal of Linguistics* 38:197-214.

Jenner, P., L. Thompson and S. Starosta: 1976, *Austroasiatic Studies,* Vol. II. Honolulu: University Press of Hawaii.

Jenner, P.: 1969, *Affixation in Modern Khmer*. Unpublished Ph.D. dissertation, University of Hawaii.

Lieberman, P. and S. Blumstein: 1988, *Speech Physiology, Speech Perception, and Acoustic Phonetics*. Cambridge University Press.

Lombardi, L.: 1991, *Laryngeal Features and Laryngeal Neutralization*, Unpublished Ph.D. dissertation, University of Massachusetts, Amherst, MA.

Lombardi, L. and J. McCarthy: 1991, 'Prosodic Circumscription in Choctaw Morphology', *Phonology* 8, 37-71.

Matisoff, J.: 1973, 'Tonogenesis in Southeast Asia', in L. Hyman (ed.) *Consonant Types and Tone*, Southern California Occasional Papers in Linguistics, 1, 71-95.

McCarthy, J.: 1979, *Formal Problems in Semitic Phonology and Morphology*, Ph.D. dissertation, MIT; published by Garland Publishers, New York.

McCarthy, J: 1981, 'A Prosodic Theory of Nonconcatenative Morphology', *Linguistic Inquiry* 12:373-418.

McCarthy, J.: 1982, 'Prosodic Templates, Morphemic Templates, and Morphemic Tiers', in v. d. Hulst and N. Smith (eds.) *The Structure of Phonological Representations*, Part I, Foris, Dordrecht.

McCarthy, J.: 1986, 'OCP effects: Gemination and Antigemination', L*inguistic Inquiry* 7:207-263.

McCarthy, J.: 1988, 'Feature Geometry and Dependency: A Review', *Phonetica* 45, 84-108.

McCarthy, J.: 1989, 'Linear Order in Phonological Representation', *Linguistic Inquiry* 20:71-99.

McCarthy, J.: 1994, 'On Coronal "Transparency"'. Paper presented at the annual Trilateral Phonology Weekend, UC Santa Cruz.

McCarthy, J.: 1993, 'Template Form in Prosodic Morphology', in L. Stran (ed.), Papers from the 3rd

Annual Meeting of the Formal Linguistic Society of Mid-America, 187-218.

McCarthy, J.: 1995, 'Extensions of Faithfulness: Rotuman Revisited', University of Massachusetts, Amherst, MA, ms.

McCarthy, J. and A. Prince: 1986. *Prosodic Morphology*. University of Massachusetts, Amherst, and Brandeis University, ms.

McCarthy, J. and A. Prince: 1990a, 'Foot and Word in Prosodic Morphology: The Arabic Broken Plural', *Natural Language and Linguistic Theory* 8: 209-283.

McCarthy, J. and A. Prince: 1990b, 'Prosodic Morphology and Templatic Morphology' in M. Eid and J. McCarthy (eds.) *Perspectives on Arabic Linguistics: Papers from the Second Symposium* 1-51, Amsterdam: Benjamins, Amsterdam.

McCarthy, J. and A. Prince. 1993a. *Prosodic Morphology I: Constraint Interaction and Satisfaction*. University of Massachusetts and Rutgers University, ms.

McCarthy, J. and A. Prince: 1993b. 'Generalized Alignment', in G. Booij and J.v. Marle (eds.), *Yearbook of Morphology*, Dordrecht: Kluwer, 79-153.

McCarthy, J. and A. Prince: 1994, 'The Emergence of the Unmarked: Optimality in Prosodic Morphology', in M. Gonzalez (ed.) *Proceedings of the North East Linguistics Society* 24, Amherst, MA, Graduate Linguistic Student Association, 333-379.

McCarthy, J. and A. Prince: 1995a, 'Reduplicative Identity', to appear in R. Kager, H. v. d Hulst and W. Zonneveld (eds.) *Proceedings of the OTS/HIL Workshop in Prosodic Morphology*.

McCarthy, J. and A. Prince: 1995b, 'Prosodic Morphology', in in J. Goldsmith, (ed.) *Handbook of Phonological Theory*, Blackwell, Oxford, 318-366.

Ní Chiosáin, M. and J. Padgett: 1993. 'Inherent Vplace', Report no. LRC-93-09, Linguistics Research Center, UC Santa Cruz.

Odden, D.: 1987, ‘Arguments Against the Vowel Plane in Gta✏’, *Linguistic Inquiry* 18, 523-529.

Öhman, S.: 1966, ‘Coarticulation in VCV Utterances: Spectrographic Measurements’, *Journal of the Acoustical Society of America* 39, 151-168.

Öhman, S.: 1967, ‘Numerical Model of Coarticulation’, *Journal of the Acoustical Society of America* 41, 310-320.

Padgett, J.: 1991, ‘OCP Subsidiary Features’, in *Proceedings of NELS 21*, GLSA, Department of Linguistics, University of Massachusetts, MA.

Padgett, J.: (to appear), ‘Feature Classes’, in *University of Massachusetts Occasional Papers*, Special Issue on Optimality Theory.

Pierrehumbert, J.: 1992, ‘Dissimilarity in the Arabic Veral Roots’, in *Proceedings of NELS* 23, GLSA, Department of Linguistics, University of Massachusetts, MA.

Paradis, C: 1988, ‘On Constraints and Repair Strategies’, *The Linguistic Review* 6, 71-97.

Purcell, E.: 1979, ‘Formant Frequency Patterns in Russian VCV Utterances’, *Journal of the Acoustical Society of America* 66, 1691-1702.

Prunet, J.-F.:1995, ‘Some Core Properties of Semitic Morphology: Evidence from the Far South’, Handout of talk presented at the *Current Trends in Phonology: Models and Methods*, Royaumont, June 19-21, 1995.

Recasens, D.: 1984, ‘Vowel-to-Vowel Coarticulation in Catalan VCV Sequences’, *Journal of the Acoustical Society of America* 76, 1624-1635.

Ruhlen, M.: 1987, *A Guide to the World’s Languages, Vol. 1: Classification*. Stanford University Press.

Prince, A. & P. Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*